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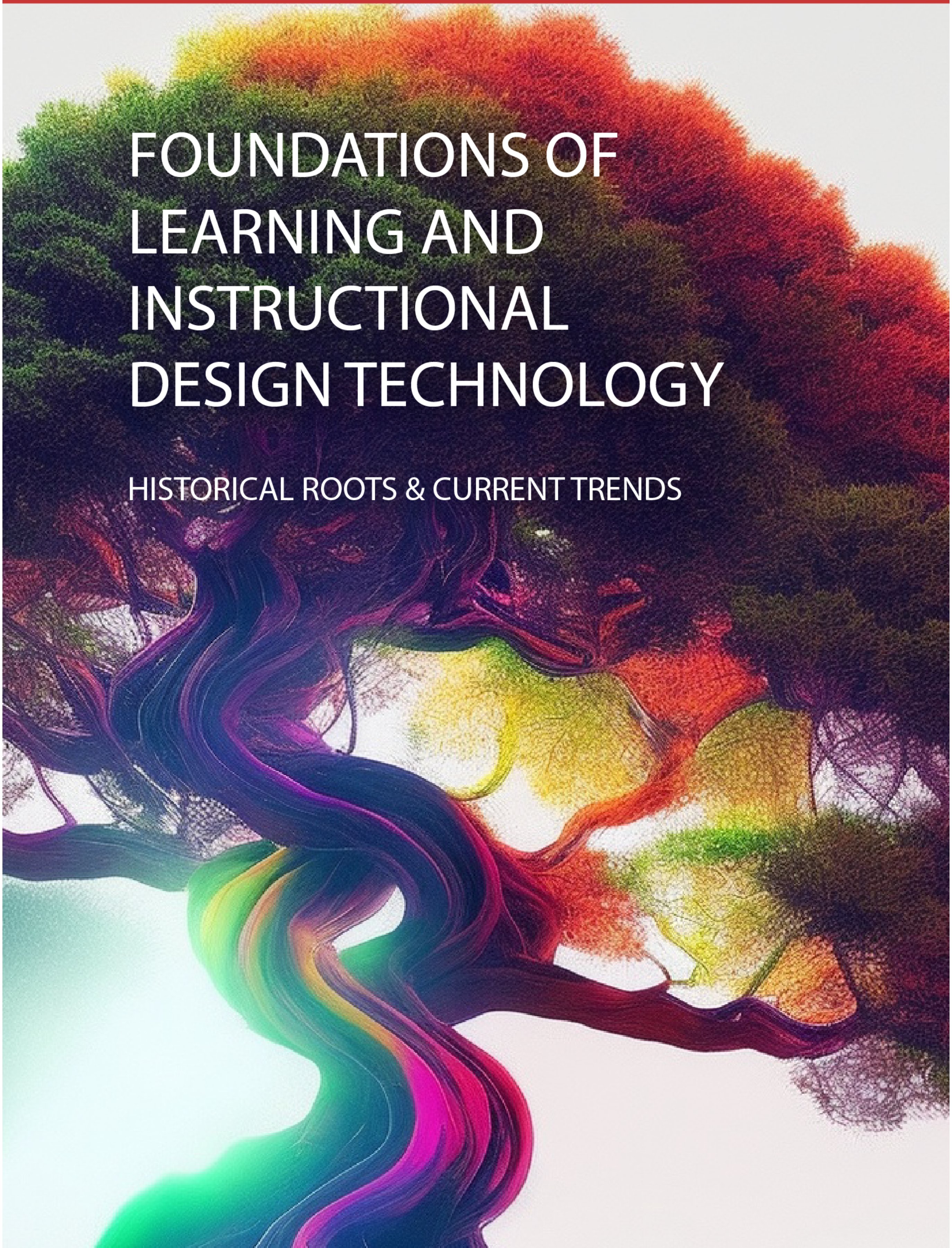
FOUNDATIONS OF LEARNING AND INSTRUCTIONAL DESIGN TECHNOLOGY

HISTORICAL ROOTS & CURRENT TRENDS



Richard E. West & Heather Leary

Foundations of Learning and Instructional Design Technology

Historical Roots & Current Trends

West, R. E. & Leary, H.

Design | Graduate Students | Instructional Design | Learning | Learning Design | Methods Instruction | Online Instruction | Technology | UX

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DOI: 10.59668/473 2024 English

Introduction

West, R. E. & Leary, H.

Educational Technology | Instructional Design | instructional designer | Instructional Designers | Learning Design | Learning Designers | Learning Theory | Social Learning Theory

In this chapter we explain the overarching metaphor for this textbook.

We all come to the field of Learning and Instructional Design Technology because we want to make a difference—we want to have an effect on others. This is the hallmark characteristic of teachers, but of learning and instructional designers as well. Once we join the field, however, we often realize how very difficult this work can be, as bringing about meaningful change in others (e.g. the learning process) is challenging. As we struggle to identify methods for creating this change, we often grasp at quick tricks or shortcuts to aid us. This can lead us, especially when we are new to the profession, to be media centric, content centric, or even strategy centric as we reach for tools to address learning challenges (see Gibbons, 2018, in the first edition of this textbook at https://edtechbooks.org/lidtfoundations/what_and_how_do_designers_design).

In short, we might reach for current answers popular at the time, while forgetting that teaching and learning is a very old, very well researched process. We strike at the problem without a strong foundation in theory, history, and past wisdom. In this we forget that a strong tree is only as strong as its roots and foundation. Similarly, for us, if we don't have a strong foundation in the theory, history, and techniques of the field, we cannot adequately attack the learning problems we seek to solve.

This book strives to provide this strong foundation, especially to new designers in the profession. Our metaphor for the book is that of a strong tree, where the beauty may be in the well developed trunk and branches, but the true strength is in the roots. As Matshona Dhliwayo stated beautifully, "It is in the roots, not the branches, that a tree's greatest strength lies."

We agree, and believe that the strength of our field is in our roots. For this reason, we believe that every strong designer entering the profession must have a solid understanding of the roots of the field: the debates that developed theories, the technologies that created new thinking, and the processes that guided previous designers. However, a new designer must also understand current theories, technologies, and processes in order to easily integrate into the first company and design team after graduation. Thus, the goal of this book is to provide both a survey of some of the historical roots of the field, as well as current thinking. This is a grandiose and challenging objective for one book, and we do not assume that the job will be done at the end of reading it. We hope, most of all, that the chapters in this text will inspire designers to keep learning, studying, and seeking answers to their design challenges from both history and modern sources. For above all, we think dogged determinism and curiosity to keep learning may be the strongest attribute of those seeking to design successful learning and instruction.

What's in a Name? Why We Call the Field Learning and Instructional Design Technology

As you grow in the profession, you will find that there are many job descriptions, job titles, and professionals working in the field who go by different names. In fact, debates over what the name of this field should be is perhaps one of the longest-running philosophical debates we have! Those who have been in the profession for a while will recall periods of time where graduate programs, academic journals, and professional associations changed their names to emphasize new trends in the field—whether this was the emphasis on instructional "systems", "technology", or "design." In addition, there are sister fields to LIDT, such as Learning Sciences and Learning Engineering, that share many of our theories, processes, and models, while layering on their own ideas and practices.

Our goal was to keep this textbook general enough to be of value to the most people. It is not our goal to wade into the debate over whether we should be an "instructionist" field or a "learning-centered" field, or whether technology, design, engineering, analytics, or social institutions are most important. We want this book to appeal to both "learning" and “instructional” designers—both of whom use hard and soft (West & Allman, 2021, see https://edtechbooks.org/id/designing_technology) technologies to do their work.

The Creation of the First Edition

This book is a second edition, with the first edition edited by Richard West and published in 2018 (see https://edtechbooks.org/lidtfoundations). This book was an important milestone in the field. At the time, there were no general open textbooks available to teachers and students. What open textbooks existed were usually for large enrollment, general education courses or niche research areas. There were also no easy tools for authoring, publishing, and discovering open textbooks in our field.

The history of this work began, as many important milestones in our field have, at the Professors of Instructional Design Technology conference (for more on this “un”conference, see https://edtechbooks.org/lidtfoundations/ipdt_important_unconference). I (West) pitched the idea of this open textbook at one of the conferences, and received feedback on potential topics to include. I then scoured the Internet to try and find openly licensed materials I could use for the book. This proved to be very difficult, as nearly all of the open content was either outdated, or academic research articles that did not do a good job of surveying/overviewing a topic.

Because of the challenge of finding content, I asked Larry Lipsitz, editor of Educational Technology about republishing classic articles from his magazine, permission that he granted me. In addition, I received permission from the Association for Educational Communications Technology to republish some articles from their publications, particularly TechTrends and Educational Technology Research and Development. I am very grateful for these early permissions, as they enabled me to start putting together content where none existed. I then started selling the idea of the book to colleagues and on social media. At a time when very little academic credit was given to authors of open content, I am very grateful to these authors for donating their time in writing key chapters to plug topical holes in the book. The story of this book creation process is told more fully in West (2019).

In addition, I am very grateful to Royce Kimmons, my colleague at Brigham Young University. After complaining to him about the lack of a good authoring service and marketplace for open textbooks, he created Edtechbooks.org to meet a clear need in the field. His programming and design brilliance is on display in this platform. In 50 years when we write about the history of the field, I am confident that Edtechbooks will have a strong placeholder in that history for how it helped unlock the aspirations of so many of us to share knowledge freely with the world. I had already published the first edition on Pressbooks, but quickly moved it to Edtechbooks when this became available.

Since 2018, the book has grown in popularity, receiving multiple awards from the Association for Educational Communications Technology and being viewed/downloaded by thousands around the world. I’m deeply grateful to the early adopters who shared with me how they were using the book in their classes and provided feedback.

What is New in the Second Edition?

One criticism we had of other open content I found when researching for the first edition, was that much of it was outdated and apparently discarded to the dusty bins of the Wayback Machine. One positive benefit provided by commercial book publishers is their insatiable thirst for newer editions they can sell, which has the benefit of encouraging authors to keep their material updated. I committed to not letting this book languish, but to revise it frequently. In addition, because much of the first edition was republished articles from past publications, it began to show its age fairly quickly.

The time had come for a second edition. For this edition, Heather Leary joined me as co-editor, bringing experience in instructional design and learning sciences, in teaching adults and children, and an understanding of both the art and technology of our field. In addition, Rebecca Nissen has been invaluable as the copyeditor, instructional designer, graphic designer, and project manager for this edition. The parts of the book that seem the most useful have benefited from her editing and instructional enhancements, as she has skillfully helped us transition this book from open content to open textbook, making the book much more useful for educational settings.

For this edition, we replaced most of the republished content with original chapters from new authors, except on topics where the historical viewpoint was important. In addition, one critique of the previous edition was that it was too large (you may find it surprising, or not, that some students wished to be able to print it out! This was not possible with the first edition and its 53 chapters).

For this second edition, we divided the previous book into two. The first four sections of the first edition, which focused on Definitions and History, Learning and Instruction theories, Design theory and process, and Technology and Media became this second edition of the Foundation textbook. The last two sections, which focused on Becoming an LIDT Professional and Preparing for an LIDT Career were developed into a second book, called Becoming a Professional in Learning and Instructional Design Technology. Heather Leary also co-edited that book, with Rebecca Nissen assisting us again, and it is available at https://edtechbooks.org/becoming_an_lidt_pro. We consider both of these books to be supportive of each other, and essentially "volumes 1 and 2" of the foundations for the field.

In addition, we have a new section of this second edition, on the Future of the Field? In this section, experienced scholars and practitioners set out different visions for what they think our field may become, or need to become, in the next 5–10 years. We may add additional chapters to this section in the future.

Technology Features of This Book

There are many helpful features of this book that we have sought to provide as a book creation team, and there are other features provided by the Edtechbooks system. We would like to make you aware of these as they will enhance your learning of these topics. This book can be read online or you can download it as a PDF. A glossary of difficult or new terms can be found throughout the book. Access the definitions by hovering over the bolded terms while reading online. The chapters include learning checks allowing you to see if you understood the author's message. We encourage you to use these as you read. At the end of each chapter are surveys for you to rate the chapter. Please do so, as this helps us know which chapters are working well and which may need revision in the future. Because the book is licensed CC-BY, you may reuse, translate, or repurpose this book, as long as you attribute and link to the original.

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Suggestions To Improve The Book

We welcome feedback on this book. Please provide a review on Amazon or here in Edtechbooks. This helps other teachers know about this book so they can adopt it. If you find errors in the book, please email the chapter author or the book editors, and we can fix those. If you have a suggestion for an important topic to add to this book in the next edition, please email your suggestion to the editors.

In addition, if you are a teacher or practitioner, and would like to contribute teaching materials to teach any of the topics in the book, please email the editors so we can share your materials with other instructors in the Instructor Materials Repository.

References

West, R. E. (2019). Developing an open textbook for learning and instructional design technology. TechTrends, 63, 226–235.

Acknowledgements

We gratefully acknowledge the wonderful assistance from several students from the Instructional Psychology and Technology department at Brigham Young University who assisted in publishing this book. Megan Charlton and Halli Romero provided outstanding copyediting of the chapters, and Rebecca Nissen was the lead instructional designer and project manager (and also assisted with copyediting). Rebecca also created the wonderful cover for this book, which represents the tree metaphor that we used for orienting our thinking on this edition. The contribution of all of these collaborators were professional, timely, and made the book far better.

We are also deeply grateful to the authors willing to publish their ideas in an open format. It is because of you that students, practitioners, and scholars can have access to these ideas.

Because this book is published online through EdTechBooks, we can continue to make edits and revisions. Please email one of the editors if you see something that needs to be addressed. Thank you for supporting open scholarship!

I. Definitions and History

What Is This Thing Called Instructional Design?

Wagner, E. D.

Design | Instructional Design | Learning Design

In this chapter, Wagner discusses the challenge of how to define the field.

Editor's Note

The following is an excerpt from Ellen Wagner's article entitled "In Search of the Secret Handshakes of Instructional Design," published in the Journal of Applied Instructional Design [http://www.jaidpub.org/]. The title for this chapter comes from a portion of Wagner's essay to better represent the portion of her article that is republished here.

Wagner, E. (2011). Essay: In search of the secret handshakes of ID [https://edtechbooks.org/-JJy]. *The Journal of Applied Instructional Design, 1*(1), 33–37.

Practitioners and scholars working in the professions clustered near the intersection of learning and technology have struggled to clearly and precisely define our practice for a long time—almost as long as technologies have been used to facilitate the creation, production, distribution, delivery and management of education and training experiences.

As a professional group, instructional designers—IDs—often bemoan the fact that it is hard to tell "civilians" what it is that we actually do for a living. Ironically this inability to clearly describe our work is one of the "secret handshakes" that unites us in our quest to better define our professional identity.

One of my favorite examples of this definitional challenge was described in a recent blog post by Cammy Bean, vice-president of learning for Kineo, a multinational elearning production company:

> *You're at a playground and you start talking to the mom sitting on the bench next to you. Eventually, she asks you what you do for work. What do you say? Are you met with comprehension or blank stares? This was me yesterday:*
>
> *Playground Mom: So, what do you do?*
>
> *Me: I'm an instructional designer. I create eLearning.*
>
> *Playground Mom: [blank stare]*
>
> *Me: …corporate training…*
>
> *Playground Mom: [weak smile]*
>
> *Me: I create training for companies that's delivered on the computer….*
>
> *Playground Mom: weak nod…"Oh, I see."*
>
> *I see that she really doesn't see and I just don't have the energy to go further. I'm sort of distracted by the naked boy who just ran by (not mine). We move on.*
>
> *Is it me? Is it the rest of the world?*
> *http://cammybean.kineo.com/2009/05/describing-whatyou-do-instructional.html*

AECT has actively supported work on the definitions of big overarching constructs that offer people working at the intersections of learning and technology with a sense of identity, purpose and direction. Lowenthal and Wilson (2007) have noted that AECT has offered definitions in 1963, 1972, 1977, 1994, and 2008 to serve as a conceptual foundation for theory and practice guiding "The Field." But they wryly observe that our definitional boundaries can be a bit fluid. For example, after years of describing what we do as "educational technology," Seels and Richey (1994) made a case for using the term "instructional technology" as the foundational, definitional descriptor. Januszewski and Molenda (2008) returned us to the term "educational technology" as being broader and more inclusive. All seemed to agree that the terms educational technology and instructional technology are often used interchangeably. In discussing these implications for academic programs, Persichitte (2008) suggested that labels—at least the label of educational technology or instructional technology—do not seem to matter very much. And yet, I wonder—without precision—do we not contribute to the confusion about what it is that people like us actually do?

And what about this thing we do called instructional design? That seems to be an even harder domain to adequately define and describe. A definition of instructional design offered by the University of Michigan (Berger and Kaw, 1996) named instructional design as one of two components (the other being instructional development) that together constitute the domain of instructional technology. Instructional design was then further described in the following four ways:

Instructional Design-as-Process: Instructional Design is the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction. It is the entire process of analysis of learning needs and goals and the development of a delivery system to meet those needs. It includes development of instructional materials and activities; and tryout and evaluation of all instruction and learner activities.

Instructional Design-as-Discipline: Instructional Design is that branch of knowledge concerned with research and theory about instructional strategies and the process for developing and implementing those strategies.

Instructional Design-as-Science: Instructional design is the science of creating detailed specifications for the development, implementation, evaluation, and maintenance of situations that facilitate the learning of both large and small units of subject matter at all levels of complexity.

Instructional Design as Reality: Instructional design can start at any point in the design process. Often a glimmer of an idea is developed to give the core of an instruction situation. By the time the entire process is done the designer looks back and she or he checks to see that all parts of the "science" have been taken into account. Then the entire process is written up as if it occurred in a systematic fashion.
http://www.umich.edu/~ed626/define.html

Ten years later, Reiser & Dempsey (2007) defined instructional design as a "systematic process that is employed to develop education and training programs in a consistent and reliable fashion" (pg. 11). They noted that instructional technology is creative and active, a system of interrelated elements that depend on one another to be most effective. They suggested that instructional design is dynamic and cybernetic, meaning that the elements can be changed and communicate or work together easily. They posited that characteristics of interdependent, synergistic, dynamic, and cybernetic are needed in order to have an effective instructional design process. In their view, instructional design is centered on the learned, is oriented on a central goal, includes meaningful performance, includes a measurable outcome, is self-correcting and empirical, and is a collaborative effort. They concluded that instructional design includes the steps of analysis, design, development, implementation, and evaluation of the instructional design.

Continue reading [Wagner's essay on JAID's website.](https://edtechbooks.org/-JJy)

2023 AECT Definition

On October 19, 2023, the AECT Board of Directors approved an updated definition for the field as follows, "Educational technology is the ethical study and application of theory, research, and practices to advance knowledge, improve learning and performance, and empower learners through strategic design, management, implementation, and evaluation of learning experiences and environments using appropriate processes and resources."

Note that many use educational technology and instructional design interchangeably, and while this AECT definition specifically refers to educational technology, it describes it as a process and practice of designing learning interventions.

[https://edtechbooks.org/-JJy]

Application Exercises

- Write a brief description of a real-world example of instructional design as a process, a discipline, a science, and/or a reality.
- Think of a time you were involved in the instructional design either as a teacher or learner. How did you work through each of these pieces? 1. Centers on the learner 2. oriented on central goal 3. includes meaningful performance & measurable outcome 4. self-correcting and empirical 5. collaborative

The Proper Way to Become an Instructional Technologist

Rieber, L.

Instructional Design Technology Instructional Technology

Learning Design students

I'm an instructional technologist, which means I: ● Help people learn new things. ● Solve problems in education and training or find people who can. ● Use lots of different tools in my job; some are 'things' like computers and video, other tools are ideas, like knowing something about how people learn and principles of design. ● Know a lot about these tools, but I know I must use them competently and creatively for the task at hand before they will work. ● Consider using all the resources available to me, though sometimes I must go and find additional resources. ● Am most interested in helping children, but many of my colleagues work with adults. ● Resist doing things only because "we've always done it that way," but

I'm also careful not to fall for fads or gimmicks. ● Always try to take the point of view of the person who is going to be using the stuff I make while I'm making it; that's really hard, so I get people to try out my stuff as soon as I can to see what I am doing wrong. ● Am not afraid to say, "Yes, that's a better way to do it."

Prologue for the 2nd Edition

I wrote this essay a long time ago in 1998. At the time I was under review for promotion to full professor, having come up through the ranks after graduating with my Ph.D. from Penn State in 1987. On my imaginary academic productivity graph, the line was heading up as time moved to the right (it's flattened out quite a bit since with a few notable dips along the way). Being asked to give the Peter Dean Lecture was a pretty big deal at the time, so I was very honored. Interestingly, I left out an important detail in my 1998 prologue—I was the second person they asked. The first person turned down the invitation (due to medical reasons). Coming in second turned out to be very helpful. The invitation came late, about two weeks prior to the AECT conference where I would be presenting the lecture, meaning I had a very limited amount of time to prepare. This constraint allowed me the luxury of not having to worry about being perfect. After all, "I only had two weeks," I could say to anyone not too impressed with my presentation. Best of all, it forced me to write from the heart about what I truly believed and what was really important to me at the time.

The purpose of the Peter Dean Lecture was to choose someone who had been around long enough to appreciate the struggles of the field and to give that person the opportunity to give a critical analysis of where we were and where we might go. This presented a nice opportunity, but a presumptuous one in my opinion, for the person chosen. Were my experiences and points of view a valid cross section of the field? Obviously not. Nevertheless, I used this opportunity to speak to some issues that interest and concern me, in the hope that they might trigger some reflection and comment—I still hope that is the case for those who now happen upon this essay.

Do I still believe or stand behind this essay twenty-five years later? Yes, despite now having a perspective that only years and experience can give you. I am not nearly as brash, not as confident, not as naïve, a bit more cynical, but most of all not as worried about the value others might attach to my ideas. I've taken to heart the motto of "put it out there and let the world decide." My enthusiasm for my work and the field of learning, design, and technology has only grown. I continue to learn new things and eagerly welcome perspectives other than my own.

If you are an "up and coming" scholar in the field of learning, design, and technology and you happened to stumble upon this essay, I hope it brings you a sense of welcoming and assurance you made a good decision with your career choice.

Introduction

The inspiration for this essay came from an article published by Robert Heinich in 1984 called "The Proper Study of Educational Technology." At the time I first read the article (around 1986), its title rubbed me the wrong way. There was something unduly pretentious about it—that there was, in fact, a proper study of educational/instructional technology (IT)[1]. When I first read the article, I must admit that I incorrectly interpreted it. Heinich warned strongly against the "craft" of IT which I wrongly interpreted as "art." I have long been sensitive to our field disavowing the artistic side of IT and instead overemphasizing, I felt, its scientific aspects. Having just reread the article, I was very impressed with how forward looking Heinich's thinking was at the time, especially regarding the role of research. The purpose of this essay, therefore, is not to take issue with Heinich's ideas, but to use them to motivate another question: What is the proper way to become an instructional technologist?

Many would quickly argue that the proper way is to go to a university and get a degree in IT. This reminds me of the scene from the *Wizard of Oz* in which the wizard tells the scarecrow that he has as much brains as anyone else, but what he needs is a diploma to prove it (L. Frank Baum was no stranger to sarcasm). Of course, there is a formal side to getting an education in our profession, but I believe that the best of our field have learned that our theories and models must be grounded in the actual context of the problem. More about this later. I have also long been struck by the many paths taken by people who now find themselves called instructional technologists. Our profession consists of individuals with an amazing diversity of backgrounds, goals, and education. It is also common for many people to say they didn't even know the field existed until they were already a practicing member of it.

Take my background, for example. I started off my undergraduate education as an engineering student. In the summer of my freshman year, I traveled in Latin America working with several youth groups. The experience convinced me that I didn't want to become an engineer, but instead I wanted to know more about the complexity of people and their cultures. I took several paths from there, at one point actually completing the paperwork to

declare a major in anthropology. I came to the education field most unexpectantly. I eventually became an elementary school teacher—trained in a large urban university in the northeast of the USA, but got my first job in a very small rural school in the American Southwest (New Mexico). This was 1980 which, coincidentally, was about the time that desktop computers were introduced into mainstream education. I found myself thrust into a position where technology, education, and different cultures were rapidly mixing.

In a lot of ways, this was the perfect position for a person like me. There were few formal ideas in force about how to use computers in education (at least in my district) and the school administration encouraged "early adopters" such as myself to explore different ideas and take some risks. I later discovered, when I entered graduate school, that many of the things I had learned on my own in those years about technology, instructional design, and learning theory had formal names in the literature (one example is the concept of rapid prototyping).

Elementary school teachers are, as a group, very sensitive to the student point of view (though don't take this as an insult to other groups). It's just that the complexity of domains (e.g., math, science, language arts, etc.) is not as demanding to the adult as they are to the student. Consequently, the adult teacher is somewhat freed from the demands of the content, but forced to consider what it must be like for a 10 year old to learn something like fractions. Most elementary school teachers are also faced with teaching a broad array of subjects, so the concept of integrating subjects in meaningful ways is familiar to us. (Heck, I also taught music—the elementary school was one of the few places where my accordion was truly appreciated!) My education to become a teacher was heavily rooted in Piagetian learning theory, so it is easy to see how I came to use LOGO[2] with students and to understand the facilitative role it demanded of teachers. In hindsight, I can't think of a better place than the elementary school classroom for me to have received my first education as an Instructional Technologist. ("Holmes, my good man, what school did you attend to become an Instructional Technologist?" "Elementary, my dear Watson, elementary.") I wonder how many of you have backgrounds exactly like mine? Few, I wager. So, while studying engineering and culture, traveling, followed by being an elementary classroom teacher in a context where technology was introduced with no training was the proper way for me to become an instructional technologist, I know it is a path not to be exactly duplicated by anyone.

Instructional Technologist as Computer Scientist

Heinich's article discussed the frustration of IT being considered a service arm of education. Our role, to many people outside the field, is to "connect the pipes" and to fix the machines. The advent, growth, and semi-dependency of education on computing has reinforced this position in many ways. Let's face it, most people outside our field equate us—and respect us—for our mastery of technologies. So, perhaps the proper way to become an instructional technologist is first to become a technology wizard, that is, to master the tools first and to assume that the knowledge of how to apply the tool in education will come merely as a consequence. However, I like to point out that "A power saw does not a carpenter make." Owning a power saw coupled even with the knowledge of how to use it safely to cut wood does not make one a carpenter. For example, consider the contrast between two carpenters who appeared on American public television shows—Roy Underhill and Norm Abrams. For those of you not familiar with these two, Roy appears on *The Woodwright's Shop*, a show dedicated to preserving carpentry skills practiced before the advent of electricity. In contrast, Norm Abrams, a self-professed power tool "junkee," appeared in *This Old House* and *The New Yankee Workshop*. Despite their different approaches and attitudes to the use of technology, I'm quite sure that both would thoroughly enjoy the other's company and wile away the hours discussing what they both love best, namely, carpentry. However, despite my respect for Roy's skills and philosophy, when I try my hand at even mid-size woodworking projects, such as building a patio deck or storage shed, you can bet that I prefer to use the power tools available to me. Likewise, in education, I prefer to take advantage of the opportunities that the available "power tools" afford. But underlying it all, is a profound core of, and respect for, the essential skills, strategies, and experiences akin to those possessed by the master carpenter.

Instructional Technologist as Philosopher

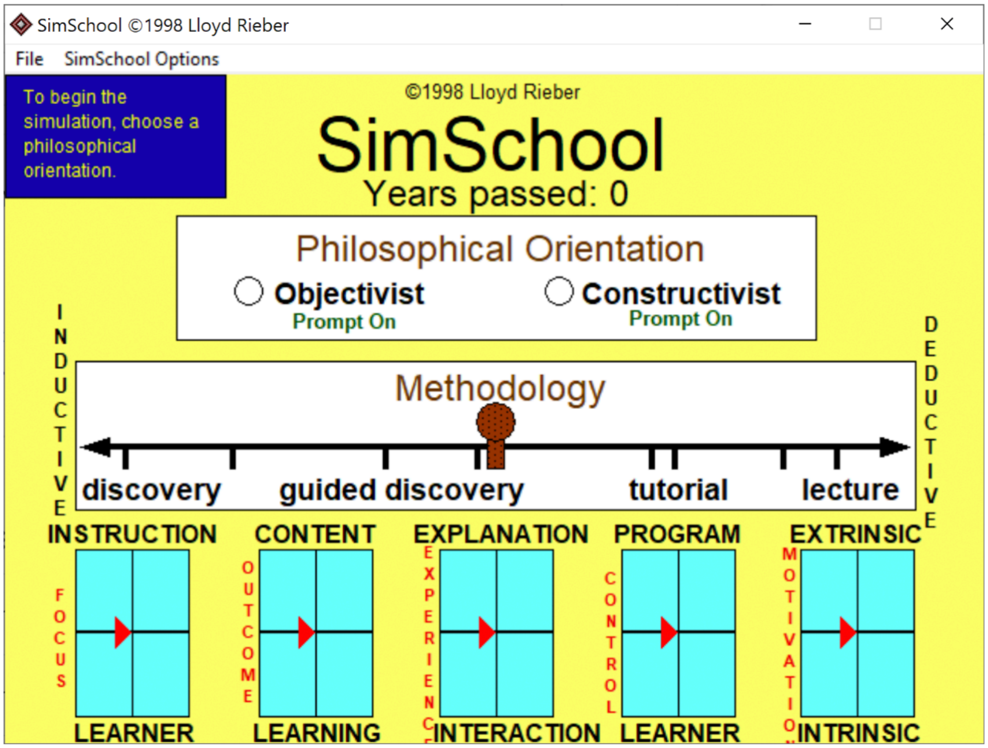
Has anyone else noticed how much of our literature in recent years has been devoted to philosophy? So, perhaps the proper way to become an instructional technologist is to become a philosopher and first unravel the mysteries of what it means to "be" and what it means to "know." The field seems quite preoccupied with uncovering if there is a "real" world or whether reality exists solely in the mind of the individual. I have concluded that Instructional Technologists are not well equipped to handle philosophical problems such as these and question if it is a good use of our time.

The debate between objectivism vs. constructivism, though a healthy and necessary one, has also had the tendency for people to believe that there is a "right answer" to what their philosophy "should be." It's almost as though they were taking some sort of test that they need to pass. I suppose most just want to be associated with the dominant paradigm instead of digging down deep to better understand their own values, beliefs, and biases. I've also noticed it is in vogue to question others about their philosophical camp, not to enter into

a dialogue of how one's philosophy informs one's design, but more to sort people in a convenient manner. (This resembles to me how Dorothy was questioned by Glinda: "Are you a good witch or a bad witch?" The answer, of course, is "Why, I'm not a witch at all.")

Don't mistake my meaning. I believe strongly in each professional developing a strong philosophical stance (I myself have tried to do so in several places, such as Rieber, 1993). It's just that we have tried, at times, to misapply the business of philosophy or to try to tackle philosophical questions that have remained unresolved for thousands of years. There are productive uses for philosophy in our field, but there is the danger of sliding into philosophical quagmires, or worse, trying to use philosophical positions to inappropriately judge people.[3]

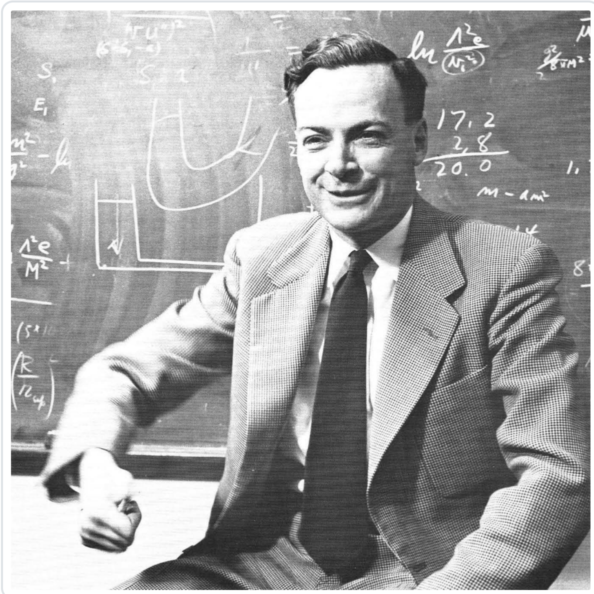
Not being a philosopher, I have found it difficult to effectively raise and lead discussions on philosophical issues in my classes. I had always joked about wanting some sort of simulation that embedded these issues in a way that one could "experience" them rather than just talk about them. You know, something like "SimCity" or "SimLife"—world building games where players can make decisions and see the outcomes play out in a world that simulates our own. Wouldn't it be great, I thought, to also have a similar simulation to help one play with these complicated educational issues as well as understand what the educational system would be like 50 or 100 years from now if a major paradigm shift really took place today! Ha ha, it was a quaint inside joke. Well, one day I decided to put a working prototype of *SimSchool* together for my next class. It offered students a chance to experiment with the philosophical perspectives of objectivism and constructivism and observe the influence of each on several educational dimensions (e.g., motivation, experience, learning outcomes, control) as well as consider what the impact a philosophical shift would have on some bigger societal factors (e.g., high school graduation rate, crime rate, etc.). The simulation also tried to clarify the relationship between philosophical orientation and instructional strategies. [4]



Instructional Technologist as Physicist or Mathematician

Perhaps the proper way to become an instructional technologist is to first become a physicist or mathematician. Many of the leading scholars in the field began this way. Seymour Papert was a mathematician by training, Alfred Bork was a physicist. Sometimes I wonder if our field suffers from "physics envy"—we want desperately, it seems, to be considered a science. Well, I enjoy reading about theoretical physics (at least as far as I can without knowing the mathematics).

One physicist I have become fascinated with is the late Nobel laureate, Richard Feynman. Some of you might know him due to his role on the committee investigating the Space Shuttle Challenger disaster. (My daughter was in first grade at the time. The whole school was gathered in the school's cafeteria to watch the lift-off. I recall my daughter coming home after school telling us that it was her job to go find the principal to tell her that the "shuttle blew up.") I have become interested in Feynman for lots of reasons, but of relevancy here was his apparent genuine concern about his teaching. While other physicists and mathematicians-turned-educators often come across to me thinking they know all the answers to the problems of education, Feynman remained quite reflective (not to mention baffled) by the entire teaching/learning process. In the preface to *The Feynman Lectures*, a set of well-known readings to introductory physics, Feynman expressed his frustration in not being able to meet the needs of students known not to be the brightest or most motivated (in other words, those like me). Rather than just blame the students, he publicly took his share of the responsibility.



I also liked the way Feynman talked about his teaching in a very reflective, almost constructivistic way. That is, he seemed to understand that teaching was a way for him to understand problems in new and important ways. He once wrote about turning down the opportunity to go and work at Princeton at the Institute for Advanced Study BECAUSE he would not have to teach. Here is an excerpt (go to https://edtechbooks.org/-ST for the complete quote):

I don't believe I can really do without teaching. . . . If you're teaching a class, you can think about the elementary things that you know very well. These things are kind of fun and delightful. It doesn't do any harm to think them over again. Is there a better way to present them? The elementary things are easy to think about; if you can't think of a new thought, no harm done; what you thought about it before is good enough for the class. If you do think of something new, you're rather pleased that you have a new way of looking at it. The questions of the students are often the source of new research. They often ask profound questions that I've thought about at times and then given up on, so to speak, for a while. It wouldn't do me any harm to think about them again and see if I can go any further now. The students may not be able to see the thing I want to answer, or the subtleties I want to think about, but they remind me of a problem by asking questions in the neighborhood of that problem. It's not so easy to remind yourself of these things. So I find that teaching and the students keep life going, and I would never accept any position in which somebody has invented a happy situation for me where I don't have to teach. Never.

While I don't know how much his students may have learned, his willingness to admit how vital teaching was to his own professional development is refreshingly straightforward.[13]

Instructional Technologist as a Graduate of an Instructional Technologist Program

I finally come to the time-honored tradition of going to a university and getting a degree. The diploma becomes one's "membership card" with all the rights and privileges therein to participate as a member of the profession (though it does not, of course, guarantee a job!). I feel I must tread lightly here so as not to be misinterpreted, especially considering I am a member of a university's faculty. Nevertheless, I have long been frustrated with the way in which instructional technologists are educated at universities (notice my deliberate avoidance of the term “train”). There are many areas to be considered here, so I will only focus on one in any depth: The congruency between instructional design as written and taught, and how it is actually done in practice. Related to this is the role played by theory and research in guiding, or even informing, practice.

One of the most problematic relationships in our field is that which exists between theory, research, and practice. The problem is shared by professors, researchers, students, and practitioners alike. That is, a professor who is unable (or unwilling) to connect theory with practice is just as guilty as a student who avoids confronting or demeans theoretical implications of practice. The textbooks make the relationship seem so clear and straightforward, yet my experience with doing instructional design has been messy and very idiosyncratic. Michael Streibel (1991, p. 12) well-articulated what I had felt as I tried to reconcile instructional design as it was written and talked about versus how I had actually done it:

I first encountered the problematic relationship between plans and situated actions when, after years of trying to follow Gagné’s theory of instructional design, I repeatedly found myself, as an instructional designer, making ad hoc decisions throughout the design and development process. At first, I attributed this discrepancy to my own inexperience as an instructional designer. Later, when I became more experienced, I attributed it to the incompleteness of instructional design theories. Theories were, after all, only robust and mature at the end of a long developmental process, and instructional design theories had a very short history. Lately, however, I have begun to believe that the discrepancy between instructional design theories and instructional design practice will never be resolved because instructional design practice will always be a form of situated activity (i.e., depend on the specific, concrete, and unique circumstances of the project I am working on).

This idea that instructional design is largely contextual and relies so heavily on creative people working with unique problems resonates with me even more due to my experience of being the parent of a child with special needs. My son Thomas was born with a severe developmental disability accompanied by a wide array of other issues, including language and behavior disorders. (At the time, the term autism was not yet mainstream. The first diagnosis given to Thomas was “pervasive developmental disorder”—a term I came to regard as meaning “we really don’t know.”) There is a not so great movie titled *Dog of Flanders,* involving a poor Dutch boy who desires to become a painter. One day he visits the studio of a master painter and is shocked to learn that this painter sometimes uses a knife to paint with. In response, the painter responds matter of factly that “I would use my teeth if I thought it would help.” There have been countless times I have felt the same thing about how I might improve my teaching or instructional design, despite of what I think I know about learning theory, etc.—I, too, would do just about anything if I thought it would help. My work with my son points to situations where the distinction between cognitive/behavioral or objectivistic/constructivistic becomes quite gray and rather unimportant. Thomas was very much into Batman, Spiderman, and other superheroes. So, I developed a little software program called “Super Hero” for him to play and enjoy. I like to say that I designed this game *with* Thomas, not *for* Thomas. He has contributed to its construction in so many ways that I feel he deserves to be called a “co-designer.” I think this notion is useful to any designer. Work with end users to such an extent that you feel you owe them co-ownership of what you design.

My current interest in play theory is also an example of my struggle with how our field characterizes the interplay between research, theory, and practice. On one hand, my interest in play is derived by working with children and watching the intensity with which they engage in activities they perceive to be worthwhile. However, I also wanted to explain more thoroughly my own experiences of being so involved in activities that nothing else seemed to matter. My curiosity led me to themes I had first encountered when I was a "short lived" student of anthropology, namely games and their cultural significance. I also found out about Flow theory (Csikszentmihalyi, (1990) and saw how well it described the play phenomena.

I have come to see the story of the Wright Brothers' invention of the airplane as a good metaphor for understanding the proper relationship between theory, research, and practice in our field (it is even a good metaphor if you live in a country that takes issue with them getting credit for being declared the first to invent the airplane!). That the Wright Brothers were technologists, inventors, and tinkerers is not questioned, but people do not realize that they were also scientists who asked the right questions about the theory of the day and crafted ingenious experiments to get at the answers. Most of all, people forget that they were also the world's most experienced pilots at the time. They took their findings into the field and practiced what they studied. These experiences likewise informed their scientific side of the enterprise, culminating in a controllable aircraft. (Incidentally, it's the "controllable" part of the invention that is the real genius of the brothers.)

In broaching the subject of the adequacy of graduate programs in preparing people to become instructional technologists, I hope I do not unleash the floodgate of individual criticisms or personal war stories. Instead, I wish us to look more broadly at the aims and goals of graduate programs as compared to what is needed or actually done in the field. For example, I think the distinction between education and training is useful here. I can't name one technical skill I learned in a graduate course that I still use exactly as taught. Instead, all the technical skills I now use were learned either on my own, through professional development, or by preparing to teach others (mostly the latter). In my opinion, universities are not supposed to prepare technicians to perform a specific job, but rather should prepare people for a life's study. It is fair to ask how well we are doing at this in our field. To our credit, many in the field are using "studio-based approaches" to teaching their students how to actually "do" instructional design. This was an approach we pioneered ourselves at the University of Georgia.[5]

Many issues on this topic remain, such as the proper role of research. (I see at least two, by the way. One is the traditional role of research contributing to the literature. A second role for research, though less recognized, is how it informs the researcher, or designer. The act of doing research becomes a source of ideas and invention, leading to a much deeper conceptual understanding of the topic or problem being studied. Even if the research itself goes wrong in some way, the researcher grows intellectually and emotionally from the experience. I'm not sure how to characterize this research purpose since it does not fit any traditional category (e.g., basic, applied, etc.), so perhaps we should just call it "constructive or reflective research.")[6] Another topic worth pursuing is the way universities assess student achievement. This is not an indictment of testing per se, but I admit I find it strange that we still assign letter grades in most of our graduate courses.

Closing

So, what is the proper way to become an instructional technologist? Obviously, my position is that there is not one way and that we should value the diversity of the people who make up our profession. I also challenge each faculty member and student to stand back from their graduate curricula and question the purpose and relevance of the experiences that are contained there. However, this is all too easy, so I end by offering two lists. The first is my way of “reverse engineering” what I do in language that people outside the field can understand (such as relatives or my barber):

I’m an instructional technologist, which means I:

- Help people learn new things.
- Solve problems in education and training or find people who can.
- Use lots of different tools in my job; some are ‘things’ like computers and video, other tools are ideas, like knowing something about how people learn and principles of design.
- Know a lot about these tools, but I know I must use them competently and creatively for the task at hand before they will work.
- Consider using all the resources available to me, though sometimes I must go and find additional resources.
- Am most interested in helping children, but many of my colleagues work with adults.
- Resist doing things only because “we’ve always done it that way,” but I’m also careful not to fall for fads or gimmicks.
- Always try to take the point of view of the person who is going to be using the stuff I make while I’m making it; that’s really hard, so I get people to try out my stuff as soon as I can to see what I am doing wrong.
- Am not afraid to say, “Yes, that’s a better way to do it.”

Finally, here is a list of things I feel one needs to do to become, and remain, an instructional technologist and represents, I hope, the best of what we are doing in our graduate programs:

- Do Instructional Technology: Work with people; take a genuine interest in their interests; listen.
- Study the design process, study how people learn individually and collectively, and study media’s role in learning.
- Strive to understand the interdependency of theory, research, and practice.
- Learn the “how’s and what’s” of media.

- Play.

I'm sure you can add to this list.

Here are a few questions, offered with the hope it will stimulate healthy discussion and debate:

1. What is your story about how you came to be an instructional technologist? What is unique about it? I am especially curious about individuals who do not hold graduate degrees in instructional technology.
2. How well prepared were you to face the problems you now encounter in your jobs?
3. Those of you who have a formal degree in IT, how satisfied are you as to how well you were prepared to do the job you now have? How well aligned were issues surrounding theory, research, and practice? I know that many non-American programs are not so reliant on course-driven models (and this is part of our redesign), so I am anxious to hear more about them.
4. What would you add to my list of things that characterize what Instructional Technologists actually do, as a profession?
5. What would you add to my list of what one needs to do to adequately prepare to become an Instructional Technologist?

Acknowledgements

I'd like to give Steve Tripp and Ron Zellner some credit for some of the ideas here, since some were derived from some long, enjoyable (and independent) conversations with them over the years.

Application Exercises

1. Reflect on your experiences and how they have brought you to the field of instructional design. How are they similar to the paths described in this chapter and how do they provide you with a unique perspective on instructional design?

2. Based on your individual goals, and what you understand of the field today, create your own list (see Rieber's in the "Closing" section) outlining how you envision your role as an Instructional Technologist/Instructional Designer.

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[1] It's been interesting to see the number of ways we have labeled ourselves over the years. At Penn State, the name of the program was instructional systems. At Texas A&M University, where I worked right after graduation from Penn State, it was called educational technology. When I arrived at the University of Georgia, we were instructional technology. The faculty at UGA eventually soured on that term and became the first program in the country to change its name to learning, design, and technology. We did so because we felt it was a more accurate description of our priorities and work (and yes, the two commas are important). For the sake of the historical context of this essay, I've kept the label instructional technology throughout.

[2] For those not familiar with LOGO, it was a programming language built to support deep learning. It was truly a revolutionary idea in the world of education at the time because the earliest uses of computers in the school were rooted in drill and practice models. Many people were involved in the creation of LOGO, but the key spokesperson was Seymour Papert. His very influential book in 1980, *Mindstorms,* introduced me to many big ideas surrounding technology, learning, and children at probably the most formative period in my career as an educator.

[3] This little foray into philosophy is probably the area where I get the most questions—and the most flak. However, you must realize that in 1998 there had been at least a decades-long debate (it was common to use the word "war") in the world of educational research between qualitative and quantitative research methodologies. Central to this debate was the tendency of groups to align themselves either with positivism or constructivism. I remember so many students at the time being worried about believing in the "wrong philosophy." There are similar debates today, often between learner-directed approaches such as inquiry-based learning, and teacher-directed approaches, or between various philosophies of culture and learning, technology and learning, or cooperative vs. individual learning. My point then— and now—is that your philosophy is your philosophy. There is nothing to apologize for. But one should be open to hearing all points of view and particularly be open to changing one's mind. Although strong opinions remain, the "us" versus "them" mentality has largely disappeared regarding core learning theories. The shift to considerations of design-based research in the field of learning, design, and technology has largely defused such methodological debates given that DBR is agnostic on the issue of whether quantitative or qualitative methods are best.

[4] SimSchool was never meant to be taken too seriously. It was just a little exercise to get my students to "try out" the philosophical implications on education, from my point of view. What was most interesting is that when people took issue with my interpretation, I then asked them how they would design SimSchool. Unfortunately, like a lot of the software I've developed, SimSchool no longer exists in a workable form because I programmed it using an authoring tool called Authorware. It is stored safely on a 3.5" floppy disk somewhere in my office.

[5] Writing now in 2023, instead of looking forward with some trepidation about how our "experiment" with a studio-based approach to graduate school might go, I now look back very fondly on the 15 years or so teaching within the face-to-face design studio environment. Although we continue today to try to embrace many of the studio design principles, the eventual switch to all-online learning has made it practically impossible to practice the type of studio-based approach that we pioneered between 1998 and about 2013 on the sixth floor of Aderhold Hall at UGA.

[6] I recommend reading Donald Stokes' 1997 book *Pasteur's Quadrant* for more contemporary ideas about the purpose of research, educational and otherwise.

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A Brief History of Educational Technology

Molenda, M. , Subramony, D. P. , & Clark-Stallkamp, R.

Since the early 1900s, education and training professionals have been intrigued with the potential of new technologies to advance human learning. The field of study and practice that evolved around this interest has borne many different labels over the years—visual education, audiovisual education, educational communications, instructional technology, and educational technology—as documented in the various "definition" statements issued by the Association for Educational Communications and Technology (AECT) and its predecessor, the Department of Audiovisual Instruction (DAVI): (McClusky, 1923) (Ely, 1963) (AECT Task Force on Definition and Terminology, 1977) (Seels & Richey, 1994) (Januszewski & Molenda, 2008). The common thread that ties these definition statements together is the quest to find ways to help people learn faster, better, more affordably, and more humanely through the application of contemporary technologies. For this concept we will use the label of *educational technology*, on the basis that it is the broadest and most popularly used term over the past century.

This quest for efficiency and effectiveness has been driven forward by a series of new psychological theories and new technological innovations, each of which appeared to offer dazzling new vistas for the enhancement of human learning. We can speak of these developments as new paradigms, that is, new frameworks or new ways of thinking about the complexities of human learning. Since educational technology is inherently an interdisciplinary field, many of the theories and innovations that have impacted the field have originated outside the field. In this chapter we focus on those external influences that made a lasting impression on educational technology. We propose that the history of educational technology can be viewed as a procession of contending paradigms, each looking at the problem a little—or a lot—differently, but all revolving around the notion of improving learning through the application of contemporary technologies. Note that *technology* can be viewed both as "hard" technology—the hardware and software employed to facilitate learning—or "soft" technology—the application of science or other organized knowledge to practical problems, exemplified by instructional design models, programmed instruction, and the other programmed technologies discussed below (see heading of "Programmed Instruction). Specifically, we will discuss the paradigms of visual education, educational communications, audiovisual education, instructional technology, programmed technologies, instructional systems development, interactive multimedia, and several Information Age paradigms—democratization of media access, inclusion, distributed learning, and emerging technologies. Each paradigm will be given approximate beginning and ending dates; these dates are meant to be interpreted loosely, signifying the period of time when each paradigm held the center stage. Of course, none of the paradigms sprang fully formed on a specific date, nor did any cease to exist. To this day, each paradigm still lingers in the consciousness of the field and each still has applicability to a certain range of issues.

Any historical narrative of educational technology must make some reference to the broader social, economic, and cultural forces impacting institutions of education and training. While exploring these external forces in depth is beyond the scope of this chapter, we do offer brief descriptions of the most important factors. More extensive discussion can be found in Saettler's authoritative history (1990) and in Bradshaw's more recent analysis (2018).

The Visual Education Paradigm, 1905-1945

Early Technological Innovations

The invention of high-volume lithography in the late 19th century enabled the mass production of large-format color prints, known today as art prints or study prints. As they were expensive to produce, a school, university, or museum might possess only a few copies of a given artwork or scientific illustration. Caring for and promoting the use of such prints began to form the basis for a new professional specialization. The invention of photography and later the incandescent light bulb added lantern slides to the domain of that specialization, known as *visual education*. The beacons of the new movement were, first, the big-city museums, then museums within school systems, most prominently, that of St. Louis. Under the leadership of curator Amelia Meissner, the St. Louis Educational Museum housed and circulated some of the largest visual collections for educational purposes – from art prints to photographs to lantern slides and stereographs. By 1906, the St. Louis Museum made some 5,000 deliveries to classrooms every year (Saettler, 1990, p. 129).

Movies and their Sociocultural Setting

The innovation that drove the movement, though, was movies. Theatrical films (silent until 1927) had been popular since the 1910s; dramatic silent films such as *The Birth of a Nation* (1915), *Ben Hur* (1925), and *Wings* (1927), were viewed by millions nationwide. As with other mass media that were to arrive later—especially radio and television—commercial producers catered to the tastes of the dominant demographic, which was white and native born. Thus, indigenous, black, Latinx, immigrant, and LGBTQ(+) communities tended to be invisible or treated as stereotypes. Indeed, movies such as *The Birth of a Nation*, which glorified the rise of the Ku Klux Klan, contributed to the consolidation of racially discriminatory attitudes. Unfortunately, even films that were expressly made for school or college use tended to reflect these biases since producers were seeking acceptance by the majority culture to avoid limiting possible sales.

In any event, dramatic theatrical films convinced educators, civic leaders, and religious leaders that film had a singular power to inform and persuade. All were eager to harness the power of film for their own purposes. This created a market for entrepreneurs to create films for educational purposes and to adapt projectors for school and church showings. Between 1905 and 1923, sixteen large-city school districts had established bureaus of visual education (McClusky, 1923, p. 11). These agencies were building libraries of films and slides for loan to teachers within their district. By 1923, the highly flammable nitrate film (which required fireproof booths) had been replaced by cellulose acetate "safety" film, which initially was 35 millimeters in width. By 1930 the new film format of 16 millimeters had become standard for non-theatrical movies, so the smaller, lighter 16 mm projectors began replacing 35 mm projectors in schools, churches, and civic organizations. Shortly after, sound films began to replace silent films. All these technological innovations made film more accessible and more affordable for educational institutions. Ownership of slides, films, and projectors crept steadily upward.

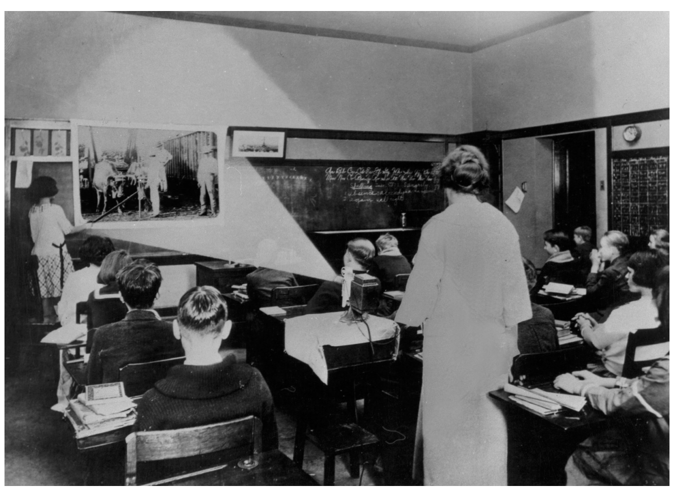

Figure 1. *Early filmstrip projector*

Pedagogy of Visual Education

The pedagogical principle underlying the visual education movement was that meaningful learning required rich and varied experiences, not just the rote memorization that characterized previous classroom practices. The shining goal of the movement was to surmount the limitations of “verbalism,” that is, reliance on the spoken and written word—lectures and textbooks (Hoban et al., 1937). Visual education advocates viewed learning experiences as falling along a continuum from concrete to abstract and then firsthand, concrete experience was not feasible, visual images could lend a measure of realism, giving concrete meaning to the ideas being studied. Edgar Dale’s “cone of experience” was the most popular reference for this principle (Dale, 1946). This concept became so misused over the following half-century that a comprehensive refutation of the corrupted uses was later issued (Subramony et al., 2014).

The Great Depression and World War II

During the Great Depression of the 1930s and continuing through World War II, schools, colleges, and community organizations were unable to continue the momentum of increasing availability of visual hardware and software; in fact, the federal government conducted an aggressive program of acquiring projectors from educational institutions in order to carry out their own agenda of massive, accelerated military training. During the war, great strides were made within the military regarding the production and utilization of training films, guided by a crash program of research on film production and utilization. Schools and colleges came to reap the benefits of the advancements made during the war, but only after demobilization brought the experts home and economic recovery allowed educational institutions to flourish again.

The Educational Communication Paradigm, 1930-1990

With the advent of broadcast radio, educators began to envision a new prospect: sending educational content out into the ether, where it could be received by listeners no matter how distant they were from educational institutions. The focus of the educational communication paradigm was on the components of the delivery system: the source, the message, the channel, and the receiver (Berlo, 1960). It was based on the newly emerging field of information theory (Shannon & Weaver, 1949). Thus, the educational communication paradigm represented another way of looking at the process of learning from visual and auditory media. It accepted the claim that auditory and (in the case of television) visual enrichment enhanced concept formation and retention, and it added the claim of logistical efficiency—being able to learn without bearing the cost of teachers or schools. This is the claim that underlies not only educational radio and television but also distance education over the internet.

Educational Communication via Radio

Radio, the new medium of the 1920s, like movies, inspired a wave of enthusiasm regarding its potential to bring the blessings of education directly into the home. Although radio carried only words, music, and sound effects, it had the ability to paint word pictures that evoked vivid visual images in the listener’s mind. If used to create dramatic portrayals, it could bring history and social studies to life. Basically, though, the rationale for considering radio was that it promised to free education from the limitation of physical location. Anyone, anywhere, could potentially receive broadcast signals. The voice of the teacher could reach thousands of people simultaneously, even those located far away from the origination site.

Figure 2. *Boys listening to the radio*

In many countries, including Canada and most European countries, radio was quickly put under the control of the national government, with the primary goal of informing and educating the populace. In the United States, the Radio Act of 1927 put the national government in charge of granting broadcast licenses, allocating most of the spectrum to commercial stations. Licenses were also granted to educational institutions, and many universities and school districts undertook experimental operations in the 1910s and 1920s. However, most withered over time as it became clear that money was required to attract and retain skilled engineers, writers, producers, and on-air talent. One state, Ohio, made a serious effort to incorporate radio programming into the K-12 curriculum. The Ohio School of the Air began broadcasting school programs in 1930. The weekly schedule addressed both elementary and secondary school subjects (Saettler, 1990, pp. 198-199). Although Ohio was considered a leader in using radio in the schools, a 1941 survey found that, even in Ohio, only 46% of schools possessed even one radio set. The national average was only 14% (Reid, 1942a).

The nature of broadcast signals entailed another barrier—without recording devices, schools had to receive the program at the time it was broadcast, meaning school schedules would have to be standardized around the broadcast schedule, which is simply unworkable in a schooling system as locally controlled as that of the U.S. That lack of standardization pertains to curricular content as well; even with today's stricter state standards, the variation in curriculum content from place to place is substantial. These problematic issues were well understood from the very beginning; they were discussed in detail by Dent (1937, pp. 125-126).

Educational Communication via Television

As with movies and radio, television inspired an outpouring of public speculation about its educational potential: "Television will be the instrument which will create as complete a revolution in the education of the future as the discovery of movable type…" (Stewart, 1941), presaging the uncritical techno-enthusiasm reflected in the "emerging technologies" paradigm, discussed below. Coming out of World War II, with rapidly expanding school and college populations, television was viewed as a potential solution. It could enable a single master teacher to reach multiple classes of students simultaneously. For adult education, it could enable interested adults to gain new knowledge and skills without leaving the comfort of home and without having the trouble and expense of matriculating at a college. However, as with radio, the United States federal policy allocated television channels mainly to commercial operators. Later, as the result of lobbying by the Joint Council on Educational Television (JCET) and the determined efforts of commissioner Frieda Hennock, the Federal Communications Commission (FCC) in 1952 reserved 242 channels for non-commercial stations. A variety of operators emerged, including community groups, universities, public school boards, vocational education boards, and state departments of education. Their missions varied widely, from cultural programming for the community to direct instruction for schools. The community stations eventually prospered after passage of the Public

Broadcasting Act of 1967, which supported the operation of non-profit stations that came to be sustained by the contributions of viewers and philanthropic foundations.

Figure 3. *Freida Hennock*

However, the adaptation of broadcast television to instructional use encountered the same obstacles as broadcast radio: how to craft program content to fit varying school district curricula and how to schedule programs to fit varying school schedules. On top of these difficulties was the ever-present issue of funding. Philanthropic foundations, such as the Ford Foundation's Fund for the Advancement of Education, supported some educational experiments. Federal programs, such as the Educational Television Facilities Act of 1962, sprinkled several tens of millions of dollars over a decade into the support of school and college television, but never enough to create real momentum to the effort. A business model that made sense for production and distribution of K-12 televised instruction was developed by the Agency for Instructional Television (AIT) in 1970. Its consortium plan allowed the cost-effective development of successful series in many different subject areas, such as math skills, writing, and early childhood and adolescent emotional development. U.S. state (and Canadian provincial) departments of education could "buy in" to a potential project that suited their needs, sharing the costs of production and distribution (Middleton, 1979). Thus, mass-distributed televised instruction—broadcast through community, school district, and university stations and distributed through closed-circuit systems—reached millions of students from the 1950s through the 1970s (Wood & Wylie, 1977; Zigerell, 1991).

Morphing from a Broadcasting Model to an Audiovisual Resource Model

It was only after the introduction of the videocassette recorder in the 1970s that educators were able to break through the timing and scheduling barriers of the broadcasting model. If one teacher in one school wanted to use a particular series, they could borrow or purchase one or a full set of videocassettes. As users began to prefer videocassettes to film, the business model of educational film libraries began to crumble. Films that could be borrowed "for preview" might be locally converted to videocassette, depriving the film library of a sale. By the late 1970s, many of these film libraries stopped purchasing new films and switched to videocassettes, duplicating films and new video titles as requested by customers. In this form, instructional television resources continued to be widely used until the onset of Web-based resources in the 1990s.

Correspondence Study to Distance Education

University-based programs of correspondence study, later to be known as *distance education*, took root at the University of Chicago and Columbia University late in the nineteenth century. These programs involved mailing printed lessons to which students mailed back written responses, which were graded by monitors who returned feedback to the student with the next lesson. This mode of operation was rendered obsolete in the 1970s when Britain's Open University (OU) inaugurated programs based on broadcast radio and television, supplemented with print and cassette tape materials mailed to students. Another key element of the program was interaction with tutors—at local learning centers or by telephone (Molenda & Subramony, 2021). This model was based on the educational communication paradigm—expanding educational opportunities by transmitting lessons through broadcast media to reach potential learners wherever they were.

The Audiovisual Education Paradigm, 1946-1983

What began as the *visual* education paradigm gradually evolved into the *audiovisual* education paradigm, referred to by Davies (1978, pp. 20-21) as "the audio-visual archetype." The shift in focus came as sound film and sound filmstrips replaced the earlier silent versions. As this was happening, sound recording and playback became more accessible, thanks to magnetic audio tape recording. In the visual education era, the only source of recorded sound was the phonograph record, which was the most frequently used technology tool in schools (Dent, 1937, pp. 120-121). The audio tape recorder allowed teachers and students to create their own audio products. Thenceforth, the movement advanced under the flag of *audiovisual* education. It carried forward the perspective of the visual education paradigm: that auditory and visual enrichment aroused the interest of learners and enabled them to grasp abstract concepts more clearly and retain them more permanently.

The Post-World War II Sociocultural Environment

The end of the war brought an end to rationing and shortages of critical materials. In the U.S., it also brought the homecoming of millions of military personnel. During the war, women stepped in to replace men who departed for military service. The resulting percentage of women in the work force rose from 26 to 36 percent. After the war, most of those women wished to remain in their jobs, but jobs shrank as industrial output turned from wartime to peacetime production. Though industrial employment for women decreased the expanding service and education sectors provided new work opportunities. At the time, these new work opportunities were still mainly identified as "women's work" (this included elementary school teaching and school library services, which were beginning to merge with audiovisual services) (Department of Labor, Women's Bureau, 1946).

Up to this point, women were not a particularly visible part of the educational technology profession. The job of school or university "audiovisual director" typically went to men—returning veterans who had participated in film and audiovisual work during the war, science teachers who were the heaviest media users, or simply men who had the physical strength to handle the bulky audiovisual equipment of the day. Women often served behind the scenes—ordering, cataloging, reviewing, storing, and distributing audiovisual materials—but seldom appeared in leadership positions. In fact, during the first half-century of AECT's existence (known then as DAVI), only four women served as president of the association. Anna L. Hyer, who served as executive secretary from 1958 to 1969, was viewed as somewhat of an anomaly—a successful woman leader in a "man's field." In the second half-century, after the nature of the profession had changed, fourteen women served as president.

Figure 4. *DAVI Board*

Figure 5. *Anna Hyer*

The return of peacetime conditions led to the “baby boom.” As families grew and moved to the newly built, expanding suburbs, educators scrambled to build schools and supply them with qualified teachers. Meanwhile, the “G.I. Bill” (officially, the Servicemen's Readjustment Act of 1944) offered subsidized college education for nearly eight million veterans over the next decade. The surge of new students at all levels prompted renewed interest in finding ways to use technology to help professors cope with overflowing classes of new students. The audiovisual education profession, then populated by thousands of veterans who had participated in “rapid mass training” programs during the war, explored methods of using audiovisual media in a systematic way to serve more students per instructor.

Technological Innovations

At the top of the hierarchy of audiovisual media was the film. As one observer noted, “the educational motion picture, in the parlance of the golf course, can be likened to the driver. A well-outfitted golf bag, however, contains a varying assortment of other types of clubs—each in its own way peculiarly adapted to a different type of shot” (Flory, 1957, p. 458). Films were then in color and with sound; they were shown on smaller, portable projectors, built rugged and reliable to military specifications. The other “clubs in the golf bag” included: 35 mm slides and filmstrips; overhead projectors that were developed during the war; record players —the most popular media device since the 1920s, now transistorized; and the magnetic tape recorder, invented in Germany and brought home by veterans. The other “clubs in the golf bag” included: (a) 35 mm slides and filmstrips; (b) overhead projectors (developed during the war); (c) record players, popular since the 1920s and now transistorized; and (d) the magnetic tape recorder, invented in Germany and brought home by veterans.

Figure 6. *Overhead projector at an elementary school*

The highest hopes of visual education advocates were lavished on television, which was beginning its explosive trajectory to become the dominant mass medium of the nation. It appeared to be the ideal solution to the problem of covering the shortfall of qualified teachers and professors. Broadcast and closed-circuit systems gained a foothold in the 1950s, supported by state and national government subsidies and philanthropic foundations —especially the Ford Foundation. By 1960, around 50,000 television receivers were being used in K-12 classrooms (Finn et al., 1962, p. 54). However, as discussed above, the issues of curricular diversity and non-uniform classroom schedules were never solved. Nor was a solution found to the high cost of acquiring and maintaining equipment and of producing high-quality programs. Hard experience also proved that teachers were leery of embracing a tool that had the potential to replace them. Video software ultimately found a good measure of acceptance when it was translated into videocassettes and added to library shelves alongside films as another audiovisual resource, useful for supplementing teachers’ class presentations.

Sputnik and the National Defense Education Act of 1958

Historically, in the U.S., the fear of a government mandated national curriculum impelled both major political parties to oppose national funding of any level for education. That fear was superseded by a larger threat—the resurgence of the Soviet Union, symbolized by the launching of the first space satellite, Sputnik 1, in 1957. Less than a year later, Congress passed the National Defense Education Act (NDEA), which authorized expenditures of around $200 million per year over a four-year period. Its major purpose was to upgrade science education, but one particular provision—Title VII– supported research and information dissemination on the utilization of radio, television, film, and other media. Further support came in the form of the Higher Education Facilities Act of 1963, the Elementary and Secondary Education Act (ESEA) of 1965, and the Higher Education Act (HEA) of 1965. These laws were meant to address the needs of the "baby boom" generation, who were now of college age and whose children were approaching elementary school age. Thousands of new schools, vocational-technical institutes, and college buildings were constructed and equipped with the latest technology. After 1969, the Nixon administration began to cut back on these initiatives, but many popular programs survived and continued to be funded for decades.

The most notable beneficiary of NDEA was the innovation known as the *language laboratory* —a room equipped with audio listening, recording, and playback equipment for foreign language practice. Although typical language labs cost around $10,000, they were snapped up by secondary schools and higher education institutions at a rapid rate. Finn, Perrin, and Campion estimated the expenditure of over $100 million in the six years after the implementation of NDEA (1962, p. 49).

Figure 7. *Tape recorder language lab*

The Civil Rights Movement and Educational Change

Throughout the late 1950s and early 1960s, protest marches and political pressure mounted, urging action to resolve the issues of poverty and racial inequalities. In response, President Lyndon Johnson, under his "War on Poverty" campaign, pushed through the Civil Rights Act of 1964 and the Elementary and Secondary Education Act of 1965. The former was intended as a mechanism for supporting school integration (which had supposedly been mandated since 1957); the latter was meant to bolster schools that served low-income children. These funds gave needed impetus to the audiovisual education enterprise by providing audiovisual equipment and materials to low-income and bilingual schools, by encouraging the use of educational television on a statewide basis to enrich the curricula of schools undergoing desegregation, and by supporting the development of stronger state education agencies, including audiovisual and school library departments.

Figure 8. *Girl operating film projector*

During the 1960s AECT grew to its largest membership, reaching almost 10,000 in 1970, and its greatest national prominence. A group plurality of members served as audiovisual coordinators at the school building and district level. It remained an overwhelmingly white profession until after the passage of the Equal Employment Opportunity Act of 1972, which prohibited job discrimination based on race, religion, national origin, or sex. Following the passing of this act, the numbers and visibility of women and people of color increased within AECT membershp; two women served consecutively as president in 1978 and 1979, and the first non-white president, Wes McJulien, was elected in 1980.

Demise of the Audiovisual Coordinator

Over the next thirty years, as “library media specialists” took over most of the school-level AV duties and as computer technologies replaced many audiovisual technologies, “AV coordinator” positions decreased dramatically. By 1999, AECT membership dropped to about 1,000—of whom only ten percent worked in K-12 education. By 2020 the percentage of members in the K-12 category fell to about one percent, with university faculty and graduate students comprising most of the remainder.

Figure 9. *Media Specialists in a library*

The Media vs. Methods Debate, 1983 to 1991

The audiovisual paradigm implies that audiovisual media themselves exert a direct impact on the quality of instruction. This assumption had been questioned since the 1970s, but the issue erupted into widespread discussion with the publication of a major research review challenging the proposition that media have direct causative influence on learning (Clark, 1983). Later, in a review of research on computer-based instruction, Clark reached a conclusion that shook the foundations of research on audiovisual media. He demonstrated that in experiments that compared an audiovisual treatment with conventional instruction, the more successful treatment was usually not the audiovisual treatment but rather the treatment that employed a more powerful *pedagogical method* (Clark, 1985). He concluded that what mattered in improving instruction was not "using more media" but "using better methods." This became known as the "media-methods debate." Discussion of this critical issue was marked by a number of exchanges between Clark and various critics, especially Robert Kozma (Kozma, 1991). All parties to the debate conceded that audiovisual media offer a wide range of logistical advantages (e.g., reaching more learners at lower cost) and pedagogical potentials (e.g., making abstract concepts more concrete), but their potential for improving learning outcomes depends on whether the lessons in which they are incorporated employ powerful instructional methods.

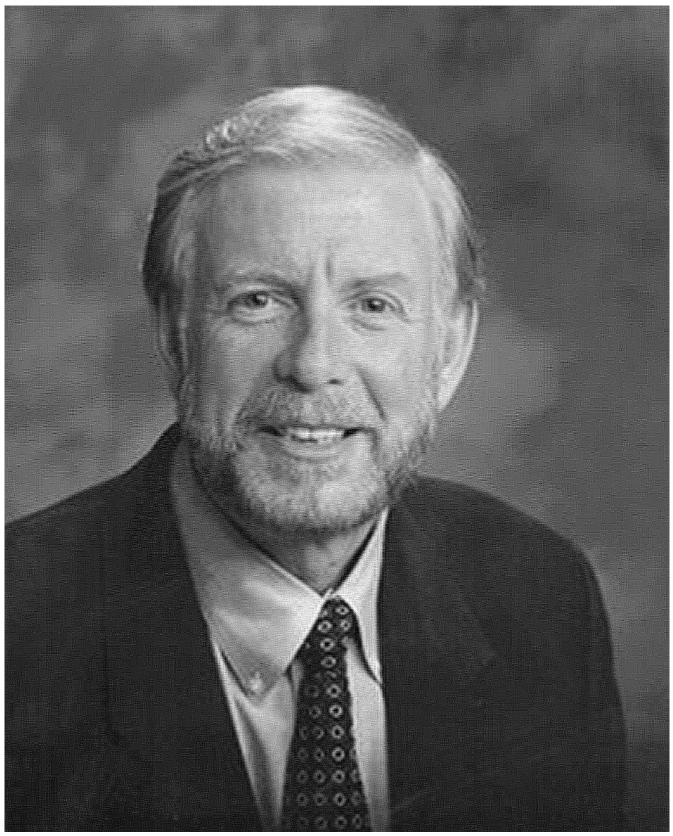

Figure 10. *Richard Clark*

Evolution of "AV Education" Paradigm toward "Instructional Technology" Paradigm

The audiovisual education movement championed the notion of making learning richer, more permanent, and more meaningful by supplementing or replacing verbal presentations with audiovisual ones. This ideal is captured in an ad for DeVry film projectors in *Educational Screen*, December 1929: "Motion pictures turn words into reality. To the sometimes dull routine of school work—motion pictures bring a dramatization of study subjects that turn words into reality—leave impressions that never fade." But one of the great visionaries of the field had an even more expansive vision. Based on his experience in officer training at the General Staff School during World War II, James D. Finn developed a vision of revolutionizing education by creating comprehensive *systems* of instruction that combined audiovisual media with diverse instructional strategies—large-group, small-group, and individualized. The instructional technology paradigm accepted the rationales of the audiovisual education paradigm and added the claims of increased efficiency and effectiveness—which were achieved by putting lessons into a more highly structured, repeatable framework and adding feedback loops in the form of testing and revision. As a professor at University of Southern California and president of the Department of Audiovisual Instruction (predecessor of AECT) in 1960, he shared his vision of *instructional technology* in over 100 books, articles, and published speeches. This promotional campaign was exemplified by his series of articles on "Automation and Education" (Finn, 1957a) (Finn, 1957b) (Finn, 1960). The acceptance of this new paradigm was signaled when the association adopted its new name in 1970—Association for Educational Communications and Technology.

Figure 11. *James Finn*

Finn's 1950s vision of *instructional technology* would not be fulfilled until the next paradigm—programmed technologies, including computer-based developments—came to fruition in the next three decades.

Programmed Technologies Paradigm, 1954-1989

The paradigm represented by programmed technologies had a completely different origin and evolution than the visual/audiovisual paradigm. It was not based on the visualization of concepts or enrichment of the learning experience. It aimed to replace the highly inefficient method of lecture-and-testing with a tightly controlled, reproducible product that maximized efficient use of learner time by emphasizing practice with feedback. By doing this, the paradigm dispensed and deleting contents or was activities that were not directly pertinent to the mastery of the specified objectives. This paradigm, which Davies refers to as the "engineering archetype" (1978, p. 22), was first manifested in the form of programmed instruction, but it morphed into other formats over the years of its prominence.

Programmed Instruction

In the early 1950s, American psychologist B. F. Skinner demonstrated that laboratory animals could be trained to perform quite complex behaviors by applying the principles of reinforcement theory, manipulating the consequences that followed responses (Ferster & Skinner, 1957). By 1954, Skinner had become interested in the possibility of applying reinforcement theory to human learning (Skinner, 1954). He developed a mechanical device, which others called a "teaching machine," in which the content was arranged in small steps, or frames, of information to which the user responded through writing or selecting an answer. The machine judged the answer and provided a reinforcer ("knowledge of correct response") if correct. The device presented the next frame only after a correct answer was given. The format became known as *programmed instruction* (PI) and the development of the software took place at Harvard University between 1954 and 1960 by a team of doctoral fellows—the most influential of whom was Susan Meyer (later Markle). She "established many of its conventions—prompting, fading, and so on" (Watters, 2021, p. 137). Markle went on to author or co-author the first "how-to" books on creating PI software (Markle et al., 1961; Markle 1964).

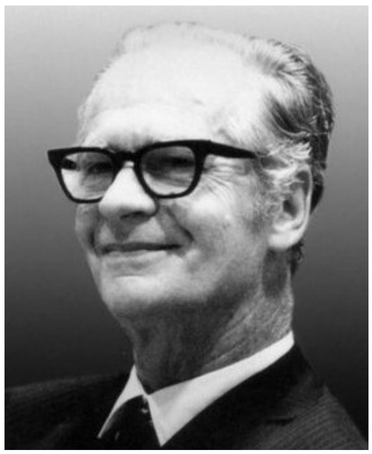

Figure 12. *B.F. Skinner*
Note. "B.F. Skinner" by Msanders nti is licensed under [CC BY-SA 4.0]

Figure 13. *Girl using the teachig machine*

Figure 14. *Susan Meyer Markle*

Alternative Format for Programmed Instruction

Not long after Skinner's format underwent developmental testing, Norman Crowder introduced a divergent format not based on learning theory but on a pragmatic concern for efficiency. Crowder's PI format presented frames of information but allowed users to jump ahead as long as they showed mastery; it provided remedial suggestions when incorrect answers were given. Its methodology came to be known as "branching programming." His device, the AutoTutor, which resembled what a desktop computer would later look like, offered individualization in terms of pacing and sequencing of frames, based on the learner's responses.

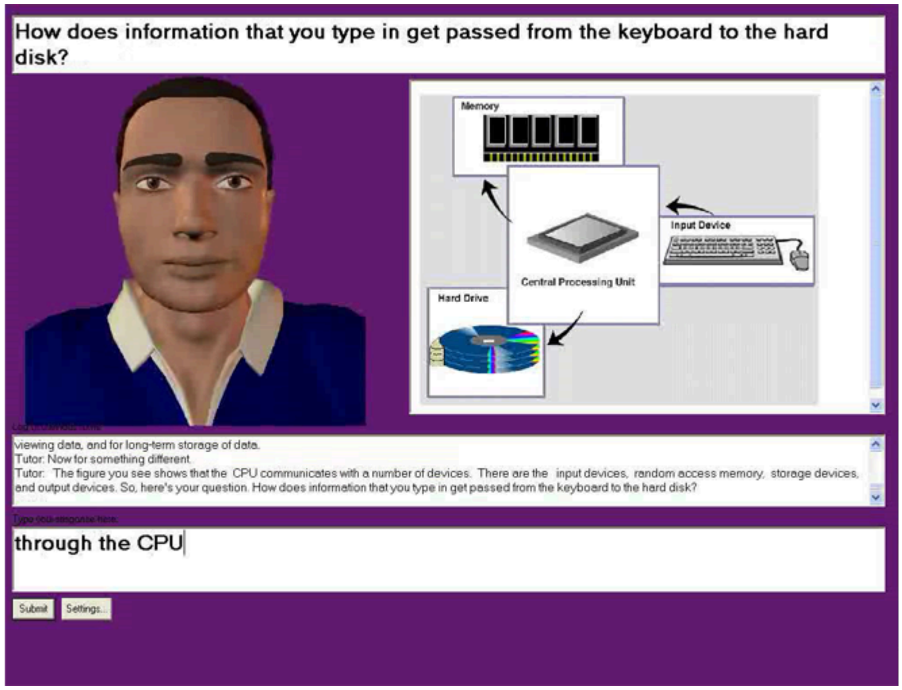

Figure 15. *Autotutor*
Note. "Screenshot of AutoTutor interface" by Sidney.dmello is licensed under [CC BY-SA 3.0](#)

In the early 1960s, PI devices based on both formats—linear and branching—were widely promoted by leading publishers. However, researchers quickly discovered that bulky and expensive machines were not required to respond to the simple sorts of responses allowed by these early programs—typically, just multiple choice or fill-in-the-blank answers. Programmed materials in print form proved to be just as effective, trusting users to write in their responses or turn to the page corresponding to their selected answer. Between 1960 and 1966, dozens of publishers released hundreds of new titles; the curve flattened after that. However, by 1976, there were still over a thousand titles of programmed books on the market. Indeed, in certain niche markets, such as reading instruction, vocational studies, and corporate training, programmed materials are still widely available.

Successor Programmed Technologies

The PI movement constituted a new paradigm for the application of technology to instruction. Unlike the audiovisual paradigm which focused on the richness of presentations, the basic claim of programmed instruction is that certain kinds of human learning can be mastered more efficiently and effectively (learn faster, retain longer) when the learner responds to the material presented and receives reinforcement for correct responses. Skinner referred to his methodology as a "technology of teaching" (1968), using *technology* in the sense of applying the science of learning theory to the practical task of instruction. Later innovators found other formulations for applying the same scientific theory to human learning; we will refer to the whole group of techniques as *programmed technologies*, the term coined by Lockee, Larson, Burton, and Moore (2008).

Programmed Tutoring

Douglas Ellson detected a weakness in programmed instruction, in that it applied only one type of reinforcer—"knowledge of correct results"—which was far from being a universal reinforcer. He developed a method of face-to-face tutorial instruction—known as programmed tutoring or structured tutoring—in which the tutor is guided by a structured set of rules for how to respond to different learner answers. Correct answers received a "social reinforcer" in the form of praise, encouragement, or a smile; incorrect answers earned one or more hints to retreat to the learner's current level of mastery and nudge them forward (Ellson et al., 1965) (Ellson et al., 1968). Due to its track record of proven success, programmed tutoring became one of the first six innovations endorsed by the U.S. Office of Education for national dissemination (RMC Research Corporation, 1976, p. 2) and was adopted by schools in 35 or more states (Wickline, 1981). The value of social reinforcers in mediated learning has been rediscovered in the form of "emotional pedagogical agents" in the recent literature (Lang et al., 2022).

Precision Teaching

According to its originator, Ogden K. Lindsley, Precision Teaching (PT) consists of "basing educational decisions on changes in continuous self-monitored performance frequencies displayed on 'standard celeration charts'" (Lindsley, 1992). It is not a format, but a system for precisely defining learning objectives, encouraging practice of the desired behaviors, and continuously measuring and graphing the frequency of learners' responses. It was developed in the 1950s as another method of applying reinforcement theory, with Lindsley's PT choosing to focus on "free operants" while Skinner's PI focused on "controlled operants" (Lockee et al., 2008, p. 193). Like PI, PT requires major restructuring of classroom routine and teacher training, which inhibited widespread adoption. However, where implemented, PT has established an enviable track record of success (Binder & Watkins, 1990). By the 2000s, computer response-judging was replacing human teachers for offering adaptive reading and math programs based on continuous measurement of learner responses, similar to the PT process (Kiriakidis & Geer, 2014).

Personalized System of Instruction

Inspired by the principles of programmed instruction, Fred Keller applied the notion to the organization of a complete course. In the personalized system of instruction (PSI), all the content of a course is divided into sequential units (such as textbook chapters or specially created modules). These units are used independently by learners, progressing at their own pace. At the end of a unit, learners take a competency test. Immediately afterward, they receive feedback from a proctor, who provides any coaching needed to correct mistakes (Keller, 1968). During the period it was being tested—the 1960s and 1970s—PSI was found to be the most efficacious innovation evaluated up to that time (Kulik et al., 1979). Since then, the mastery-based, resource-centered, self-paced approach of PSI has been incorporated into many face-to-face courses in schools, universities, and corporate training centers. It serves as the basic pattern for many forms of distance education.

A similar method was developed by Sam Postlethwait, under the label of Audio-Tutorial System. From modest beginnings in 1961—making audio recordings of his botany lectures for students who missed class—the project evolved into an independent study system in which students worked in laboratory carrels, listening to recordings, viewing visual materials, and conducting hands-on experiments. They also interacted in discussion sessions and attended weekly large-group presentations (Postlethwait et al., 1964). This formula proved so successful that Postlethwait and fellow enthusiasts formed an organization in 1970, the International Audio-Tutorial Congress, which morphed over the years through several identities before arriving at its present name, International Society for Exploring Teaching and Learning (ISETL), while continuing to attract supporters.

Human Performance Technology

In the 1970s, corporate training consultants steeped in the behaviorist perspective brought the tools of programmed technologies—conducting task analysis, specifying behavioral objectives, selecting procedures for shaping behavior, implementing procedures, evaluating results, and making revisions as necessary—to bear on performance deficiencies in the workplace (Ainsworth, 1979; Brethower, 1999). This engendered a new field that came to be known as Human Performance Technology (HPT). Early on, practitioners such as Joe Harless discovered that not all performance deficiencies were attributable to ignorance, thus requiring training. Insufficient incentives, inadequate tools, or dysfunctional working conditions were often to blame (Harless, 1975). Wile (1996) ultimately identified six categories of interventions in addition to training—personnel selection, physical environment, tools, cognitive support, incentives, or organizational change—that could be part of a plan for performance improvement.

The field that eventually came to be known as HPT has been most authoritatively defined as "the study and ethical practice of improving productivity in organizations by designing and developing effective interventions that are results-oriented, comprehensive, and systemic" (Pershing, 2006, p. 6). HPT is a construct that lies largely outside the boundaries of educational technology but is connected to it in that both fields share an interest in instruction as a performance intervention. Molenda and Pershing (2004) developed the Strategic Impact Model to show how instructional and non-instructional interventions could be designed and developed in tandem to solve organizational performance problems.

Computer-Assisted Instruction

Many of the early attempts to apply computer technology to the control of instruction followed the formats of programmed instruction. Users typically interacted by inputting a verbal or numerical answer or choosing an answer from multiple alternatives; the machine program responded by confirming the correct answer and directing the user to another frame of information. The format differed from mechanical teaching machines mainly in that the software had a more sophisticated ability to judge responses and a more flexible menu of "next steps" in reaction to learners' input.

During the 1970s, when "computer" generally meant mainframe computer, the computer-assisted instruction (CAI) stage was dominated by large-scale projects at a small number of universities, e.g., PLATO at University of Illinois, TICCIT at Brigham Young University, and Computer Curriculum Corporation at Stanford University (Saettler, 1990, pp. 308-309). Access to appropriate hardware and the development of software programs mushroomed in the 1980s with the advent of the "microcomputer." Not all CAI applications were derived from programmed instruction. Even in the earliest period, some applications used a simulation or game format or offered problem-solving activities (Feldhusen & Szabo, 1969, p. 37).

The lasting legacy of the programmed technologies movement is seen in the design of all sorts of CAI programs and in the many corporate training manuals that require frequent user response.

The Instructional Systems Development Paradigm, 1967-1983

The idea of having a formulaic approach to the design of lessons that is based on current knowledge of human learning stretches back at least to Johann Heinrich Pestalozzi (1746-1827) and Johann Friedrich Herbart (1776-1841), both of whom had strong and lasting influence on teacher education programs in Europe and the U.S. (Saettler, 1990, pp. 36-47). But the approach that superseded earlier traditions—instructional systems development (ISD)—did not come from educational philosophy or curriculum studies. A detailed account of the historical evolution of ISD and of the theoretical perspectives that came to be incorporated in it can be found in Molenda's historical account (2010). Here, we will briefly summarize three major sources of the concept of ISD: the systems approach, arising out of military training doctrine; academic research on integrating media into instruction; and the programmed instruction movement. These approaches were all aimed at constructing a roadmap for the process of lesson planning, making instructional planning more efficient and its outcomes more effective. This is the essence of the ISD paradigm, or what Seels refers to as the "instructional design movement" (1989) and Davies refers to as the "problem-solving archetype" (1978, pp. 22-23).

Inspired by the Systems Approach

During World War II, the U.S. Navy was pursuing its computing problems—such as submarine hunting—with an early IBM computer (Williams, 1999). Putting this computing power into practical application required the development of a new planning tool, systems analysis—a way of organizing thinking about "man-machine" problems. In the 1960s, the U.S. armed forces changed their bidding procedures for new weapons systems, requiring contractors to provide not only the hardware, but also the training needed by the operators (Dick, 1987). Weapons were now part of "weapons systems," and training was part of that system. Training designers began to apply what they termed a *systems approach*. In 1973 a team at Florida State University were tasked with developing a systems-approach model for the design of U.S. Army training, a model that was later adapted for use by all the American military services, called the Interservice Procedures for Instructional Systems Development (IPISD) (Branson, et al., 1975). The IPISD model eventually had enormous influence in military and industrial training because its use was mandated not only in all the U.S. armed services but also among defense contractors. The many and varied ISD models that followed differed in details but typically adhered to a common conceptual framework: analyze, design, develop, implement, and evaluate. This conceptual framework came to be called by its acronym, ADDIE (Molenda, 2003).

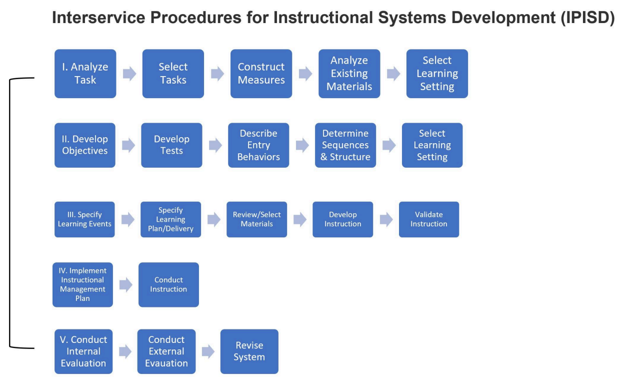

Figure 16. *IPISD Model*

Inspired by Academic Research on Media Integration

A team of leading researchers at the American Institutes for Research were at work in the 1960s, trying to systematize the process of developing lessons that would incorporate multiple types of audiovisual media (Briggs et al., 1967). The lead author, Leslie J. Briggs later used these ideas to generate an early textbook, *Handbook for the Design of Instruction* (1970). Separately, research and development funds from the Elementary and Secondary Education Act and the Higher Education Act of 1965 supported a large number of research projects based at university audiovisual centers, seeking models for more systematic integration of media into classroom lessons and into more advanced teaching-learning systems. The Instructional Systems Development project, based at Michigan State University in collaboration with three other universities (University of Colorado, Syracuse University, and San Francisco State College), produced an influential model and a set of heuristic guidelines for developers (Barson, 1967).

Inspired by the Programmed Instruction Movement

The procedures for creating PI materials specified: analyzing the task to be learned in order to break it down into a series of small steps, specifying the behavioral indicator of mastery for each step (performance objective), sequencing the behavioral responses in hierarchical order, creating prompts for the desired responses, observing the learner response, and administering appropriate consequences for each response. Further, since reinforcement theory called for practicing mostly correct responses, each frame of the program had to be tested for efficacy; hence, the development process entailed repeated rounds of testing and revision. Gradually, PI developers began to realize that it was the painstaking development process that made PI successful:

> *The uniqueness and strength of programed [sic] instruction lies mainly in its production process …. Programed [sic] instruction is developed through a process which has empirical and analytic qualities. (Lange, 1967, p. 57)*

Or, as Susan Meyer Markle and her research partner, Phil Tiemann, succinctly proclaimed: "programming is a process" (Markle & Tiemann, 1967). That is, it is not the PI *format* that accounts for success, but rather the developmental *process*. Markle and Tiemann's procedural flow chart for PI product development consisted of analyzing learners and learning tasks, specifying performance objectives, requiring active practice and feedback, and subjecting prototypes to testing and revision; it can be seen as a precursor to the analyze, design, develop, implement, evaluate (ADDIE) cycle proposed in later ISD models. By the early 1980s, textbooks—such as Dick and Carey's (1978) and Kemp's (1971)—had codified the knowledge base of the instructional development paradigm, enabling new research to flesh out its articulation. By 1983 the Division of Instructional Development was the largest division of AECT, signaling the shift of the center-of-gravity of the field from audiovisual media to ISD.

Hidden Bias of the "Technological" Paradigms

As Bradshaw (2018, p. 338) points out, certain paradigms of educational technology share a bias with the *social efficiency* movement, popularized by Franklin Bobbitt (1924). With their emphasis on helping students learn more efficiently and effectively, the paradigms of instructional technology, programmed technologies, and instructional systems development (ISD) implicitly accept the assumption that instructional objectives can be stated in clinically precise terms and that the sum of these instructional objectives statements equals the educational mission of the institution. The focus on efficiency, while meant to reduce time wasted on non-essential activities, obscures the role of other "inefficient" educative activities (such as play, discussion, mentoring, creative production, trial-and-error problem-solving, sports, and participation in student government). That, together with instruction, comprise the total educational experience. Indeed, *instructed learning* comprises only one of at least three distinct types of learning taking place in educational institutions, alongside *spontaneous learning* and *observational learning* (Molenda, 2021, pp. 7-9).

The Interactive Multimedia Paradigm, 1977-2000

During the 1960s and 1970s, the PI movement had championed the issue of learners' active response, but so did the movement of the "cognitive revolution." Behaviorist theory insisted that learner performance be as close as possible to the target objective, and so did cognitive theory, as exemplified by Reigeluth's elaboration theory (Reigeluth, 1979). At the same time, audiovisual advocates were promoting the benefits of sensorily rich experiences. The technology of the time did not offer an affordable, easy-to-use platform for creating instructional materials that were as interactive, immersive, and sensorily rich as these theoretical imperatives were demanding. The technological advances of the coming era would allow educators to combine audiovisual media with the practice-with-feedback methodology of the programmed technologies. Thus, the interactive multimedia paradigm incorporated the claims of the audiovisual paradigm and the programmed technologies paradigm; it focused on creating environments in which learners were highly motivated to immerse themselves in a problem space (often in the form of a simulation or game) and to learn through persistent trial-and-error.

User-Controlled Videocassette and Videodisc

A minimal amount of user control became possible in the late 1970s with Betamax and VHS videocassette recorders; functions such as "pause," "fast forward," and "slow motion" enabled some adaptation to individual learning needs. These functions became even easier with the videodisc systems of the early 1980s. Videodiscs stored up to 30 minutes of motion video; user control of its laser beam allowed rapid random access to high-quality still or motion sequences, making them much more suitable for instructional applications (A.K. Betrus, personal communication, September 8, 2022). The educational potential of videodisc was demonstrated in the late 1980s, particularly by *The Adventures of Jasper Woodbury*, a 12-disc series of interactive problem-solving scenarios for the mathematics curriculum. Commercially produced videodiscs such as this had a control program permanently embedded in the audio track; typically, it offered the user a menu of responses—leading to different content—following a video episode.

Immersive Experiences in Video Games

In the 1970s, face-to-face fantasy role-playing games, such as *Dungeons and Dragons*, began to attract growing numbers of players, ultimately reaching tens of millions. At the same time, arcade video games, such as *Space Invaders* and *Pac-Man*, used computer technology to translate users' physical manipulations into exciting on-screen gaming action. There were some false starts before gaming techniques were reflected in home, and later school, use. First came the conversion of arcade video games to special-purpose home video game consoles. A number of the console systems of the late 1970s included educational games, such as "Basic Math" and "Math Gran Prix" for Atari 2600 and others from Coleco and Intellivision (A.K. Betrus, personal communication, September 8, 2022). These video games incorporated minimal pedagogical strategy, but they did encourage practice of target skills through the motivational structure of a game. After a quick burst of popularity in the early 1980s, the video game industry crashed in 1983. It had a rebirth in

1985, thanks to the Nintendo Entertainment System, but remained a niche product, not integrated into the home or office communication environment (Edd Schneider, personal communication, September 8, 2022).

It was in the mid-1980s that affordable microcomputer technology brought such immersive game and simulation activities into the home, the office, and later, the school. Apple's Macintosh and Apple II series demonstrated the advantages of a graphical user interface (GUI), making computer use and computer program development vastly easier. However, by 1987, the business-oriented DOS personal computer (PC) was becoming the dominant platform for computer games, replacing Apple and Commodore platforms environment (Ed Schneider, personal communication, September 8, 2022).

The new technologies of CD-ROM and DVD made storage, distribution, and playback of interactive multimedia programs easier and more affordable. First came multimedia encyclopedias, simply using the storage capacity of CD-ROMS for random access to banks of data. By the mid-1990s a flood of interactive educational games and simulations, such as *The Oregon Trail*, *Where in the World is Carmen Sandiego?* and *Clue Finders*, reached the market—a market eventually worth hundreds of millions of dollars.

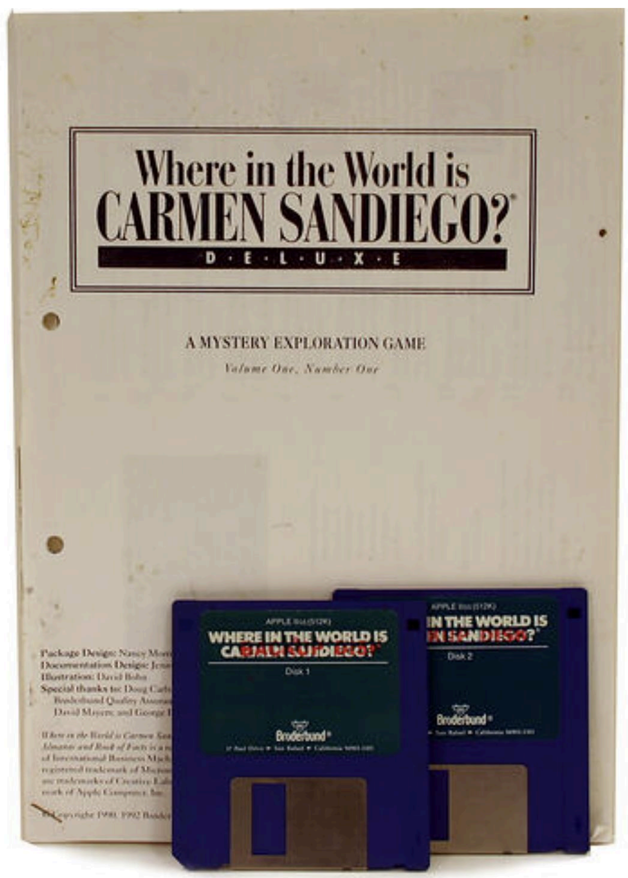

Figure 17. *Carmen Sandiego*

Information Age Paradigms, 1990 to Present

The final set of paradigms to be examined in this chapter sprout from a common source, the forces unleashed by the Information Age, by which we mean the historical epoch—beginning with computer proliferation and culminating with the internet, the web, and social media, in which information technology has come to represent, in Marxian terms, the primary "means of production."

The Distributed Learning Paradigm, 1990 to Present

In the 1990s, advances in communication technology were beginning to shift the focus of interactive multimedia from media stored on disks to experiences shared through wired, later wireless, networks. During the 1990s, dial-up telephone modems were used to allow keyboard communications among users, with courses being offered through computer conferencing. Communication became easier and richer after the development of the World Wide Web in 1993, especially after the development of the web browser. Netscape Navigator, introduced in 1994, became the dominant browser for the next decade. By 2005, most homes linked to the internet via a broadband connection, typically through the wires that carried cable television. The higher speed of broadband allowed fast access to graphically complex materials, even streaming video. People could communicate with each other in writing, seeing, and hearing in real-time.

While homes and businesses—and most universities—became connected to the internet, schools fell behind. During his administration (1993–2001), Bill Clinton attempted several legislative initiatives to assist schools in connecting to “the information superhighway.” While the Clinton administration was unable to persuade a Republican Congress to pass a major bill, it did have some piecemeal successes, including reducing long-distance telephone charges for school computer systems—the so-called "e-rate” program added to the 1996 Telecommunications Act. In addition, it pushed to establish public-private partnerships among schools, businesses, and nonprofits to get schools wired for information technology through programs such as NetDay and One Laptop Per Child.

The wiring of campuses to connect to the internet also had a profound impact on distance education. Since its beginnings during the early twentieth century, distance education had progressed from correspondence study based on print materials to the use of broadcast radio and television to give greater numbers of learners access to richer resources. The paradigm—synchronous, group-based communication—was still that of the classroom, only with geographically dispersed students. However, advancements in communications technology in the 1990s—especially the explosive growth of internet-based learning, and later of social media and mobile media—made possible a different learning model. This model came to known as “distributed cognition”—knowledge shared across the members of a community (Dede, 1996). An early conceptualization of this paradigm was computer-supported collaborative learning (CSCL), in which small groups of students interact through computer applications to solve an unstructured problem or create a product of some sort. The concept was inspired by Vygotsky’s social learning theory, proposing that tasks too complex for an individual can be mastered with the assistance of knowledgeable others (Vygotsky, 1978). Thus, the distributed learning paradigm accepts the educational communications paradigm’s commitment to overcoming the boundaries of geography and economics and adds the claim that groups should be able to interact to solve problems and attain understandings that are shared as a learning community.

In the late 1990s there occurred a “gold rush” mentality as dozens of universities and hastily created for-profit ventures sought to capture the enormous audiences anticipated to flock to internet-based, collaborative distance education. Almost all these ventures perished when the “dot-com” bubble burst in 2000 (Molenda & Sullivan, 2003). Programs that survived the crash tended to be those that proceeded gradually, taking care to offer courses that incorporated “best practices” in instructional design. Such institutions and programs came to be a major employment source for educational technology practitioners in the 2000s.

The Democratization of Media Access Paradigm, 1990 to Present

Empowering Users

During the 1990s, as personal computers proliferated in the office and home, teachers gained experience and confidence with computers and ventured into the use of computers in school—and even the creation of instructional programs. Presentation software, such as PowerPoint, incorporated in Microsoft’s Windows in 1992, enabled business and educational users to create attractive “slide sets”—at first, for overhead transparency masters and later for direct projection via computer projector—without the assistance of graphic artists or other media production specialists. New multimedia authoring software (e.g., Hypercard, Macromedia Director, and Authorware) also supported teachers and other users in becoming producers. While this was empowering for users, it spelled the death knell for one of the major services of audiovisual centers, further undermining what had been the dominant paradigm of educational technology.

These developments coincided with the "constructivist" movement in pedagogy, which put particular emphasis on authentic contexts, learner control, and problem-solving activities (Wilson, 1996). The learning model for the "constructivist learning environment" is analogical, case-based knowledge construction; learners immersed in a problem space try various strategies and learn by trial-and-error how to navigate toward a satisfactory conclusion. Often, students themselves were able to use authoring systems to create their own content. This pedagogical movement gave further support to the development of teacher and student designed software, with students often taking the lead.

Learning management systems (LMS), first introduced in 1991, tied together the many pedagogical and administrative processes needed to have a coherent online course. As with presentation software and multimedia authoring software, the LMS empowered teachers and trainers to undertake do-it-yourself construction of robust online lessons and courses. And like the other applications just discussed, it tended to undercut the expertise of instructional design specialists, diminishing their role to consultants rather than producers.

The democratization of the media access paradigm thus represents an expansion of control over media access and media production to people who previously had to rely on experts and gatekeepers—such as educational film, radio, and television producers; radio and television station administrators; computer programmers; instructional designers; and the like—to use Information Age tools.

The Digital Divide

On the other hand, despite the forces of democratization, access to these media tools has never been equitably distributed. Access to information and communications technologies (ICTs) has been linked to a number of characteristics, including socioeconomic status, race, gender, geographic location (urban-rural), age, and technological skills. The latter includes individuals who struggle to participate due to cognitive or physical limitations. The Universal Design for Learning (UDL) movement (Rose & Meyer, 2002) proposed that educational materials should incorporate multiple means of representation, expression, and engagement (Rose & Meyer, 2002, p. 75). Assistive technologies can help overcome physical handicaps in using information technology. Assistive technologies and other UDL practices have been incorporated into American law in the Assistive Technology Act of 1998, the Individuals with Disabilities Education Act, and the Higher Education Opportunity Act of 2008.

As Tapscott (2000) described, contemporary societies are divided into haves v. have-nots, knowers v. know-nots, and doers v. do-nots. This digital divide was harshly foregrounded globally during the emergency remote-education response to the COVID-19 pandemic (Sosa Diaz, 2021). Steps toward reducing the digital divide represent the distance that scholars, practitioners, and policymakers have traversed since Michael K. Powell—as chair of the powerful Federal Communications Commission— dismissed ICT access as a gratuitous caprice akin to luxury car ownership by likening the digital divide to a "Mercedes divide" back in 2001 (Irving, 2001).

Educational technologists working under this paradigm have implemented various innovative interventions to help bridge the digital divide. Open-source technologies, open educational resources (OER), 1:1 student computing, and mobile learning—which seeks to capitalize on the Information Age's media convergence trends to promote learning via personal electronic devices that are more physically and economically accessible to learners—are being explored as ways to bridge the digital divide's 'access' aspect; early age coding, logic, and computational thinking initiatives (e.g., Code.org and MIT Media Lab's Scratch)are being implemented to address the digital divide's knowledge/skills aspect, while mentoring/role-modeling programs are offered as ways to address its affective aspect. Activities within this paradigm recognize the importance of learner empowerment within the Information Age teaching-learning context. Educational technology professionals have therefore been striving to increase learner agency and control over the teaching-learning process via participatory web technologies to encourage active participation and content contribution over passive content consumption.

The Inclusion Paradigm, 1990 to present

Given the powerful impact that Information Age technologies have on national economies—and on the lives of the people contending with those social and economic forces—some education scholars and practitioners have turned their attention to the issue of historically underrepresented, underserved, and marginalized populations. The “War on Poverty” programs of the 1960s ran had run out of steam by the 1990s. Schools were slipping back into segregation by residential pattern and the gap between rich and poor was growing again. In educational technology, among the first scholar-practitioners to voice sociocultural concerns was Gary C. Powell (1997) in a pioneering *Educational Technology* special issue devoted to this topic. Later Thomas, Mitchell, & Joseph (2002) suggested innovative modifications to the field’s venerable ADDIE model to make the ISD process more socially and culturally cognizant. Subramony (2004) took the field’s temperature a couple years afterwards to discover a rather dire state of inattention to social and cultural issues within its mainstream discourse, and followed up more than a decade later (2017) to find that the changes taking place in the interim were more of a peripheral, piecemeal nature as opposed to a core, systemic one.

That said, some of these efforts do represent significant incremental steps towards making the field more socioculturally conscious and inclusive, viz., (a) an increasing number of scholarly conference presentations and journal articles—along with multiple journal special issues and full-length books—focusing on social, cultural, and power issues in educational technology, (b) the evolution of the AECT-affiliated ‘Minorities in Media’ (MIM) group into a full-fledged (Culture, Learning, and Technology) division of the organization—which, among other initiatives, is currently engaged in the valuable task of recording the oral histories of pioneering MIM members, and (c) AECT’s noteworthy incorporation of the terms “ethical” and “appropriate” into its revised 2008 definition (Januszewski & Moldena, 2008; Subramony, 2017). More recently, attention is also being drawn to the needs of the field’s LGBTQ+ stakeholders, as, for example, in Subramony 2018. In short, the inclusion paradigm aims to ensure that the fruits of Information Age learning are accessible to historically overlooked or excluded populations.

The Emerging Technologies Paradigm, 1998 to Present

Educational technology has been dealing with “emerging technologies” since its inception. Sound-on-film was a technological breakthrough in 1930, magnetic tape recording in 1946, video cassette recording in 1970, and so on. As these innovations entered the marketplace, educational technology professionals quickly attempted to figure out how the innovations could be exploited for educational use. However, over the course of the past five decades, thanks to the digital revolution, the pace of ICT evolution has only grown exponentially more rapid. This growth brings us to what we may call the emerging technologies paradigm, which centers around the question of how to appropriately respond to technological, theoretical, and philosophical “developments so diverse and fast-changing that they are best described not by their physical features but simply as being emergent” (Molenda & Subramony, 2021, p. 18). For instance, Martin Weller (2018) listed the following “emerging phenomena” that grabbed the attention of educational technologists, viewed in chronological order: Wikis in 1998, e-learning in 1999, learning objects in 2000, e-learning standards in 2001, open educational resources in 2002, blogs in 2003, learning management systems in 2004, streaming video in 2005, web 2.0 in 2006, online virtual worlds in 2007, e-portfolios in 2008, social media in 2009, connectivism in 2010, personal learning environments in 2011, massive open online courses in 2012, open textbooks in 2013, learning analytics in 2014, digital badges in 2015, artificial intelligence in 2016, and blockchain in 2017.

The emerging technologies paradigm proposes that whichever technological innovations are being promoted in the world at large at a given time will or should eventually impact education, however tenuous the connection might be. This situation has been effortlessly feeding into the field’s longstanding technocentric bias, with the end goal appearing to be persuading educators to adopt technologies irrespective of their relevance to a specific problem (Weller, 2018), or, as Cuban put it, “a solution in search of a problem” (Cuban, 1986).

The emerging technologies paradigm is marked by an increasing cognizance understanding of the tendency of technological interventions to over-promise and under-deliver (see Stoll, 2001, for more detail Clifford Stoll’s prescient lament about computers being uncritically embraced by the educational establishment as filmstrips were in a previous era). Instead of incurring the costs—and opportunity costs—of reflexively jumping onto the technological bandwagon of the year without thinking things through, those operating within this paradigm are increasingly asking if said technological intervention is indeed the most appropriate solution to the educational problem(s) at hand.

Conclusions

One of the purposes of studying history is to look for lessons that can be gleaned from the experiences of those who have gone before us. In this spirit, we suggest a handful of generalizations that can be inferred through a century's experience with educational technology.

Boom and Bust Cycles

It is all too easy to fall into the trap of assuming that because a technology is new that it has great potential to quickly revolutionize education, leading educators down the path of "a solution in search of a problem." The cycle begins with extravagant promises, followed by failure to live up to expectations, then speculations on where to assign blame, and finally criticism that the innovation itself is ineffective or costly. This "boom and bust" cycle was repeated with film, radio, television, teaching machines, desktop computers, and many other emerging technologies of the 21st century. Each of these innovations has some merit and has generated local successes, some of which have continued to yield benefits. However, the field of educational technology has suffered a serious credibility problem because of the tendency of its more hasty proponents to rush to embrace of the latest technology.

Dependence on New Money

The instructional budgets of educational institutions are largely consumed by personnel costs, so the adoption of instructional innovations is often contingent on finding new, outside sources of funding. For example, the explosive growth of the educational technology field in the U.S. occurred only because of the massive federal programs of the 1940s through 1960s—the GI Bill, NDEA, ESEA, HEA, Higher Education Facilities Act, and the like. During that period, support from foundations and nonprofits also played a large role in covering the added costs of purchasing and installing new technologies. Indeed, without The Rockefeller Foundation's huge support of educational film and the Ford Foundation's massive investment in school television, those technologies might never have achieved a significant presence in formal education. In later eras, it became more difficult to obtain federal financial assistance, so the U.S. and other governments turned to "public-private initiatives"—creating nonprofits such as NetDay and One Laptop Per Child—to encourage philanthropic support from the high-tech industry.

Resistance to Innovations that Threaten to Replace Instructors

It should not be surprising to learn that teachers, trainers, and professors are resistant to embracing innovations that take over the traditional roles of the teacher, especially major classroom activities such as presenting information. Radio and television programs, for example, clearly proclaimed their ability to perform the tasks of selecting and presenting lectures better than teachers could. Teaching machines were sold based on their ability to replace teachers altogether. Many of the early computer-assisted instruction programs were sold as complete, "teacher-proof" course packages. In response to all these claims, teachers chose to assign the innovation to a supplementary role—to show a film or video clip to supplement their lecture, to offer a computer game as an enrichment activity, or to assign a podcast as a homework activity. Consequently, none of these purportedly revolutionary technologies have ever had a chance to truly affect overall economic productivity—which would require replacing the most expensive category of cost: labor costs.

Difficulty of Curricular Integration

Technology advocates who are not themselves teachers tend to underestimate the difficulty of integrating innovative materials into the instructional plan. In the case of K-12 schools, teachers are concerned whether the audiovisual material addresses mandated curriculum standards. In the case of higher education, instructors wonder if the audiovisual material addresses their specific objectives. Since most instructors consider themselves subject-matter experts, they wonder if the material is as clear and authoritative as their own treatment. Often the answers to these questions has been "no," so the proposed materials have been rejected.

Summary

The field we are labeling as *educational technology* has always had multiple nodes of theory and practice. Over the past century, different nodes have occupied center stage at different times. Shifts in attention have typically occurred in response to new technological developments or new discoveries in the psychology of learning. The earliest period (1905–1983) was dominated by the visual/audiovisual education paradigm, promoting auditory and visual media—especially film—as an alternative to the “verbalism” of traditional instruction. Running parallel in time (1930–1990) was the educational communication paradigm propounded by the educational radio and television community, which promised to deliver auditory (and later visual) programs at low cost to vast audiences, expanding the scope of education beyond the walls of schools and colleges. By the 1960s, visionaries were beginning to imagine combining audiovisual and broadcast media within a systematic framework , a framework in which instructional methods, grouping patterns, and assessment methods were chosen based on what would be most efficient and effective for attaining the specified learning objectives. They referred to this new paradigm as *instructional technology*.

A major contributor to this new way of thinking was programmed instruction and its successor technologies (1954–1989), developed in the field of experimental psychology. They offered concrete procedures for enabling individuals to master specific objectives without the presence of a teacher. It was embraced by audiovisualists as a new tool to help fulfill their vision of instructional technology: “a complex, integrated process…for analyzing problems, and devising, implementing, evaluating, and managing solutions to those problems” (AECT Task Force on Definition and Terminology, 1977, p. 3).

After World War II, new complex weapon *systems* required a new approach to training, which evolved into the instructional systems development (ISD) process, which represented a new paradigm for instructional planning in formal education. Between 1967 and 1983, attention was focused on devising more efficient and effective models for conducting ISD.

In the years that followed, the computer played an even? greater role in determining what educational technology was about. For those coming from the audiovisual tradition or the educational communication tradition, the computer offered the opportunity to not only organize, present, and store a vast array of audiovisual programs but also provoke learner response, to which appropriate feedback could be given…thus the era of the interactive multimedia paradigm (1977-2000). The creativity unleashed by these new technological capabilities spawned an outpouring of instructional games, simulations, simulation games, and story-based problem-solving activities.

The most recent set of paradigms that have driven educational technology revolve around the forces unleashed by the Information Age: the internet, the web, social media, mobile media, and ubiquitous computing. We have organized these developments under four broad headings:

- The distributed learning paradigm (1990 to present): represented concretely by the explosive growth in distance learning programs based on the internet, represented more abstractly by a new learning paradigm—distributed cognition. A core tenet of distributed learning is that knowledge can be created and shared by groups operating as a learning community.
- The democratization of media access paradigm (1990 to present): first, computer technology enabled educators to create their own instructional materials, then it enabled “constructivist learning environments”—settings in which students are immersed in a problem space requiring them to construct their own solutions. Through authoring systems, students could even create their own content either alone or in collaboration with others.
    - Such possibilities are open only to those who have access to information and communications technology (ICT); those who do not are characterized as being on the other side of the Digital Divide. Since the early 2000s, educational technology professionals have joined with others to enact legal solutions, new computer protocols, such as Universal Design for Learning, and new initiatives in computer training and mentoring.
- The inclusion paradigm (1990 to present): the essence of this paradigm is to hear the voices of historically underrepresented, underserved, and marginalized populations. A growing number of educational technology professionals are seeking ways and means of making the field more socially and culturally conscious.
- The emerging technologies paradigm (1998 to present): the essence of this paradigm is to call attention to the uncritical embrace of the cascade of novel applications and platforms that emerge at an exponentially rapid pace.

Postscript on Historiography

Any attempt to create a narrative about a complex set of events and the people involved in them must necessarily be selective. Different observers are bound to choose different events to highlight, and each observer interprets those events through their own set of filters and lenses. A story such as educational technology’s is especially susceptible to gendered interpretations given the different roles—with different power relationships—played by men and women over the century of historical evolution. The same can be said for the largely unrecorded perspectives of the many gender non-conforming individuals whose voices have traditionally been silenced. De Vaney and Butler (1996) examined the discourse of educational technology's founders—men and women—unveiling gendered perceptions through historical vignettes. Additionally, Butler and Lockee (2016) disclosed the voices of women pioneers in the field through vignettes revealed in oral histories.

Bradshaw (2018) and others raised the questions: what significant events have not been recorded and what contributions have gone unrecognized by the blinders imposed by traditional historiography? Young (2001) argues that African American contributions to educational technology have been largely overlooked for the post century, while Subramony (2018) asks a vital question: Where are LGBTQ(+) voices in the literature of the field? These questions remain largely unanswered, but they do open the door for future research and practice.

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Think About It!

1. In a group or independently, construct a timeline of the history of the field. Take note of important events, people, and innovations. Do you notice recurring trends along the timeline? What is unique on the timeline? What may be missing from the timeline/gaps?
2. Write a one-page argumentative reflection using historical evidence in response to the following question: Why is it important to recognize and study the field's history?
3. Re-create a historical broadcast with a leader in the field. Include significant biographical information and interesting contributions to the field. (Hint: while the broadcast media is your choice, think "podcast" style)

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A Short History of the Learning Sciences

Lee, V.

Learning Learning Sciences Learning Theory

This chapter summarizes the history of the field of Learning Sciences, and discusses its relationship with the LIDT field.

It is inevitable that someone studying learning and instructional design and technology (LIDT) will come across the term Learning Sciences. Yet, for many, that moniker is fundamentally ambiguous and misunderstood, and questions abound about this thing called Learning Sciences. Are there multiple learning sciences or is there one dedicated and official field referred to with the plural of Learning Sciences? Is one supposed to capitalize both words when writing about it? Is it essentially classic educational psychology with a new name? Does it involve things beyond the mental phenomenon of learning? Is it actually a science? Are there points of convergence, divergence, or redundant overlap with other fields, including those that would be seen in the field of instructional design and technology? Are those who call themselves learning scientists best seen as friends, rivals, or innocuous others to those who consider themselves instructional designers? There are so many questions. There are also many answers. And a lack of a one-to-one correspondence between questions and answers has persisted in the roughly 30 years (see Figure 1) since the term began to see heavy use (assuming we are concerned with the capitalized L and capitalized S version, which will be the default for this chapter).

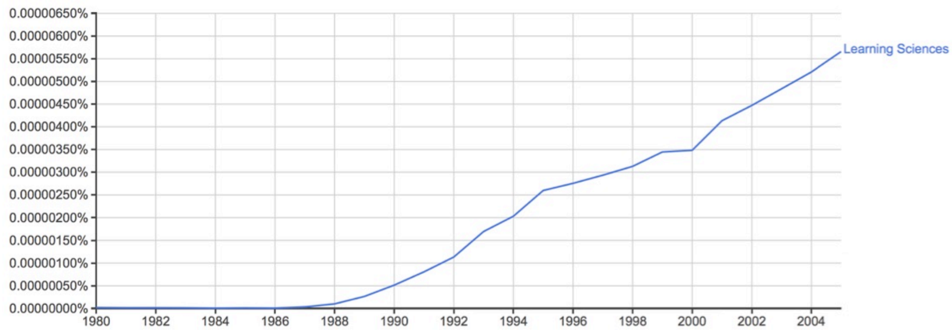


Figure 1. *Use of the term Learning Sciences as depicted in Google's Ngram viewer. A major continuous increase appears to occur around 1990.*

No article, book, nor chapter has been written that gives authoritative and definitive answers to these questions. The current chapter is no exception. Others have made noteworthy efforts, including contributors to a special issue of Educational Technology (Hoadley, 2004; Kolodner, 2004), those who have edited handbooks of the Learning Sciences (Fischer, Hmelo-Silver, Goldman, & Reimann, in press; Sawyer, 2006), and those who have prepared edited volumes that gather and publish firsthand reports from a number of seminal learning scientists (Evans, Packer, & Sawyer, 2016). In a sense, all of the above are snapshots of a still-unfolding history, and I recommend them all for the interested reader. This chapter exists as an effort to crudely present Learning Sciences to the LIDT community as it exists at this point in time from one point of view. The current point of view is presumably legitimized because the author of this chapter has the words Learning Sciences on his diploma and serves professionally for Learning Sciences conferences, journals, and academic societies. As the author, I do lead with the caveat that some of what I have to say here is an approximation and inherently incomplete. However, I present the following with confidence that it helps one make some progress on understanding what this thing is called Learning Sciences.

To Understand, We Must Look Backwards

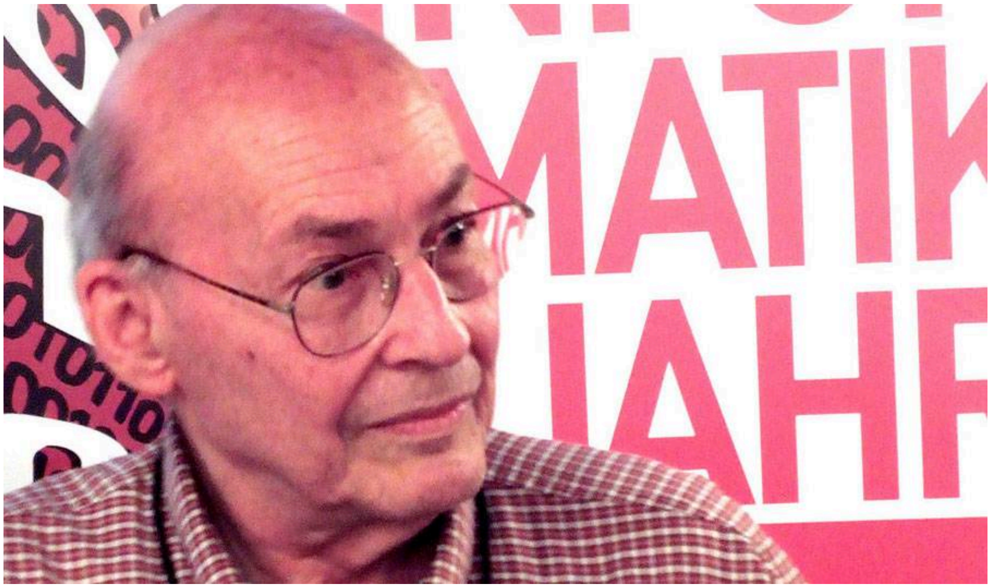
There seems to be consensus that Learning Sciences is a relatively young,[1] interdisciplinary academic field. (The word learning is obviously important.) Yet the same could be said for other fields, including many that are more prominently known as LIDT fields. In addition, many seemingly related questions and problems touching on teaching, learning, and technology are addressed by both Learning Sciences and LIDT fields. Yet some people will adamantly maintain that the fields are, at their core, fundamentally different bodies who do different things. Others will argue that those differences are inconsequential and that, functionally, they are the same. So in response to these differing views, I suggest we consider the similarities between Learning Sciences and other LIDT fields as analogous to convergent evolution in evolutionary biology—the process by which dolphins and sharks evolved similar traits but were preceded by different genetic histories. There is certainly much overlap in what each field does and the spaces each inhabits, but the histories leading up to each are markedly different. Those histories matter, because they formed the skeletons for the bodies that exist today and help us understand why there may be some underlying differences coupled with functional similarities.

Cognitive and Artificial Intelligence Roots

If Figure 1 is any indication, the recent history of Learning Sciences goes back about 30 years, and it can be traced to some important locations and events[2] [#footnote-796-2]: namely, the first International Conference of the Learning Sciences (ICLS), which took place in 1991 and was connected to the Artificial Intelligence in Education (AIED) community. No formal society nor publication venue for Learning Sciences existed at that time. The first ICLS was hosted in Evanston, Illinois, in the United States, home of what was then the Institute for the Learning Sciences and the first degree program in Learning Sciences, at Northwestern University. The year 1991 was also when the first issue of the Journal of the Learning Sciences was published.

The connection to the AIED community is central to the historic identity of Learning Sciences. In the 1980s, cognitive science had emerged as an interdisciplinary field that, along with segments of computer science, was concerned with the workings of the human mind. The so-called "cognitive revolution" led to interdisciplinary work among researchers to build new models of human knowledge. The models would enable advances in the development of artificial intelligence technologies, meaning that problem solving, text comprehension, and natural language processing figured prominently. The concern in the artificial intelligence community was on the workings of the human mind, not immediately on issues of training or education. The deep theoretical commitments were to knowledge representations (rather than to human behaviors) and how computers could be used to model knowledge and cognitive processes.

Of course, as work in the years leading up to the first ICLS progressed in how to model and talk about (human) cognition, many had also become interested in using these new understandings to support learning and training. Intelligent tutoring systems gained prominence and became an important strand of work in Learning Sciences. That work continues to this day, with much of the work having ties historically to institutions like Carnegie Mellon University and the University of Pittsburgh. These tutoring systems were informed by research on expertise and expert-novice differences along with studies of self-explanation, worked examples, and human tutoring. Many of those who did original work in those areas still remain in Pittsburgh, but their students, colleagues, postdoctoral fellows, and others have since established their own careers in other institutions.



Marvin Minsky

Another locus of work on artificial intelligence was at the Massachusetts Institute of Technology, home to the Artificial Intelligence Laboratory (now known as the Computer Science and Artificial Intelligence Laboratory [CSAIL]) founded by the late Marvin Minsky. Also at MIT was Seymour Papert, who was named co-director of the AI Lab. Papert was a mathematician who contributed significantly to early AI research with Minsky. Papert saw early on the tremendous power of computers and their potential for learning and knowledge construction and became a passionate advocate for learning through computation, expressed largely through his theory of constructionism (Papert, 1980) and in the creation of the Logo programming language with Wallace Feurzig. Papert's research program migrated away from classical AI research and more toward issues of epistemology and learning. His efforts later led to the creation of the MIT Media Lab. A number of scholars trained with him, and the ideas and technologies generated at the Media Lab would spread with students who went on to positions at other institutions. As a result, constructionism, computational thinking, and Papert's sense of "powerful ideas" continue to be major strands of Learning Sciences to this day.

Papert was not the only one interested in how people learned to do computer programming.[3] Relatedly, programming was a concern for the Pittsburgh tutoring systems and also for others involved in the field, such as Elliot Soloway, who was initially at Yale before later relocating to University of Michigan. Others influential in the field were asking questions about what cognitive benefits result from learning to program. One such person was Roy Pea, who had been doing work in new educational technology and media with Jan Hawkins at the Bank Street College in New York. In Cambridge, educational technology endeavors informed by recent cognitive science were being pursued at places like Bolt, Beranek, and Newman (BBN) by the likes of John Seely Brown and Allan Collins, among other talented social scientists and technologists. These early scholars represented a part of the new educational media and computer programming sphere of research and development.

Text comprehension was another important area of initial research in artificial intelligence, with research on text and reading taking pace in numerous places, including Yale, University of Illinois, and Vanderbilt to name a few. There are numerous scholars of major influence who were involved at these different institutions, and any effort on my part to name them all would certainly fail to be exhaustive. A few to note, however, include Roger Schank, who relocated from Yale to Northwestern University, established the Institute for the Learning Sciences, and amassed faculty who would subsequently establish what has become the oldest academic program in the field; Janet Kolodner, who studied case-based reasoning in AI text-comprehension systems at Yale, proceeded to move on to a successful professorship at Georgia Tech, and was founding editor of the field's first journal; John Bransford at Vanderbilt University; and Ann Brown at University of Illinois, who then moved with her husband, Joseph Campione, to University of California, Berkeley. Schank and Bransford, with their respective teams at their institutions, were developing new ways to integrate narrative story structures into technology-enhanced learning environments based on the discoveries that were being made in text-comprehension and related cognition research. Brown, with her student Annemarie Palincsar (who moved on to University of Michigan), worked on extending seminal work on reciprocal teaching (Palincsar & Brown, 1984) to support improvement in text comprehension in actual real-world classroom contexts. The desire to use the new tools and techniques that were being developed from this cognitive research in actual learning settings rather than laboratories had been growing at all the aforementioned locations and led to the development of a methodological staple in Learning Sciences research: design-based research (Brown, 1992; Collins, 1992), to be elaborated upon more below.

Thus far, what one should be able to see from this gloss of Learning Sciences history is the major areas of research. For instance, cognitive science and artificial intelligence figured prominently. Understanding how to best model knowledge and understanding in complex domains continued to be a major strand of research. New technological media and a focus on children expressing and exploring new ideas through computer programming played prominently. There were also inclinations to look at story structure as it related to human memory in order to improve the design of tools and technologies for learning. Finally, there was a desire to take all these discoveries and findings and try to get them to work in actual learning settings rather than laboratories. These were not unified positions but rather all core areas of research and interest in the group that was coming together to establish the field of Learning Sciences. With that list in mind, and knowing that academic conference keynote lectures are usually given to high-profile or aspirational figures in the field, we have some context for the following list of invited keynote addresses at the first ICLS in 1991.

- Cognition and Technology Group at Vanderbilt—Designing Environments that Invite Thinking and Innovation
- Allan Collins—Design Issues for Interactive Learning Environments
- Andrea diSessa—Computational Media as a Foundation for New Learning Cultures
- James Greeno—Environments for Situated Conceptual Learning
- Marlene Scardamalia—An Architecture for the Social Construction of Knowledge
- Elliot Soloway—"Fermat's Last Theorem? I Learned About It on Star Trek"

In that list, we can see the Vanderbilt group represented along with Collins and Soloway. Andrea diSessa, a prominent and frequently cited scholar in Learning Sciences (Lee, Yuan, Ye, & Recker, 2016) and in other fields, had completed his PhD at MIT in physics and worked closely with Seymour Papert. diSessa's areas of research included students learning to program and how physics is learned. His academic career is largely associated with the institution where he spent most of his time as a professor: the University of California, Berkeley. Other important scholars at this point were Greeno and Scardamalia, who will be covered in the sections below.

Sociocultural Critiques and Situative Perspectives

Cognitive science and artificial intelligence were major influences in Learning Sciences, but contemporary work in the field is not exclusively intelligent tutoring systems, research on students' mental models, or how people learn to program or use new digital media. A major, if not primary, strand of Learning Sciences research is based on a sociocultural perspective on learning. At times, this maintains an ongoing tension with the cognitive- and AI-oriented perspectives, and active dialogue continues (diSessa, Levin, & Brown, 2016).

John Seely Brown, mentioned previously as being a key figure in the New England area, was later brought to the West Coast to work for Xerox PARC (Palo Alto Research Center) and head the new Institute for Research on Learning (IRL). Part of the activities of the IRL team at PARC involved studying how to support learning, including in the photocopying business (Brown & Duguid, 1991). Importantly, the Bay Area location positioned PARC near the University of California, Berkeley, where scholars like Alan Schoenfeld, Peter Pirolli, Marcia Linn, Ann Brown, Andrea diSessa, and James Greeno had all been hired into a new program focusing on education in mathematics, science, and technology.

Of great importance was the presence of Jean Lave, who was also on the faculty at Berkeley. Lave, an anthropologist by training, had studied how mathematics was done in everyday life, discovering that what mathematics looked like in practice was very different from how mathematics understanding was conceptualized by the cognitive psychologists (e.g., Lave, Murtaugh, & de la Rocha, 1984). Additionally, Lave and Wenger published a seminal monograph, Situated Learning (1991), summarizing several cases of learning as it took place in actual communities of practice. The learning involved much more than knowledge acquisition and instead was better modeled as changes from peripheral to central participation in a community. Adequately encapsulating the extensive work of Lave, Wenger, and colleagues is well beyond what can be done in a chapter. However, they earned the attention of Greeno (Greeno & Nokes-Malach, 2016) and others by suggesting that entirely different units of analysis were necessary for people to study learning. These perspectives were largely cultural and social in nature, taking talk and interaction and material artifacts as they were taken up in practice as critical. At the time, there were also groundbreaking works published, such as the translation of Lev Vygotsky's work (1978), Barbara Rogoff's studies of real-world apprenticeship (Rogoff, 1990), and Edwin Hutchins's bold proposal that AI approaches to cognitive science were being far too restrictive in recognizing and understanding cognition as it happened "in the wild" (Hutchins, 1995).

These ideas had a great deal of influence on the emerging community of learning scientists, and the close proximity of the scholars and their ideas led to major public debates about how learning could best be understood (Anderson, Reder, & Simon, 1996; Greeno, 1997). The establishment and acceptance of cultural-historical activity theory and the work of Michael Cole (an institutional colleague of Hutchins) and Yrjo Engestrom also figured prominently as CHAT found a place in education and other scholarly communities. Also influential was James Wertsch, an anthropologically oriented, cultural historical educational scholar.

In essence, a critique of mainstream cognitive science and an alternative perspective had emerged and attracted a contingent. Graduate programs and major research centers formed, and still the networks of scholars that existed continued to dialogue with one another and produce trainees who would later continue developing the newly created field of Learning Sciences. Those individuals would shape the scholarly agenda and produce theoretical innovations for how learning was conceptualized that were different from what had been dominant in previous academic discourse.

Much of contemporary Learning Sciences research has extended these ideas. Rather than focusing on knowledge, many learning scientists focus on social practices, whether they be scientific or mathematical practices, classroom practices, or informal practices. Identity as a socially constructed and continually mediated construct has become a major concern. Seeking continuities between cultures (with cultures not necessarily being geographical nor ethnic in nature) and discovering how to design activities, tools, or routines that are taken up by a culture or give greater understanding of how cultures operate remain ongoing quests. Other concerns include historicity, marginalization of communities, cultural assets rather than cultural deficits, equity, social justice, and social and material influences on spaces that are intended to support learning.

Helping people learn and using new technologies remain important themes, but rather than focusing on computers solely as tutoring systems or spaces where simulations of complex phenomena can be run, current learning sciences technologies with a sociocultural bent allow for youth to collect data about their cities and critically examine equity and opportunity; to become community documentarians and journalists so that local history is valued and conserved in line with the individual interests of participating youth; to build custom technologies of students' own design that better the circumstances of their peers, homes, and communities; and to obtain records of everyday family or museum or after-school activities that have embedded within them germs of rich literary, mathematical, historical, or scientific thought. Current technologies also act as data- and knowledge-sharing tools that help make invisible practices and routines in schools more visible to teachers and other educators.

Computer-supported Collaborative Learning

In the early days of Learning Sciences, cognitive and sociocultural perspectives figured prominently, in addition to the opportunity to look at and modify intact educational systems rather than relegating research to strictly the laboratory. The relationships being built and dialogues taking place were critically important, as was the proximity of research centers to universities that were establishing associated degree programs. However, according to Stahl (2016), some distance grew after the first ICLS conference. Some of this distance was geographic, but it also had a great deal to do with what got spotlighted as internally sanctioned Learning Sciences research. The community that participated in the first ICLS that began to feel a rift was the Computer Supported Collaborative Learning (CSCL) community. Many, but not all, scholars in this area were located in Europe.

CSCL, like the rest of the Learning Sciences community, was also seriously interested in cognition, new technologies, and social contexts of learning. However, if there were some distinguishing features of the CSCL community, the focus on technology-mediated group cognition figured prominently. Several topics were important for looking at how people learned together online in designed spaces. Examining conceptual change as it became a reciprocal and negotiated process between multiple parties using a technology was also part of this group emphasis. Scripting that informed implicit expectations for how students would interact and move through collaborative learning activities became a major focus. Online knowledge building environments with asynchronous participation and online discourse were also a big focus of CSCL. Ideas about collaborative learning from Naomi Miyake (Chukyo University, then University of Tokyo, Japan), Jeremy Roschelle (SRI International, USA), Stephanie Teasley (SRI International, now at University of Michigan, USA), Claire O'Malley (University of Nottingham, UK), Frank Fischer (Ludwig-Maximilian University of Munich, Germany), Pierre Dillenbourg (University of Geneva and later at École Polytechnique Fédérale de Lausanne, Switzerland), Paul Kirschner (Open University, Netherlands), Gerry Stahl (Drexel University, USA), Marlene Scardamalia and Carl Bereiter (Ontario Institute for Studies in Education, Canada), and Timothy Koschmann (Southern Illinois University, USA) were formative.[4] [#footnote-796-4] Sometimes classrooms were the focus, but other learning settings, such as surgical rooms or online forums, became important research sites as well.

CSCL became a distinct enough strand of research that its own workshop was held in 1992 and then its own conference in 1995. Analyses of networks of collaboration and conference topics appear in Kienle and Wessner (2006). There were scholars who consistently appeared at both ICLS and CSCL conferences. Activity in one conference was in no way mutually exclusive from activity in the other. However, there were eventually contingents that were more drawn to one community over the other. Ultimately, given deep overlaps and crossover between CSCL and ICLS, a formal society that oversaw both conference series, the International Society of the Learning Sciences (ISLS), was established in 2002. Many of the aforementioned CSCL scholars were elected president of that society as the years proceeded, and many early graduate students who participated in the formation of these communities and the Learning Sciences field, who went on to become established scholars themselves, were elected as well. In 2006, the International Journal of Computer-Supported Collaborative Learning was established as a leading publication venue, with Gerry Stahl as founding editor. This was officially sponsored by the ISLS, as was the society's other flagship journal that had been operating since 1991, Journal of the Learning Sciences, with Janet Kolodner as the founding editor.

Learning Sciences Organizations, Academic Venues, and Resources

- **Professional Organizations**
  - International Society of the Learning Sciences
  - American Educational Research Association SIGs Learning Sciences and Advanced Technologies for Learning
- **Conference Venues**
  - International Conference of the Learning Sciences
  - Computer-Supported Collaborative Learning
- **Academic Journals**
  - Journal of the Learning Sciences
  - International Journal of Computer-Supported Collaborative Learning
- **Academic Programs and Online Resources**
  - Network of Academic Programs in the Learning Sciences (NAPLeS)

Design-based Research

As an interdisciplinary field with a mix of cognitive, computational, sociocultural, and anthropological traditions all in dialogue, the methodological palette began with and maintained a great deal of diversity. Controlled experiments, think-aloud protocols, interview studies, field work, and computational modeling all appear in Learning Sciences research along with other methods and methodological approaches. However, Learning Sciences strongly associates itself also with the articulation of design-based research as a methodology.

The nature of design-based research has been described in many places elsewhere (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; The Design-Based Research Collective, 2003; Sandoval & Bell, 2004), and new innovations to support that paradigm have been developed in the over two and a half decades since it was first introduced in academic publication (e.g., Sandoval, 2013). The simplest articulation of design-based research is that it involves researchers working with real educational settings and introducing new tools, practices, or activities that embody a set of assumptions that exist based on prior research.

For example, one might know from the existing literature that metacognitive support can improve learning outcomes during laboratory text-comprehension tasks. Rather than accept that as a given and hope that this finding gets translated on its own into classroom practice, the aspiring design-based researcher may then design and develop a new software tool that helps students continually monitor their own understanding and reflect on their own progress when reading science texts at school. The researcher would then test it informally to make sure it is usable and make arrangements with a local school to have some of their English classes use it. Upon bringing it into a school classroom, they discover that the metacognitive supports are actually confusing and counterproductive in the classroom because so much depends on whether students find the topic engaging and whether the teacher can orchestrate a classroom activity to split instructional time such that students begin by using the tool, participate in a reflective discussion with the teacher, and then return to the tool. The design-based researcher may discover that, unlike the 15-minute sessions reported in the existing literature when metacognitive training was done in the lab, a week is actually required to smoothly implement the tool in the classroom. The teachers need some help noticing what student comments to build upon in the reflection discussions. Texts need to be modified to immediately connect more to topics students already know.

In this experience, a well-meaning researcher attempted to take the best of what was known from prior research and ended up taking participants on a much more complicated journey than intended. That journey began to reveal how metacognitive activity works in a real education setting, how software tools should be designed and used in school settings, and what sorts of things classroom teachers need to do with the software to make it maximally effective. To verify that these new discoveries are actually valid ones, the researcher implements some revisions and sees if the expected outcomes emerge. If not, the design-based researcher repeats, or reiterates, the design work with that classroom.

That cycle is a very general summary of how design-based research unfolds. The researcher may have varying levels of involvement in the educational setting, where they may provide some initial professional development or training to a facilitator and then watch what unfolds later or where they may directly lead the classroom activities by their self. Design-based research can be a solo endeavor or a major team one. The benefit of this type of research is that it puts theoretical assertions (e.g., metacognitive supports improve text comprehension) in harm's way by allowing for the complexity of the real world to be introduced. This helps to refine (or even establish) stronger theory that speaks to complexities of how learning works in different systems. The intact unit could be a single student, a single classroom, a group of teachers, multiple classrooms, multiple grade bands in a school, a museum exhibit, a museum floor, an after-school program, a university course, or an online course. The outcomes of design-based research are articulated especially nicely by Edelson (2002), who argues that design-based research ultimately produces new knowledge about domain theories, design frameworks, and design methodologies. diSessa and Cobb (2004) have also suggested that design-based research can be the locus for new theoretical constructs to emerge.

As design-based research has matured, some have pushed to broaden its scope to speak to larger educational systems. Rather than working with individual students or classrooms, design-based implementation research (DBIR) promotes partnership with educational institutions such as entire schools or school districts (Penuel, Fishman, Cheng, & Sabelli, 2014). Related design-based approaches also appear as improvement science (Lewis, 2015) and in research-practice partnerships (Coburn & Penuel, 2016). As of late, these have been receiving more attention. Optimistically, we could see this as the desire of funding agencies and academic communities to scale important findings from the past decades of design-based research and to understand what enables new and powerful tools and activities to support learning and impact more learners.

As such, it is common for design-based research to appear in Learning Sciences research, whether in a single study or across a multi-year research program that may involve dozens of researchers and multiple academic institutions working in partnership with educational systems. Again, even though design-based research is prominent, effective and successful learning scientists need not claim design involvement in order to be considered as meaningfully contributing to the field. It does help, however, to be aware of the methodological approach, its history, warrants for arguments made through design-based research, and the kinds of knowledge that the field develops from design-based studies. It is also important to consider that design-based research has broadened in its appeal such that other fields are participating in design-based research without having prior historical ties to the Learning Sciences.

Learning Sciences and LIDT Fields

To summarize, Learning Sciences has a history that gives it its unique character. That history is tied to cognitive science and artificial intelligence, to new forms of educational media, to sociocultural and situative critiques and studies of learning, to group cognition as it involves multiple learners and technology mediation, and to an appreciation for what design can do in service of advancing academic knowledge. At its surface, this looks much like what LIDT fields also care about and also pursue. In broad strokes, that is true. However, the histories of Learning Sciences and LIDT fields have differences, and those origins ripple unintentionally in terms of what conferences and what journals are favored. The argument has been made that LIDT and Learning Sciences have much to gain from more cross talk, and that is likely true. However, that cross talk has not always happened (Kirby, Hoadley, & Carr-Chellman, 2005), and perceptions remain that fundamental barriers exist that discourage such cross talk. In some cases, strong academic departments have split because faculty in them felt that LIDT and Learning Sciences were incompatible.

However, there have since been deliberate efforts to close perceived rifts. For example, Pennsylvania State University made a deliberate effort to hire individuals trained in Learning Sciences (Chris Hoadley, Brian K. Smith) into their already strong LIDT-oriented department, and that promoted dialogue and relationship building, although the LS-oriented faculty composition has since changed. Utah State University hired Mimi Recker, an early student of the Berkeley program that emerged in the 1990s and subsequently took on a blended departmental identity (USU ITLS Faculty, 2009). Members of the University of Georgia Learning and Performance Systems Laboratory (Daniel Hickey and Kenneth Hay) took positions in a new Learning Sciences program established at Indiana University. The push for more relationship building is now there.

The future of the relationship between LIDT and Learning Sciences organizations and programs is ultimately up to those who are currently training as students in those fields. As someone who has been operating in both spaces, although I was explicitly trained in one, I understand many barriers are actually illusory. There are different foci and theoretical commitments and expectations in each field, but both communities deeply care about learning and how we can build knowledge to improve the tools, practices, and environments that support it. To gain traction in the other field, people simply start by reserving judgment and then reading the other field’s core literatures. They start conversations with individuals who are connected to the other field and initiate collaborations. They get excited about ideas that other parties are also currently thinking about, and they have dialogue. In fact, that’s the simplified version of how Learning Sciences began. It could be the beginning of the history for a new multidisciplinary field in the future as well.

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Footnotes

1. Compared to, say, Philosophy, Mathematics, or History ↵ [#return-footnote-796-1]
2. The prehistory of Learning Sciences is presented quite compellingly by Pea (2016) and Schank (2016). ↵ [#return-footnote-796-2]
3. A true Papert perspective would likely not privilege computer programming so much as rich and generative representational media embedded in contexts that allow the exploration, construction, and sharing of powerful ideas. ↵ [#return-footnote-796-3]
4. Of course, there were far more highly influential CSCL scholars than are in this list, and many were also participating in ICLS primarily. ↵ [#return-footnote-796-4]

LIDT Timeline

Ramsey, J.

History

Instructional Design

Learning Sciences

This chapter provides interactive timelines of the history of LIDT, broken into major eras of the field.

1905–1953

1954–1969

1970–1984

1985–2003

2004–2009

2010–2022

Programmed Instruction

Instructional Design
Instructional Design History
programmed instruction

Programmed instruction (PI) was devised to make the teaching-learning process more humane by making it more effective and customized to individual differences. This chapter reviews B.F. Skinner's original prescription, its limitations, and later innovation that incorporated more human interaction, social reinforcers and other forms of feedback, larger and more flexible chunks of instruction, and more attention to learner appeal. Although PI itself has receded from the spotlight, technologies derived from PI, such as programmed tutoring, Direct Instruction, and Personalized System of Instruction continue on and elements of these ideas persist in computer-based instruction and distance learning.

Editor's Note

The following was originally published by Michael Molenda in *TechTrends* with the following citation:

Molenda, M. (2008). The Programmed Instruction Era: When effectiveness mattered. *TechTrends*, *52*(2), 52-58.

Programmed instruction (PI) was devised to make the teaching-learning process more humane by making it more effective and customized to individual differences. B.F. Skinner's original prescription, although it met with some success, had serious limitations. Later innovators improved upon the original notion by incorporating more human interaction, social reinforcers and other forms of feedback, larger and more flexible chunks of instruction, and more attention to learner appeal. Although PI itself has receded from the spotlight, technologies derived from PI, such as programmed tutoring, Direct Instruction, and Personalized System of Instruction have compiled an impressive track record of success when compared to so-called conventional instruction. They paved the way for computer-based instruction and distance learning. The success of the PI movement can be attributed largely to the commitment of its proponents to relentless, objective measurement of effectiveness.

Origins of the Programmed Instruction Movement

During the first half of the 20th century, research and theory in American psychology tended to revolve around the perspective of behaviorism, and Thorndike's (1911) theorems—the law of recency, the law of effect, and the law of exercise—remained at the center of discussion for decades. In the 1920s Sidney Pressey, a psychology professor at Ohio State University, invented a mechanical device based on a typewriter drum, designed primarily to automate testing of simple informational material (1926). As he experimented with the device he realized that it could also provide control over drill-and-practice exercises, teaching as well as testing. In explaining why his device was successful he explicitly drew upon Thorndike's laws of recency, effect, and exercise as theoretical rationales (Pressey, 1927). Unfortunately, despite the fact that Pressey continued to develop successful self-teaching devices, including punchboards, that had all the qualities of later "teaching machines," his efforts were essentially a dead end in terms of a lasting effect on education. However, Pressey lived and worked long enough to participate in the discussions surrounding the new generation of teaching machines that came along in the 1950s.

The movement that had a more enduring impact on education and training was animated by a reframing of Thorndike's behaviorist principles under the label of radical behaviorism. This school of thought proposed a more rigorous definition of the law of effect, adopting the term *reinforcer* to refer to any event that increases the frequency of a preceding behavior. Operant conditioning, the major operationalization of this theory, involves the relationships among stimuli, the responses, and the consequences that follow a response (Burton, Moore & Magliaro, 2004, p. 10). The leading proponent of radical behaviorism, B.F. Skinner, demonstrated that by manipulating these three variables experimenters could elicit quite complex new behaviors from laboratory animals (Ferster & Skinner, 1957).

Skinner's Invention of Programmed Instruction

Skinner was led to apply the principles of operant conditioning to academic tasks by a personal experience with one of his own children. As reported by his older daughter, Julie:

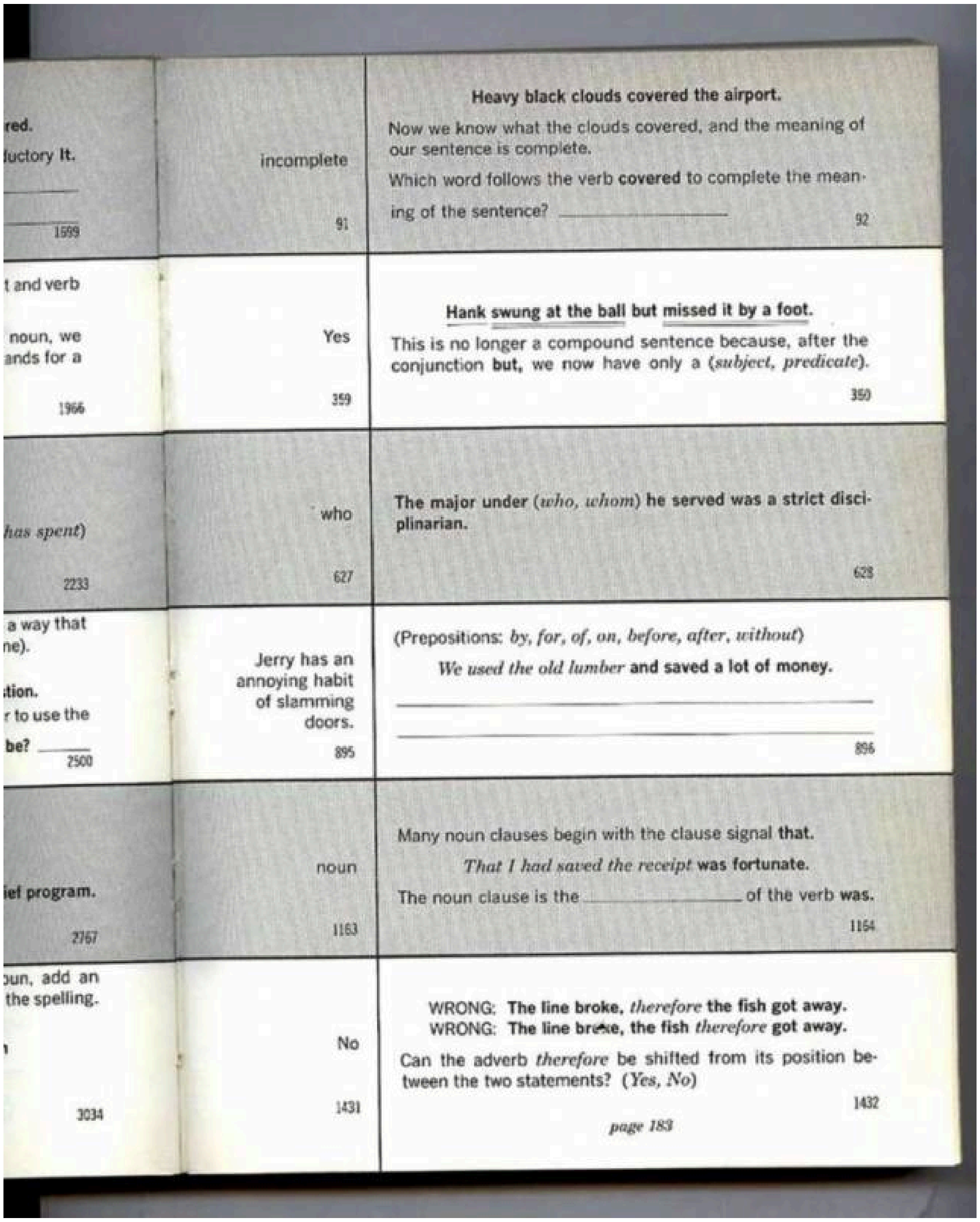
> *When the younger [daughter, Deborah] was in fourth grade, on November 11, 1953, Skinner attended her math class for Father's Day. The visit altered his life. As he sat at the back of that typical fourth grade math class, what he saw suddenly hit him with the force of an inspiration. As he put it, 'through no fault of her own the teacher was violating almost everything we knew about the learning process. '(Vargas, n.d.)*

Having analyzed the deficiencies of group-based traditional instruction, Skinner (1954) proceeded to develop a mechanical device (shown in Figure 1) that could overcome the limitations of lock-step group presentation, replacing it with individually guided study in which the contingencies of reinforcement could be carefully controlled. In Skinner's new format the content was arranged in small steps, or frames, of information. These steps lead the learner from the simple to the complex in a carefully ordered sequence, and, most importantly, at each step the learner is required to make a response—to write or select an answer. The program then judges whether the response is correct. The theory dictated that the learner should then receive some sort of reinforcer if the response were correct. In Skinner's method, the reinforcer took the form of "knowledge of correct response," that is, telling the learner the right answer or confirming that they got the right answer. The main purpose of the mechanical elements of the system was to ensure that users could not peek ahead at the correct answers. The next step in the sequence could only take place after a response was written inside a little window frame and a lever pulled to cover the learner's response with a transparent cover while revealing the correct answer. The device, referred to by others as a *teaching machine*, soon gained national attention and attracted a following of eager software authors.

Figure 1. A teaching machine of the Skinner type. Used with permission of AECT, successor to DAVI.

Further Development of Programmed Instruction

The instructional format used in teaching machines became known as programmed instruction (PI), and this new technology became a popular subject of educational research and development by the late 1950s. Within a few years developers were dispensing with the elaborate mechanical apparatus, instead relying on users (rightly or wrongly) to discipline themselves and refrain from peeking ahead at the correct answer. Thus PI lessons could be published in book format, with short instructional units ("frames") followed by a question, with the correct answer lower on the page (to be covered up by the user) or on the next page. Released from the necessity of providing hardware along with the software, publishers rushed to produce books in programmed format. They offered programmed books that appealed to mass audiences, such as *Goren's Easy Steps to Winning Bridge* (1963) by the famous bridge master Charles Goren, and those that aimed at the school market, such as *English 2600* (Blumenthal, 1961), which taught the fundamentals of grammar in a step-by-step linear program, illustrated in Figure 2.



red. luctory **It.** 1699	incomplete 91	**Heavy black clouds covered the airport.** Now we know what the clouds covered, and the meaning of our sentence is complete. Which word follows the verb **covered** to complete the meaning of the sentence? ____ 92
t and verb noun, we ands for a 1966	Yes 359	**Hank swung at the ball but missed it by a foot.** This is no longer a compound sentence because, after the conjunction **but,** we now have only a (*subject, predicate*). 360
has spent) 2233	who 627	**The major under (*who, whom*) he served was a strict disciplinarian.** 628
a way that ne). **tion.** r to use the **be?** ____ 2500	Jerry has an annoying habit of slamming doors. 895	(Prepositions: *by, for, of, on, before, after, without*) *We used the old lumber* **and saved a lot of money.** ____ ____ 896
ief program. 2767	noun 1163	Many noun clauses begin with the clause signal **that.** *That I had saved the receipt* **was fortunate.** The noun clause is the ____ of the verb **was.** 1164
oun, add an the spelling. 3034	No 1431	WRONG: **The line broke, *therefore* the fish got away.** WRONG: **The line broke, the fish *therefore* got away.** Can the adverb *therefore* be shifted from its position between the two statements? (*Yes, No*) 1432 *page 183*

Figure 2. Example of page layout of a linear programmed instruction book: English 3200 by Joseph Blumenthal, New York: Harcourt Brace & World, 1962.

Linear vs. Intrinsic Programming

The original programs devised by B.F. Skinner and his followers led users through a pre-specified sequence of small steps. Shortly after Skinner's invention, Norman Crowder introduced a variation that was not founded on any particular theory of learning, but only on practicality. It featured a more flexible programmed lesson structure that allowed learners to skip ahead through material that was easy for them or to branch off to remedial frames when they had difficulty. Crowder (1962) labeled his method *intrinsic programming*, but it was quickly dubbed *branching programming* because a schematic outline of the program resembled a tree trunk (the prime path) with multiple branches (the remedial sequences).

Skinner's method was thereafter known as *linear programming*. The two approaches are contrasted in Figure 3.

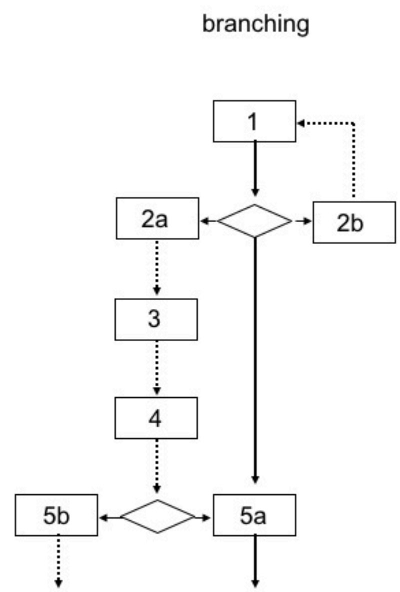


Figure 3. Comparison of the organization of a linear vs. branching programmed text. © Michael Molenda. Used with permission.

Initially, Crowder's programs were incorporated into the *AutoTutor*, a desktop teaching machine which used his branching technique to tailor the lesson to the responses of the learner. The original *AutoTutor*, released in the early 1960s, provided individualized instruction long before general-purpose desktop computers were feasible. But Crowder also joined the rush to convert programs to book form. His *TutorText* series became one of the best-known series of programmed materials. In the print format, readers encountered multiple-choice questions and each alternative answer led to a different "next page" in the book.

Pi in Formal Education

PI was first employed in formal education in the college courses taught by Skinner and his colleagues in the late 1950s. Experiments in schools began with teaching spelling to second- and third-graders in 1957 and teaching mathematics in high schools in 1959 (Saettler, 1990, p. 297). Large-scale school implementation projects were conducted in the early 1960s in Denver and Long Island, NY. The major lesson learned in these experiments was that although the materials themselves were effective, PI could not make a substantial impact on the efficiency or effectiveness of schooling without extensive restructuring of classroom routines and school organization. Schools then, as now, were resistant to systemic restructuring (Saettler, 1990, pp. 297-302).

The Programmed Instruction Boom

Authors and publishers unleashed a flood of programmed materials both in linear and branching formats. Between the early 1960s and 1966, new titles proliferated at an accelerating rate as publishers vied with each other for market dominance. Figure 4 illustrates this boom, showing the growth curve of programmed materials in the United Kingdom, which was paralleled in the U.S. As with other technological innovations, the upward slope did not continue indefinitely. After 1966 the publication of new titles declined rather rapidly and then leveled off. Although there is little fanfare today, programmed materials are still distributed and used by learners, many of whom continue to feel empowered by the ability to work through material methodically with frequent checks for comprehension.

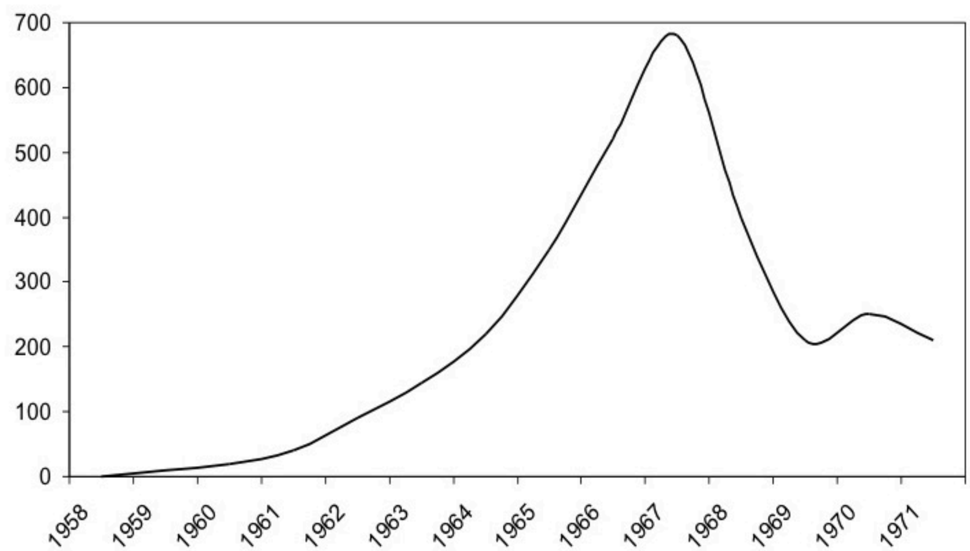


Figure 4. Number of programmed instruction titles available in the market each year in the United Kingdom. Adapted from Figure 1 in Hamer, J.W., Howe, A. & Romiszowski, A.J. (1972). Used with permission of SEDA, successor to APLET.

Striving for Effectiveness

One of the major tenets of PI was that learners should practice mainly correct responses, so that they could experience frequent reinforcement. The only way of assuring this was to test and revise each program during development. In fact, *developmental testing* was a mandatory specification for materials destined for the military training market. The US Air Force required that "at least 90% of the target population will achieve 90% of the objectives" (Harris, p. 142). This was known as the 90/90 criterion and was widely accepted as the standard benchmark of effectiveness. One of the consequences of this practice was to promote the flowering of a systematic procedure for designing, testing, and revising programmed materials, a precursor to later instructional design models.

Another consequence was to encourage an empirical, data-based approach to instruction, since each PI development project was similar to a controlled experiment. The professional literature of the 1960s carried hundreds of reports on testing of PI programs and comparisons of programmed treatments with other sorts of treatments. One of the first casualties of this research was Skinner's set of specifications. Small steps did not prove to be essential, nor linear sequencing…as demonstrated by Crowder's branching method. The immediacy of reinforcement did not prove to be critical for a great many types of learning tasks. Indeed, the efficacy of "knowledge of results" as a reinforcer did not stand up under scrutiny. In retrospect, it was predictable that "knowledge of correct response" would not work as a universal reinforcer. Researchers (and lay people) already knew that different people respond to different reinforcers at different times. When a person is satiated with ice cream, ice cream is no longer reinforcing. The same is true of being told the correct answer. At some point curiosity is satiated. Researchers rediscovered that there are no universal reinforcers.

Interestingly, even though the individual hypotheses making up PI did not prove to be robust, experiments comparing PI to so-called *conventional instruction* (a construct that needs to be critically deconstructed in its own right!) tended to show PI as superior (Walberg, 1984; Ellson, 1986). Why was that? In retrospect, we can surmise that PI did have several advantages over so-called conventional instruction. First, in many educational experiments, the experimental treatment simply received more time and effort in its preparation and delivery. Second, users are often attracted to the novelty of any new treatment—at least until the novelty wears off. Finally, the PI treatments not only had more time and attention, they were designed through a rigorously thought-out, systematic process, which included not only precise specification of objectives but also testing, revision, and re-testing. Indeed, it was the realization that the *design process* was the valuable part of programmed instruction that led to the emergence of systematic instructional design as a powerful tool (Markle, 1967).

Programmed Instruction in Davi

It was not inevitable that PI would become a factor in the field then known as audiovisual (AV) communications, represented by AECT's predecessor, the Department of Audio-Visual Instruction (DAVI), a unit of the National Education Association. In the late 1950s and early 1960s DAVI was enjoying a growth spurt stimulated, first, by the mushrooming of new schools in the post-World War II expansion period and, second, by the largest ever federal infusion of money into public education, the National Defense Education Act (NDEA) of 1958. Schools and colleges, like the rest of American society, lived under the shadow of the Cold War, and the feeling of a life-or-death struggle with the Soviet Union was palpable. With the Soviet launch of Sputnik I in 1957, America confronted the prospect of a dangerous technological inferiority. Education—especially in mathematics, science, and engineering—became an urgent priority.

The DAVI community benefited from the reinvigorated march to expand and improve education through the NDEA. *New educational media* became the hot topic of ramped-up research and development activity as well as the beneficiary of enhanced school-equipment budgets. Attendance at DAVI conventions zoomed from the hundreds to the thousands as school AV administrators, many newly assigned, flocked to see and buy the new hardware and software exhibited there: film, slide and filmstrip, phonograph and audio tape, opaque and overhead projection, radio, and television (Godfrey, 1967).

The 1959 DAVI convention program was primarily devoted to these audiovisual media. It had a single research paper devoted to PI, "Teaching Machines and Self-Instructional Materials: Recent Developments and Research Issues," but by 1960 there were several sessions devoted to PI, including a major one entitled "Programmed Instructional Materials for Use in Teaching Machines" (Sugar & Brown, n.d.). This title gives a clue to the connection between AV administrators and PI: mechanical devices were initially used to deliver the programmed lessons. When schools and colleges acquired teaching machines someone had to take care of them. Who was more suited to this task than the AV coordinator who already took care of film, filmstrip, slide, and overhead projectors? The focus on hardware is indicated by the name that marked this new special interest group at the next several DAVI conventions: the Teaching Machine Group.

DAVI's commitment to this new phenomenon was signaled by the publication of a collection of key documents on PI (Lumsdaine & Glaser) in 1960, and then a follow-up compilation of later research and commentary in 1965 (Glaser). Attention at the annual DAVI convention grew; by the late 1960s the convention offered about a dozen sessions a year on PI, representing about a one-tenth share of the stage. The conversation was still predominantly about AV media, but PI had a visible, sustained presence. PI was even more visible in scholarly circles, as indicated by Torkelson's (1977) analysis of the contents of *AV Communication Review*, which showed that between 1963 and 1967 the topics of teaching machines and programmed instruction represented a plurality of all articles published in that journal.

DAVI was not the only, or even the primary professional association interested in PI. When Air Force experiments in 1961 demonstrated the dramatic time and cost advantages of PI (efficiency as well as effectiveness) military trainers and university researchers quickly formed an informal interest group, which by 1962 became a national organization, the National Society for Programmed Instruction (NSPI). The organization grew to encompass over 10,000 members in the U.S., Canada, and forty other countries. As the interests of members also grew and evolved to include all sorts of technological interventions for improved human performance, the name, too, evolved to its current form, International Society for Performance Improvement (ISPI).

The Emergence of a Concept of Educational Technology

Gradually, throughout the 1960s the central focus of the field was shifting from the production and use of AV materials to designing and utilizing interactive self-instructional systems. B.F. Skinner coined the term *technology of teaching* in 1968 to describe PI as an application of the science of learning to the practical task of instruction. Other authors used the term *educational technology*; an early example being *Educational technology: Readings in programmed instruction* (DeCecco, 1964). This idea supported the notion promoted by James D. Finn (1965) that *instructional technology* could be viewed as *a way of thinking* about instruction, not just a conglomeration of devices. Thereafter, more and more educators and trainers came to accept *soft* technology, the "application of scientific thinking" as well as *hard* technology, the various communications media. And when the time came to reconsider the name of the association in the late 1960s, one of the names offered to the membership for vote combined elements of both. The vote in June 1970 showed a three-to-one preference for the hybrid name, Association for Educational Communications and Technology (AECT).

Other Soft Technologies Derived From Programmed Instruction

Over the decades since Sidney Pressey's and B.F. Skinner's bold innovations in self-instruction, many other concerned educators have tried their hands at improving upon the format initially incorporated into teaching machines. Obviously, computer-assisted instruction was heavily influenced by PI. In addition, a number of other technological spin-offs from PI have gone on to chart a record of success in improving the effectiveness of education. Three will be examined in some detail—programmed tutoring, Direct Instruction, and Personalized System of Instruction.

Programmed Tutoring

A psychology professor at Indiana University, Douglas Ellson, had a life-long consuming interest in improving the teaching-learning process. He examined PI very closely, detected its weaknesses, and in 1960 developed a new approach to address those weaknesses (Ellson, Barber, Engle & Kampwerth, 1965). Programmed tutoring (PT) puts the learner together with a tutor who has been trained to follow a structured pattern for guiding the tutee. Like PI, students work at their own pace and they are constantly active—reading, solving problems, or working through other types of materials. The tutor watches and listens. When the tutee struggles to complete a step, the tutor gives hints, taking the learner back to something he already knows, then helps him to move forward again. Thus, learners are usually generating their own answers. And instead of receiving "knowledge of correct response" as reinforcement, they receive *social* reinforcers from the tutor—praise, encouragement, sympathy, or at least some attention.

Of course, giving every student a tutor is a labor-intensive proposition, but Ellson solved this problem by using *peers*as tutors—students of the same age or a little older, a role they proved able to play after a little training in how to follow the specified procedures. Not only did tutors serve as "free manpower," but research showed that it was a win-win situation because tutors showed learning gains even greater than the tutees'! By going through the material repeatedly and teaching it to someone else, they strengthened their own grasp of the material.

During the early 1980s PT gained credibility due to its track record in comparison studies (Cohen, J.A. Kulik & C. C. Kulik, 1982). It was recognized by the U.S. Department of Education as one of the half-dozen most successful innovations and it was widely disseminated (although not as widely as it deserves, as with many of the other soft technologies that have been developed over the years).

Direct Instruction

Direct Instruction (DI) was actually not derived explicitly from programmed instruction. Its originator, Siegfried "Zig" Engelmann was an advertising executive with a degree in philosophy. He developed DI as a way to help disadvantaged children succeed academically. He was an eager experimenter, and, through trial, he worked out an instructional framework that produced rapid learning gains. It consists of fast-paced, scripted, teacher-directed lessons with teacher showing-and-telling punctuated by group responses in unison. As the method evolved it happened to incorporate many features that coincided with behaviorist principles:

- overt practice—students respond to teacher cues in unison
- social reinforcers—teacher attention, praise, and encouragement
- ongoing feedback and correction from the teacher
- lessons developed through extensive testing and revision.

DI has been extensively used and tested since the 1960s. A large-scale comparison of twenty different instructional models implemented with at-risk children showed DI to be the most effective in terms of basic skills, cognitive skills, and self-concept (Watkins, 1988). More recently it has been found to be one of three comprehensive school reform models "to have clearly established, across varying contexts and varying study designs, that their effects are relatively robust and … can be expected to improve students' test scores" (Borman, Hewes, Overman & Brown, 2002, p. 37).

Personalized System of Instruction

Fred Keller devised the Personalized System of Instruction (PSI) or "Keller Plan" in 1963 for the introductory psychology course at a new university in Brasilia. He was seeking a course structure that would maximize students' success and satisfaction. He and his collaborators were inspired by Skinner's programmed course at Harvard and Ferster's at the Institute for Behavioral Research (Keller, 1974). In PSI, all the content material of a course is divided into sequential units (such as textbook chapters or specially created modules). These units are used independently by learners, progressing at their own pace. At the end of a unit, learners take a competency test and immediately afterward they receive feedback from a proctor with any coaching needed to correct mistakes. This procedure prevents ignorance from accumulating so that students to fall further and further behind if they miss a key point (Keller, 1968). During the period it was being tested at many colleges and universities, the 1960s and 1970s, PSI was found to be the most instructionally powerful innovation evaluated up to that time (J.A. Kulik, C. C. Kulik & Cohen, 1979; Keller, 1977). Although "pure PSI" courses are not common nowadays, the mastery-based, resource-centered, self-paced approach has been incorporated into many face-to-face courses in schools, universities, and corporate training centers…and it set the pattern for what was to become "distance education."

Conclusion

The programmed instruction movement was born as a radical reconstruction of the traditional procedures for teaching. It aimed to free learners (and teachers!) from the misery of the lock-step group lecture method. The innovators who followed were similarly motivated to expand human freedom and dignity by giving learners more customized programs of instruction in a humane, caring context with frequent one-to-one contact. They developed methods of instruction that were amenable to objective examination, testing, and revision. They viewed caring instruction as synonymous with effective instruction. In the words of Zig Engelmann:

My goal for years has been to do things that are productive and that help make life better for kids, particularly at-risk kids. I don't consider myself a kinderphile…. For me it's more an ethical obligation. Certainly kids are enchanting, but they also have a future, and their future will be a lot brighter if they have choices. We can empower them with the capacity to choose between being an engineer, a musician, an accountant, or a vagrant through instruction (Engelmann, n.d.).

They welcomed empirical testing of their products and demanded it of others. Instruction that was wasting students' time or grinding down their enthusiasm was simply malpractice. Their legacy lives on, mainly in corporate and military training, where efficiency and effectiveness matter because savings in learning time and learning cost have direct bearing on the well-being of the organization. As public purse strings tighten, the day may come when learning time and learning costs are subjected to close accountability in public school and university education also.

Application Exercises

1. Think about Programmed Instruction, Programmed Tutoring, Direct Instruction, and Personalized System of Instruction. What type of instruction would you prefer to receive? What type would you prefer to give?
2. What aspects of Skinner's programmed instruction are still used in instructional design today?

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Is Programmed Instruction Still Relevant Today?

Hack Education [http://teachingmachin.es/] is a collection of essays by Audrey Watters that discuss the fascination in our field and society with automizing teaching and learning, from Skinner's teaching machines to modern day MOOCs.

Can you think of any other examples of the principles of Programmed Instruction still being discussed today?

? Please complete this short survey to provide feedback on this chapter: http://bit.ly/ProgrammedInstruction

Edgar Dale and the Cone of Experience

Dale's Cone of Experience

Experiential Learning

Instructional Design History

This chapter reviews the career of Edgar Dale and focuses on his key idea of the Cone of Experience.

Editor's Note

The following chapter was based on the following article, previously published in *Educational Technology*.

Lee, S. J., & Reeves, T. C. (2007). Edgar Dale: A significant contributor to the field of educational technology. *Educational Technology, 47*(6), 56.

How can teachers use audiovisual materials to promote learning that persists? How can audiovisual materials enable students to enjoy learning through vicarious experience? These were two of the many important research and development questions addressed by an extraordinary educational technology pioneer, Edgar Dale. Although he is perhaps best remembered today for his often misinterpreted "Cone of Experience," Dale made significant contributions in many areas as evidenced by just a few of the titles of the many books he wrote during his long lifespan (1900-1988), including: *How to Appreciate Motion Pictures* (1933), *Teaching with Motion Pictures* (1937), *How to Read a Newspaper* (1941), *Audiovisual Methods in Teaching* (1946, 1954, 1969), *Techniques of Teaching Vocabulary*(1971), *Building a Learning Environment* (1972), *The Living Word Vocabulary: The Words We Know* (1976), and *The Educator's Quotebook* (1984).

Background

Born in 1900 at the dawn of a new millennium, Edgar Dale's work continues to influence educational technologists in the 21st Century. Dale grew up on a North Dakota farm, and according to Wagner (1970), he retained the no-nonsense thinking habits and strong work ethic of his Scandinavian forebears throughout his illustrious career. While working on the family farm and later as a teacher in a small rural school, Dale earned both his Bachelors and Masters degrees from the University of North Dakota partially through correspondence courses.

In 1929, he completed a Ph.D. at the University of Chicago, and then joined the Eastman Kodak Company where he collaborated on some of the earliest studies of learning from film. Interestingly, although many of these early studies were experimental ones designed to compare learning from film with other media, Dale later expressed distain for such studies. According to De Vaney and Butler (1996):

> *When Dale was asked why he did not do experimental research in which a scholar attempted to prove over and over that students learn from radio or film, he replied: "It always bothers me, because anybody knows that we learn from these things (media). There's no issue about that. . . . Well I suppose in any field, to be respectable you have to do a certain kind of research. (p. 17)*

In addition to his own prolific scholarship, Edgar Dale mentored an outstanding cadre of doctoral students during his long role as a professor at Ohio State University (1929-1973), including Jeanne Chall and James Finn. Dale also served as President of the Division of Visual Instruction (DVI) of the National Education Association (NEA) from 1937-38, the professional association that is now known as the Association for Educational Communications and Technology (AECT).

Influences

Although he traced his ideas back as far as Pestalozzi (1746 – 1827), who pioneered the concept of learning through activity, and Froebel (1782 – 1852), who first promoted the principle that children have unique needs and capabilities, Edgar Dale's work was most heavily influenced by John Dewey (1859-1952). Dewey stressed the importance of the continuity of learning experiences from schools into the real world and argued for a greater focus on higher order outcomes and meaningful learning.

In his first edition of *Audiovisual Methods in Teaching* (1946), Dale expanded Dewey's concept of the continuity of learning through experience by developing the "Cone of Experience" which relates a concrete to abstract continuum to audiovisual media options (Seels, 1997). Dale (1969) regarded the Cone as a "visual analogy" (p. 108) to show the progression of learning experiences from the concrete to the abstract (see Figure 1) rather than as a prescription for instruction with media. In the last edition of *Audiovisual Methods in Teaching* (1969), Dale integrated Bruner's (1966) three modes of learning into the Cone by categorizing learning experiences into three modes: enactive (i.e., learning by doing), iconic (i.e., learning through observation), and symbolic experience (i.e., learning through abstraction).

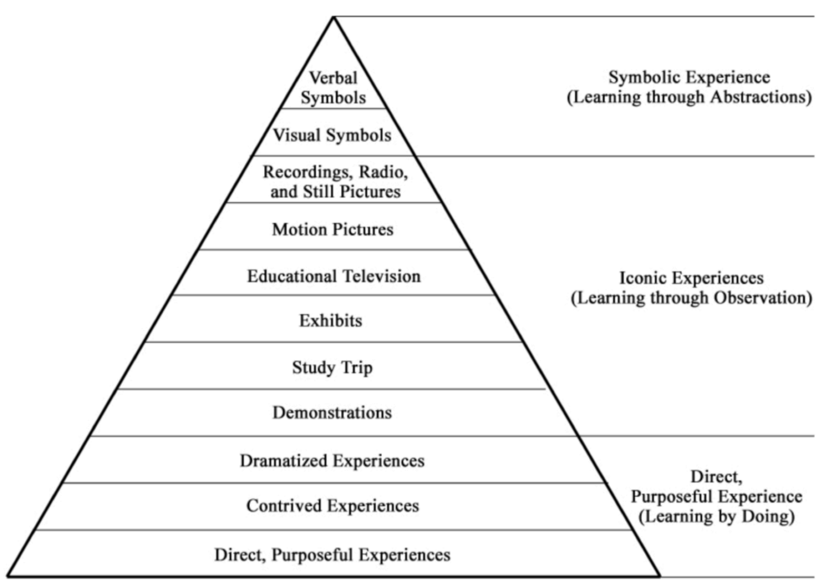

Figure 1. Dale's Cone of Experience.

In moving toward the pinnacle of the Cone from direct, purposeful experiences to verbal symbols, the degree of abstraction gradually increases. As a result, learners become spectators rather than participants (Seels, 1997). The bottom of the Cone represented "purposeful experience that is seen, handled, tasted, touched, felt, and smelled" (Dale, 1954, p. 42). By contrast, at the top of the Cone, verbal symbols (i.e., words) and messages are highly abstract. They do not have physical resemblance to the objects or ideas. As Dale (1969) wrote, "The word *horse* as we write it does not look like a horse or sound like a horse or feel like a horse" (p. 127).

Dale (1969) explained that the broad base of the cone illustrated the importance of direct experience for effective communication and learning. Especially for young children, real and concrete experiences are necessary to provide the foundation of their permanent learning. The historical importance of Dale's Cone rests in its attempt to relate media to psychological theory (Seels, 1997) and the Cone has shaped various sets of media selection guidelines ever since. For example, influenced by Dale, Briggs (1972) delineated general principles for media selection according to the age of learners, the type of learners, and the type of task.

Current Application

Dale's Cone of Experience continues to influence instructional designers today in both theory and practice. For example, Baukal, Auburn, and Ausburn built upon Dale's ideas in developing their Multimedia Cone of Abstraction [https://edtechbooks.org/-Yq], available at http://files.eric.ed.gov/fulltext/EJ1101723.pdf.

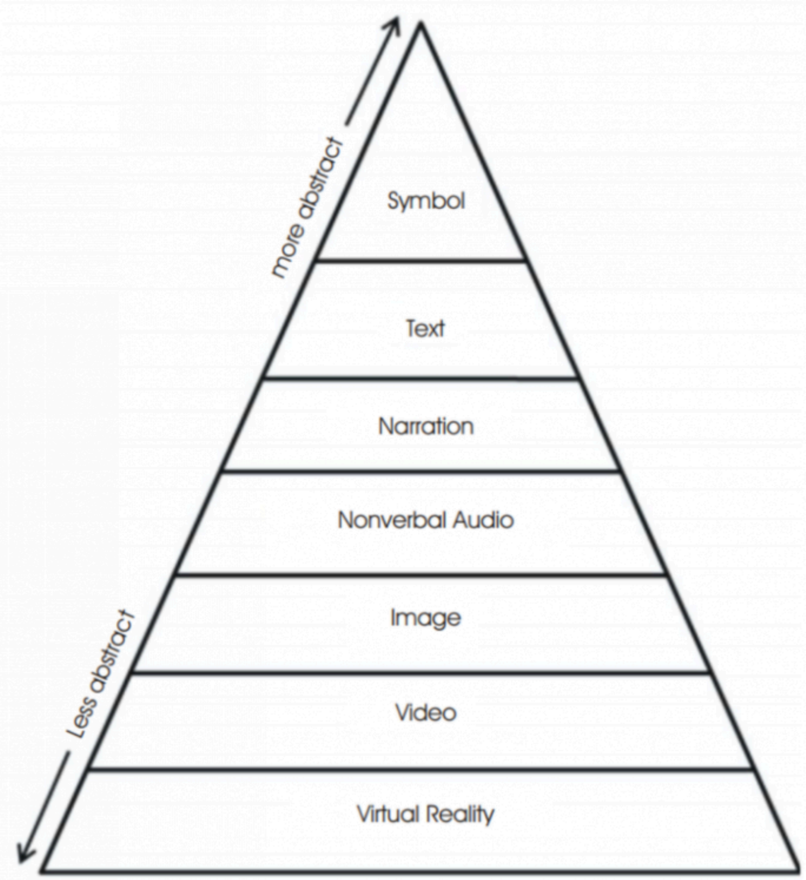

Figure 3. Proposed Multimedia Cone of Abstraction

Multimedia Cone of Abstraction

As noted above, Dale's Cone has been frequently misunderstood and misused. Dale's Cone is often confounded with the "Remembering Cone" or "Bogus Cone" (Subramony, 2003, p. 27) which claims that learners will generally remember 10 percent of what they read, 20 percent of what they hear, 30 percent of what they see, 50 percent of what they hear and see, 70 percent of what they say, and 90 percent of what they both say and do. Even though Dale did not mention the relationship between the level of the Cone and a learner's level of recall, many practitioners mistakenly believe that the bogus "Remembering Cone" was Dale's work. A Google search reveals an astonishing number of attributions of the "Bogus Cone" to Edgar Dale. Molenda (2003) concludes that the so-called empirical evidence for the "Remembering Cone" appears to have been fabricated by petroleum industry trainers in the 1960s.

In addition to this confusion, the implications of Dale's Cone have been misunderstood or misapplied. For example, Dale's Cone has been used to maintain that more realistic and direct experience is always better. However, Dale (1969) demurred, writing that, "Too much reliance on concrete experience may actually obstruct the process of meaningful generalization" (p. 130). Also, Dale noted that providing realistic learning experiences may not be efficient in terms of cost, time, and efforts. Instead, Dale suggested that teachers should balance combinations of concrete and abstract learning experiences.

Further Reading

For a thorough analysis of the prevalence of the "Remembering Cone" myth in instructional design, along with analysis tracing the history of this myth and the evidence against it, see the final issue in 2014 of Educational Technology, which presented a special issue on the topic.

Application Exercises

While learning by doing (direct, purposeful experience) may be better than learning through abstraction (symbolic experience), explain why you think Dale (1969) felt that "Too much reliance on concrete experience may actually obstruct the process of meaningful generalization."

Experiential Learning Environments

In another book *Can You Give The Public What It Wants* (1967), Dale reiterated Dewey's influence on his ideas by writing: "As I return to *Democracy and Education* [published by Dewey in 1916] I always find a new idea that I had not seen or adequately grasped before" (p. 186). Dale (1969) described learning as a "fourfold organic process" (p. 42) which consisted of needs, experiences, incorporation of the experiences, and the use of them. To promote permanent learning, Dale asserted that teachers should help students identify their *needs* for learning and set clearly defined learning goals related to their needs. A learning *experience* must be personally meaningful with respect to students' backgrounds and developmental stages and the nature of the experience should be logically arranged to help students *incorporate* new knowledge with what they already have. Later, students should have opportunities to *practice and try out* their new knowledge in real life as well as in learning contexts. Dale (1972) wrote:

> *To experience an event is to live through it, to participate in it, to incorporate it, and to continue to use it. To experience is to test, to try out. It means to be a concerned participant, not a half-attentive observer. (p. 4)*

Thus, effective learning environments should be filled with rich and memorable experiences where students can see, hear, taste, touch, and try. Dale (1969) articulated the characteristics of rich experiences. In a rich experience:

- students are immersed in it and use their eyes, ears, noses, mouths and hands to explore the experience,
- students have a chance to discover new experiences and new awareness of them,
- students have emotionally rewarding experiences that will motivate them for learning throughout their lives,
- students have chances to practice their past experiences and combine them to create new experiences,
- students have a sense of personal achievement, and
- students can develop their own dynamic experiences.

In Dale's perspective (1972), most students in schools did not learn how to think, discover, and solve real problems. Rather, students were forced to memorize facts and knowledge in most schools, and as a result, any knowledge they acquired was inert in their real lives. For this reason, he argued that we should have revolutionary approaches to improve the quality of educational learning environments. To build learning environments infused with rich experiences, Dale argued for the development of new materials and methods of instruction. Dale promoted the potential of audiovisual materials, believing that they could provide vivid and memorable experiences and extend them regardless of the limitations of time and space. Dale (1969) argued:

> *Thus, through the skillful use of radio, audio recording, television, video recording, painting, line drawing, motion picture, photograph, model, exhibit, poster, we can bring the world to the classroom. We can make the past come alive either by reconstructing it or by using records of the past. (p. 23)*

Dale believed that audiovisual materials could help students learn from others' first-hand experience, or *vicarious*experience. Dale (1967) claimed, "Audiovisual materials furnish one especially effective way to extend the range of our vicarious experience" (p. 23). Dale concluded that audiovisual materials could provide a concrete basis for learning concepts, heighten students' motivation, encourage active participation, give needed reinforcement, widen student experiences and improve the effectiveness of other materials.

Although as noted above, Dale (1969) did not advocate comparative media studies, he did recommend evaluating combinations of media and instructional materials in actual learning environments. Amazingly, Dale anticipated the direction of media research as if he had been privy to the Great Media Debate between Clark (1994) and Kozma (1994). Dale (1969) provided an analogy:

> *As we think about freight cars and their contents we can and do distinguish them. But the vehicle and its contents are closely linked. The gondola car is linked with coal: we do not haul oil in it. The piggy-back conveyances for transporting automobiles are not used to transport wheat. In all communicating of messages, therefore, we must consider the kind of vehicle used to transport them, realizing that medium-message characteristics will influence what can be "sent" to a receiver. (p. 133)*

Dale recommended that researchers should look at the effects of combinations of media in the environment where they will be used rather than the testing of a single, isolated medium in the laboratory. By conducting research in real classrooms, the varied combinations of possible factors such as attributes of audiovisual materials, how to use and administer them, learners' characteristics, and learning environments could be examined because learning occurs through dynamic interaction among the learner, the context, and the media. Although the experimental methods of educational and psychological research were focused on testing the tenets of behaviorism and pitting one media against another throughout most of his career, Dale was prescient in his recognition that the complexities of learning render most such studies fruitless.

Final Remarks

Dale was much more than a scholar isolated in the ivory towers of academe. As described by Wagner (1970), "He actively fought for better schools, academic freedom, civil rights, and other causes long before these became popular issues" (p. 94). Dale also anticipated the still-neglected importance of media education by promoting in the 1930s the then radical notion that teachers should help their students to understand the effects of media on them, their parents, and society, and to learn how to critically evaluate the contents of the radio, newspapers, and films. Dale was a socially responsible researcher, a thoughtful humanist, and dedicated educator. Any educational technologist seeking inspiration for their work in our field would find no better role model than Edgar Dale.

Application Exercises

- Think about your most memorable learning experience. How was it (or how was it not) a "rich experience" as defined by Dale?
- Dale felt that a rich experience would be "emotionally rewarding" and "motivate [learners] for learning throughout their lives." Describe an experience you have had that was emotionally rewarding and motivated you to continue learning throughout your life.
- Why does Dale suggest teachers balance their time providing concrete and abstract teaching opportunities?

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? Please complete this short survey to provide feedback on this chapter: http://bit.ly/ConeExperience

II. Learning and Instruction

Behaviorism, Cognitivism, Constructivism

Comparing Critical Features From an Instructional Design Perspective

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Behaviorism Cognitivism Constructivism

Instructional Design Learning Theory

This article compares critical features from an instructional design perspective, focusing on behaviorism, cognitivism, and constructivism. It emphasizes the importance of understanding learning theories in translating principles into optimal instructional actions. The authors argue that instructional designers must diagnose and analyze practical learning problems, as well as understand the potential sources of solutions (i.e., learning theories). They highlight the value of learning theories in providing verified instructional

strategies, tactics, and techniques, as well as a foundation for intelligent and reasoned strategy selection. The article presents three distinct perspectives on the learning process, including behavioral, cognitive, and constructivist approaches, and discusses how each theory can inform instructional design decisions.

Editor's Note

This article was originally published in 1993 and then republished in 2013 by *Performance Improvement Quarterly*. © 2013 International Society for Performance Improvement Published online in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/piq.21143. The original citation is below:

Ertmer, P. A., & Newby, T. J. (2013). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly, 26*(2), 43-71.

The need for a bridge between basic learning research and educational practice has long been discussed. To ensure a strong connection between these two areas, Dewey (cited in Reigeluth, 1983) called for the creation and development of a “linking science”; Tyler (1978) a “middleman position”; and Lynch (1945) for employing an “engineering analogy” as an aid for translating theory into practice. In each case, the respective author highlighted the information and potential contributions of available learning theories, the pressing problems faced by those dealing with practical learning issues, and a general lack of using the former to facilitate solutions for the latter. The value of such a bridging function would be its ability to translate relevant aspects of the learning theories into optimal instructional actions. As described by Reigeluth (1983, p. 5), the field of Instructional Design performs this role.

Instructional designers have been charged with “translating principles of learning and instruction into specifications for instructional materials and activities” (Smith & Ragan, 1993, p. 12). To achieve this goal, two sets of skills and knowledge are needed. First, the designer must understand the position of the practitioner. In this regard, the following questions would be relevant: What are the situational and contextual constraints of the application? What is the degree of individual differences among the learners? What form of solutions will or will not be accepted by the learners as well as by those actually teaching the materials? The designer must have the ability to diagnose and analyze practical learning problems. Just as a doctor cannot prescribe an effective remedy without a proper diagnosis, the instructional designer cannot properly recommend an effective prescriptive solution without an accurate analysis of the instructional problem.

In addition to understanding and analyzing the problem, a second core of knowledge and skills is needed to "bridge" or "link" application with research–that of understanding the potential sources of solutions (i.e., the theories of human learning). Through this understanding, a proper prescriptive solution can be matched with a given diagnosed problem. The critical link, therefore, is not between the design of instruction and an autonomous body of knowledge about instructional phenomena, but between instructional design issues and the theories of human learning.

Why this emphasis on learning theory and research? First, learning theories are a source of verified instructional strategies, tactics, and techniques. Knowledge of a variety of such strategies is critical when attempting to select an effective prescription for overcoming a given instructional problem. Second, learning theories provide the foundation for intelligent and reasoned strategy selection. Designers must have an adequate repertoire of strategies available, and possess the knowledge of when and why to employ each. This knowledge depends on the designer's ability to match the demands of the task with an instructional strategy that helps the learner. Third, integration of the selected strategy within the instructional context is of critical importance. Learning theories and research often provide information about relationships among instructional components and the design of instruction, indicating how specific techniques/strategies might best fit within a given context and with specific learners (Keller, 1979). Finally, the ultimate role of a theory is to allow for reliable prediction (Richey, 1986). Effective solutions to practical instructional problems are often constrained by limited time and resources. It is paramount that those strategies selected and implemented have the highest chance for success. As suggested by Warries (1990), a selection based on strong research is much more reliable than one based on "instructional phenomena."

The task of translating learning theory into practical applications would be greatly simplified if the learning process were relatively simple and straightforward. Unfortunately, this is not the case. Learning is a complex process that has generated numerous interpretations and theories of how it is effectively accomplished. Of these many theories, which should receive the attention of the instructional designer? Is it better to choose one theory when designing instruction or to draw ideas from different theories? This article presents three distinct perspectives of the learning process (behavioral, cognitive, and constructivist) and although each has many unique features, it is our belief that each still describes the same phenomena (learning). In selecting the theory whose associated instructional strategies offers the optimal means for achieving desired outcomes, the degree of cognitive processing required of the learner by the specific task appears to be a critical factor. Therefore, as emphasized by Snelbecker (1983), individuals addressing practical learning problems cannot afford the "luxury of restricting themselves to only one theoretical position… [They] are urged to examine each of the basic science theories which have been developed by psychologists in the study of learning and to select those principles and conceptions which seem to be of value for one's particular educational situation' (p. 8).

If knowledge of the various learning theories is so important for instructional designers, to what degree are they emphasized and promoted? As reported by Johnson (1992), less than two percent of the courses offered in university curricula in the general area of educational technology emphasize “theory” as one of their key concepts. It appears that the real benefits of theoretical knowledge are, at present, not being realized. This article is an attempt to “fill in some of the gaps” that may exist in our knowledge of modern learning theories. The main intent is to provide designers with some familiarity with three relevant positions on learning (behavioral, cognitive, and constructivist) which should provide a more structured foundation for planning and conducting instructional design activities. The idea is that if we understand some of the deep principles of the theories of learning, we can extrapolate to the particulars as needed. As Bruner (1971) states, “You don’t need to encounter everything in nature in order to know nature” (p. 18). A basic understanding of the learning theories can provide you with a “canny strategy whereby you could know a great deal about a lot of things while keeping very little in mind” (p. 18).

It is expected that after reading this article, instructional designers and educational practitioners should be better informed “consumers”of the strategies suggested by each viewpoint. The concise information presented here can serve as an initial base of knowledge for making important decisions regarding instructional objectives and strategies.

Learning Defined

Learning has been defined in numerous ways by many different theorists, researchers and educational practitioners. Although universal agreement on any single definition is nonexistent, many definitions employ common elements. The following definition by Shuell (as interpreted by Schunk, 1991) incorporates these main ideas: “Learning is an enduring change in behavior, or in the capacity to behave in a given fashion, which results from practice or other forms of experience” (p. 2).

Undoubtedly, some learning theorists will disagree on the definition of learning presented here. However, it is not the definition itself that separates a given theory from the rest. The major differences among theories lie more in interpretation than they do in definition. These differences revolve around a number of key issues that ultimately delineate the instructional prescriptions that flow from each theoretical perspective. Schunk (1991) lists five definitive questions that serve to distinguish each learning theory from the others:

1. How does learning occur?
2. Which factors influence learning?
3. What is the role of memory?
4. How does transfer occur? and
5. What types of learning are best explained by the theory?

Expanding on this original list, we have included two additional questions important to the instructional designer:

6. What basic assumptions/principles of this theory are relevant to instructional design? and

7. How should instruction be structured to facilitate learning?

In this article, each of these questions is answered from three distinct viewpoints: behaviorism, cognitivism, and constructivism. Although learning theories typically are divided into two categories–behavioral and cognitive–a third category, constructive, is added here because of its recent emphasis in the instructional design literature (e.g., Bednar, Cunningham, Duffy, & Perry, 1991; Duffy & Jonassen, 1991; Jonassen, 1991b; Winn, 1991). In many ways these viewpoints overlap; yet they are distinctive enough to be treated as separate approaches to understanding and describing learning. These three particular positions were chosen because of their importance, both historically and currently, to the field of instructional design. It is hoped that the answers to the first five questions will provide the reader with a basic understanding of how these viewpoints differ. The answers to the last two questions will translate these differences into practical suggestions and recommendations for the application of these principles in the design of instruction.

These seven questions provide the basis for the article's structure. For each of the three theoretical positions, the questions are addressed and an example is given to illustrate the application of that perspective. It is expected that this approach will enable the reader to compare and contrast the different viewpoints on each of the seven issues.

As is common in any attempt to compare and contrast similar products, processes, or ideas, differences are emphasized in order to make distinctions clear. This is not to suggest that there are no similarities among these viewpoints or that there are no overlapping features. In fact, different learning theories will often prescribe the same instructional methods for the same situations (only with different terminology and possibly with different intentions). This article outlines the major differences between the three positions in an attempt to facilitate comparison. It is our hope that the reader will gain greater insight into what each viewpoint offers in terms of the design and presentation of materials, as well as the types of learning activities that might be prescribed.

Historical Foundations

Current learning theories have roots that extend far into the past. The problems with which today's theorists and researchers grapple and struggle are not new but simply variations on a timeless theme: Where does knowledge come from and how do people come to know? Two opposing positions on the origins of knowledge-empiricism and rationalism have existed for centuries and are still evident, to varying degrees, in the learning theories of today. A brief description of these views is included here as a background for comparing the "modern" learning viewpoints of behaviorism, cognitivism, and constructivism.

Empiricism is the view that experience is the primary source of knowledge (Schunk, 1991). That is, organisms are born with basically no knowledge and anything learned is gained through interactions and associations with the environment. Beginning with Aristotle (384-322 B.C.), empiricists have espoused the view that knowledge is derived from sensory impressions. Those impressions, when associated contiguously in time and/or space, can be hooked together to form complex ideas. For example, the complex idea of a tree, as illustrated by Hulse, Egeth, and Deese (1980), can be built from the less complex ideas of branches and leaves, which in turn are built from the ideas of wood and fiber, which are built from basic sensations such as greenness, woody odor, and so forth. From this perspective, critical instructional design issues focus on how to manipulate the environment in order to improve and ensure the occurrence of proper associations.

Rationalism is the view that knowledge derives from reason without the aid of the senses (Schunk, 1991). This fundamental belief in the distinction between mind and matter originated with Plato (c. 427-347 B.C.), and is reflected in the viewpoint that humans learn by recalling or "discovering" what already exists in the mind. For example, the direct experience with a tree during one's lifetime simply serves to reveal that which is already in the mind. The "real" nature of the tree (greenness, woodiness, and other characteristics) becomes known, not through the experience, but through a reflection on one's idea about the given instance of a tree. Although later rationalists differed on some of Plato's other ideas, the central belief remained the same: that knowledge arises through the mind. From this perspective, instructional design issues focus on how best to structure new information in order to facilitate (1) the learners' encoding of this new information, as well as (2) the recalling of that which is already known.

The empiricist, or associationist, mindset provided the framework for many learning theories during the first half of this century, and it was against this background that behaviorism became the leading psychological viewpoint (Schunk, 1991). Because behaviorism was dominant when instructional theory was initiated (around 1950), the instructional design (ID) technology that arose alongside it was naturally influenced by many of its basic assumptions and characteristics. Since ID has its roots in behavioral theory, it seems appropriate that we turn our attention to behaviorism first.

Behaviorism

How Does Learning Occur?

Behaviorism equates learning with changes in either the form or frequency of observable performance. Learning is accomplished when a proper response is demonstrated following the presentation of a specific environmental stimulus. For example, when presented with a math flashcard showing the equation "2 + 4 = ?" the learner replies with the answer of "6." The equation is the stimulus and the proper answer is the associated response. The key elements are the stimulus, the response, and the association between the two. Of primary concern is how the association between the stimulus and response is made, strengthened, and maintained.

Behaviorism focuses on the importance of the consequences of those performances and contends that responses that are followed by reinforcement are more likely to recur in the future. No attempt is made to determine the structure of a student's knowledge nor to assess which mental processes it is necessary for them to use (Winn, 1990). The learner is characterized as being reactive to conditions in the environment as opposed to taking an active role in discovering the environment.

Which Factors Influence Learning?

Although both learner and environmental factors are considered important by behaviorists, environmental conditions receive the greatest emphasis. Behaviorists assess the learners to determine at what point to begin instruction as well as to determine which reinforcers are most effective for a particular student. The most critical factor, however, is the arrangement of stimuli and consequences within the environment.

What is the Role of Memory?

Memory, as commonly defined by the layman, is not typically addressed by behaviorists. Although the acquisition of “habits” is discussed, little attention is given as to how these habits are stored or recalled for future use. Forgetting is attributed to the “nonuse” of a response over time. The use of periodic practice or review serves to maintain a learner’s readiness to respond (Schunk, 1991).

How Does Transfer Occur?

Transfer refers to the application of learned knowledge in new ways or situations, as well as to how prior learning affects new learning. In behavioral learning theories, transfer is a result of generalization. Situations involving identical or similar features allow behaviors to transfer across common elements. For example, the student who has learned to recognize and classify elm trees demonstrates transfer when (s)he classifies maple trees using the same process. The similarities between the elm and maple trees allow the learner to apply the previous elm tree classification learning experience to the maple tree classification task.

What Types of Learning Are Best Explained by This Position?

Behaviorists attempt to prescribe strategies that are most useful for building and strengthening stimulus-response associations (Winn, 1990), including the use of instructional cues, practice, and reinforcement. These prescriptions have generally been proven reliable and effective in facilitating learning that involves discriminations (recalling facts), generalizations (defining and illustrating concepts), associations (applying explanations), and chaining (automatically performing a specified procedure). However, it is generally agreed that behavioral principles cannot adequately explain the acquisition of higher level skills or those that require a greater depth of processing (e.g., language development, problem solving, inference generating, critical thinking) (Schunk, 1991).

What Basic Assumptions/principles of This Theory Are Relevant to Instructional Design?

Many of the basic assumptions and characteristics of behaviorism are embedded in current instructional design practices. Behaviorism was used as the basis for designing many of the early audio-visual materials and gave rise to many related teaching strategies, such as

Skinner's teaching machines and programmed texts. More recent examples include principles utilized within computer-assisted instruction (CAI) and mastery learning.

Specific assumptions or principles that have direct relevance to instructional design include the following (possible current ID applications are listed in italics and brackets following the listed principle):

1. An emphasis on producing observable and measurable outcomes in students [behavioral objectives, task analysis, criterion-referenced assessment]
2. Pre-assessment of students to determine where instruction should begin [learner analysis]
3. Emphasis on mastering early steps before progressing to more complex levels of performance [sequencing of instructional presentation, mastery learning]
4. Use of reinforcement to impact performance [tangible rewards, informative feedback]
5. Use of cues, shaping and practice to ensure a strong stimulus-response association [simple to complex sequencing of practice, use of prompts]

How Should Instruction Be Structured?

The goal of instruction for the behaviorist is to elicit the desired response from the learner who is presented with a target stimulus. To accomplish this, the learner must know how to execute the proper response, as well as the conditions under which that response should be made. Therefore, instruction is structured around the presentation of the target stimulus and the provision of opportunities for the learner to practice making the proper response. To facilitate the linking of stimulus-response pairs, instruction frequently uses cues (to initially prompt the delivery of the response) and reinforcement (to strengthen correct responding in the presence of the target stimulus).

Behavioral theories imply that the job of the teacher/designer is to (1) determine which cues can elicit the desired responses; (2) arrange practice situations in which prompts are paired with the target stimuli that initially have no eliciting power but which will be expected to elicit the responses in the "natural" (performance) setting; and (3) arrange environmental conditions so that students can make the correct responses in the presence of those target stimuli and receive reinforcement for those responses (Gropper, 1987).

For example, a newly-hired manager of human resources may be expected to organize a meeting agenda according to the company's specific format. The target stimulus (the verbal command "to format a meeting agenda") does not initially elicit the correct response nor does the new manager have the capability to make the correct response. However, with the repeated presentation of cues (e.g., completed templates of past agendas, blank templates arranged in standard format) paired with the verbal command stimulus, the manager begins to make the appropriate responses. Although the initial responses may not be in the final proper form, repeated practice and reinforcement shape the response until it is correctly executed. Finally, learning is demonstrated when, upon the command to format a meeting agenda, the manager reliably organizes the agenda according to company standards and does so without the use of previous examples or models.

Cognitivism

In the late 1950's, learning theory began to make a shift away from the use of behavioral models to an approach that relied on learning theories and models from the cognitive sciences. Psychologists and educators began to de-emphasize a concern with overt, observable behavior and stressed instead more complex cognitive processes such as thinking, problem solving, language, concept formation and information processing (Snelbecker, 1983). Within the past decade, a number of authors in the field of instructional design have openly and consciously rejected many of ID's traditional behavioristic assumptions in favor of a new set of psychological assumptions about learning drawn from the cognitive sciences. Whether viewed as an open revolution or simply a gradual evolutionary process, there seems to be the general acknowledgment that cognitive theory has moved to the forefront of current learning theories (Bednar et al., 1991). This shift from a behavioral orientation (where the emphasis is on promoting a student's overt performance by the manipulation of stimulus material) to a cognitive orientation (where the emphasis is on promoting mental processing) has created a similar shift from procedures for manipulating the materials to be presented by an instructional system to procedures for directing student processing and interaction with the instructional design system (Merrill, Kowalis, & Wilson, 1981).

How Does Learning Occur?

Cognitive theories stress the acquisition of knowledge and internal mental structures and, as such, are closer to the rationalist end of the epistemology continuum (Bower & Hilgard, 1981). Learning is equated with discrete changes between states of knowledge rather than with changes in the probability of response. Cognitive theories focus on the conceptualization of students' learning processes and address the issues of how information is received, organized, stored, and retrieved by the mind. Learning is concerned not so much with what learners do but with what they know and how they come to acquire it (Jonassen, 1991b). Knowledge acquisition is described as a mental activity that entails internal coding and structuring by the learner. The learner is viewed as a very active participant in the learning process.

Which Factors Influence Learning?

Cognitivism, like behaviorism, emphasizes the role that environmental conditions play in facilitating learning. Instructional explanations, demonstrations, illustrative examples and matched non-examples are all considered to be instrumental in guiding student learning. Similarly, emphasis is placed on the role of practice with corrective feedback. Up to this point, little difference can be detected between these two theories. However, the "active" nature of the learner is perceived quite differently. The cognitive approach focuses on the mental activities of the learner that lead up to a response and acknowledges the processes of mental planning, goal-setting, and organizational strategies (Shuell, 1986). Cognitive theories contend that environmental "cues" and instructional components alone cannot account for all the learning that results from an instructional situation. Additional key elements include the way that learners attend to, code, transform, rehearse, store and retrieve information. Learners' thoughts, beliefs, attitudes, and values are also considered to be influential in the learning process (Winne, 1985). The real focus of the cognitive approach is on changing the learner by encouraging him/her to use appropriate learning strategies.

What is the Role of Memory?

As indicated above, memory is given a prominent role in the learning process. Learning results when information is stored in memory in an organized, meaningful manner. Teachers/designers are responsible for assisting learners in organizing that information in some optimal way. Designers use techniques such as advance organizers, analogies, hierarchical relationships, and matrices to help learners relate new information to prior knowledge. Forgetting is the inability to retrieve information from memory because of interference, memory loss, or missing or inadequate cues needed to access information.

How Does Transfer Occur?

According to cognitive theories, transfer is a function of how information is stored in memory (Schunk, 1991). When a learner understands how to apply knowledge in different contexts, then transfer has occurred. Understanding is seen as being composed of a knowledge base in the form of rules, concepts, and discriminations (Duffy & Jonassen, 1991). Prior knowledge is used to establish boundary constraints for identifying the similarities and differences of novel information. Not only must the knowledge itself be stored in memory but the uses of that knowledge as well. Specific instructional or real-world events will trigger particular responses, but the learner must believe that the knowledge is useful in a given situation before he will activate it.

What Types of Learning Are Best Explained by This Position?

Because of the emphasis on mental structures, cognitive theories are usually considered more appropriate for explaining complex forms of learning (reasoning, problem-solving, information-processing) than are those of a more behavioral perspective (Schunk, 1991). However, it is important to indicate at this point that the actual goal of instruction for both of these viewpoints is often the same: to communicate or transfer knowledge to the students in the most efficient, effective manner possible (Bednar et al., 1991). Two techniques used by both camps in achieving this effectiveness and efficiency of knowledge transfer are simplification and standardization. That is, knowledge can be analyzed, decomposed, and simplified into basic building blocks. Knowledge transfer is expedited if irrelevant information is eliminated. For example, trainees attending a workshop on effective management skills would be presented with information that is “sized” and “chunked” in such a way that they can assimilate and/or accommodate the new information as quickly and as easily as possible. Behaviorists would focus on the design of the environment to optimize that transfer, while cognitivists would stress efficient processing strategies.

What Basic Assumptions/principles of This Theory Are Relevant to Instructional

Design?

Many of the instructional strategies advocated and utilized by cognitivists are also emphasized by behaviorists, yet usually for different reasons. An obvious commonality is the use of feedback. A behaviorist uses feedback (reinforcement) to modify behavior in the desired direction, while cognitivists make use of feedback (knowledge of results) to guide and support accurate mental connections (Thompson, Simonson, & Hargrave, 1992).

Learner and task analyses are also critical to both cognitivists and behaviorists, but once again, for different reasons. Cognitivists look at the learner to determine his/her predisposition to learning (i.e., How does the learner activate, maintain, and direct his/her learning?) (Thompson et al., 1992). Additionally, cognitivists examine the learner to determine how to design instruction so that it can be readily assimilated (i.e., What are the learner's existing mental structures?). In contrast, the behaviorists look at learners to determine where the lesson should begin (i.e., At what level are they currently performing successfully?) and which reinforcers should be most effective (i.e., What consequences are most desired by the learner?).

Specific assumptions or principles that have direct relevance to instructional design include the following (possible current ID applications are listed in italics and brackets following the listed principle):

1. Emphasis on the active involvement of the learner in the learning process [learner control, metacognitive training (e.g., self-planning, monitoring, and revising techniques)]
2. Use of hierarchical analyses to identify and illustrate prerequisite relationships [cognitive task analysis procedures]
3. Emphasis on structuring, organizing, and sequencing information to facilitate optimal processing [use of cognitive strategies such as outlining, summaries, synthesizers, advance organizers, etc.]
4. Creation of learning environments that allow and encourage students to make connections with previously learned material [recall of prerequisite skills; use of relevant examples, analogies]

How Should Instruction Be Structured?

Behavioral theories imply that teachers ought to arrange environmental conditions so that students respond properly to presented stimuli. Cognitive theories emphasize making knowledge meaningful and helping learners organize and relate new information to existing knowledge in memory. Instruction must be based on a student's existing mental structures, or schema, to be effective. It should organize information in such a manner that learners are able to connect new information with existing knowledge in some meaningful way. Analogies and metaphors are examples of this type of cognitive strategy. For example, instructional design textbooks frequently draw an analogy between the familiar architect's profession and the unfamiliar instructional design profession to help the novice learner conceptualize, organize and retain the major duties and functions of an instructional designer (e.g. Reigeluth, 1983, p. 7). Other cognitive strategies may include the use of framing, outlining, mnemonics, concept mapping, advance organizers and so forth (West, Farmer, & Wolff, 1991).

Such cognitive emphases imply that major tasks of the teacher/designer include (1) understanding that individuals bring various learning experiences to the learning situation which can impact learning outcomes; (2) determining the most effective manner in which to organize and structure new information to tap the learners' previously acquired knowledge, abilities, and experiences; and (3) arranging practice with feedback so that the new information is effectively and efficiently assimilated and/or accommodated within the learner's cognitive structure (Stepich & Newby, 1988).

Consider the following example of a learning situation utilizing a cognitive approach: A manager in the training department of a large corporation had been asked to teach a new intern to complete a cost-benefit analysis for an upcoming development project. In this case, it is assumed that the intern has no previous experience with cost-benefit analysis in a business setting. However, by relating this new task to highly similar procedures with which the intern has had more experience, the manager can facilitate a smooth and efficient assimilation of this new procedure into memory. These familiar procedures may include the process by which the individual allocates his monthly paycheck, how (s)he makes a buy/no-buy decision regarding the purchase of a luxury item, or even how one's weekend spending activities might be determined and prioritized. The procedures for such activities may not exactly match those of the cost-benefit analysis, but the similarity between the activities allows for the unfamiliar information to be put within a familiar context. Thus processing requirements are reduced and the potential effectiveness of recall cues is increased.

Constructivism

The philosophical assumptions underlying both the behavioral and cognitive theories are primarily objectivistic; that is: the world is real, external to the learner. The goal of instruction is to map the structure of the world onto the learner (Jonassen, 1991b). A number of contemporary cognitive theorists have begun to question this basic objectivistic assumption and are starting to adopt a more constructivist approach to learning and understanding: knowledge "is a function of how the individual creates meaning from his or her own experiences" (p.10). Constructivism is not a totally new approach to learning. Like most other learning theories, constructivism has multiple roots in the philosophical and psychological viewpoints of this century, specifically in the works of Piaget, Bruner, and Goodman (Perkins, 1991). In recent years, however, constructivism has become a "hot" issue as it has begun to receive increased attention in a number of different disciplines, including instructional design (Bednar et al., 1991).

How Does Learning Occur?

Constructivism is a theory that equates learning with creating meaning from experience (Bednar et al., 1991). Even though constructivism is considered to be a branch of cognitivism (both conceive of learning as a mental activity), it distinguishes itself from traditional cognitive theories in a number of ways. Most cognitive psychologists think of the mind as a reference tool to the real world; constructivists believe that the mind filters input from the world to produce its own unique reality (Jonassen, 1991a). Like with the rationalists of Plato's time, the mind is believed to be the source of all meaning, yet like the empiricists, individual, direct experiences with the environment are considered critical. Constructivism crosses both categories by emphasizing the interaction between these two variables.

Constructivists do not share with cognitivists and behaviorists the belief that knowledge is mind-independent and can be "mapped" onto a learner. Constructivists do not deny the existence of the real world but contend that what we know of the world stems from our own interpretations of our experiences. Humans create meaning as opposed to acquiring it. Since there are many possible meanings to glean from any experience, we cannot achieve a predetermined, "correct" meaning. Learners do not transfer knowledge from the external world into their memories; rather they build personal interpretations of the world based on individual experiences and interactions. Thus, the internal representation of knowledge is constantly open to change; there is not an objective reality that learners strive to know. Knowledge emerges in contexts within which it is relevant. Therefore, in order to understand the learning which has taken place within an individual, the actual experience must be examined (Bednar et al., 1991).

Which Factors Influence Learning?

Both learner and environmental factors are critical to the constructivist, as it is the specific interaction between these two variables that creates knowledge. Constructivists argue that behavior is situationally determined (Jonassen, 1991a). Just as the learning of new vocabulary words is enhanced by exposure and subsequent interaction with those words in context (as opposed to learning their meanings from a dictionary), likewise it is essential that content knowledge be embedded in the situation in which it is used. Brown, Collins, and Duguid (1989) suggest that situations actually co-produce knowledge (along with cognition) through activity. Every action is viewed as "an interpretation of the current situation based on an entire history of previous interactions" (Clancey, 1986). Just as shades of meanings of given words are constantly changing a learner's "current" understanding of a word, so too will concepts continually evolve with each new use. For this reason, it is critical that learning occur in realistic settings and that the selected learning tasks be relevant to the students' lived experience.

What is the Role of Memory?

The goal of instruction is not to ensure that individuals know particular facts but rather that they elaborate on and interpret information. "Understanding is developed through continued, situated use … and does not crystallize into a categorical definition" that can be called up from memory (Brown et al., 1989, p. 33). As mentioned earlier, a concept will continue to evolve with each new use as new situations, negotiations, and activities recast it in a different, more densely textured form. Therefore, "memory" is always under construction as a cumulative history of interactions. Representations of experiences are not formalized or structured into a single piece of declarative knowledge and then stored in the head. The emphasis is not on retrieving intact knowledge structures, but on providing learners with the means to create novel and situation-specific understandings by "assembling" prior knowledge from diverse sources appropriate to the problem at hand. For example, the knowledge of "design" activities has to be used by a practitioner in too many different ways for them all to be anticipated in advance. Constructivists emphasize the flexible use of pre-existing knowledge rather than the recall of prepackaged schemas (Spiro, Feltovich, Jacobson, & Coulson, 1991). Mental representations developed through task-engagement are likely to increase the efficiency with which subsequent tasks are performed to the extent that parts of the environment remain the same: “Recurring features of the environment may thus afford recurring sequences of actions” (Brown et al., p. 37). Memory is not a context-independent process.

Clearly the focus of constructivism is on creating cognitive tools which reflect the wisdom of the culture in which they are used as well as the insights and experiences of individuals. There is no need for the mere acquisition of fixed, abstract, self-contained concepts or details. To be successful, meaningful, and lasting, learning must include all three of these crucial factors: activity (practice), concept (knowledge), and culture (context) (Brown et al., 1989).

How Does Transfer Occur?

The constructivist position assumes that transfer can be facilitated by involvement in authentic tasks anchored in meaningful contexts. Since understanding is “indexed” by experience (just as word meanings are tied to specific instances of use), the authenticity of the experience becomes critical to the individual’s ability to use ideas (Brown et al., 1989). An essential concept in the constructivist view is that learning always takes place in a context and that the context forms an inexorable link with the knowledge embedded in it (Bednar et al., 1991). Therefore, the goal of instruction is to accurately portray tasks, not to define the structure of learning required to achieve a task. If learning is decontextualized, there is little hope for transfer to occur. One does not learn to use a set of tools simply by following a list of rules. Appropriate and effective use comes from engaging the learner in the actual use of the tools in real-world situations. Thus, the ultimate measure of learning is based on how effective the learner’s knowledge structure is in facilitating thinking and performing in the system in which those tools are used.

What Types of Learning Are Best Explained by This Position?

The constructivist view does not accept the assumption that types of learning can be identified independent of the content and the context of learning (Bednar et al., 1991). Constructivists believe that it is impossible to isolate units of information or divide up knowledge domains according to a hierarchical analysis of relationships. Although the emphasis on performance and instruction has proven effective in teaching basic skills in relatively structured knowledge domains, much of what needs to be learned involves advanced knowledge in ill-structured domains. Jonassen (1991a) has described three stages of knowledge acquisition (introductory, advanced, and expert) and argues that constructive learning environments are most effective for the stage of advanced knowledge acquisition, where initial misconceptions and biases acquired during the introductory stage can be discovered, negotiated, and if necessary, modified and/or removed. Jonassen agrees that introductory knowledge acquisition is better supported by more objectivistic approaches (behavioral and/or cognitive) but suggests a transition to constructivistic approaches as learners acquire more knowledge which provides them with the conceptual power needed to deal with complex and ill-structured problems.

What Basic Assumptions/principles of This Theory Are Relevant to Instructional Design?

The constructivist designer specifies instructional methods and strategies that will assist learners in actively exploring complex topics/environments and that will move them into thinking in a given content area as an expert user of that domain might think. Knowledge is not abstract but is linked to the context under study and to the experiences that the participants bring to the context. As such, learners are encouraged to construct their own understandings and then to validate, through social negotiation, these new perspectives. Content is not prespecified; information from many sources is essential. For example, a typical constructivist's goal would not be to teach novice ID students straight facts about instructional design, but to prepare students to use ID facts as an instructional designer might use them. As such, performance objectives are not related so much to the content as they are to the processes of construction.

Some of the specific strategies utilized by constructivists include situating tasks in real-world contexts, use of cognitive apprenticeships (modeling and coaching a student toward expert performance), presentation of multiple perspectives (collaborative learning to develop and share alternative views), social negotiation (debate, discussion, evidencegiving), use of examples as real "slices of life," reflective awareness, and providing considerable guidance on the use of constructive processes.

The following are several specific assumptions or principles from the constructivist position that have direct relevance for the instructional designer (possible ID applications are listed in italics and brackets following the listed principle):

1. An emphasis on the identification of the context in which the skills will be learned and subsequently applied [anchoring learning in meaningful contexts].
2. An emphasis on learner control and the capability of the learner to manipulate information [actively using what is learned].
3. The need for information to be presented in a variety of different ways [revisiting content at different times, in rearranged contexts, for different purposes, and from different conceptual perspectives].
4. Supporting the use of problem-solving skills that allow learners to go "beyond the information given." [developing pattern-recognition skills, presenting alternative ways of representing problems].
5. Assessment focused on transfer of knowledge and skills [presenting new problems and situations that differ from the conditions of the initial instruction].

How Should Instruction Be Structured?

As one moves along the behaviorist-cognitivist-constructivist continuum, the focus of instruction shifts from teaching to learning, from the passive transfer of facts and routines to the active application of ideas to problems. Both cognitivists and constructivists view the learner as being actively involved in the learning process, yet the constructivists look at the learner as more than just an active processor of information; the learner elaborates upon and interprets the given information (Duffy & Jonassen, 1991). Meaning is created by the learner: learning objectives are not pre-specified nor is instruction predesigned. “The role of instruction in the constructivist view is to show students how to construct knowledge, to promote collaboration with others to show the multiple perspectives that can be brought to bear on a particular problem, and to arrive at self-chosen positions to which they can commit themselves, while realizing the basis of other views with which they may disagree” (Cunningham, 1991, p. 14).

Even though the emphasis is on learner construction, the instructional designer/ teacher’s role is still critical (Reigeluth, 1989). Here the tasks of the designer are two-fold: (1) to instruct the student on how to construct meaning, as well as how to effectively monitor, evaluate, and update those constructions; and (2) to align and design experiences for the learner so that authentic, relevant contexts can be experienced.

Although constructivist approaches are used quite frequently in the preparation of lawyers, doctors, architects, and businessmen through the use of apprenticeships and on-the-job training, they are typically not applied in the educational arena (Resnick, 1987). If they were, however, a student placed in the hands of a constructivist would likely be immersed in an “apprenticeship” experience. For example, a novice instructional design student who desires to learn about needs assessment would be placed in a situation that requires such an assessment to be completed. Through the modeling and coaching of experts involved in authentic cases, the novice designer would experience the process embedded in the true context of an actual problem situation. Over time, several additional situations would be experienced by the student, all requiring similar needs assessment abilities. Each experience would serve to build on and adapt that which has been previously experienced and constructed. As the student gained more confidence and experience, (s)he would move into a collaborative phase of learning where discussion becomes crucial. By talking with others (peers, advanced students, professors, and designers), students become better able to articulate their own understandings of the needs assessment process. As they uncover their naive theories, they begin to see such activities in a new light, which guides them towards conceptual reframing (learning). Students gain familiarity with analysis and action in complex situations and consequently begin to expand their horizons: they encounter relevant books, attend conferences and seminars, discuss issues with other students, and use their knowledge to interpret numerous situations around them (not only related to specific design issues). Not only have the learners been involved in different types of learning as they moved from being novices to “budding experts,” but the nature of the learning process has changed as well.

General Discussion

It is apparent that students exposed to the three instructional approaches described in the examples above would gain different competencies. This leads instructors/designers to ask two significant questions: Is there a single “best” approach and is one approach more efficient than the others? Given that learning is a complex, drawn-out process that seems to be strongly influenced by one's prior knowledge, perhaps the best answer to these questions is "it depends." Because learning is influenced by many factors from many sources, the learning process itself is constantly changing, both in nature and diversity, as it progresses (Shuell, 1990). What might be most effective for novice learners encountering a complex body of knowledge for the first time, would not be effective, efficient or stimulating for a learner who is more familiar with the content. Typically, one does not teach facts the same way that concepts or problem-solving are taught; likewise, one teaches differently depending on the proficiency level of the learners involved. Both the instructional strategies employed and the content addressed (in both depth and breadth) would vary based on the level of the learners.

So how does a designer facilitate a proper match between learner, content, and strategies? Consider, first of all, how learners' knowledge changes as they become more familiar with a given content. As people acquire more experience with a given content, they progress along a low-to-high knowledge continuum from 1) being able to recognize and apply the standard rules, facts, and operations of a profession (knowing what), to 2) thinking like a professional to extrapolate from these general rules to particular, problematic cases (knowing how), to 3) developing and testing new forms of understanding and actions when familiar categories and ways of thinking fail (reflection-in-action) (Schon, 1987). In a sense, the points along this continuum mirror the points of the learning theory continuum described earlier. Depending on where the learners "sit" on the continuum in terms of the development of their professional knowledge (knowing what vs. knowing how vs. reflection-in-action), the most appropriate instructional approach for advancing the learners' knowledge at that particular level would be the one advocated by the theory that corresponds to that point on the continuum. That is, a behavioral approach can effectively facilitate mastery of the content of a profession (knowing what); cognitive strategies are useful in teaching problem-solving tactics where defined facts and rules are applied in unfamiliar situations (knowing how); and constructivist strategies are especially suited to dealing with ill-defined problems through reflection-in-action.

A second consideration depends upon the requirements of the task to be learned. Based on the level of cognitive processing required, strategies from different theoretical perspectives may be needed. For example, tasks requiring a low degree of processing (e.g., basic paired associations, discriminations, rote memorization) seem to be facilitated by strategies most frequently associated with a behavioral outlook (e.g., stimulus-response, contiguity of feedback/reinforcement). Tasks requiring an increased level of processing (e.g., classifications, rule or procedural executions) are primarily associated with strategies having a stronger cognitive emphasis (e.g., schematic organization, analogical reasoning, algorithmic problem solving). Tasks demanding high levels of processing (e.g., heuristic problem solving, personal selection and monitoring of cognitive strategies) are frequently best learned with strategies advanced by the constructivist perspective (e.g., situated learning, cognitive apprenticeships, social negotiation).

We believe that the critical question instructional designers must ask is not "Which is the best theory?" but "Which theory is the most effective in fostering mastery of specific tasks by specific learners?" Prior to strategy(ies) selection, consideration must be made of both the learners and the task. An attempt is made in Figure 1 to depict these two continua (learners' level of knowledge and cognitive processing demands) and to illustrate the degree to which strategies offered by each of the theoretical perspectives appear applicable. The figure is useful in demonstrating: (a) that the strategies promoted by the different perspectives overlap in certain instances (i.e., one strategy may be relevant for each of the different perspectives, given the proper amount of prior knowledge and the corresponding amount of cognitive processing), and (b) that strategies are concentrated along different points of the continua due to the unique focus of each of the learning theories. This means that when integrating any strategies into the instructional design process, the nature of the learning task (i.e., the level of cognitive processing required) and the proficiency level of the learners involved must both be considered before selecting one approach over another. Depending on the demands of the task and where the learners are in terms of the content to be delivered/discovered, different strategies based on different theories appear to be necessary. Powerful frameworks for instruction have been developed by designers inspired by each of these perspectives. In fact, successful instructional practices have features that are supported by virtually all three perspectives (e.g., active participation and interaction, practice and feedback).

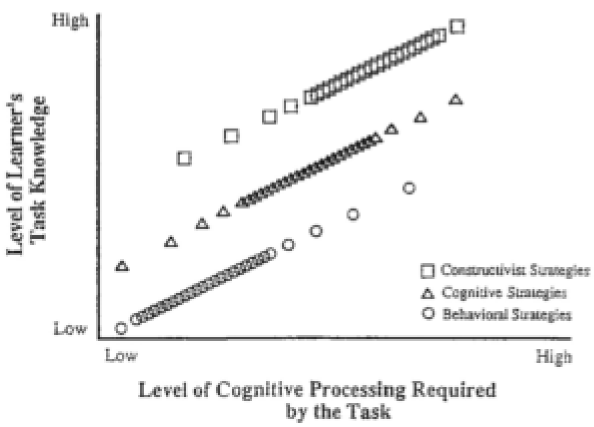

Figure 1. *Comparison of the associated instructional strategies of the behavioral, cognitive, and constructivist viewpoints based on the learner's level of task knowledge and the level of cognitive processing required by the task.*

For this reason, we have consciously chosen not to advocate one theory over the others, but to stress instead the usefulness of being well versed in each. This is not to suggest that one should work without a theory, but rather that one must be able to intelligently choose, on the basis of information gathered about the learners' present level of competence and the type of learning task, the appropriate methods for achieving optimal instructional outcomes in that situation.

As stated by Smith and Ragan (1993, p. viii): "Reasoned and validated theoretical eclecticism has been a key strength of our field because no single theoretical base provides complete prescriptive principles for the entire design process." Some of the most crucial design tasks involve being able to decide which strategy to use, for what content, for which students, and at what point during the instruction. Knowledge of this sort is an example of conditional knowledge, where "thinking like" a designer becomes a necessary competency. It should be noted however, that to be an eclectic, one must know a lot, not a little, about the theories being combined. A thorough understanding of the learning theories presented above seems to be essential for professional designers who must constantly make decisions for which no design model provides precise rules. Being knowledgeable about each of these theories provides designers with the flexibility needed to be spontaneous and creative when a first attempt doesn't work or when they find themselves limited by time, budget, and/or personnel constraints. The practitioner cannot afford to ignore any theories that might provide practical implications. Given the myriad of potential design situations, the designer's "best" approach may not ever be identical to any previous approach, but will truly "depend upon the context." This type of instructional "cherry-picking" has been termed "systematic eclecticism" and has had a great deal of support in the instructional design literature (Snelbecker, 1989).

In closing, we would like to expand on a quote by P. B. Drucker, (cited in Snelbecker, 1983): "These old controversies have been phonies all along. We need the behaviorist's triad of practice/reinforcement/feedback to enlarge learning and memory. We need purpose, decision, values, understanding–the cognitive categories–lest learning be mere behavioral activities rather than action" (p. 203).

And to this we would add that we also need adaptive learners who are able to function well when optimal conditions do not exist, when situations are unpredictable and task demands change, when the problems are messy and ill-formed and the solutions depend on inventiveness, improvisation, discussion, and social negotiation.

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Additional Reading

An update was published in *Performance Improvement Quarterly* in 2013 by the authors to accompany the 30 year anniversary and republication of the original article. This update adds a strong second part to this article, and you are encouraged to read it here.

Ertmer, P. A., & Newby, T. J. (2013). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly*, *26*(2), 43–71.

Application Exercises

- How would the instruction be designed differently by a behaviorist, a cognitivist, and a constructivist? Scenario: A high school social study teacher is planning a class on the Vietnam War.
- Describe an example from your life of when you were taught using each method described in this article: behaviorism, cognitivism, and constructivism.
- Based on your reading, would you consider your current instruction style more behavioralist, cognitivist, or constructivist? Elaborate with your specific mindset and examples.

This content was previously published as follows:

Ertmer, P. A. & Newby, T. (2018). Behaviorism, Cognitivism, Constructivism: Comparing Critical Features From an Instructional Design Perspective. In R. E. West (Ed.), *Foundations of Learning and*

Instructional Design Technology. EdTech Books. https://edtechbooks.org/-pGtE

Memory

Spielman, R. , Jenkins, W. , & Lovett, M.

This chapter describes the basic functions of memory and three stages of memory storage. It provides an overview of procedural and declarative memory and semantic and episodic memory, and provides implications for designers.

Editor's Notes

The following is excerpted from an OpenStax book produced by Rice University. It can be downloaded for free at https://openstax.org/details/books/psychology-2e

Spielman, R. M., Jenkins, W. J., & Lovett, M. D. (2020). How memory functions. In *Psychology 2e*. Retrieved from https://openstax.org/details/books/psychology-2e

How Memory Functions

Learning Objectives

By the end of this section, you will be able to:

- Discuss the three basic functions of memory
- Describe the three stages of memory storage
- Describe and distinguish between procedural and declarative memory and semantic and episodic memory

Memory is an information processing system; therefore, we often compare it to a computer. Memory is the set of processes used to encode, store, and retrieve information over different periods of time (Figure 1).

Figure 1. Encoding involves the input of information into the memory system. Storage is the retention of the encoded information. Retrieval, or getting the information out of memory and back into awareness, is the third function. Image available in original Openstax chapter.

Encoding

We get information into our brains through a process called **encoding**, which is the input of information into the memory system. Once we receive sensory information from the environment, our brains label or code it. We organize the information with other similar information and connect new concepts to existing concepts. Encoding information occurs through automatic processing and effortful processing.

If someone asks you what you ate for lunch today, more than likely you could recall this information quite easily. This is known as **automatic processing**, or the encoding of details like time, space, frequency, and the meaning of words. Automatic processing is usually done without any conscious awareness. Recalling the last time you studied for a test is another example of automatic processing. But what about the actual test material you studied? It probably required a lot of work and attention on your part in order to encode that information. This is known as **effortful processing** (Figure 2).

Figure 2. When you first learn new skills such as driving a car, you have to put forth effort and attention to encode information about how to start a car, how to brake, how to handle a turn, and so on. Once you know how to drive, you can encode additional information about this skill automatically. (credit: Robert Couse-Baker)

What are the most effective ways to ensure that important memories are well encoded? Even a simple sentence is easier to recall when it is meaningful (Anderson, 1984). Read the following sentences (Bransford & McCarrell, 1974), then look away and count backwards from 30 by threes to zero, and then try to write down the sentences (no peeking back at this page!).

1. The notes were sour because the seams split.
2. The voyage wasn't delayed because the bottle shattered.
3. The haystack was important because the cloth ripped.

How well did you do? By themselves, the statements that you wrote down were most likely confusing and difficult for you to recall. Now, try writing them again, using the following prompts: bagpipe, ship christening, and parachutist. Next count backwards from 40 by fours, then check yourself to see how well you recalled the sentences this time. You can see that the sentences are now much more memorable because each of the sentences was placed in context. Material is far better encoded when you make it meaningful.

There are three types of encoding. The encoding of words and their meaning is known as **semantic encoding**. It was first demonstrated by William Bousfield (1935) in an experiment in which he asked people to memorize words. The 60 words were actually divided into 4 categories of meaning, although the participants did not know this because the words were randomly presented. When they were asked to remember the words, they tended to recall them in categories, showing that they paid attention to the meanings of the words as they learned them.

Visual encoding is the encoding of images, and **acoustic encoding** is the encoding of sounds, words in particular. To see how visual encoding works, read over this list of words: *car, level, dog, truth, book, value*. If you were asked later to recall the words from this list, which ones do you think you'd most likely remember? You would probably have an easier time recalling the words *car, dog, and book*, and a more difficult time recalling the words *level, truth, and value*. Why is this? Because you can recall images (mental pictures) more easily than words alone. When you read the words car, dog, and book you created images of these things in your mind. These are concrete, high-imagery words. On the other hand, abstract words like level, truth, and value are low-imagery words. High-imagery words are encoded both visually and semantically (Paivio, 1986), thus building a stronger memory.

Now let's turn our attention to acoustic encoding. You are driving in your car and a song comes on the radio that you haven't heard in at least 10 years, but you sing along, recalling every word. In the United States, children often learn the alphabet through song, and they learn the number of days in each month through rhyme: "Thirty days hath September, / April, June, and November; / All the rest have thirty-one, / Save February, with twenty-eight days clear, / And twenty-nine each leap year." These lessons are easy to remember because of acoustic encoding. We encode the sounds the words make. This is one of the reasons why much of what we teach young children is done through song, rhyme, and rhythm.

Which of the three types of encoding do you think would give you the best memory of verbal information? Some years ago, psychologists Fergus Craik and Endel Tulving (1975) conducted a series of experiments to find out. Participants were given words along with questions about them. The questions required the participants to process the words at one of the three levels. The visual processing questions included such things as asking the participants about the font of the letters. The acoustic processing questions asked the participants about the sound or rhyming of the words, and the semantic processing questions asked the participants about the meaning of the words. After participants were presented with the words and questions, they were given an unexpected recall or recognition task.

Words that had been encoded semantically were better remembered than those encoded visually or acoustically. Semantic encoding involves a deeper level of processing than the shallower visual or acoustic encoding. Craik and Tulving concluded that we process verbal information best through semantic encoding, especially if we apply what is called the self-reference effect. The **self-reference effect** is the tendency for an individual to have better memory for information that relates to oneself in comparison to material that has less personal relevance (Rogers, Kuiper, & Kirker, 1977). Could semantic encoding be beneficial to you as you attempt to memorize the concepts in this chapter?

Storage

Once the information has been encoded, we have to somehow retain it. Our brains take the encoded information and place it in storage. **Storage** is the creation of a permanent record of information.

In order for a memory to go into storage (i.e., long-term memory), it has to pass through three distinct stages: Sensory Memory, Short-Term Memory, and finally Long-Term Memory. These stages were first proposed by Richard Atkinson and Richard Shiffrin (1968). Their model of human memory (Figure 3), called Atkinson and Shiffrin's model, is based on the belief that we process memories in the same way that a computer processes information.

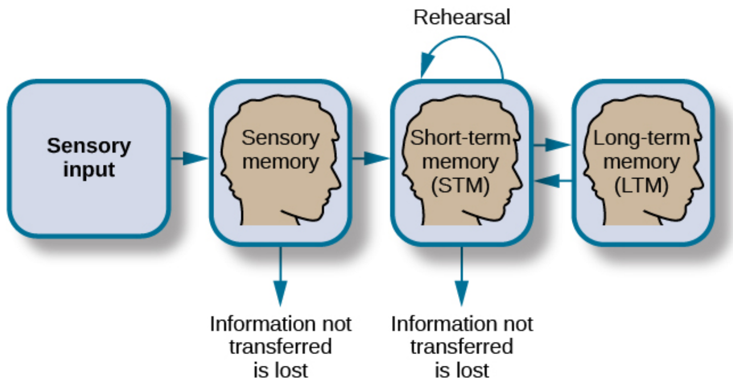

Figure 3. According to the Atkinson-Shiffrin model of memory, information passes through three distinct stages in order for it to be stored in long-term memory. Image available in original Openstax chapter.

Atkinson and Shiffrin's model is not the only model of memory. Baddeley and Hitch (1974) proposed a working memory model in which short-term memory has different forms. In their model, storing memories in short- term memory is like opening different files on a computer and adding information. The working memory files hold a limited amount of information. The type of short-term memory (or computer file) depends on the type of information received. There are memories in visual-spatial form, as well as memories of spoken or written material, and they are stored in three short-term systems: a visuospatial sketchpad, an episodic buffer (Baddeley, 2000), and a phonological loop. According to Baddeley and Hitch, a central executive part of memory supervises or controls the flow of information to and from the three short-term systems, and the central executive is responsible for moving information into long-term memory.

Sensory Memory

In the Atkinson-Shiffrin model, stimuli from the environment are processed first in **sensory memory**: storage of brief sensory events, such as sights, sounds, and tastes. It is very brief storage—up to a couple of seconds. We are constantly bombarded with sensory information. We cannot absorb all of it, or even most of it. And most of it has no impact on our lives. For example, what was your professor wearing the last class period? As long as the professor was dressed appropriately, it does not really matter what she was wearing. Sensory information about sights, sounds, smells, and even textures, which we do not view as valuable information, we discard. If we view something as valuable, the information will move into our short-term memory system.

Short-Term Memory

Short-term memory (STM) is a temporary storage system that processes incoming sensory memory. The terms short-term and working memory are sometimes used interchangeably, but they are not exactly the same. Short-term memory is more accurately described as a component of working memory. Short-term memory takes information from sensory memory and sometimes connects that memory to something already in long-term memory. Short-term memory storage lasts 15 to 30 seconds. Think of it as the information you have displayed on your computer screen, such as a document, spreadsheet, or website. Then, information in STM goes to long-term memory (you save it to your hard drive), or it is discarded (you delete a document or close a web browser).

Rehearsal moves information from short-term memory to long-term memory. Active rehearsal is a way of attending to information to move it from short-term to long-term memory. During active rehearsal, you repeat (practice) the information to be remembered. If you repeat it enough, it may be moved into long-term memory. For example, this type of active rehearsal is the way many children learn their ABCs by singing the alphabet song. Alternatively, elaborative rehearsal is the act of linking new information you are trying to learn to existing information that you already know. For example, if you meet someone at a party and your phone is dead but you want to remember his phone number, which starts with area code 203, you might remember that your uncle Abdul lives in Connecticut and has a 203 area code. This way, when you try to remember the phone number of your new prospective friend, you will easily remember the area code. Craik and Lockhart (1972) proposed the levels of processing hypothesis that states the deeper you think about something, the better you remember it.

You may find yourself asking, “How much information can our memory handle at once?” To explore the capacity and duration of your short-term memory, have a partner read the strings of random numbers (Figure 4) out loud to you, beginning each string by saying, “Ready?” and ending each by saying, “Recall,” at which point you should try to write down the string of numbers from memory.

9754	68259	913825	5316842	86951372	719384273
6419	67148	648327	5963827	51739826	163875942

Figure 4. Work through this series of numbers using the recall exercise explained above to determine the longest string of digits that you can store. Image available in original Openstax chapter.

Note the longest string at which you got the series correct. For most people, the capacity will probably be close to 7 plus or minus 2. In 1956, George Miller reviewed most of the research on the capacity of short-term memory and found that people can retain between 5 and 9 items, so he reported the capacity of short-term memory was the "magic number" 7 plus or minus 2. However, more contemporary research has found working memory capacity is 4 plus or minus 1 (Cowan, 2010). Generally, recall is somewhat better for random numbers than for random letters (Jacobs, 1887) and also often slightly better for information we hear (acoustic encoding) rather than information we see (visual encoding) (Anderson, 1969).

Memory trace decay and interference are two factors that affect short-term memory retention. Peterson and Peterson (1959) investigated short-term memory using the three letter sequences called trigrams (e.g., CLS) that had to be recalled after various time intervals between 3 and 18 seconds. Participants remembered about 80% of the trigrams after a 3-second delay, but only 10% after a delay of 18 seconds, which caused them to conclude that short-term memory decayed in 18 seconds. During decay, the memory trace becomes less activated over time, and the information is forgotten. However, Keppel and Underwood (1962) examined only the first trials of the trigram task and found that proactive interference also affected short-term memory retention. During proactive interference, previously learned information interferes with the ability to learn new information. Both memory trace decay and proactive interference affect short-term memory. Once the information reaches long-term memory, it has to be consolidated at both the synaptic level, which takes a few hours, and into the memory system, which can take weeks or longer.

Long-term Memory

Long-term memory (LTM) is the continuous storage of information. Unlike short-term memory, long-term memory storage capacity is believed to be unlimited. It encompasses all the things you can remember that happened more than just a few minutes ago. One cannot really consider long-term memory without thinking about the way it is organized. Really quickly, what is the first word that comes to mind when you hear “peanut butter”? Did you think of jelly? If you did, you probably have associated peanut butter and jelly in your mind. It is generally accepted that memories are organized in semantic (or associative) networks (Collins & Loftus, 1975). A semantic network consists of concepts, and as you may recall from what you’ve learned about memory, concepts are categories or groupings of linguistic information, images, ideas, or memories, such as life experiences. Although individual experiences and expertise can affect concept arrangement, concepts are believed to be arranged hierarchically in the mind (Anderson & Reder, 1999; Johnson & Mervis, 1997, 1998; Palmer, Jones, Hennessy, Unze, & Pick, 1989; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976; Tanaka & Taylor, 1991). Related concepts are linked, and the strength of the link depends on how often two concepts have been associated.

Semantic networks differ depending on personal experiences. Importantly for memory, activating any part of a semantic network also activates the concepts linked to that part to a lesser degree. The process is known as spreading activation (Collins & Loftus, 1975). If one part of a network is activated, it is easier to access the associated concepts because they are already partially activated. When you remember or recall something, you activate a concept, and the related concepts are more easily remembered because they are partially activated. However, the activations do not spread in just one direction. When you remember something, you usually have several routes to get the information you are trying to access, and the more links you have to a concept, the better your chances of remembering.

There are two types of long-term memory: *explicit and implicit* (Figure 5). Understanding the difference between explicit memory and implicit memory is important because aging, particular types of brain trauma, and certain disorders can impact explicit and implicit memory in different ways. **Explicit memories** are those we consciously try to remember, recall, and report. For example, if you are studying for your chemistry exam, the material you are learning will be part of your explicit memory. In keeping with the computer analogy, some information in your long-term memory would be like the information you have saved on the hard drive. It is not there on your desktop (your short-term memory), but most of the time you can pull up this information when you want it. Not all long-term memories are strong memories, and some memories can only be recalled using prompts. For example, you might easily recall a fact, such as the capital of the United States, but you might struggle to recall the name of the restaurant at which you had dinner when you visited a nearby city last summer. A prompt, such as that the restaurant was named after its owner, might help you recall the name of the restaurant. Explicit memory is sometimes referred to as declarative memory, because it can be put into words. Explicit memory is divided into episodic memory and semantic memory.

Learn More

View this video that explains short-term and long-term memory (https://www.youtube.com/watch?v=TUoJc0NPajQ) to learn more about how memories are stored and retrieved.

Episodic memory is information about events we have personally experienced (i.e., an episode). For instance, the memory of your last birthday is an episodic memory. Usually, episodic memory is reported as a story. The concept of episodic memory was first proposed about in the 1970s (Tulving, 1972). Since then, Tulving and others have reformulated the theory, and currently scientists believe that episodic memory is memory about happenings in particular places at particular times—the what, where, and when of an event (Tulving, 2002). It involves recollection of visual imagery as well as the feeling of familiarity (Hassabis & Maguire, 2007). **Semantic memory** is knowledge about words, concepts, and language-based knowledge and facts. Semantic memory is typically reported as facts. Semantic means having to do with language and knowledge about language. For example, answers to the following questions like "what is the definition of psychology" and "who was the first African American president of the United States" are stored in your semantic memory.

Implicit memories are long-term memories that are not part of our consciousness. Although implicit memories are learned outside of our awareness and cannot be consciously recalled, implicit memory is demonstrated in the performance of some task (Roediger, 1990; Schacter, 1987). Implicit memory has been studied with cognitive demand tasks, such as performance on artificial grammars (Reber, 1976), word memory (Jacoby, 1983; Jacoby & Witherspoon, 1982), and learning unspoken and unwritten contingencies and rules (Greenspoon, 1955; Giddan & Eriksen, 1959; Krieckhaus & Eriksen, 1960). Returning to the computer metaphor, implicit memories are like a program running in the background, and you are not aware of their influence. Implicit memories can influence observable behaviors as well as cognitive tasks. In either case, you usually cannot put the memory into words that adequately describe the task. There are several types of implicit memories, including procedural, priming, and emotional conditioning.

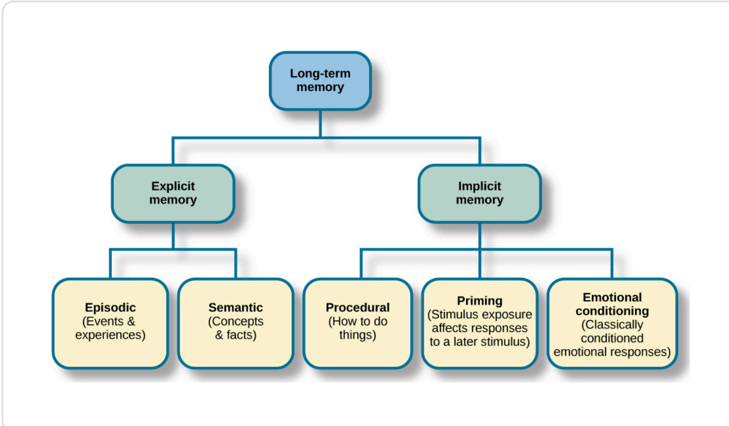

Figure 5. There are two components of long-term memory: explicit and implicit. Explicit memory includes episodic and semantic memory. Implicit memory includes procedural memory and things learned through conditioning. Image available in original Openstax chapter.

Implicit **procedural memory** is often studied using observable behaviors (Adams, 1957; Lacey & Smith, 1954; Lazarus & McCleary, 1951). Implicit procedural memory stores information about the way to do something, and it is the memory for skilled actions, such as brushing your teeth, riding a bicycle, or driving a car. You were probably not that good at riding a bicycle or driving a car the first time you tried, but you were much better after doing those things for a year. Your improved bicycle riding was due to learning balancing abilities. You likely thought about staying upright in the beginning, but now you just do it. Moreover, you probably are good at staying balanced, but cannot tell someone the exact way you do it. Similarly, when you first learned to drive, you probably thought about a lot of things that you just do now without much thought. When you first learned to do these tasks, someone may have told you how to do them, but everything you learned since those instructions that you cannot readily explain to someone else as the way to do it is implicit memory.

Implicit priming is another type of implicit memory (Schacter, 1992). During priming exposure to a stimulus affects the response to a later stimulus. Stimuli can vary and may include words, pictures, and other stimuli to elicit a response or increase recognition. For instance, some people really enjoy picnics. They love going into nature, spreading a blanket on the ground, and eating a delicious meal. Now, unscramble the following letters to make a word.

AETPL

What word did you come up with? Chances are good that it was "plate."

Had you read, “Some people really enjoy growing flowers. They love going outside to their garden, fertilizing their plants, and watering their flowers,” you probably would have come up with the word "petal" instead of plate.

Do you recall the earlier discussion of semantic networks? The reason people are more likely to come up with “plate” after reading about a picnic is that plate is associated (linked) with picnic. Plate was primed by activating the semantic network. Similarly, “petal” is linked to flower and is primed by flower. Priming is also the reason you probably said jelly in response to peanut butter.

Implicit emotional conditioning is the type of memory involved in classically conditioned emotion responses (Olson & Fazio, 2001). These emotional relationships cannot be reported or recalled but can be associated with different stimuli. For example, specific smells can cause specific emotional responses for some people. If there is a smell that makes you feel positive and nostalgic, and you don't know where that response comes from, it is an implicit emotional response. Similarly, most people have a song that causes a specific emotional response. That song's effect could be an implicit emotional memory (Yang, Xu, Du, Shi, & Fang, 2011).

Think About It!

Can You Remember Everything You Ever Did or Said? Episodic memories are also called autobiographical memories. Let’s quickly test your autobiographical memory. What were you wearing exactly five years ago today? What did you eat for lunch on April 10, 2009? You probably find it difficult, if not impossible, to answer these questions. Can you remember every event you have experienced over the course of your life—meals, conversations, clothing choices, weather conditions, and so on? Most likely none of us could even come close to answering these questions; however, American actress Marilu Henner, best known for the television show Taxi, can remember. She has an amazing and highly superior autobiographical memory (Figure 6).

Figure 6. *Marilu Henner’s super autobiographical memory is known as hyperthymesia. (credit: Mark Richardson)*

Very few people can recall events in this way; right now, fewer than 20 have been identified as having this ability, and only a few have been studied (Parker, Cahill & McGaugh 2006). And although hyperthymesia normally appears in adolescence, two children in the United States appear to have memories from well before their tenth birthdays.

Retrieval

So you have worked hard to encode (via effortful processing) and store some important information for your upcoming final exam. How do you get that information back out of storage when you need it? The act of getting information out of memory storage and back into conscious awareness is known as **retrieval**. This would be similar to finding and opening a paper you had previously saved on your computer's hard drive. Now it's back on your desktop, and you can work with it again. Our ability to retrieve information from long-term memory is vital to our everyday functioning. You must be able to retrieve information from memory in order to do everything from knowing how to brush your hair and teeth, to driving to work, to knowing how to perform your job once you get there.

There are three ways you can retrieve information out of your long-term memory storage system: recall, recognition, and relearning. **Recall** is what we most often think about when we talk about memory retrieval: it means you can access information without cues. For example, you would use recall for an essay test. **Recognition** happens when you identify information that you have previously learned after encountering it again. It involves a process of comparison. When you take a multiple-choice test, you are relying on recognition to help you choose the correct answer. Here is another example. Let's say you graduated from high school 10 years ago, and you have returned to your hometown for your 10-year reunion. You may not be able to recall all of your classmates, but you recognize many of them based on their yearbook photos.

The third form of retrieval is **relearning**, and it's just what it sounds like. It involves learning information that you previously learned. Whitney took Spanish in high school, but after high school she did not have the opportunity to speak Spanish. Whitney is now 31, and her company has offered her an opportunity to work in their Mexico City office. In order to prepare herself, she enrolls in a Spanish course at the local community center. She's surprised at how quickly she's able to pick up the language after not speaking it for 13 years; this is an example of relearning.

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Intelligence

Spielman, R. , Jenkins, W. , & Lovett, M.

Cognitive abilities

Creativity

Emotional Intelligence

Intelligence

Triarchic Theory

This excerpt from an Openstax book explores the concept of intelligence and creativity. Intelligence is defined as a collection of distinct abilities, with various theories proposing different types of intelligence, including crystallized and fluid intelligence, practical, creative, and analytical intelligence, and multiple intelligences theory. The triarchic theory of intelligence, developed by Robert Sternberg, suggests that intelligence consists of three parts: practical, creative, and analytical. Emotional intelligence is also discussed, encompassing the ability to understand emotions in oneself and others. The Cattell-Horn-Carroll (CHC) theory of cognitive abilities is presented as a comprehensive theory of intelligence. The importance of cultural values and norms in defining intelligence is also highlighted.

Editor's Note

The following is excerpted from an Openstax book produced by Rice University. Download at https://openstax.org/details/books/psychology-2e.

Spielman, R. M., Jenkins, W. J., & Lovett, M. D. (2020). What are intelligence and creativity? In *Psychology 2e*. Retrieved from https://openstax.org/details/books/psychology-2e

What are Intelligence and Creativity?

Learning Objectives

By the end of this section, you will be able to:

- Define intelligence
- Explain the triarchic theory of intelligence
- Identify the difference between intelligence theories
- Explain emotional intelligence
- Define creativity

A four-and-a-half-year-old boy sits at the kitchen table with his father, who is reading a new story aloud to him. He turns the page to continue reading, but before he can begin, the boy says, “Wait, Daddy!” He points to the words on the new page and reads aloud, “Go, Pig! Go!” The father stops and looks at his son. “Can you read that?” he asks. “Yes, Daddy!” And he points to the words and reads again, “Go, Pig! Go!”

This father was not actively teaching his son to read, even though the child constantly asked questions about letters, words, and symbols that they saw everywhere: in the car, in the store, on the television. The dad wondered about what else his son might understand and decided to try an experiment. Grabbing a sheet of blank paper, he wrote several simple words in a list: mom, dad, dog, bird, bed, truck, car, tree. He put the list down in front of the boy and asked him to read the words. “Dad, dog, bird, bed, truck, car, tree,” he read, slowing down to carefully pronounce bird and truck. Then, “Did I do it, Daddy?” “You sure did! That is very good.” The father gave his little boy a warm hug and continued reading the story about the pig, all the while wondering if his son’s abilities were an indication of exceptional intelligence or simply a normal pattern of linguistic development. Like the father in this example, psychologists have wondered what constitutes intelligence and how it can be measured.

Classifying Intelligence

What exactly is intelligence? The way that researchers have defined the concept of intelligence has been modified many times since the birth of psychology. British psychologist Charles Spearman believed intelligence consisted of one general factor, called *g*, which could be measured and compared among individuals. Spearman focused on the commonalities among various intellectual abilities and de-emphasized what made each unique. Long before modern psychology developed, however, ancient philosophers, such as Aristotle, held a similar view (Cianciolo & Sternberg, 2004).

Others psychologists believe that instead of a single factor, intelligence is a collection of distinct abilities. In the 1940s, Raymond Cattell proposed a theory of intelligence that divided general intelligence into two components: crystallized intelligence and fluid intelligence

(Cattell, 1963). **Crystallized intelligence** is characterized as acquired knowledge and the ability to retrieve it. When you learn, remember, and recall information, you are using crystallized intelligence. You use crystallized intelligence all the time in your coursework by demonstrating that you have mastered the information covered in the course. **Fluid intelligence** encompasses the ability to see complex relationships and solve problems. Navigating your way home after being detoured onto an unfamiliar route because of road construction would draw upon your fluid intelligence. Fluid intelligence helps you tackle complex, abstract challenges in your daily life, whereas crystallized intelligence helps you overcome concrete, straightforward problems (Cattell, 1963).

Other theorists and psychologists believe that intelligence should be defined in more practical terms. For example, what types of behaviors help you get ahead in life? Which skills promote success? Think about this for a moment. Being able to recite all 45 presidents of the United States in order is an excellent party trick, but will knowing this make you a better person?

Robert Sternberg developed another theory of intelligence, which he titled the **triarchic theory of intelligence** because it sees intelligence as comprised of three parts (Sternberg, 1988): practical, creative, and analytical intelligence (Figure 1).

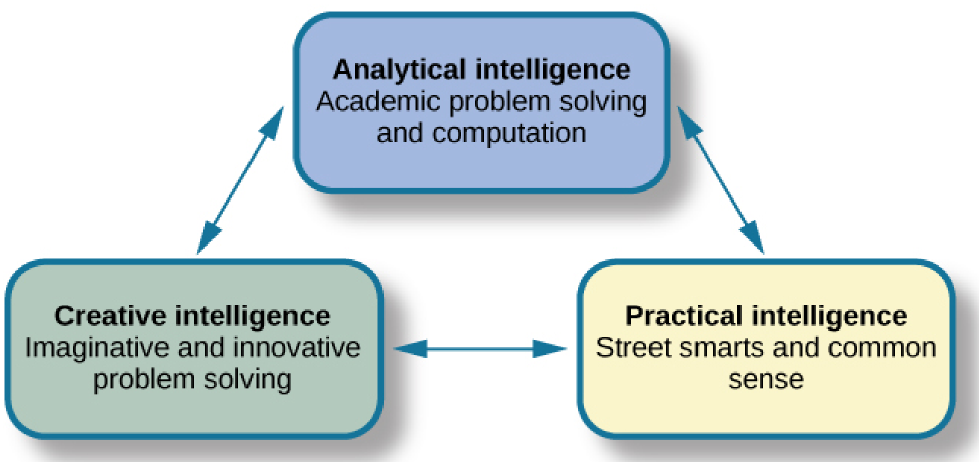

Figure 1. *Sternberg's theory identifies three types of intelligence: practical, creative, and analytical. Image available in original Openstax chapter.*

Practical intelligence, as proposed by Sternberg, is sometimes compared to "street smarts." Being practical means you find solutions that work in your everyday life by applying knowledge based on your experiences. This type of intelligence appears to be separate from traditional understanding of IQ; individuals who score high in practical intelligence may or may not have comparable scores in creative and analytical intelligence (Sternberg, 1988).

Analytical intelligence is closely aligned with academic problem solving and computations. Sternberg says that analytical intelligence is demonstrated by an ability to analyze, evaluate, judge, compare, and contrast. When reading a classic novel for literature class, for example, it is usually necessary to compare the motives of the main characters of the book or analyze the historical context of the story. In a science course such as anatomy, you must study the processes by which the body uses various minerals in different human systems. In developing an understanding of this topic, you are using analytical intelligence. When solving a challenging math problem, you would apply analytical intelligence to analyze different aspects of the problem and then solve it section by section.

Creative intelligence is marked by inventing or imagining a solution to a problem or situation. Creativity in this realm can include finding a novel solution to an unexpected problem or producing a beautiful work of art or a well-developed short story. Imagine for a moment that you are camping in the woods with some friends and realize that you've forgotten your camp coffee pot. The person in your group who figures out a way to successfully brew coffee for everyone would be credited as having higher creative intelligence.

Multiple Intelligences Theory was developed by Howard Gardner, a Harvard psychologist and former student of Erik Erikson. In Gardner's theory, each person possesses at least eight intelligences. The eight intelligences are linguistic intelligence, logical-mathematical intelligence, musical intelligence, bodily kinesthetic intelligence, spatial intelligence, interpersonal intelligence, intrapersonal intelligence, and naturalistic intelligence. Among cognitive psychologists, Gardner's theory has been heavily criticized for lacking empirical evidence. However, educators continue to study and use Gardner's theory, with some colleges even discussing how they integrate Gardner's theory into their classrooms. Gottfredson describes one possible reason for the continued use of Gardner's theory: " . . . that there are multiple independent intelligences, suggesting that everyone can be smart in some way. This is, understandably, a very attractive idea in democratic societies" (2004).

Gardner's inter- and intrapersonal intelligences are often combined into a single type: emotional intelligence. **Emotional intelligence** encompasses the ability to understand the emotions of yourself and others, show empathy, understand social relationships and cues, and regulate your own emotions and respond in culturally appropriate ways (Parker, Saklofske, & Stough, 2009). People with high emotional intelligence typically have well-developed social skills. Some researchers, including Daniel Goleman, the author of *Emotional Intelligence: Why It Can Matter More than IQ*, argue that emotional intelligence is a better predictor of success than traditional intelligence (Goleman, 1995). However, emotional intelligence has been widely debated, with researchers pointing out inconsistencies in how it is defined and described, as well as questioning results of studies on a subject that is difficult to measure and study empirically (Locke, 2005; Mayer, Salovey, & Caruso, 2004)

The most comprehensive theory of intelligence to date is the Cattell-Horn-Carroll (CHC) theory of cognitive abilities (Schneider & McGrew, 2018). In this theory, abilities are related and arranged in a hierarchy with general abilities at the top, broad abilities in the middle, and narrow (specific) abilities at the bottom. The narrow abilities are the only ones that can be directly measured; however, they are integrated within the other abilities. At the general level is general intelligence. Next, the broad level consists of general abilities such as fluid reasoning, short-term memory, and processing speed. Finally, as the hierarchy continues, the narrow level includes specific forms of cognitive abilities. For example, short-term memory would further break down into memory span and working memory capacity.

Intelligence can also have different meanings and values in different cultures. If you live on a small island, where most people get their food by fishing from boats, it would be important to know how to fish and how to repair a boat. If you were an exceptional angler, your peers would probably consider you intelligent. If you were also skilled at repairing boats, your intelligence might be known across the whole island. Think about your own family's culture. What values are important for Latinx families? Italian families? In Irish families, hospitality and telling an entertaining story are marks of the culture. If you are a skilled storyteller, other members of Irish culture are likely to consider you intelligent.

Some cultures place a high value on working together as a collective. In these cultures, the importance of the group supersedes the importance of individual achievement. When you visit such a culture, how well you relate to the values of that culture exemplifies your **cultural intelligence**, sometimes referred to as cultural competence.

Learn More

Watch this video to learn more (http://openstax.org/l/theoryintel).

Creativity

Creativity is the ability to generate, create, or discover new ideas, solutions, and possibilities. Very creative people often have intense knowledge about something, work on it for years, look at novel solutions, seek out the advice and help of other experts, and take risks. Although creativity is often associated with the arts, it is actually a vital form of intelligence that drives people in many disciplines to discover something new. Creativity can be found in every area of life, from the way you decorate your residence to a new way of understanding how a cell works.

Creativity is often connected to a person's ability to engage in **divergent thinking**. Divergent thinking can be described as thinking "outside the box;" it allows an individual to arrive at unique, multiple solutions to a given problem. In contrast, **convergent thinking** describes the ability to provide a correct or well-established answer or solution to a problem (Cropley, 2006; Gilford, 1967).

Think About It!

Creativity

Dr. Tom Steitz, former Sterling Professor of Biochemistry and Biophysics at Yale University, spent his career looking at the structure and specific aspects of RNA molecules and how their interactions could help produce antibiotics and ward off diseases. As a result of his lifetime of work, he won the Nobel Prize in Chemistry in 2009. He wrote, “Looking back over the development and progress of my career in science, I am reminded how vitally important good mentorship is in the early stages of one's career development and constant face-to-face conversations, debate and discussions with colleagues at all stages of research. Outstanding discoveries, insights and developments do not happen in a vacuum” (Steitz, 2010, para. 39). Based on Steitz’s comment, it becomes clear that someone’s creativity, although an individual strength, benefits from interactions with others. Think of a time when your creativity was sparked by a conversation with a friend or classmate. How did that person influence you and what problem did you solve using creativity?

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Motivation Theories on Learning

Seifert, K. & Sutton, R.

Learning Motivation

Like motivation itself, theories of it are full of diversity. For convenience in navigating through the diversity, we have organized the chapter around six major theories or perspectives about motives and their sources. We call the topics (1) motives as behavior change, (2) motives as goals, (3) motives as interests, (4) motives as attributions about success, (5) motives as beliefs about self-efficacy, and (6) motives as self-determination. We end with a perspective called expectancy-value theory, which integrates ideas from some of the other six theories and partly as a result implies some additional suggestions for influencing students' motivations to learn in positive ways.

Editor's Note

This chapter is abridged from Educational Psychology, 3rd edition [https://edtechbooks.org/-oSs].

Seifert, K. & Sutton, R. *Educational Psychology*. Published by the Saylor Foundation. Available at https://pressbooks.pub/uwgedpsych/front-matter/223/

Not so long ago, a teacher named Barbara Fuller taught general science to elementary years students, and one of her units was about insects and spiders. As part of the unit, she had students search for insects and spiders around their own homes or apartments. They brought the creatures to school (safely in jars), answered a number of questions about them in their journals, and eventually gave brief oral reports about their findings to the class. The assignment seemed straightforward, but Barbara found that students responded to it in very different ways. Looking back, here is how Barbara described their responses:

> *I remember Jose couldn't wait to get started, and couldn't bear to end the assignment either! Every day he brought more bugs or spiders—eventually 25 different kinds. Every day he drew pictures of them in his journal and wrote copious notes about them. At the end he gave the best oral presentation I've ever seen from a third-grader; he called it "They Have Us Outnumbered!" I wish I had filmed it, he was so poised and so enthusiastic.*
>
> *Then there was Lindsey—the one who . . . always wanted to be the best in everything, regardless of whether it interested her. She started off the work rather slowly—just brought in a few bugs and only one spider. But she kept an eye on what everyone else was bringing, and how much. When she saw how much Jose was doing, though, she picked up her pace, like she was trying to match his level. Except that instead of bringing a diversity of creatures as Jose was doing, she just brought more and more of the same ones—almost twenty dead house flies, as I recall! Her presentation was OK—I really could not give her a bad mark for it—but it wasn't as creative or insightful as Jose's. I think she was more concerned about her mark than about the material.*
>
> *And there was Tobias—discouraging old Tobias. He did the work, but just barely. I noticed him looking a lot at other students' insect collections and at their journal entries. He wasn't cheating, I believe, just figuring out what the basic level of work was for the assignment—what he needed to do simply to avoid failing it. He brought in fewer bugs than most others, though still a number that was acceptable. He also wrote shorter answers in his journal and gave one of the shortest oral reports. It was all acceptable, but not much more than that.*

> *And Zoey: she was quite a case! I never knew whether to laugh or cry about her. She didn't exactly resist doing the assignment, but she certainly liked to chat with other students. So she was easily distracted, and that cut down on getting her work done, especially about her journal entries. What really saved her—what kept her work at a reasonably high level of quality—were the two girls she ended up chatting with. The other two were already pretty motivated to do a lot with the assignment—create fine-looking bug collections, write good journal entries, and make interesting oral presentations. So when Zoey attempted chitchat with them, the conversations often ended up focusing on the assignment anyway! She had them to thank for keeping her mind on the work. I don't know what Zoey would have done without them.*

As Barbara Fuller's recollections suggest, students assign various meanings and attitudes to academic activities—personal meanings and attitudes that arouse and direct their energies in different ways. We call these and their associated energizing and directing effects by the term *motivation* or sometimes *motivation to learn*. As you will see, differences in motivation are an important source of diversity in classrooms, comparable in importance to differences in prior knowledge, ability, or developmental readiness. When it comes to school learning, furthermore, students' motivations take on special importance because students' mere presence in class is (of course) no guarantee that students really want to learn. It is only a sign that students live in a society requiring young people to attend school. Since modern education is compulsory, teachers cannot take students' motivation for granted, and they have a responsibility to insure students' motivation to learn. Somehow or other, teachers must persuade students to want to do what students have to do anyway. This task—understanding and therefore influencing students' motivations to learn—is the focus of this chapter. Fortunately, as you will see, there are ways of accomplishing this task that respect students' choices, desires, and attitudes.

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Motives as Behavior

Sometimes it is useful to think of motivation not as something "inside" a student driving the student's behavior, but as *equivalent* to the student's outward behaviors. This is the perspective of behaviorism. In its most thorough-going form, behaviorism focuses almost completely on what can be directly seen or heard about a person's behavior and has relatively few comments about what may lie behind (or "underneath" or "inside") the behavior. When it comes to motivation, this perspective means minimizing or even ignoring the distinction between the inner drive or energy of students and the outward behaviors that express the drive or energy. The two are considered the same or nearly so.

Sometimes the circumstances of teaching limit teachers' opportunities to distinguish between inner motivation and outward behavior. Certainly teachers see plenty of student behaviors—signs of motivation of some sort. But the multiple demands of teaching can limit the time available to determine what the behaviors mean. If a student asks a lot of questions during discussions, for example, is he or she curious about the material itself or just wanting to look intelligent in front of classmates and the teacher? In a class with many students and a busy agenda, there may not be a lot of time for a teacher to decide between these possibilities. In other cases, the problem may not be limited time as much as communication difficulties with a student. Consider a student who is still learning English or who belongs to a cultural community that uses patterns of conversation that are unfamiliar to the teacher or who has a disability that limits the student's general language skill. In these cases, discerning the student's inner motivations may take more time and effort. It is important to invest the extra time and effort for such students, but while a teacher is doing so, it is also important for her to guide and influence the students' behavior in constructive directions. That is where behaviorist approaches to motivation can help.

Operant Conditioning as a Way of Motivating

The most common version of the behavioral perspective on motivation is the theory of *operant conditioning*associated with B. F. Skinner (1938, 1957). To understand this model in terms of motivation, think of the *likelihood* of response as the motivation and the *reinforcement* as the motivator. Imagine, for example, that a student learns by operant conditioning to answer questions during class discussions: each time the student answers a question (the operant), the teacher praises (reinforces) this behavior. In addition to thinking of this situation as behavioral *learning,* however, you can also think of it in terms of *motivation:* the likelihood of the student answering questions (the motivation) is increasing because of the teacher's praise (the motivator).

Many concepts from operant conditioning, in fact, can be understood in motivational terms. Another one, for example, is the concept of *extinction,* the tendency for learned behaviors to become less likely when reinforcement no longer occurs—a sort of "unlearning" or at least a decrease in performance of previously learned behaviors. The decrease in performance frequency can be thought of as a loss of motivation, and removal of the reinforcement can be thought of as removal of the motivator. Table 1 summarizes this way of reframing operant conditioning in terms of motivation.

Table 1. Operant Conditioning as Learning and as Motivation

Concept	Definition phrased in terms of learning	Definition phrased in terms of motivation	Classroom Example
Operant	Behavior that becomes more likely because of reinforcement	Behavior that suggests an increase in motivation	Student listens to teacher's comments during lecture or discussion

Concept	Definition phrased in terms of learning	Definition phrased in terms of motivation	Classroom Example
Reinforcement	Stimulus that increases likelihood of a behavior	Stimulus that motivates	Teacher praises student for listening
Positive reinforcement	Stimulus that *increases*likelihood of a behavior by being *introduced* or *added* to a situation	Stimulus that motivates by its *presence;* an "incentive"	Teacher makes encouraging remarks about student's homework
Negative reinforcement	Stimulus that *increases* the likelihood of a behavior by being *removed* or taken away from a situation	Stimulus that motivates by its *absence* or *avoidance*	Teacher stops nagging student about late homework
Punishment	Stimulus that *decreases* the likelihood of a behavior by being *introduced* or *added* to a situation	Stimulus that *decreases*motivation by its *presence*	Teacher deducts points for late homework
Extinction	Removal of reinforcement for a behavior	Removal of motivating stimulus that leads to decrease in motivation	Teacher stops commenting altogether about student's homework
Shaping successive approximations	Reinforcements for behaviors that gradually resemble (approximate) a final goal behavior	Stimuli that gradually shift motivation toward a final goal motivation	Teacher praises student for returning homework a bit closer to the deadline; gradually she praises for actually being on time
Continuous reinforcement	Reinforcement that occurs *each*time that	Motivator that occurs *each* time a behavioral	Teacher praises highly active student for *every*

Concept	Definition phrased in terms of learning	Definition phrased in terms of motivation	Classroom Example
	an operant behavior occurs	sign of motivation occurs	time he works for five minutes without interruption
Intermittent reinforcement	Reinforcement that *sometimes*occurs following an operant behavior, but not on every occasion	Motivator that occurs *sometimes*when a behavioral sign of motivation occurs, but not on every occasion	Teacher praises highly active student *sometimes* when he works without interruption, but not every time

Cautions about Behavioral Perspectives On Motivation

As we mentioned, behaviorist perspectives about motivation do reflect a classroom reality: that teachers sometimes lack time and therefore must focus simply on students' appropriate outward behavior. But there are nonetheless cautions about adopting this view. An obvious one is the ambiguity of students' specific behaviors; what looks like a sign of one motive to the teacher may in fact be a sign of some other motive to the student (DeGrandpre, 2000). If a student looks at the teacher intently while she is speaking, does it mean the student is motivated to learn or only that the student is daydreaming? If a student invariably looks away while the teacher is speaking, does it mean that the student is disrespectful of the teacher or that the student comes from a family or cultural group where *avoiding* eye contact actually shows more respect for a speaker than direct eye contact?

Another concern about behaviorist perspectives, including operant conditioning, is that it leads teachers to ignore students' choices and preferences and to "play God" by making choices on their behalf (Kohn, 1996). According to this criticism, the distinction between "inner" motives and expressions of motives in outward behavior does not disappear just because a teacher (or a psychological theory) chooses to treat a motive and the behavioral expression of a motive as equivalent. Students usually *do* know what they want or desire, and their wants or desires may not always correspond to what a teacher chooses to reinforce or ignore. Approaches that are exclusively behavioral, it is argued, are not sensitive enough to students' *intrinsic,* self-sustaining motivations. As it happens, help with being selective and thoughtful can be found in the other, more cognitively oriented theories of motivation. These use the goals, interests, and beliefs of students as ways of explaining differences in students' motives and in how the motives affect engagement with school. We turn to these cognitively oriented theories next, beginning with those focused on students' goals.

Motives as Goals

One way motives vary is by the kind of goals that students set for themselves and by how the goals support students' academic achievement. As you might suspect, some goals encourage academic achievement more than others, but even motives that do not concern academics explicitly tend to affect learning indirectly.

Goals That Contribute to Achievement

What kinds of achievement goals do students hold? Imagine three individuals, Maria, Sara, and Lindsay, who are taking algebra together. Maria's main concern is to learn the material as well as possible because she finds it interesting and because she believes it will be useful to her in later courses, perhaps at university. Hers is a mastery goal, because she wants primarily to learn or master the material. Sara, however, is concerned less about algebra than about getting top marks on the exams and in the course. Hers is a performance goal, because she is focused primarily on looking successful; learning algebra is merely a vehicle for performing well in the eyes of peers and teachers. Lindsay, for her part, is primarily concerned about avoiding a poor or failing mark. Hers is a performance-avoidance goal or failure-avoidance goal, because she is not really as concerned about learning algebra, as Maria is, or about competitive success, as Sara is; she is simply intending to avoid failure.

As you might imagine, mastery, performance, and performance-avoidance goals often are not experienced in pure form, but in combinations. If you play the clarinet in the school band, you might want to improve your technique simply because you enjoy playing as well as possible—essentially a mastery orientation. But you might also want to look talented in the eyes of classmates—a performance orientation. Another part of what you may wish, at least privately, is to avoid looking like a complete failure at playing the clarinet. One of these motives may predominate over the others, but they all may be present.

Mastery goals tend to be associated with enjoyment of learning the material at hand and in this sense represent an outcome that teachers often seek for students. By definition, therefore, they are a form of *intrinsic motivation.* As such, mastery goals have been found to be better than performance goals at sustaining students' interest in a subject. In one review of research about learning goals, for example, students with primarily mastery orientations toward a course they were taking not only tended to express greater interest in the course, but also continued to express interest well beyond the official end of the course and to enroll in further courses in the same subject (Harackiewicz et al., 2002; Wolters, 2004).

Performance goals, on the other hand, imply *extrinsic motivation* and tend to show the mixed effects of this orientation. A positive effect is that students with a performance orientation do tend to get higher grades than those who express primarily a mastery orientation. The advantage in grades occurs both in the short term (with individual assignments) and in the long term (with overall grade point average when graduating). But there is evidence that performance-oriented students do not actually learn material as deeply or permanently as students who are more mastery oriented (Midgley, Kaplan, & Middleton, 2001). A possible reason is that measures of performance—such as test scores—often reward relatively shallow memorization of information and therefore guide performance-oriented students away from processing the information thoughtfully or deeply. Another possible reason is that a performance orientation, by focusing on gaining recognition as the best among peers, encourages competition among peers. Giving and receiving help from classmates is thus not in the self-interest of a performance-oriented student, and the resulting isolation limits the student's learning.

Goals That Affect Achievement Indirectly

Failure-avoidant Goals

Failure-avoidant goals by nature undermine academic achievement. Often they are a negative byproduct of the competitiveness of performance goals (Urdan, 2004). If a teacher (and sometimes also fellow students) put too much emphasis on being the best in the class and if interest in learning the material therefore suffers, then some students may decide that success is beyond their reach or may not be desirable in any case. The alternative—simply avoiding failure—may seem wiser as well as more feasible. Once a student adopts this attitude, he or she may underachieve more or less deliberately, doing only the minimum work necessary to avoid looking foolish or to avoid serious conflict with the teacher. Avoiding failure in this way is an example of self-handicapping—deliberate actions and choices that reduce chances of success. Students may self-handicap in a number of ways; in addition to not working hard, they may procrastinate about completing assignments, for example, or set goals that are unrealistically high.

Social Goals

Most students need and value relationships, both with classmates and with teachers, and often (though not always) they get a good deal of positive support from the relationships. But the effects of social relationships are complex and at times can work both for and against academic achievement. If a relationship with the teacher is important and reasonably positive, then the student is likely to try pleasing the teacher by working hard on assignments (Dowson & McInerney, 2003). Note, though, that this effect is closer to performance than mastery; the student is primarily concerned about looking good to someone else. If, on the other hand, a student is especially concerned about relationships with peers, the effects on achievement depend on the student's motives for the relationship as well as on peers' attitudes. The abilities and achievement motivation of peers themselves can also make a difference, but once again the effects vary depending on the context. Low achievement and motivation by peers affect an individual's academic motivation more in elementary school than in high school, more in learning mathematics than learning to read, and more if there is a wide range of abilities in a classroom than if there is a more narrow range (Burke & Sass, 2006).

In spite of these complexities, social relationships are valued so highly by most students that teachers should generally facilitate them, though also keep an eye on their nature and their consequent effects on achievement. Many assignments can be accomplished productively in groups, for example, as long as the groups are formed thoughtfully. But the majority of students' social contacts are likely always to come from students' own initiatives with each other in simply taking time to talk and interact. The teacher's job is to encourage these informal contacts, especially when they happen at times that support rather than interfere with learning.

Encouraging Mastery Goals

Even though a degree of performance orientation may be inevitable in school because of the mere presence of classmates, it does not have to take over students' academic motivation completely. Teachers can encourage mastery goals in various ways and should in fact do so, because a mastery orientation leads to more sustained, thoughtful learning, at least in classrooms, where classmates may sometimes debate and disagree with each other (Darnon, Butera, & Harackiewicz, 2006).

How can teachers do so? One way is to allow students to choose specific tasks or assignments for themselves, where possible, because their choices are more likely than usual to reflect prior personal interests, and hence be motivated more intrinsically than usual. The limitation of this strategy, of course, is that students may not see some of the connections between their prior interests and the curriculum topics at hand. In that case it also helps for the teacher to look for and point out the relevance of current topics or skills to students' personal interests and goals. Suppose, for example, that a student enjoys the latest styles of music. This interest may actually have connections with a wide range of school curriculum, such as:

- biology (because of the physiology of the ear and of hearing)
- physics or general science (because of the nature of musical acoustics)
- history (because of changes in musical styles over time)
- English (because of relationships of musical lyrics and themes with literary themes)
- foreign languages (because of comparisons of music and songs among cultures)

Still another way to encourage mastery orientation is to focus on students' individual effort and improvement as much as possible, rather than on comparing students' successes to each other. You can encourage this orientation by giving students detailed feedback about how they can improve performance, by arranging for students to collaborate on specific tasks and projects rather than to compete about them, and in general by showing your own enthusiasm for the subject at hand.

Reflection

Much of education focuses on comparisons in grades, test scores, publications, and awards. How can you develop more of an orientation yourself for your own growth and learning, rather than comparative norms?

Motives as Interests

In addition to holding different kinds of goals—with consequent differences in academic motivation—students show obvious differences in levels of interest in the topics and tasks of the classroom. Suppose that two high school classmates, Frank and Jason, both are taking chemistry, specifically learning how to balance chemical equations. Frank finds the material boring and has to force himself to study it; as a result he spends only the time needed to learn the basic material and to complete the assignments at a basic level. Jason, on the other hand, enjoys the challenges of balancing chemical equations. He thinks of the task as an intriguing puzzle; he not only solves each of them, but also compares the problems to each other as he goes through them.

Frank's learning is based on effort compared to Jason's, whose learning is based more fully on interest. As the example implies, when students learn from interest, they tend to devote more attention to the topic than if they learn from effort (Hidi & Renninger, 2006). The finding is not surprising since interest is another aspect of intrinsic motivation—energy or drive that comes from within. A distinction between effort and interest is often artificial, however, because the two motives often get blended or combined in students' personal experiences. Most of us can remember times when we worked at a skill that we enjoyed and found interesting, but that also required effort to learn. The challenge for teachers is therefore to draw on and encourage students' interest as much as possible and thus keep the required effort within reasonable bounds—neither too hard nor too easy.

Situational Interest Versus Personal Interest

Students' interests vary in how deeply or permanently they are located within students. Situational interests are ones that are triggered temporarily by features of the immediate situation. Unusual sights, sounds, or words can stimulate situational interest. A teacher might show an interesting image on the overhead projector or play a brief bit of music or make a surprising comment in passing. At a more abstract level, unusual or surprising topics of discussion can also arouse interest when they are first introduced. Personal interests are relatively permanent preferences of the student and are usually expressed in a variety of situations. In the classroom, a student may (or may not) have a personal interest in particular topics, activities, or subject matter. Outside class, though, he or she usually has additional personal interests in particular non-academic activities (e.g. sports, music) or even in particular people (a celebrity, a friend who lives nearby). The non-academic personal interests may sometimes conflict with academic interest; it may be more interesting to go to the shopping mall with a friend than to study even your most favorite subject.

Motives Related to Attributions

Attributions are perceptions about the causes of success and failure. Suppose that you get a low mark on a test and are wondering what caused the low mark. You can construct various explanations for—make various attributions about—this failure. Maybe you did not study very hard; maybe the test itself was difficult; maybe you were unlucky; maybe you just are not smart enough. Each explanation attributes the failure to a different factor. The explanations that you settle upon may reflect the truth accurately—or then again, they may not. What is important about attributions is that they reflect personal beliefs about the sources or causes of success and failure. As such, they tend to affect motivation in various ways, depending on the nature of the attribution (Weiner, 2005).

Locus, Stability, and Controllability

Attributions vary in three underlying ways: locus, stability, and controllability. **Locus** of an attribution is the location (figuratively speaking) of the source of success or failure. If you attribute a top mark on a test to your ability, then the locus is internal; if you attribute the mark to the test's having easy questions, then the locus is external. The **stability** of an attribution is its relative permanence. If you attribute the mark to your ability, then the source of success is relatively stable—by definition, ability is a relatively lasting quality. If you attribute a top mark to the effort you put in to studying, then the source of success is unstable—effort can vary and has to be renewed on each occasion or else it disappears. The **controllability** of an attribution is the extent to which the individual can influence it. If you attribute a top mark to your effort at studying, then the source of success is relatively controllable—you can influence effort simply by deciding how much to study. But if you attribute the mark to simple luck, then the source of the success is uncontrollable—there is nothing that can influence random chance.

As you might suspect, the way that these attributions combine affects students' academic motivations in major ways. It usually helps both motivation and achievement if a student attributes academic successes and failures to factors that are internal and controllable, such as effort or a choice to use particular learning strategies (Dweck, 2000). Attributing successes to factors that are internal but stable or controllable (like ability), on the other hand, is both a blessing and a curse: sometimes it can create optimism about prospects for future success ("I always do well"), but it can also lead to indifference about correcting mistakes (Dweck, 2006), or even create pessimism if a student happens not to perform at the accustomed level ("Maybe I'm not as smart as I thought"). Worst of all for academic motivation are attributions, whether stable or not, related to external factors. Believing that performance depends simply on luck ("The teacher was in a bad mood when marking") or on excessive difficulty of material removes incentive for a student to invest in learning. All in all, then, it seems important for teachers to encourage internal, stable attributions about success.

Teachers can influence students' attributions in various ways. It's useful to frame the teachers' own explanations of success and failure around internal, controllable factors. Instead of telling a student: "Good work! You're smart!", try saying: "Good work! Your effort really made a difference, didn't it?" If a student fails, instead of saying,"Too bad! This material is just too hard for you," try saying, "Let's find a strategy for practicing this more, and then you can try again." In both cases the first option emphasizes uncontrollable factors (effort, difficulty level), and the second option emphasizes internal, controllable factors (effort, use of specific strategies).

Such attributions will only be convincing, however, if teachers provide appropriate conditions for students to learn—conditions in which students' efforts really do pay off. There are three conditions that have to be in place in particular. First, academic tasks and materials actually have to be at about the right level of difficulty. If you give problems in advanced calculus to a first-grade student, the student will not only fail them but also be justified in attributing the failure to an external factor, task difficulty. If assignments are assessed in ways that produce highly variable, unreliable marks, then students will rightly attribute their performance to an external, unstable source: luck. Both circumstances will interfere with motivation.

Second, teachers also need to be ready to give help to individuals who need it—even if they believe that an assignment is easy enough or clear enough that students should not need individual help. Third, teachers need to remember that ability—usually considered a relatively stable factor—often actually changes incrementally over the long term. Effort and its results appear relatively immediately; a student expends effort this week, this day, or even at this very moment, and the effort (if not the results) are visible right away. But ability may take longer to show itself.

Motivation as Self-efficacy

In addition to being influenced by their goals, interests, and attributions, students' motives are affected by specific beliefs about the student's personal capacities. In self-efficacy theory the beliefs become a primary, explicit explanation for motivation (Bandura, 1977, 1986, 1997). Self-efficacy is the belief that you are capable of carrying out a specific task or of reaching a specific goal. Note that the belief and the action or goal are specific. Self-efficacy is a belief that you can write an acceptable term paper, for example, or repair an automobile, or make friends with the new student in class. These are relatively specific beliefs and tasks. Self-efficacy is not about whether you believe that you are intelligent in general, whether you always like working with mechanical things, or think that you are generally a likeable person. These more general judgments are better regarded as various mixtures of self-concepts (beliefs about general personal identity) or of self-esteem (evaluations of identity). They are important in their own right, and sometimes influence motivation, but only indirectly (Bong & Skaalvik, 2004). Self-efficacy beliefs, furthermore, are not the same as "true" or documented skill or ability. They are self-constructed, meaning that they are personally developed perceptions. As with confidence, it is possible to have either too much or too little self-efficacy. The optimum level seems to be either at or slightly above true capacity (Bandura, 1997). As we indicate below, large discrepancies between self-efficacy and ability can create motivational problems for the individual.

Effects of Self-efficacy On Students' Behavior

Self-efficacy may sound like a uniformly desirable quality, but research as well as teachers' experience suggests that its effects are a bit more complicated than they first appear. Self-efficacy has three main effects, each of which has both a "dark" or undesirable side and a positive or desirable side. The first effect is that self-efficacy makes students more willing to choose tasks where they already feel confident of succeeding. Since self-efficacy is self-constructed, furthermore, it is also possible for students to miscalculate or misperceive their true skill, and the misperceptions themselves can have complex effects on students' motivations. A second effect of high self-efficacy is to increase a persistence at relevant tasks. If you believe that you can solve crossword puzzles, but encounter one that takes longer than usual, then you are more likely to work longer at the puzzle until you (hopefully) really do solve it. This is probably a desirable behavior in many situations, unless the persistence happens to interfere with other, more important tasks (what if you should be doing homework instead of working on crossword puzzles?).

Third, high self-efficacy for a task not only increases a person's persistence at the task, but also improves their ability to cope with stressful conditions and to recover their motivation following outright failures. Suppose that you have two assignments—an essay and a science lab report—due on the same day, and this circumstance promises to make your life hectic as you approach the deadline. You will cope better with the stress of multiple assignments if you already believe yourself capable of doing both of the tasks, than if you believe yourself capable of doing just one of them or (especially) of doing neither. The bad news, at least from a teacher's point of view, is that the same resilience can sometimes also serve non-academic and non-school purposes. How so? Suppose, instead of two school assignments due on the same day, a student has only one school assignment due, but also holds a part-time evening job as a server in a local restaurant. Suppose, further, that the student has high self-efficacy for both of these tasks; he believes, in other words, that he is capable of completing the assignment as well as continuing to work at the job.

Learned Helplessness and Self-efficacy

If a person's sense of self-efficacy is very low, he or she can develop learned helplessness, a perception of complete lack of control in mastering a task. The attitude is similar to depression, a pervasive feeling of apathy and a belief that effort makes no difference and does not lead to success. Learned helplessness was originally studied from the behaviorist perspective of classical and operant conditioning by the psychologist Martin Seligman (1995). The studies used a somewhat "gloomy" experimental procedure in which an animal, such as a rat or a dog, was repeatedly shocked in a cage in a way that prevented the animal from escaping the shocks. In a later phase of the procedure, conditions were changed so that the animal could avoid the shocks by merely moving from one side of the cage to the other. Yet frequently they did not bother to do so! Seligman called this behavior learned helplessness. In people, learned helplessness leads to characteristic ways of dealing with problems. They tend to attribute the source of a problem to themselves, to generalize the problem to many aspects of life, and to see the problem as lasting or permanent. More optimistic individuals, in contrast, are more likely to attribute a problem to outside sources, to see it as specific to a particular situation or activity, and to see it as temporary or time-limited.

Sources of Self-efficacy Beliefs

Psychologists who study self-efficacy have identified four major sources of self-efficacy beliefs (Pajares & Schunk, 2001, 2002). In order of importance they are (1) prior experiences of mastering tasks, (2) watching others' mastering tasks, (3) messages or "persuasion" from others, and (4) emotions related to stress and discomfort. Fortunately the first three can be influenced by teachers directly, and even the fourth can sometimes be influenced indirectly by appropriate interpretive comments from the teacher or others.

A Caution: Motivation as Content Versus Motivation as Process

A caution about self-efficacy theory is its heavy emphasis on just the process of motivation, at the expense of the content of motivation. The basic self-efficacy model has much to say about how beliefs affect behavior, but relatively little to say about which beliefs and tasks are especially satisfying or lead to the greatest well-being in students. The answer to this question is important to know, since teachers might then select tasks as much as possible that are intrinsically satisfying, and not merely achievable.

Motivation as Self-determination

Common sense suggests that human motivations originate from some sort of inner "need". We all think of ourselves as having various "needs", a need for food, for example, or a need for companionship—that influences our choices and activities. This same idea also forms part of some theoretical accounts of motivation, though the theories differ in the needs that they emphasize or recognize.

According to Maslow and his hierarchy of needs, individuals must satisfy physical survival needs before they seek to satisfy needs of belonging, they satisfy belonging needs before esteem needs, and so on. In theory, too, people have both deficit needs and growth needs, and the deficit needs must be satisfied before growth needs can influence behavior (Maslow, 1970). In Maslow's theory, as in others that use the concept, a need is a relatively lasting condition or feeling that requires relief or satisfaction and that tends to influence action over the long term. Some needs may decrease when satisfied (like hunger), but others may not (like curiosity). Either way, needs differ from the selfefficacy beliefs discussed earlier, which are relatively specific and cognitive, and affect particular tasks and behaviors fairly directly.

A recent theory of motivation based on the idea of needs is self-determination theory, proposed by the psychologists Edward Deci and Richard Ryan (2000), among others. The theory proposes that understanding motivation requires taking into account three basic human needs:

- autonomy—the need to feel free of external constraints on behavior
- competence—the need to feel capable or skilled
- relatedness—the need to feel connected or involved with others

Note that these needs are all psychological, not physical; hunger and sex, for example, are not on the list. They are also about personal growth or development, not about deficits that a person tries to reduce or eliminate. Unlike food (in behaviorism) or safety (in Maslow's hierarchy), you can never get enough of autonomy, competence, or relatedness. You (and your students) will seek to enhance these continually throughout life

The key idea of self-determination theory is that when persons (such as you or one of your students) feel that these basic needs are reasonably well met, they tend to perceive their actions and choices to be intrinsically motivated or "self-determined". In that case they can turn their attention to a variety of activities that they find attractive or important, but that do not relate directly to their basic needs. Among your students, for example, some individuals might read books that you have suggested, and others might listen attentively when you explain key concepts from the unit that you happen to be teaching. If one or more basic needs are not met well, however, people will tend to feel coerced by outside pressures or external incentives. They may become preoccupied, in fact, with satisfying whatever need has not been met and thus exclude or avoid activities that might otherwise be interesting, educational, or important. If the persons are students, their learning will suffer.

Self-determination and Intrinsic Motivation

In proposing the importance of needs, then, self-determination theory is asserting the importance of intrinsic motivation. The self-determination version of intrinsic motivation emphasizes a person's perception of freedom, rather than the presence or absence of "real" constraints on action. Self-determination means a person feels free, even if the person is also operating within certain external constraints. In principle, a student can experience self-determination even if the student must, for example, live within externally imposed rules of appropriate classroom behavior. To achieve a feeling of self-determination, however, the student's basic needs must be met—needs for autonomy, competence, and relatedness. In motivating students, then, the bottom line is that teachers have an interest in helping students to meet their basic needs, and in not letting school rules or the teachers' own leadership styles interfere with or block satisfaction of students' basic needs.

Using Self-determination Theory in the Classroom

What are some teaching strategies for supporting students' needs? Educational researchers have studied this question from a variety of directions, and their resulting recommendations converge and overlap in a number of ways. For convenience, the recommendations can be grouped according to the basic need that they address, beginning with the need for autonomy. A major part of supporting autonomy is to give students choices wherever possible (Ryan & Lynch, 2003). The choices that encourage the greatest feelings of self-control, obviously, are ones that are about relatively major issues or that have relatively significant consequences for students, such as whom to choose as partners for a major group project. But choices also encourage some feeling of self-control even when they are about relatively minor issues, such as how to organize your desk or what kind of folder to use for storing your papers at school. It is important, furthermore, to offer choices to all students, including students needing explicit directions in order to work successfully; avoid reserving choices for only the best students or giving up offering choices altogether to students who fall behind or who need extra help. All students will feel more self-determined and therefore more motivated if they have choices of some sort. Teachers can also support students' autonomy more directly by minimizing external rewards (like grades) and comparisons among students' performance, and by orienting and responding themselves to students' expressed goals and interests.

A second strategy for using self-determination theory is to support students' needs for competence. The most obvious way to make students feel competent is by selecting activities which are challenging but nonetheless achievable with reasonable effort and assistance (Elliott, McGregor, & Thrash, 2004). There are some strategies that are generally effective even if you are not yet in a position to know the students well. One is to emphasize activities that require active response from students. Sometimes this simply means selecting projects, experiments, discussions and the like that require students to do more than simply listen. Other times it means expecting active responses in all interactions with students. Another generally effective way to support competence is to respond and give feedback as immediately as possible.

A third strategy for using self-determination theory is to support students' relational needs. The main way of support students' need to relate to others is to arrange activities in which students work together in ways that are mutually supportive, that recognize students' diversity, and minimize competition among individuals. You can, for example, deliberately arrange projects that require a variety of talents; some educators call such activities "rich group work" (Cohen, 1994; Cohen, Brody, & Sapon-Shevin, 2004). As a teacher, you can encourage the development of your own relationships with class members. Your goal, as teacher, is to demonstrate caring and interest in your students not just as students, but as people.

Keeping Self-determination in Perspective

In certain ways self-determination theory provides a sensible way to think about students' intrinsic motivation and therefore to think about how to get them to manage their own learning. A particular strength of the theory is that it recognizes degrees of self-determination and bases many ideas on this reality. Although these are positive features for understanding and influencing students' classroom motivation, some educators and psychologists nonetheless have lingering questions about the limitations of self-determination theory. One is whether merely providing choices actually improves students' learning, or simply improves their satisfaction with learning. Another question is whether it is possible to overdo attention to students' needs—and again there is evidence for both favoring and contradicting this possibility. Too many choices can actually make anyone (not just a student) frustrated and dissatisfied with a choice the person actually does make (Schwartz, 2004).

Target: A Model for Integrating Ideas about Motivation

A model of motivation that integrates many ideas about motivation, including those in this chapter, has been developed by Carole Ames (1990, 1992). The acronym or abbreviated name for the program is TARGET, which stands for six elements of effective motivation:

- Task
- Authority
- Recognition
- Grouping
- Evaluating

- Time

Each of the elements contributes to students' motivation either directly or indirectly.

Task

As explained earlier, students experience tasks in terms of their value, their expectation of success, and their authenticity. The value of a task is assessed by its importance, interest to the student, usefulness or utility, and the cost in terms of effort and time to achieve it. Expectation of success is assessed by a student's perception of the difficulty of a task. Generally a middling level of difficulty is optimal for students; too easy, and the task seems trivial (not valuable or meaningful), and too hard, and the task seems unlikely to succeed and in this sense useless. Authenticity refers to how much a task relates to real-life experiences of students; the more it does so, the more it can build on students' interests and goals, and the more meaningful and motivating it becomes.

Authority

Motivation is enhanced if students feel a degree of autonomy or responsibility for a learning task. Autonomy strengthens self-efficacy and self-determination—two valued and motivating attitudes described earlier in this chapter. Where possible, teachers can enhance autonomy by offering students' choices about assignments and by encouraging them to take initiative about their own learning.

Recognition

Teachers can support students' motivation by recognizing their achievements appropriately. Much depends, however, on how this is done; as discussed earlier, praise sometimes undermines performance. It is not especially effective if praise is very general and lacking in detailed reasons for the praise; or if praise is for qualities which a student cannot influence (like intelligence instead of effort); or if praise is offered so widely that it loses meaning or even becomes a signal that performance has been substandard. Many of these paradoxical effects are described by self-determination and self-efficacy theory (and were explained earlier in this chapter).

Grouping

Motivation is affected by how students are grouped together for their work—a topic discussed in more detail in Chapter 8 ("Instructional Strategies"). There are many ways to group students, but they tend to fall into three types: cooperative, competitive, and individualistic (Johnson & Johnson, 1999). In cooperative learning, a set of students work together to achieve a common goal (for example, producing a group presentation for the class); often they receive a final grade, or part of a final grade, in common. In competitive learning, students work individually, and their grades reflect comparisons among the students (for example, their performances are ranked relative to each other, or they are "graded on a curve"). In individualistic learning, students work by themselves, but their grades are unrelated to the performance of classmates. Research that compares these three forms of grouping tends to favor cooperative learning groups, which apparently supports students' need for belonging—an idea important in self-determination theory discussed earlier in this chapter.

Evaluation

Grouping structures obviously affect how students' efforts are evaluated. A focus on comparing students, as happens with competitive structures, can distract students from thinking about the material to be learned, and to focus instead on how they appear to external authorities; the question shifts from "What am I learning?" to "What will the teacher think about my performance?" A focus on cooperative learning, on the other hand, can have doubleedged effects: students are encouraged to help their group mates, but may also be tempted to rely excessively on others' efforts or alternatively to ignore each other's contributions and overspecialize their own contributions. Some compromise between cooperative and individualistic structures seems to create optimal motivation for learning (Slavin, 1995).

Time

As every teacher knows, students vary in the amount of time needed to learn almost any material or task. Accommodating the differences can be challenging, but also important for maximizing students' motivation. School days are often filled with interruptions and fixed intervals of time devoted to non-academic activities—facts that make it difficult to be flexible about granting individuals different amounts of time to complete academic tasks. Nonetheless a degree of flexibility is usually possible: larger blocks of time can sometimes be created for important activities (for example, writing an essay), and sometimes enrichment activities can be arranged for some students while others receive extra attention from the teacher on core or basic tasks.

Chapter Summary

Motivation—the energy or drive that gives behavior direction and focus—can be understood in a variety of ways, each of which has implications for teaching. One perspective on motivation comes from behaviorism, and equates underlying drives or motives with their outward, visible expression in behavior. Most others, however, come from cognitive theories of learning and development. Motives are affected by the kind of goals set by students—whether they are oriented to mastery, performance, failure-avoidance, or social contact. They are also affected by students' interests, both personal and situational. And they are affected by students' attributions about the causes of success and failure—whether they perceive the causes are due to ability, effort, task difficulty, or luck.

A major current perspective about motivation is based on self-efficacy theory, which focuses on a person's belief that he or she is capable of carrying out or mastering a task. High self-efficacy affects students' choice of tasks, their persistence at tasks, and their resilience in the face of failure. It helps to prevent learned helplessness, a perception of complete lack of control over mastery or success. Teachers can encourage high self-efficacy beliefs by providing students with experiences of mastery and opportunities to see others' experiences of mastery, by offering well-timed messages persuading them of their capacity for success, and by interpreting students' emotional reactions to success, failure and stress.

An extension of self-efficacy theory is self-determination theory, which is based on the idea that everyone has basic needs for autonomy, competence, and relatedness to others. According to the theory, students will be motivated more intrinsically if these three needs are met as much as possible. A variety of strategies can assist teachers in doing so. One program for doing so is called TARGET; it draws on ideas from several theories of motivation to make practical recommendations about motivating students.

Key Terms

Albert Bandura

Attributions of success or failure

Autonomy, need for

Behaviorist perspective on motivation

Competence, need for

Failure-avoidant goals

Intrinsic motivation

Jigsaw classroom

Learned helplessness

Mastery goals

Motivation Need for relatedness

Performance goals

Personal interests

Self-determination theory

Self-efficacy

Situational interests

TARGET

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Further Resources

This page lists several materials and links [https://edtechbooks.org/-pPa] related to motivating students in classroom situations.

Sociocultural Perspectives on Learning

Allman, B. , Casto, A. , & Polly, D.

Cognitive Development | Collaboration | Learning Design
Lev Vygotsky | Sociocultural Learning
Zone of Proximal Development

Modern sociocultural learning theories stem from the work of Russian psychologist Lev Vygotsky. When examining learning theories, LIDT professionals should consider the role culture, interaction, and collaboration have on quality learning. We propose a set of principles to guide the design of learning experiences. We provide examples of applications and environments that promote deep and meaningful learning.

When examining learning theories, LIDT professionals should consider **sociocultural** perspectives and the role culture, interaction, and collaboration have on quality learning.

Modern sociocultural learning theories stem from the work of Russian psychologist Lev Vygotsky. Vygotsky noticed the **dynamic interdependence** of social and individual psychological processes and recognized the role social interactions, language, and culture play in developing higher-order thinking skills. Although Vygotsky's views are considered primarily developmental, they have practical implications for learners of all ages (Kozulin, 1990). Most recently, Vygotsky's and other sociocultural scholars' work have led to new approaches to learning, teaching, and instructional and learning design.

In this chapter, we first review the sociocultural theory's central tenets. We then propose a set of principles informed by sociocultural perspectives to guide the design of learning experiences. We also provide examples of applications and environments that promote deep and meaningful learning.

Sociocultural Perspectives On Learning

Three themes can be identified within Vygotsky's view of sociocultural learning: (a) learning is inherently a social process, (b) psychological tools mediate learning, and (c) learning occurs within the **Zone of Proximal Development** and can be supported by assistance from others.

Learning Is Inherently a Social Process

Proponents of sociocultural theory contend that thinking has social origins and social interactions play a critical role in developing higher-order thinking skills and learning (Vygotsky, 1978). Learners adopt socially shared experiences and acquire strategies and knowledge as they work with others on various tasks (Scott & Palincsar, 2013). While working together toward a common goal, such as solving a problem, learners seek to understand the problem, search for possible solutions, share multiple perspectives, negotiate meaning, and potentially come up with a mutually-satisfying solution. During this process, they gain a deeper understanding of issues related to the problem, including the knowledge of needed facts, theories, processes, and activities associated with the discipline. They use relevant terminology and discourse and practice valuable soft skills and strategies. This type of learning reflects a "transformation of participation in a sociocultural activity" rather than a traditional transmission of discrete cultural knowledge or skills (Matusov, 2015, p. 315).

In addition to learning being social in origin and participatory in character, Vygotsky believed that cognitive development, and learning, in particular, cannot be fully understood without considering the social, cultural, and historical context within which it is embedded (Vygotsky, 1978). Social structures determine people's working conditions and interactions, shaping their cognition, beliefs, attitudes, and perception of reality (Vygotsky, 1978). The opposite is also true. People influence, adjust and transform social structures and their environment. The bidirectional nature of individuals and their context has important implications for learning design and research, highlighting the need to focus on the activity rather than on the sequestered individual. As we design and research learning experiences, we need to consider the participants (the learner, peers, the teacher) and their roles, available tools, artifacts to be used and created, as well as the community with its rules (Engeström, 2015).

Psychological Tools Mediate Learning

Another key aspect of sociocultural theory is the role tools play in the learning process. Vygotsky reasoned that social and individual work is mediated by signs or **semiotics**, such as language, systems of counting, conventional signs, works of art, and such (McLeod, 2022). These tools facilitate social and individual functioning. They also support meaning-making and co-construction of knowledge (Vygotsky, 1978).

Appropriation, a process where an individual adopts these socially available psychological tools to assist future independent problem solving, plays a vital role in learning (John-Steiner & Mahn, 1996). Learners do not need to reinvent already existing tools to be able to use them. They only need to be introduced to how a particular tool is used, and then they can apply it across various situations solving new problems (Scott & Palincsar, 2013).

Vygotsky viewed language as the most powerful tool at our disposal, the ultimate collection of symbols that emerge within a culture (Vygotsky, 1986). Language as a form of symbolic mediation assists with two critical roles: (a) communicating with others and (b) facilitating our cognitive development. Using language as a tool for thinking enables us to add meaning to our experiences, organize our thoughts, construct logical meaning, and develop broad and abstract concepts (McLeod, 2022).

Learning Occurs Within the Zone of Proximal Development

The most widely applied Vygotskian sociocultural concept is the **Zone of Proximal Development (ZPD)**, which is “the difference between what a learner can do without help and what he or she can achieve with guidance and encouragement from a skilled partner” (McLeod, 2019). For learning to be most effective, ZPD should be matched with an individual’s developmental level and be slightly beyond their capability. See Figure 1.

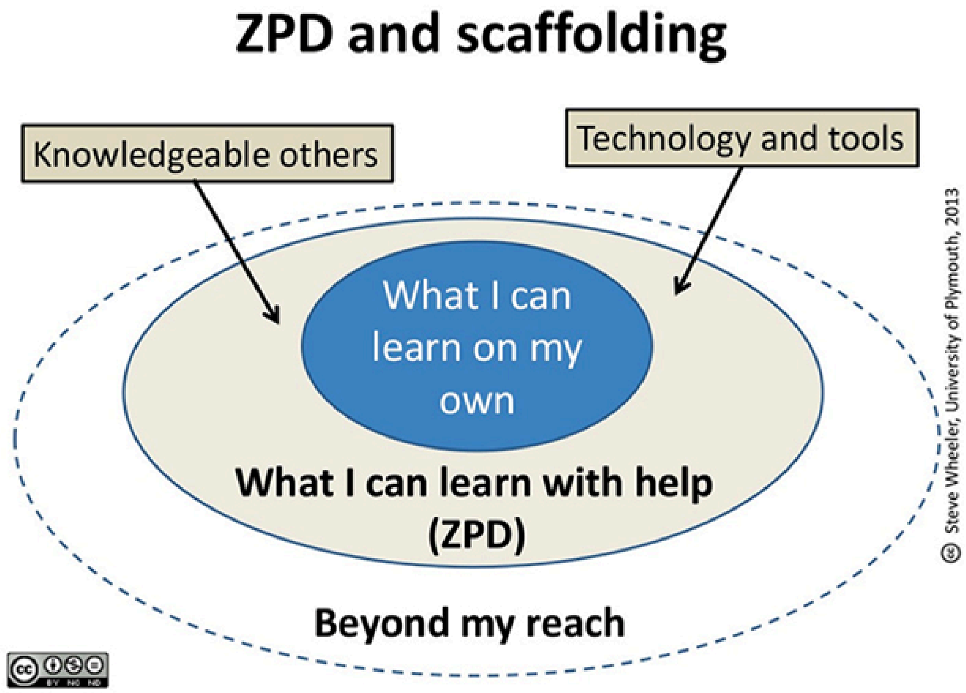


Figure 1. *Learning in the Zone of Proximal Development. From "Vygotsky's Sociocultural Theory of Cognitive Development," by S. Mcleod, 2019, SimplyPsychology (https://www.simplypsychology.org/vygotsky.html). CC BY-ND 2013 by Steve Wheeler, University of Plymouth.*

In practice, work within the ZPD can be done through productive interactions. Through **guided participation**, learners actively acquire new valuable skills and capabilities as they engage in a meaningful collaborative activity with an assisting, more experienced other (Rogoff, 1990). The notion of instructional **scaffolding** is also related to learning in the ZPD. Scaffolding is any support provided to a learner throughout the learning process to help them complete a task within the ZPD. The types and the extent of support provided are based on performance needs and should be gradually removed as the learner becomes more confident and capable of completing the task independently (Miller, 2011).

Ideas such as ZPD, guided participation, and scaffolding bring to light a fundamentally different view of an instructor who serves as a facilitator of learning rather than a fount of knowledge. Likewise, the learner takes on more responsibilities, such as actively collaborating in the learning process, determining their learning goals, and becoming a resource of knowledge for peers (Grabinger et al., 2007). This shift in roles promotes individualized, differentiated, and learner-centered instruction. When paired with effective **pedagogical** practices, it can become a powerful alternative for reforming current educational systems and creating environments where many different individuals develop a deep understanding of important subjects (Watson & Reigeluth, 2016).

Strengths and Limitations of Sociocultural Theory

The sociocultural theory has several widely recognized strengths. First, it emphasizes any human activity's broader social, cultural, and historical context. It does not view individuals as isolated entities; instead, it provides a richer perspective, focusing on the fluid boundary between self and others. It portrays the dynamic of a learner acquiring knowledge and skills from society and then shaping their environment (Miller, 2011).

Second, the sociocultural theory is sensitive to individual and cross-cultural diversity. In contrast to many other **universalist theories**, sociocultural theory acknowledges differences in individuals within and across cultures. Moreover, it recognizes that “different historical and cultural circumstances may encourage different developmental routes to any given developmental endpoint” depending on particular social or physical circumstances and tools available (Miller, 2011, p. 198).

Finally, sociocultural theory contributes to our theoretical understanding of cognitive development by integrating the notions of learning and development. The idea of learning driving development rather than learning being determined by the learner’s developmental level fundamentally changes our understanding of the learning process and has significant instructional and educational implications (Miller, 2011).

There are also limitations to the sociocultural perspective. The first relates to Vygotsky’s premature death, as many of his theories remained incomplete. Additionally, his work was largely unknown until relatively recently for political reasons and issues with translation. The second major limitation is associated with the vagueness of the ZPD theory. For example, the zone varies among individual learners and differs for an individual across different learning domains and time. Additionally, there is no standard metric scale to measure it. Finally, some constructs within the theory may not be as applicable to all cultures as initially thought. For example, since scaffolding heavily depends on verbal instruction, it may not be equally effective in all cultures and for all types of learning (Rogoff, 1990).

Learning Check

(MC) According to Vygotsky's theory of Zone of Proximal Development (ZPD), for learning to be most effective

- [ ] the rigor of a lesson must be matched to a student’s IQ score
- [ ] ZPD should be matched with an individual’s developmental level and be slightly beyond their capability
- [ ] support should be provided to a learner to help them complete a task outside their ZPD.

(T/F) Learner-centered instruction paired with effective pedagogical practices may lead to learning environments where many different individuals may simultaneously develop a deep understanding of important subjects.

- [ ] True
- [ ] False

(MC) One possible shortcoming of sociocultural perspectives on learning is that it

- [ ] emphasizes the broader social, cultural, and historical context of any human activity
- [ ] promotes the idea that learning is purely determined by the learner's developmental level
- [ ] is an "incomplete" theory that may not be consistent across all cultures or situations

Read and Reflect

Consider a learning experience that you participated in as a learner. How can you understand this experience based on sociocultural views of learning? For example, how did you learn through interaction with others or through cultural tools? What aspects of the experience were beneficial? How could sociocultural aspects have been applied to improve the learning experience?

Principles to Guide Design of Learning Experiences

The concepts reviewed above emphasize the importance of always considering the learners and their context, orchestrating collaborative learning in communities, providing assistance to support learning, and promoting active participation.

Consider the Learner in Context

Sociocultural theory and related perspectives focus on the learner within their social, cultural, and historical context as an essential part of sound pedagogical solutions that facilitate the development of critical thinking and lifelong learning (Grabinger et al., 2007). Likewise, sociocultural perspectives of instructional design recognize how learners construct their personal meanings of material, with the primary goal of engaging in **authentic context**s that help develop transferable skills and knowledge (Grabinger et al., 2007). To do so, instructional designers must take into account learner diversity and encourage learning in authentic contexts.

Account for Individual and Cross-Cultural Differences

Most instructional design models consider an isolated concept of the learner. However, a strong call has recently been issued for a complete shift in our education and instructional design approaches to reflect our society's changing educational needs (Watson & Reigeluth, 2016). More contemporary design approaches, such as Universal Design for Learning, recognize that every learner is unique and influenced by his or her embedded context. These approaches strive to provide challenging and engaging curricula for diverse learners while designing for the social influences surrounding them.

Another implication based on Vygotskian views of learning is acknowledging individual and cross-cultural differences in learning and development. As instructional designers, we should be more sensitive to diversity in learners and recognize that a large amount of research has been done on white, middle-class individuals associated with Western tradition. The resulting understanding of development and learning often incorrectly assumes universality. Realizing that "ideal thinking and behavior may differ for different cultures" and that "different historical and cultural circumstances may encourage different developmental routes to any given developmental endpoint" may prevent incorrect universalist views of all individuals and allow for environments that value diversity as a resource (Miller, 2011, p. 198).

Additionally, recognizing learners as individuals involves considering their autonomy in addition to appreciating their identities and social contexts. As teachers function more as facilitators than masters of knowledge, learners have increased opportunities to develop their goals, identify their learning pathways, and even contribute to making assessment decisions. Compared to a more traditional model in which the decisions for learning rest with the teacher, sociocultural perspectives advocate for involving learners in the decision-making processes of "what to learn, how to study, and which [instructional] resources to use" (Grabinger et al., 2007, p. 7).

Encourage Learning in Authentic Contexts

An **authentic context** is a scenario the learners may experience in real life. Learning within authentic contexts provides learners with opportunities to experience daily practice and explore realistic problems. Authentic activities contextualize learning and allow for a diverse application of skills and knowledge within real-world scenarios. Students' backgrounds, cultures, and locations should be considered when identifying contexts for social learning experiences. For example, authentic contexts for learners on the Florida coast differ from those in a rural town in the midwestern United States. As a result, the development of curriculum, instructional materials, and resources for learning experiences cannot be a one-size-fits-all approach. Instead, it should provide opportunities for teachers to modify the activities to ensure authenticity for their students.

An example of collaborative learning in authentic contexts is **anchored instruction**, which focuses on developing knowledge and skills through collaborative problem-solving experiences. Typically presented in a narrative format, anchored learning begins with the “anchor,” or a story in which the problem is set, and uses multimedia outlets to allow learners to explore the problem (Bransford et al., 1990). As learners collaborate and engage with the material, the teacher becomes a coach and guides them in developing creative solutions to complex problems.

Learning Check

(T/F) The education field’s collective understanding of learning development often incorrectly assumes universality due to the inequitable amount of research that has been done on white, middle-class individuals associated with Western tradition.

- ☐ True
- ☐ False

(T/F) Anchored instruction allows learners to engage in collaborative problem solving within learning contexts that provide for connection-building across the curriculum in order to develop meaning.

- ☐ True
- ☐ False

(MC) In her university class, Susan has been asked to write an essay on an important lesson learned in high school. However, Susan was homeschooled, attending a virtual high school part-time, supplemented with material from her parents. She is not sure how to approach the assignment. According to sociocultural learning theory, why is this assignment not working for Susan? (Select all that apply)

- ☐ the teacher assumed that one approach to learning was universal for all of the students
- ☐ the assignment is not authentic because it is not related to the student’s real experiences
- ☐ there were no choices for Susan in writing this essay.

Orchestrate Collaborative Learning in Communities

Sociocultural perspectives value learning through interaction, negotiation, and collaboration as learners solve authentic problems, emphasizing learning from experience and dialogue. The principles of collaborative practice go beyond social constructivism and cooperative learning by situating learning activities within **communities of practice** where novices and experts work and learn together. Collaborative learning environments encourage learners to think critically and apply knowledge and skills as they explore and solve problems embedded in real-life situations (Reeves et al., 2002). It promotes contextualization of learning in simulating practical problems, developing cultural skills through guided participation, and using language to communicate and internalize learning. Furthermore, “in interactive and collaborative instructional contexts, individuals have an opportunity for perspective taking and reflective thinking that may lead to higher levels of cognitive, social, and moral development, as well as self-esteem” (APA Work Group, 1997, p. 6).

Teachers, trainers, and facilitators guide and support collaborative efforts as they help learners make sense of the problems, ask questions that promote deep understanding, and scaffold learning with tools and resources. When designing collaborative learning experiences, it is critical to foster learning in communities of practice, engage all learners, and facilitate collaboration.

Foster Learning in Communities of Practice

As instructional designers and educators plan collaborative learning experiences, they should find ways to help establish and foster communities of practice that enhance learning. Wenger (1998) identified **communities of practice** as groups of individuals who are engaged with each other on a shared project or focus and who share similar skills.

Approaches grounded in sociocultural theory attend to the discourse, norms, and practices associated with a particular community of practice and believe these are key to successful learning (Scott & Palincsar, 2013). As learners and those facilitating learning engage in authentic practices within the target context in communities, learning and transfer of knowledge and skills occur naturally and on deeper levels (Lave & Wenger, 1991). “People who use tools actively rather than just acquire them, by contrast, build an increasingly rich implicit understanding of the world in which they use the tools and of the tools themselves” (Brown et al., 1989, p. 33).

Community of inquiry is an instructional design framework for creating and supporting educational communities where groups of learners actively engage in constructing understanding. It provides valuable guidance about what elements and processes may be necessary when designing successful community-based learning experiences.

Learn More About the Community of

Inquiry Model

[Watch on YouTube](https://edtechbooks.org/-jczw)

XRP News. (2021, June 8). Community of inquiry model simply explained: Inquiry-based learning. [Video]. YouTube. https://edtechbooks.org/-jczw

Engage All Learners

Learners of all ages benefit from understanding expectations for a collaborative activity. Having clear goals and establishing rules for interaction provide support. The acronym PIES represents features of collaborative learning (Kagan, 1999) that instructional designers and teachers could utilize to support successful collaboration:

- **Positive interdependence** – the work that the group does is greater than if each individual worked alone.
- **Individual accountability** – each learner is responsible for some aspects of the work; participants should have a sense of shared authority over the process.
- **Equal participation** – a fair share of work is required; all participants should actively collaborate to co-construct understanding.
- **Simultaneous interaction** – learners are working together simultaneously instead of working on their own on separate pieces that are compiled at the end.

When creating learning experiences for adults, the tasks must be complex enough to foster positive interdependence and hold individuals accountable. Adult learners and more experienced younger collaborators may be able to organize themselves, assuming their roles and distributing tasks naturally. Instructional designers and teachers who prepare collaborative learning experiences for younger children or less experienced collaborators may consider supporting equal participation by assigning specific roles within learning teams (i.e., leader/facilitator, recorder, timekeeper, spokesperson).

Such support helps establish communities of learners who are comfortable working with others across various contexts. It also assists learners from different backgrounds in understanding expectations and learning as they collaborate successfully.

Facilitate Collaboration Online

New technologies enable online collaborative learning experiences, offering significant access, flexibility, and economic advantages. They afford unique ways of interacting within communities of practice, promote synchronous and asynchronous collaboration, and enhance reflective thinking opportunities. Besides affording more democratic participation in the learning process, online technologies also provide a possibility of a greater diversity of participants than in a physical classroom, bringing about more cross-cultural connections to inspire social learning (Garrison & Akyol, 2013; Harasim, 2017).

Higher-order learning that emerges in collaborative learning communities represents both the process and its outcomes. “Its quality and success are strongly influenced by the design features (i.e., the structure, types of interactions, sequences of activities) and the teaching approach (facilitating, mentoring, and guidance to support the integration of ideas into meaningful constructs)” (Allman, 2021, pp. 35-36) and must be carefully orchestrated. Two process-oriented models help instructional designers intentionally design critical discourse interaction opportunities necessary for meaningful learning: **online collaborative learning theory** (Harasim, 2017) and **the practical inquiry process** (Garrison & Akyol, 2013). Although intended for online learning, understanding these processes makes creating effective collaborative learning experiences possible in any environment (i.e., online, blended, technology-mediated, in-person).

Learn More About the Online Collaborative Learning Theory

Online Collaborative Learning Theory

[Watch on YouTube](https://edtechbooks.org/-qbTw)

McDowell, K. (2019, June 3). Online collaborative learning theory. [Video]. YouTube. https://edtechbooks.org/-qbTw

Learn More About the Practical Inquiry Process

Quick-Tip: The 4 simple steps of a practical-inquiry proce

Watch on YouTube

Teaching Online. (2022, March 6). Quick-tip: The 4 simple steps of a practical-inquiry process for deep topic engagement. [Video]. YouTube. https://edtechbooks.org/-AdFB

Learning Check

(T/F) Community of inquiry framework provides valuable guidance about what elements and processes may be necessary when designing and enacting successful community-based learning experiences.

- [ ] True
- [ ] False

(T/F) According to Kagan's PIES features of collaborative learning, learners have a greater potential to achieve more working individually than as a group.

- [ ] True
- [ ] False

(MC) Which of the following is NOT a shared characteristic among communities of practice:

- [ ] Situated cognition developed from interacting with others in real-life contexts
- [ ] Mutual engagement built from established norms
- [ ] Joint enterprise created by a shared understanding of what binds the group

Provide Assistance to Support Learning

As teachers and instructional designers create learning experiences for interaction, they need to strategically embed opportunities for assistance to support learning within the ZPD. The assistance of the more knowledgeable other, whether it is a teacher or peer, and the support through embedded scaffolds and technology, enable the learner to stretch their ability, learn beyond what they could do on their own, and develop skills and strategies they will eventually apply independently in other situations (Vygotsky, 1978).

Support Through Scaffolding

Instructional scaffolding can be embedded or contingent. **Embedded (hard) scaffolding** is any structure prepared ahead of the learning task that is expected to be difficult. The teacher or instructional designer anticipates points of difficulty and provides ways to support the learners. This can be as simple as building on prior knowledge, pre-teaching key vocabulary at the beginning of a lesson, using visual aids and graphic organizers, conducting checks for understanding, and revisiting key ideas strategically during the lesson. It can also be modeling valuable strategies such as think-aloud or mind maps and encouraging learners to use them effectively.

Embedded scaffolds could be used to support performance during assessments by providing clear instructions, rubrics, practice, and examples. In the case of digital learning experiences, scaffolds are not necessarily provided by individuals but may be embedded into the experience using technology. For example, **Learning Management Systems** (LMSs) help organize lesson content, activities, and assessments. Alternatively, think about how the multimedia content, learning checks, and examples from practice embedded in this chapter support your learning of the content.

Teachers and instructional designers should also create space and opportunities for **contingent (soft) scaffolding**. This type of support varies based on the individual learner's needs during the instructional event. The expert motivates and guides the learner by providing just enough assistance, modeling, and highlighting critical features of the task while continually evaluating and adjusting supports as needed. The dynamic nature of interaction enables both the learner and the one providing the scaffold to influence each other and adjust their behavior as they collaborate. Typically, the expert is the teacher, but it could also be a peer or a group of peers collaboratively working together (reciprocal scaffolding). Each group member has their own experiences, knowledge, and understanding. As they work together on a shared task, they learn from each other and actively assist those that may need support. Technology tools, such as adaptive learning technologies and intelligent-tutoring systems, could also provide flexible assistance that meets learners' specific needs and is dynamically responsive.

Utilize Technology to Enhance Learning

Technology can provide support for learning in the classroom in many valuable ways. Through current and emerging online collaborative spaces (e.g., Google tools, Microsoft Teams, Zoom, wikis) as well as hands-on collaborative technology in the classroom (SMART tablets and iPads), students have robust opportunities to experience meaningful collaborative learning that embody the tenets of sociocultural learning (Polly, 2011). In addition, technological and online tools can assist with more effective communication, realistic simulations of real-world problem scenarios, and even greater flexibility when seeking to scaffold instruction within learners' ZPD.

Digital tools can make learning more visible for both the learner and the teacher and create a space for reflection and improvement (Mercer et al., 2019). Embracing technology within collaborative learning can also foster an equal distribution of voices compared to in-person groupings (Deal, 2009), providing opportunities for active participation for all students. Using technology to support the implementation of social learning theories in the classroom, students experience collaboration while refining 21st-century skills.

While the array of technology available to support social learning is beneficial, the volume of resources available for technology-based collaboration may be overwhelming to some groups of students. Therefore, incorporating different types of scaffolding based on individual class needs may be appropriate to ensure technology is used productively. In addition, by providing students with resources and being explicit about technology use, students may focus better on the actual problem-solving task rather than wrestling with technical issues.

Learning Check

(T/F) When scaffolding instruction, it is important for teachers to remove all levels of support when learners are stuck and unable to continue with the task.

- ☐ True
- ☐ False

(T/F) Utilizing different technological and online tools can lead to greater classroom equity by fostering an equal distribution of voices and providing greater flexibility when seeking to scaffold instruction within students' ZPD.

- ☐ True
- ☐ False

(MC) Instructional designers should consider providing assistance in technology-mediated contexts for these reasons, EXCEPT

- ☐ Second-language learners do not need assistance with technology as they are still learning the language
- ☐ the volume of resources available for online and in-person technology-based collaboration may be overwhelming to some students
- ☐ it ensures that technology is used productively
- ☐ it helps students focus on learning

Promote Active Learning

Humans are naturally curious and inquisitive beings. Therefore, instructional designers and teachers should take advantage and strive to increase engagement and active participation as they create meaningful learning experiences. Several instructional approaches may be employed to provide students with more agentive and autonomous roles in the learning process. **Dialogic teaching**, inquiry-based approaches, and **flipped classroom** models are a few such methods that place students in the nucleus of activity in the classroom.

Encourage Teaching Through Dialogue

Dialogic teaching is an approach where learning takes place through dialogue between the teacher and students. It harnesses the power of language to exchange ideas, facilitate thinking, and co-construct understanding (Mercer et al., 2019). The teacher and students learn together. They share ideas, listen to each other, and consider alternative viewpoints. All learners are encouraged to participate and explain, explore, analyze, evaluate, justify, and question. They build on each other's ideas and connect them into coherent and deepening lines of inquiry. Teachers talk less to give information but carefully listen to assess students' understanding and assist their learning by restating, asking questions, and probing beyond simple recall. With a specific learning goal in view, they encourage learners to think, conceptualize ideas differently, and extend their understanding.

Learn More About Dialogic Learning

Dialogic teaching introduction

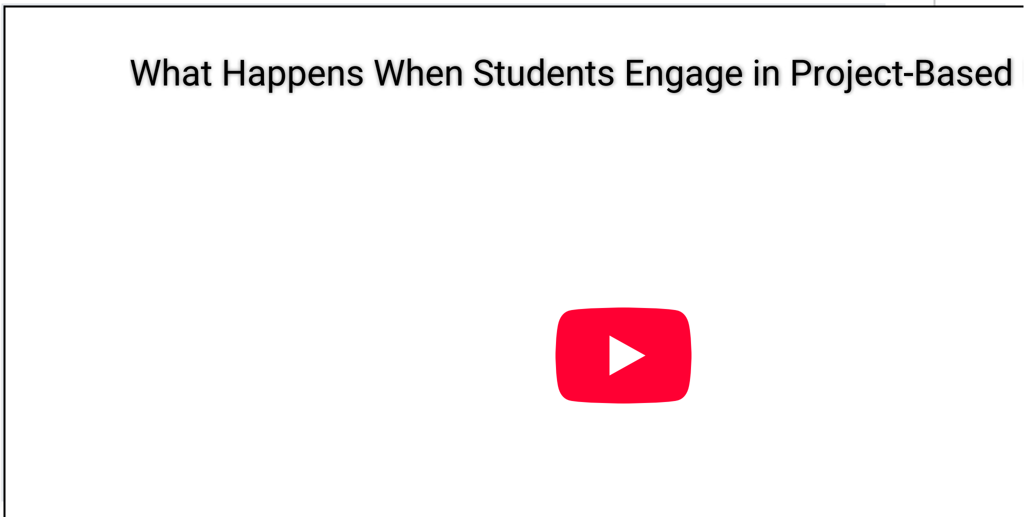
[Watch on YouTube](https://edtechbooks.org/-KwoS)

Kemp, B. (2020, June 24). Dialogic teaching introduction. [Video] YouTube. https://edtechbooks.org/-KwoS

Nurture Inquiry

Inquiry-based approaches actively engage learners as they explore and solve authentic, complex problems through dialogue in collaborative learning environments. As students work together and conduct an inquiry, they learn content and apply their skills and knowledge. Three similar approaches that differ in focus and scope offer ways to design learning through inquiry: inquiry-based learning, problem-based learning, and project-based learning.

Learn More About Project-Based Learning



[Watch on YouTube](https://edtechbooks.org/-foCz)

Spencer, J. (2019, August 20). What happens when students engage in project-based learning? [Video]. YouTube. https://edtechbooks.org/-foCz

Flipped Learning

The **flipped classroom** is one way to maximize students' learning engagement. In a flipped classroom, students prepare for an upcoming lesson by learning content and watching instructional videos before class. Instead of using the class time for lecture and other passive knowledge and skill acquisition methods, students participate in active and social learning activities, a key component of sociocultural theories. Being able to prepare before class is a great equalizer.

Flipped learning enables students with diverse needs to spend as much time preparing as needed, using strategies to access the content and learn. They can use dictionaries or translation to access information and learn the language. They can pause, rewind, reread, and reflect on their learning as it is happening, a phenomenon that rarely occurs during a lecture given in class and in real-time (Educause, 2012; Brame, 2013). Preparing before class enables students to spend more time communicating about the subjects in meaningful ways, constructing knowledge with hands-on activities during class, and gaining a deeper understanding of the content (Educause, 2012).

Learn More About Flipped Learning Model

What Is Flipped Learning?

Watch on YouTube

Common Sense Education. (2016, July 12). What is flipped learning? [Video]. YouTube. https://edtechbooks.org/-uRhA

Learning Check

(MC) Dialogic learning approach enables (select all that apply)

- [ ] teacher and students learning together

- [ ] teachers to talk more to give information
- [ ] learners to consider alternate viewpoints
- [ ] teachers to assess students' understanding

(T/F) Inquiry-based approaches actively engage learners in exploration and solving authentic, complex problems in collaborative learning environments.

- [ ] True
- [ ] False

(T/F) The flipped classroom model enables learners with diverse needs to spend as much time as needed preparing to access the content and learn.

- [ ] True
- [ ] False

Summary

The notion of social origins of learning, the interrelationship of language and thought, and the Zone of Proximal Development are Vygotsky's most important contributions. Practical applications of sociocultural theory emphasize creating learner-centered instructional environments in authentic contexts, where learning by discovery, inquiry, active problem solving, and critical thinking are fostered through dialogue and collaboration with experts and peers in communities of learners. Encouraging self-directed lifelong learning habits, presenting authentic and cognitively challenging tasks, scaffolding learners' efforts, and providing authentic and dynamic assessment opportunities are all important aspects of this approach.

Sociocultural principles can be applied in effective and meaningful ways to design instruction across the curriculum for learners of different ages and various skills. They can be effectively integrated using a wide range of technologies and learning environments. The challenge remains for educators and instructional designers to elevate our practices from efficient, systemic teaching and instructional design approaches to a focus on individual learners and effective pedagogical practices that foster empowered learners ready to successfully negotiate the rapidly changing era of information. Technology is at our fingertips, and it is up to us to competently implement its unique affordances to promote new ways to educate and support deep, meaningful, and self-directed learning. Grounding our practices in sociocultural theory can significantly aid our efforts.

Think About It!

Consider what are common aspects of learning experiences that have been influenced by sociocultural views of learning? What are some advantages of designing learning experiences based on sociocultural views of learning?

Editor's Note

To read more on this topic, see the chapter titled "Sociocultural Perspectives of Learning" published in the first edition of this textbook.

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What is a Community?

A Framework To Guide Research and Practice

West, R. E. & Williams, G.

Community Development Education Technology

Learning Communities

Because learning communities are so important to student learning and satisfaction, clear definitions that enable sharing of best practices are essential. By clarifying our understanding and expectations about what we hope students will be able to do, learn, and become in a learning community, we can more precisely identify what our ideal learning community would be like and distinguish this ideal from the less effective/efficient communities existing in everyday life and learning. In this chapter we discuss definitions for four potential boundaries of a learning community. Two of these can be observed externally: access (Who is present physically or virtually?) and function (Who has

been organized specifically to achieve some goal?). Two of these potential boundaries are internal to the individuals involved and can only be researched by helping participants describe their feelings and thoughts about the community: relationships (Who feels connected and accepted?) and vision (who shares the same mission or purpose?).

Editor's note

The following article was first published under an open license in *Educational Technology Research and Development* with the following citation:

West, R. E. & Williams, G. (2018). I don't think that word means what you think it means: A proposed framework for defining learning communities. *Educational Technology Research and Development*. Available online at https://edtechbooks.org/-hA.

A strong learning community "sets the ambience for life-giving and uplifting experiences necessary to advance an individual and a whole society" (Lenning and Ebbers, 1999); thus the learning community has been called "a key feature of 21st century schools" (Watkins, 2005) and a "powerful educational practice" (Zhao & Kuh, 2004). Lichtenstein (2005) documented positive outcomes of student participation in learning communities such as higher retention rates, higher grade point averages, lower risk of academic withdrawal, increased cognitive skills and abilities, and improved ability to adjust to college. Watkins (2005) pointed to a variety of positive outcomes from emphasizing the development of community in schools and classes, including higher student engagement, greater respect for diversity of all students, higher intrinsic motivation, and increased learning in the areas that are most important. In addition, Zhao and Kuh (2004) found learning communities associated with enhanced academic performance; integration of academic and social experiences; gains in multiple areas of skill, competence, and knowledge; and overall satisfaction with the college experience.

Because of the substantial learning advantages that research has found for strong learning communities, teachers, administrators, researchers, and instructional designers must understand how to create learning communities that provide these benefits. Researchers and practitioners have overloaded the literature with accounts, studies, models, and theories about how to effectively design learning communities. However, synthesizing and interpreting this scholarship can be difficult because researchers and practitioners use different terminology and frameworks for conceptualizing the nature of learning communities. Consequently, many become confused about what a learning community is or how to measure it.

In this chapter we address ways learning communities can be operationalized more clearly so research is more effective, based on a thorough review of the literature described in our other article (West & Williams, 2017).

Defining Learning Communities

Knowing what we mean when we use the word community is important for building understanding about best practices. Shen et al. (2008) concluded, "[H]ow a community of learners forms and how social interaction may foster a sense of community in distance learning is important for building theory about the social nature of online learning" (p. 18). However, there is very little agreement among educational researchers about what the specific definition of a learning community should be. This dilemma is, of course, not unique to the field of education, as rural sociologists have also debated for decades the exact meaning of community as it relates to their work (Clark, 1973); Day & Murdoch, 1993; Hillery , 1955).

In the literature, learning communities can mean a variety of things, which are certainly not limited to face-to-face settings. Some researchers use this term to describe something very narrow and specific, while others use it for broader groups of people interacting in diverse ways, even though they might be dispersed through time and space. Learning communities can be as large as a whole school, or as small as a classroom (Busher, 2005) or even a subgroup of learners from a larger cohort who work together with a common goal to provide support and collaboration (Davies et al., 2005). The concept of community emerges as an ambiguous term in many social science fields.

Perhaps the most frustrating aspect of researching learning communities is the overwhelming acceptance of a term that is so unclearly defined. Strike (2004) articulated this dilemma through an analogy: "The idea of community may be like democracy: everyone approves of it, but not everyone means the same thing by it. Beneath the superficial agreement is a vast substratum of disagreement and confusion" (p. 217). When a concept or image is particularly fuzzy, some find it helpful to focus on the edges (boundaries) to identify where "it" begins and where "it" ends, and then work inward to describe the thing more explicitly. We will apply this strategy to learning communities and seek to define a community by its boundaries.

However, researchers have different ideas about what those boundaries are (Glynn, 1981; Lenning and Ebbers, 1999; McMillan and Chavis, 1986; Royal and Rossi, 1996) and which boundaries are most critical for defining a learning community. In our review of the literature, we found learning community boundaries often defined in terms of participants' sense that they share access, relationships, vision, or function (see Figure 1). Each of these boundaries contributes in various ways to different theoretical understandings of a learning community.

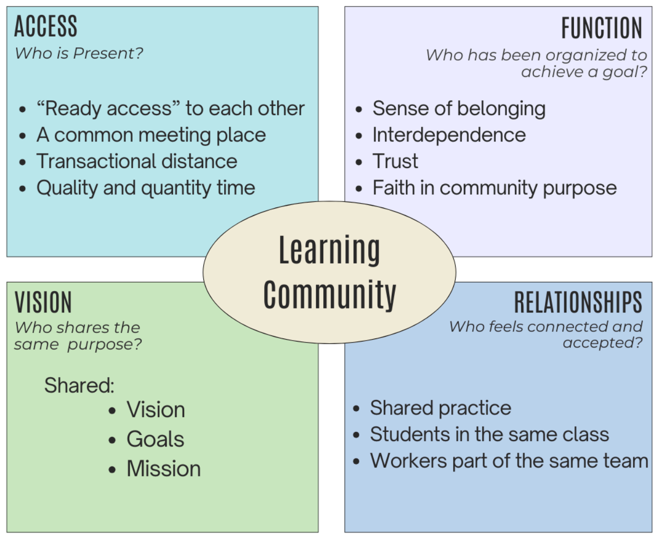

Figure 1. The defining characteristics of learning communities, representing different ways of defining the boundaries of a community

Community Defined by Access

Access might have been at one point the easiest way to define a community. If people lived close together, they were a community. If the children attended the same school or classroom, then they were a school or class community. Some researchers and teachers continue to believe that defining a community is that simple (For example, Kay et al., 2011).

This perception about spatial/geographic communities is common in community psychology research, but also emerges in education when scholars refer to the "classroom community" as simply a synonym for the group of students sitting together. Often this concept is paired with the idea of a cohort, or students entering programs of professional or educational organizations who form a community because they share the same starting time and the same location as their peers.

However, because of modern educational technologies, the meaning of being "present" or having access to one another in a community is blurred, and other researchers are expanding the concept of what it means to be "present" in a community to include virtual rather than physical opportunities for access to other community members.

Rovai et al. (2004) summarized general descriptions of what it means to be a community from many different sources (Glynn, 1981; McMillan, 1996; Royal and Rossi, 1996; Sarason, 1974) and concluded that members of a learning community need to have “ready access” to each other (Rovai et al., 2004). He argued that access can be attained without physical presence in the same geographic space. Rovai (2002) previously wrote that learning communities need a common meeting place, but indicated that this could be a common virtual meeting place. At this common place, members of the community can hold both social and intellectual interactions, both of which are important for fostering community development. One reason why many virtual educational environments do not become full learning communities is that although the intellectual activity occurs in the learning management system, the social interactions may occur in different spaces and environments, such as Twitter and Facebook—thus outside of the potential community.

The negotiation among researchers about what it means to be accessible in a learning community, including whether these boundaries of access are virtual or physical, is still ongoing. Many researchers are adjusting traditional concepts of community boundaries as being physical in order to accommodate modern virtual communities. However, many scholars and practitioners still continue to discuss communities as being bounded by geographic locations and spaces, such as community college math classrooms (Weissman et al., 2011), preservice teachers’ professional experiences (Cavanagh and Garvey, 2012), and music educator PhD cohorts (Shin, 2013). More important is the question of how significant physical or virtual access truly is. Researchers agree that community members should have access to each other, but the amount of access and the nature of presence needed to qualify as a community are still undefined.

Community Defined by Relationships

Being engaged in a learning community often requires more than being present either physically or virtually. Often researchers define learning communities by their relational or emotional boundaries: the emotional ties that bind and unify members of the community (Blanchard et al., 2011). Frequently a learning community is identified by how close or connected the members feel to each other emotionally and whether they feel they can trust, depend on, share knowledge with, rely on, have fun with, and enjoy high quality relationships with each other (Kensler et al. 2009). In this way, affect is an important aspect of determining a learning community. Often administrators or policymakers attempt to force the formation of a community by having the members associate with each other, but the sense of community is not discernible if the members do not build the necessary relational ties. In virtual communities, students may feel present and feel that others are likewise discernibly involved in the community, but still perceive a lack of emotional trust or connection.

In our review of the literature, we found what seem to be common relational characteristics of learning communities: (1) sense of belonging, (2) interdependence or reliance among the members, (3) trust among members, and (4) faith or trust in the shared purpose of the community.

Belonging

Members of a community need to feel that they belong in the community, which includes feeling like one is similar enough or somehow shares a connection to the others. Sarason (1974) gave an early argument for the psychological needs of a community, which he defined in part as the absence of a feeling of loneliness. Other researchers have agreed that an essential characteristic of learning communities is that students feel "connected" to each other (Baker and Pomerantz, 2000) and that a characteristic of ineffective learning communities is that this sense of community is not present (Lichtenstein, 2005).

Interdependence

Sarason (1974) believed that belonging to a community could best be described as being part of a "mutually supportive network of relationships upon which one could depend" (p. 1). In other words, the members of the community need each other and feel needed by others within the community; they feel that they belong to a group larger than the individual self. Rovai (2002) added that members often feel that they have duties and obligations towards other members of the community and that they "matter" or are important to each other.

Trust

Some researchers have listed trust as a major characteristic of learning communities (Chen et al., 2007; Mayer et al., 1995; Rovai et al., 2004). Booth's (2012) focus on online learning communities is one example of how trust is instrumental to the emotional strength of the learning group. "Research has established that trust is among the key enablers for knowledge sharing in online communities" (Booth, 2012, p. 5). Related to trust is the feeling of being respected and valued within a community, which is often described as essential to a successful learning community (Lichtenstein, 2005). Other authors describe this feeling of trust or respect as feeling "safe" within the community (Baker and Pomerantz, 2000). For example, negative or ineffective learning communities have been characterized by conflicts or instructors who were "detached or critical of students and unable or unwilling to help them" (Lichtenstein, 2005, p. 348).

Shared Faith

Part of belonging to a community is believing in the community as a whole—that the community should exist and will be sufficient to meet the members' individual needs. McMillan and Chavis (1986) felt that it was important that there be "a shared faith that members' needs will be met through their commitment to be together" (p. 9). Rovai et al. (2004) agreed by saying that members "possess a shared faith that their educational needs will be met through their commitment to the shared goals and values of other students at the school" (p. 267).

These emotional boundaries not only define face-to-face learning communities, but they define virtual communities as well—perhaps more so. Because virtual communities do not have face-to-face interaction, the emotional bond that members feel with the persons beyond the computer screen may be even more important, and the emergence of video technologies is one method for increasing these bonds (Borup et al. 2014).

Community Defined by Vision

Communities defined by shared vision or sense of purpose are not as frequently discussed as boundaries based on relationships, but ways members of a community think about their group are important. Rather than feeling like a member of a community—with a sense of belonging, shared faith, trust, and interdependence—people can define community by thinking they are a community. They conceptualize the same vision for what the community is about, share the same mission statements and goals, and believe they are progressing as a community towards the same end. In short, in terms many researchers use, they have a shared purpose based on concepts that define the boundaries of the community. Sharing a purpose is slightly different from the affective concept of sharing faith in the existence of the community and its ability to meet members' needs. Community members may conceptualize a vision for their community and yet not have any faith that the community is useful (e.g., a member of a math community who hates math). Members may also disagree on whether the community is capable of reaching the goal even though they may agree on what the goal is ("my well intentioned study group is dysfunctional"). Thus conceptual boundaries of a community of learners are distinct from relational ties; they simply define ways members perceive the community's vision. Occasionally the shared conception is the most salient or distinguishing characteristic of a particular learning community.

Schrum et al. (2005) summarized this characteristic of learning communities by saying that a community is "individuals who share common purposes related to education" (p. 282). Royal and Rossi (1996) also described effective learning communities as rich environments for teamwork among those with a common vision for the future of their school and a common sense of purpose.

Community Defined by Function

Perhaps the most basic way to define the boundaries of a learning community is by what the members do. For example, a community of practice in a business would include business participants engaged in that work. This type of definition is often used in education which considers students members of communities simply because they are doing the same assignments: Participants' associations are merely functional, and like work of research teams organized to achieve a particular goal, they hold together as long as the work is held in common. When the project is completed, these communities often disappear unless ties related to relationships, conceptions, or physical or virtual presence [access] continue to bind the members together.

The difference between functional boundaries and conceptual boundaries [boundaries of function and boundaries of vision or purpose] may be difficult to discern. These boundaries are often present simultaneously, but a functional community can exist in which the members work on similar projects but do not share the same vision or mental focus about the community's purpose. Conversely, a group of people can have a shared vision and goals but be unable to actually work together towards this end (for example, if they are assigned to different work teams). Members of a functional community may work together without the emotional connections of a relational community, and members who are present in a community may occupy the same physical or virtual spaces but without working together on the same projects. For example, in co-working spaces, such as Open Gov Hub in Washington D.C., different companies share an open working space, creating in a physical sense a very real community, but members of these separate companies would not be considered a community according to functional boundaries. Thus all the proposed community boundaries sometimes overlap but often represent distinctive features.

The importance of functional cohesion in a learning community is one reason why freshman learning communities at universities usually place cohorts of students in the same classes so they are working on the same projects. Considering work settings, Hakkarainen et al. (2004) argued that the new information age in our society requires workers to be capable of quickly forming collaborative teams (or networked communities of expertise) to achieve a particular functional purpose and then be able to disband when the project is over and form new teams. They argued that these networked communities are increasingly necessary to accomplish work in the 21st Century.

Relying on functional boundaries to define a learning community is particularly useful with online communities. A distributed and asynchronously meeting group can still work on the same project and perhaps feel a shared purpose along with a shared functional assignment, sometimes despite not sharing much online social presence or interpersonal attachment.

Conclusion

Many scholars and practitioners agree that learning communities "set the ambience for life-giving and uplifting experiences necessary to advance an individual and a whole society" (Lenning and Ebbers, 1999). Because learning communities are so important to student learning and satisfaction, clear definitions that enable sharing of best practices are essential. By clarifying our understanding and expectations about what we hope students will be able to do, learn, and become in a learning community, we can more precisely identify what our ideal learning community would be like and distinguish this ideal from the less effective/efficient communities existing in everyday life and learning.

In this chapter we have discussed definitions for four potential boundaries of a learning community. Two of these can be observed externally: access (Who is present physically or virtually?) and function (Who has been organized specifically to achieve some goal?). Two of these potential boundaries are internal to the individuals involved and can only be researched by helping participants describe their feelings and thoughts about the community: relationships (Who feels connected and accepted?) and vision (who shares the same mission or purpose?).

Researchers have discussed learning communities according to each of these four boundaries, and often a particular learning community can be defined by more than one. By understanding more precisely what we mean when we describe a group of people as a learning community—whether we mean that they share the same goals, are assigned to work/learn together, or simply happen to be in the same class—we can better orient our research on the outcomes of learning communities by accounting for how we erected boundaries and defined the subjects. We can also develop better guidelines for cultivating learning communities by communicating more effectively what kinds of learning communities we are trying to develop.

Application Exercises

- Evaluate your current learning community. How can you strengthen your personal learning community? Make one commitment to accomplish this goal.
- Analyze an online group (Facebook users, Twitter users, NPR readers, Pinners on Pinterest, etc.) that you are part of to determine if it would fit within the four proposed boundaries of a community. Do you feel like an active member of this community? Why or why not?

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Greg Williams

I'm a designer, evaluator, published researcher, and PMP certified project manager with a curiosity and love for design, leadership, and the psychology of learning. For over 10 years I've been designing, facilitating, and evaluating learning experiences to fuel my desire to measurably improve the lives of others and create a better world.

Informal Learning

Boileau, T.

Adult Learners
Informal Learning
Knowledge Economy
Lifelong Learning
Performance

In today's digitally connected world we are constantly acquiring new personal knowledge and skills, discovering new methods of work and ways to earn a living, solving problems, and changing the way we create, access and share information, through informal learning. The topic of informal learning can be discussed in many different contexts and from a variety of theoretical perspectives. For the purposes of this chapter, informal learning is examined through the lens of lifelong learning and performance, primarily as it relates to adult learners. Jay Cross (2007) may be credited for popularizing the term "informal learning", although he claimed to have first heard it from Peter Henschel sometime during the mid-1990s, who at the time was director of the Institute for Research on Learning (IRL), when he said:

> *People are learning all the time, in varied settings and often most effectively in the context of work itself. 'Training'—formal learning of all kinds—channels some important learning but doesn't carry the heaviest load. The workhorse of the knowledge economy has been, and continues to be, informal learning. (Cross, 2007, p. xiii)*

Indeed, the concept of informal learning has been around for many years preceding the peak of the industrial revolution during the 19th century in the form of guild support for traditional apprenticeships, and is ubiquitous in the knowledge-based economy of the 21st century in the form of cognitive apprenticeship (Collins & Kapur, 2014).

From a performance perspective, informal learning occurs through self-initiated activity undertaken by people in a work setting, resulting in the creation of new skills and knowledge, in the completion of a job or task (Boileau, 2011). In other words, informal learning is situated in meaningful experiences that are built on top of prior experiences and pre-existing knowledge constructs, thereby facilitating the development of new tacit and explicit knowledge. This is different from formal learning where the emphasis is on transfer of explicit knowledge from instructor to learner, typically associated with a separation of time and space between the formal learning event and application of the knowledge or skill. In this scenario, additional performance support is often needed in order to close the gap between existing knowledge and skills, and expected performance. According to Boileau (2011, p. 13), “Humans learn when they perceive a need to know, and evidence of learning is in their ability to do something they could not do before.”

In this chapter, I explore the nuances of informal learning to better understand its unique role in lifelong learning and performance. The remainder of this chapter is organized in the following sections:

- Definition of Informal vs. Formal Learning
- Informal Learning Trends and Issues
- Informal Learning and Culture

Definition of Informal vs. Formal Learning

A review of the literature on the definition of informal vs. formal learning shows that much ambiguity exists, leading to contradiction and disagreement among scholars (Czerkawski, 2016). As I will argue in this section, informal and formal learning can be shown to coexist at opposite ends of a continuum, with most learning occurring somewhere in between as opposed to an absolute definition for informal learning. Let us begin with the definition of learning provided by Driscoll (2005, p. 9) “as a persisting change in human performance or performance potential,” adding that the change “must come about as a result of the learner’s experience and interaction with the world.” Note that the first part of this definition emphasizes outcomes of the learning experience in terms of purposeful and intentional change occurring within the learner as a consequence of the learning experience provided via the learning setting. The second part recognizes that learning is inherently social and that authentic learning is achieved only through interaction with the world. This premise is reflected in the “Seven Principles of Learning” provided by Peter Henschel of the Institute for Research on Learning, at TechLearn 1999 (Henschel, 2001):

- Learning is fundamentally social.
- Knowledge is integrated in the life of communities.
- Learning is an act of participation.
- Knowing depends on engagement in practice.
- Engagement is inseparable from empowerment.
- Failure to Learn is often the result of exclusion from participation.
- We are all lifelong learners.

Learning may also be described using different classifications linked to the setting or circumstances in which the learning is most likely to occur, such as formal, non-formal, and informal learning. Taking a brief look at this typology, formal learning implies learning settings provided by educational institutions where the primary mission is the construction of new knowledge. Non-formal learning settings may be found in organizations and businesses within the community where the primary mission is not necessarily educational. However, formal learning activities are present such as in the delivery of specialized training that is linked to achieving the goals of the organization (Coombs, Prosser, & Ahmed, 1973). Informal learning, on the other hand, refers to embedded learning activities that are linked to performance, in the setting of one's everyday life. Within each category, there are identifiable subcategories representing different learning taxonomies. Merriam and Bierema (2014) identified four sub-types of learning specific to informal learning, which can be summarized as:

- Self-directed learning – learner-initiated and -guided learning activity including goal setting, resource identification, strategy selection, and evaluation of outcomes.
- Incidental learning – an accidental by-product of another learning activity that occurs outside of the learner's direct stream of consciousness as an unplanned or unintended consequence of doing something else.
- Tacit learning – the most subtle form of informal learning, which occurs at the subconscious level based on intuition, personal experience, or emotion that is unique to the individual learner.
- Integrative learning – integration of non-conscious tacit knowledge with conscious learning activities providing creative insight through non-linear implicit processing.

In the training industry, informal learning is often discussed in the context of the "70:20:10 Rule" (please see Association for Talent Development (ATD) at www.td.org [http://www.td.org/] and do a search on 70:20:10). Generally speaking, this suggests that: 70% of learning occurs through informal or on-the-job learning; 20% through mentoring and other specialized developmental relationships; and the remaining 10% through formal learning including course work and associated reading.

There are two important takeaways from the assertion of the so-called 70:20:10 Rule, as it relates to workplace learning. First, there is a growing body of research providing insight into just how widespread and embedded informal learning is in the lives of adult learners, with estimates of as high as 70-90% of all learning over the course of a lifetime, occurring via informal learning activity (Merriam & Bierema, 2014). Specific to learning about science, Falk and Dierking (2010) placed the estimate even higher, with as much as 95% of all science learning occurring outside of school, given the richness, availability, and increased access to "free-choice" (i.e., informal) digital learning resources. Based on this premise, Falk and Dierking (2010) contended that a policy of increased investment in informal learning resources would provide a cost-effective way to increase public understanding of science. The second takeaway is the recognition that formal and informal learning occurs along a continuum—comprised of both formal and informal learning activities, depending on the type of learning and level of mastery required, as well as the characteristics and prior experience of the learner—as opposed to dichotomous categories of formal vs. informal learning (Sawchuk, 2008).

In the following illustration, Cross (2007) presented what he referred to as the spending/outcome paradox of learning. The suggested paradox is that while formal learning represents 80% of an organization's training budget, it provides a mere 20% return on learning in terms of performance outcomes. Conversely, informal learning on average represents 20% of training resources, yet delivers 80% of the learning occurring within the organization, measured in terms of performance or potential performance. The spending/outcome paradox remains a global challenge as noted by De Grip (2015), “Policies tend to emphasize education and formal training, and most firms do not have strategies to optimize the gains from informal learning at work.” (p. 1).

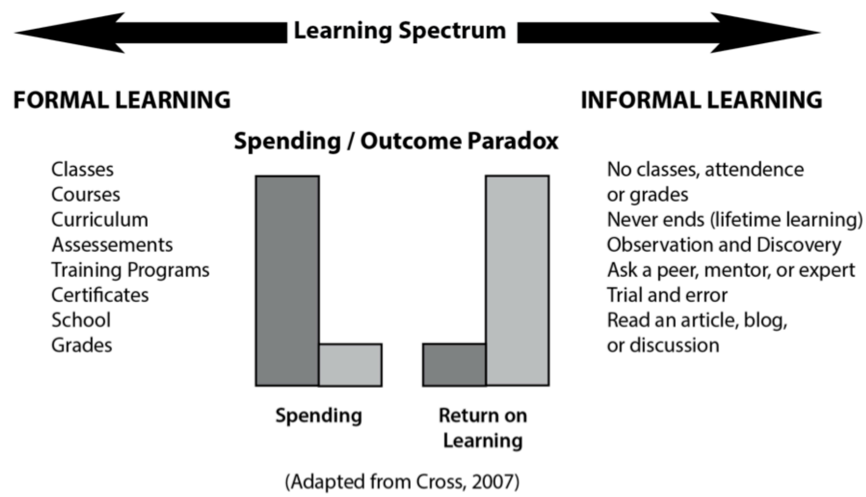

Figure 1. Learning spectrum

This leads us to a definition of *informal learning* as “the unofficial, unscheduled, impromptu way people learn to do their jobs . . . Informal learning is like riding a bike; the rider [learner] chooses the destination, the speed, and the route.” (Cross, 2007, p. 236). In other words, learners decide what they need to learn and then establish their own learning objectives and agenda. In addition, learners determine when they should learn, and select the format and modality that best meets their needs. Perhaps most importantly, the learner is responsible for organizing and managing his or her own learning-related activities. To fully engage learners and to ensure that a transfer of knowledge occurs, informal learning should be authentic and ideally occur in the workplace or other performance setting, be situated in a meaningful context that builds on prior knowledge, and employ strategies and activities to promote transfer of knowledge (Boileau, 2011). In informal learning, learners are “pulled” into the learning experience based on a problem, or identified knowledge and skills gap, which is determined by the learner who then engages in learning activities intended to close the knowledge gap or otherwise mitigate the performance challenge or problem.

In contrast, in *formal learning*, learning objectives and curricula are determined by someone else. Formal learning or “book learning” is what most people in western culture think of when they envision learning in terms of schools, classrooms, and instructors who decide what, when, and how learning is to take place. “Formal learning is like riding a bus: the driver [instructor] decides where the bus is going; the passengers [learners] are along for the ride” (Cross, 2007, p. 236). In formal learning, learning is “pushed” to the learners according to a set of needs or predetermined curricula that are established by someone other than the learner.

In this section, I have discussed informal and formal learning as co-existing in a spectrum or continuum of learning activities linked to experience and performance context over the course of a lifetime, as opposed to dichotomous branches of learning that are fixed in time and space. This is an important precept to keep in mind because increasingly, blended learning experiences may include elements or activities associated with formal learning settings such as lectures or media-based presentations, along with informal learning activities such as discussions with peers, Web-based searches for examples, and practice experimenting with new techniques and tools (Lohman, 2006).

Informal Learning Trends and Issues

This section examines some of the trends and issues associated with informal learning from an individual and organizational perspective. In previous generations, learning was (and still is) often viewed as separate from performance, and linked to identifiable stages of human social-cultural development. In terms of formal learning, this includes primary and secondary education (K-12) to prepare an individual for participation in society, whereas post-secondary education has historically provided additional preparation for a career with increased earnings potential. Informal learning, as discussed in the preceding sections, addresses learning in terms of a series of non-linear episodic events, experiences, and activities occurring in the real world over the course of a lifetime, having financial and social consequences for individuals and organizations.

Science learning. There is increased recognition of the need to support lifelong science learning in order to meet the growing demand for science and engineering jobs in a modern global economy. It can be argued that science literacy, acquired through informal learning, is essential to economic growth (as discussed in the next topic), and to promoting the shared cultural values of a democratic society. According to Falk et al. (2007), "the majority of the public constructs much of its understanding of science over the course of their lives, gathering information from many places and contexts, and for a diversity of reasons." (p. 455). Evidence of this trend can be seen in new standards for compulsory testing and curriculum changes, placing greater emphasis on STEM (science, technology, engineering, and mathematics) subjects in publicly funded K-12 education. Yet, the average adult spends a small fraction of their life (1-3 percent) in formal education related to science learning (Falk, Storksdieck, & Dierking, 2007). Indeed, the research literature suggests that most science learning, as with other domains of learning, occurs informally and is driven by self-identified needs and interests of learners. This suggests that informal learning activities within the workplace, personal investigation using internet-based tools and resources, and active leisure pursuits such as visits to museums, zoos and aquariums, and national parks account for the majority of science learning in America (Falk & Dierking, 2010).

Other forms of informal science learning include hobbies such as model rockets and drones, organic and sustainable farming, beekeeping, mineralogy, and amateur astronomy. Life events may also trigger a personal need for informal science learning via the web such as when individuals are diagnosed with an illness like cancer or heart disease, or in the wake of environmental disasters such as oil spills, the discovery of radon gas in rock, or tracking the path of a hurricane. The Internet now represents the major source of science information for adults and children, with the tipping point occurring in 2006, when the Internet surpassed broadcast media as a source for public science information, according to the Pew Internet and American Life Project (Falk & Dierking, 2010). In a similar fashion, more people now turn to the Internet for medical diagnostic information using services like WebMD.com, before scheduling an appointment with their physician.

Return on learning within organizations. The implications of informal learning for organizations are significant in terms of expectations for individual and organizational performance. Specifically, *return on learning* (i.e., return on spending for learning) has increasingly become linked to an organization's bottom-line. It is no longer enough to simply have well-trained employees with advanced degrees and certifications gained through formal education and training, unless employees are also able to demonstrate advanced skills leading to valued on-the-job performance outcomes. The result is a shift in many organizations from training to talent management, taking advantage of eLearning innovations, including online and just-in-time learning technologies, to support personalized and sustainable professional development. This trend is supported by a growing body of evidence from the Organisation for Economic Co-operation and Development (OECD.org), suggesting that informal learning in the workplace is a principal driver of human capital development for employees of all age groups, with the greatest impact shown in the performance of younger workers as advanced learning and skills are attained through work experience (De Grip, 2015).

Microtraining. As previously suggested, organizations have continued to over-invest in and, in some instances, overestimate the value of formal training programs relative to the spending/outcome paradox and return on learning, while potentially missing out on opportunities to fully leverage informal learning processes (Cross, 2007). *Microtraining* provides a possible mechanism to help address this perceived imbalance, by focusing attention along the entire learning spectrum, as opposed to a strict separation of learning activities between formal and informal learning domains. Microtraining is an instructional technology intervention that integrates formal with informal learning activities, using short learning segments designed for rapid development and dissemination of knowledge that can be completed in 15-minute time blocks, in close proximity to the work setting (De Vries & Brall, 2008). According to De Vries and Brall (2008), microtraining learning segments are used to provide a structure combining semi-formal learning activities with informal and ad hoc learning processes. This structure begins with activation of prior knowledge, followed by demonstration/practice, feedback session, and transfer strategy. In addition, all microtraining segments should promote critical thinking and reflection on work, to facilitate deeper learning.

The microtraining approach is generally well suited for performance remediation, knowledge refreshing, and development of mastery in topics already familiar to learners. Conversely, microtraining may be less ideally suited for novice learners unless it is combined with other strategies for scaffolding learning in order to build prerequisite knowledge and skills. The primary benefit of microtraining is in its ability to provide just-in-time, non-formal training within the work setting, causing minimal disruption to the daily work schedule as employees considered vital to the enterprise are not required to travel to another location in order for learning to occur (De Vries & Brall, 2008).

Microtraining draws from the theoretical foundations of constructivism and connectivism, recognizing the social aspects of informal learning, and the role of learning communities within communities of practice, for facilitation of lifelong learning. Learners play a central role in contributing to the collective knowledge of the community while building their personal sense of identity, at the same time providing a positive incentive for sustained participation in the learning community (Lave & Wenger, 1991). Organizations committed to microtraining understandably play an instrumental role in enabling communities of practice. In this capacity, the organization commits the resources to support development of microtraining learning units. Implementation of microtraining via learning communities also requires different roles for learners and trainers than those traditionally held within the organization. Specifically, learners assume primary responsibility for personal and team learning processes; whereas the trainer's role shifts from presenter to learning coach/facilitator in support of informal learning activities.

Microlearning. A closely related trend is *microlearning*, which is an emergent informal learning strategy intended to quickly close gaps in knowledge and skills, in the context of completing a task. Microlearning is most often mediated by Web 2.0 technology on mobile devices, involving short bursts of inter-connected and loosely coupled learning activities, having a narrow topical focus (Buchem & Hamelmann, 2010). In other words, microlearning tends to build depth, as opposed to breadth of knowledge, particularly when the learning event is situated in the performance of a skill needed to complete a task.

Microlearning is dependent upon access to microcontent, referring to small, user-created, granular pieces of content or learning objects in varied media format ranging from a YouTube video to a Wikipedia entry, intended to convey a single concept or idea. Learners engage in microlearning activities to find immediate answers to questions that arise in completing a task such as "how does this work?", or "what does this mean?", or "who said that?". A common theme is that the microlearning event triggered by the informal learning inquiry draws context from the learning setting and performance task at hand, where immediacy in the application of learning is the primary objective. This type of episodic informal learning event stands in contrast to learning simply for learning's sake, as it relates to knowledge retention and recollection. There are additional affordances that may be associated with microlearning, which include:

- Diversity of sources – Sources for microlearning activities include a range of options and services in diverse media formats including blogs, wikis, Kahn Academy video courses and lessons, YouTube tutorials, infographics, TEDTalks, and an increasing number of Open Educational Resources (OER).
- Learning types – Microlearning may be applied to a wide range of learning types, goals, preferences, and theoretical frameworks (e.g., cognitivist, constructivist, connectivist), producing mashups of informal and formal learning activities.
- Cost – Production costs of learning objects used in microlearning tend to be lower than traditional course development costs given the brevity and narrow topical focus of learning episodes. As the range of topics and number of Open Educational Resources continues to rise, content costs should be expected to continue to decline.

- Access – Increased Web 2.0 and mobile access for content production and consumption has made microlearning ubiquitous for learners in many parts of the world, via learner-defined Personal Learning Environments (PLE) where all you need is a smartphone to participate.
- Connected learning – Microlearning facilitated by social media technologies (e.g., Facebook, Twitter, LinkedIn) provides new ways for collaborative and cooperative learning to occur via Personal Learning Networks (PLN) and within Communities of Practice (CoP).

Performance support tools. Another informal learning trend is Performance Support Tools (PST). Rossett and Schafer (2007) defined performance support as "A helper in life and work, performance support is a repository for information, processes, and perspectives that inform and guide planning and action." (p. 2). Performance support tools are in many ways analogous to the concepts and affordances discussed with microlearning. Indeed, many of the tools and activities used to support learning and performance discussed in the preceding paragraphs have existed since the early days of personal computing and the Internet, in the form of Electronic Performance Support Systems (EPSS). Gery (1991) first coined the term EPSS as the intentional and purposeful integration of technology, information and cognitive tools to provide on-demand access to expert advice, guidance, assistance, and training to facilitate high performance levels on the job, while requiring minimal support from others.

Performance Support Tools serve as job-aids to help facilitate completion of a task or achievement of a goal, while at the same time have a mediating effect on informal learning activities that support desired performance outcomes (Boileau, 2011). This results in the formation of reproducible patterns for learning and performance, comprised of linked actions and operations that are aligned with performance outcomes, adding to the learner's personal knowledge and skills repertoire. Over time, these regular and recurring patterns in learning and performance activity systems can evolve into practices shared by other members of the community of practice (Greeno & Engeström, 2014). These practices are shaped by and, in turn, shape the way PSTs are used to support learning and to affect the transfer of knowledge and skills to on-the-job performance. Information and communications technology (e.g., social media) has been shown to have a mediating effect on practice, using digital representation of signs and symbols for linguistic communication, along with knowledge objects that are produced and exist within the community (Boileau, 2011).

As previously stated, Rossett and Schafer (2007) viewed this effect on practice in terms of support for performance, specifically by building a repository of externally curated information, processes, resources and perspectives that inform and guide performance planning and execution, using performance support tools. This approach is less concerned with new knowledge acquisition and more so in direct application and transfer of knowledge, mediated by PSTs.

Rossett and Schafer (2007) further categorized PSTs as sidekicks and planners. A *sidekick* functions as a job aid in the context of specific types of activity performed in realtime, concurrent with the task at hand. An example of a sidekick is a GPS navigation system (e.g., Google® maps application on a mobile device) providing turn-by-turn navigational instructions in the situated context of operating a vehicle.

A *planner*, on the other hand, is typically used in advance of the activity to access prior, externally created, knowledge shared by the community of practice, for use in a specific learning and performance context. An example of this would be accessing Google® Maps via the Web to determine (i.e., plan) the most efficient route of travel between two pre-determined points, in advance of starting the trip.

A distinction can be made between performance support tools and other types of tools such as a file cabinet or office chair, used to support informal learning and performance. The difference with non-PST tools is that there is no innate support for the informal learning or performance activity; there is only potential support for manipulating the environment to make it more conducive to achieving the goal for the activity. In a similar manner, "Instruction is not performance support. It is planned experience that enables an individual to acquire skills and knowledge to advance the capability to perform." (Rossett & Schafer, 2007, p. 5). In other words, there is a separation between the learning event and the performance context. Performance support for informal learning may be further characterized by looking at four factors: convergence, simplicity, relevance to performance, and personalization (Rossett & Schafer, 2007).

- Convergence is rooted in proximity, meaning that the information and guidance to support learning is situated where the learner/performer and task or challenge exists.
- Simplicity means having a focus on the content in the here and now, to accomplish a task or to quickly close a gap in skills and knowledge.
- Relevance increases support for the performer, ensuring the right tools for the job to accomplish his or her goals in a specific context, resulting in increased learner motivation.
- Personalization allows the learner to dynamically adjust the level of information and support needed, according to the needs of the situation and the prior experience of the learner. Personalization also facilitates user-generated content adding new insight and lessons learned, thus increasing the utility of the tool and contributing new artifacts to the collective body of knowledge available to the community of practice, via a more integrative user experience.

Digital open badging. As opportunities for informal learning continue to increase for personal and professional development across different industries and disciplines, a question on the minds of many learners is how informal learning achievements may be recognized (Law, 2015). *Digital open badges* provide validated recognition of participation and achievement from informal learning activities, and evidence of learning milestones such as completion of a microtraining learning segment. The use of digital badges can also be seen with formal learning in educational institutions, as a motivational tool and in the form of micro-credentials to demonstrate incremental achievement in a variety of education settings.

The amount of OER content available to support informal learning has increased exponentially in recent years in support of microlearning. Concurrent with the increase in OER is the emergence of different business models to support the issuance of digital open badges. For example, learners can access OER content for free, through a variety of MOOC (Massive Open Online Course) service providers such as EdX and Coursera. These services provide access to hundreds of courses for free. If you would like to receive a micro-credential (i.e., certificate) as evidence of successful completion, however, you are required to pay a nominal fee. This changes our definition of informal learning provided by Cross (2007) when learners begin to pay-for certification by MOOC providers, because informal learning is no longer anonymous when attendance is tracked and grades are issued (Law, 2015). This trend is expected to continue according to Law (2015) as “learners in an informal environment are willing to pay for certification and recognition of unsupported informal learning.” (p. 232).

Summary. In this section, we have examined some of the trends, issues, and tools used to facilitate informal learning, noting the emergence of four themes. First is that informal learning is situated in performance, knowledge development, or in completion of a task, and is driven by intrinsic as well as extrinsic motivation. Second, as organizations refocus their attention from training to talent management, they look to innovative methods and learner-centered processes to enable communities of practice. Third is that technology and more specifically, performance support tools are at the forefront of informal learning, serving as job-aids intended to mediate informal learning activities that support job performance. Finally, the use of digital open badges is expected to increase, to eventually provide validated evidence of informal learning outcomes.

Informal Learning and Culture

I conclude this chapter by considering the role of culture in learning. The paradigm used to understand informal learning is influenced by a set of assumptions around learning that are firmly rooted in culture. For example, the concept of informal learning in the West is inevitably linked to Western philosophies such as liberalism, progressivism, humanism, behaviorism, and radicalism (Merriam & Bierema, 2014). This provides a unique cultural lens through which learning events and activities are perceived that is further shaped by personal experience and access to information surrounding global events, which may vastly differ from the view of education and learning held by people living in different cultural settings from our own. Ironically, while informal or experiential learning is clearly evident in all cultures, “it is less valued in the West where formal book knowledge predominates.” (Merriam & Bierema, 2014, p. 243). It is also interesting to note that this is consistent with the “spending/outcome paradox” noted by Cross (2007) that was discussed earlier in this chapter.

Merriam and Bierema (2014) identified three themes in knowing and learning that are more prevalent among **non**-Western cultures, characterized as communal, lifelong and informal, and holistic. To say that learning is *communal*implies that it is situated within the community as a means for collaborative knowledge development that benefits from, and exists within, the entire community through strong interdependency and relationships among the members. This stands in contrast with Western culture in which the learner is more typically viewed from an individualistic and independent perspective. The second theme is that informal learning is a *lifelong* pursuit that is also situated within the communal ethic (Merriam & Kim, 2011). The concept of informal lifelong learning is evident in the Buddhist principles of mindfulness; can be seen in the African cultural expectation that members of the community share their knowledge with each other for the benefit of the community at large; and may be found in the words of the Prophet Muhammad: to "Seek knowledge from the cradle to the grave." Finally, the culturally-based theme of informal learning as *holistic* represents a clear shift from a Western emphasis on cognitive knowing, to alternative types of learning that include: somatic, spiritual, emotional, moral, experiential and social learning (Merriam & Kim, 2011).

Approaching informal learning from a more culturally holistic perspective creates new opportunities to increase cultural sensitivity among increasingly diverse learner and worker populations, by recognizing that learning is embedded in performance activities and in the experiences of everyday life.

Application Exercises

- Take five minutes and think about your own experiences with informal learning. How has technology influenced your informal learning? Give your best assumption of how much informal learning occurs outside of a technological medium vs. how much informal learning occurs through a technological medium.
- Think of a work or school situation where learning was formal. Knowing that there is a better chance of meeting learning outcomes with informal learning, what adjustments would you make to create a more informal learning experience?

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Connectivism

Siemens, G.

Connectivism

digital age

knowledge management

Learning Theory

Connectivism is a theory that attempts to explain the link between individual and organizational learning. This paper was originally published on Siemens's personal website in 2004 before being published in the International Journal of Instructional Technology and Distance Learning. It has been cited thousands of times and is considered a landmark theory for the Internet age.

Editor's Note

This landmark paper, originally published on Siemens's personal website in 2004 before being published in the International Journal of Instructional Technology and

Distance Learning, has been cited thousands of times and is considered a landmark theory for the Internet age. Siemens has since added a website to explore this concept.

Siemens, G. (2004). *Connectivism: A learning theory for the digital age.* Retrieved from http://www.elearnspace.org/Articles/connectivism.htm

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Introduction

Behaviorism, **cognitivism**, and **constructivism** are the three broad learning theories most often utilized in the creation of instructional environments. These theories, however, were developed in a time when learning was not impacted through technology. Over the last twenty years, technology has reorganized how we live, how we communicate, and how we learn. Learning needs and theories that describe learning principles and processes, should be reflective of underlying social environments. Vaill emphasizes that "learning must be a way of being—an ongoing set of attitudes and actions by individuals and groups that they employ to try to keep abreast of the surprising, novel, messy, obtrusive, recurring events . . ." (1996, p. 42).

Learners as little as forty years ago would complete the required schooling and enter a career that would often last a lifetime. Information development was slow. The life of knowledge was measured in decades. Today, these foundational principles have been altered. Knowledge is growing exponentially. In many fields the life of knowledge is now measured in months and years. Gonzalez (2004) describes the challenges of rapidly diminishing knowledge life:

> *One of the most persuasive factors is the shrinking half-life of knowledge. The "half-life of knowledge" is the time span from when knowledge is gained to when it becomes obsolete. Half of what is known today was not known 10 years ago. The amount of knowledge in the world has doubled in the past 10 years and is doubling every 18 months according to the American Society of Training and Documentation (ASTD). To combat the shrinking half-life of knowledge, organizations have been forced to develop new methods of deploying instruction.*

Some significant trends in learning:

- Many learners will move into a variety of different, possibly unrelated fields over the course of their lifetime.
- Informal learning is a significant aspect of our learning experience. Formal education no longer comprises the majority of our learning. Learning now occurs in a variety of

ways—through communities of practice, personal **networks**, and through completion of work-related tasks.
- Learning is a continual process, lasting for a lifetime. Learning and work related activities are no longer separate. In many situations, they are the same.
- Technology is altering (rewiring) our brains. The tools we use define and shape our thinking.
- The organization and the individual are both learning organisms. Increased attention to knowledge management highlights the need for a theory that attempts to explain the link between individual and organizational learning.
- Many of the processes previously handled by learning theories (especially in cognitive information processing) can now be off-loaded to, or supported by, technology.
- Know-how and know-what is being supplemented with know-where (the understanding of where to find knowledge needed).

Background

Driscoll (2000) defines learning as “a persisting change in human performance or performance potential…[which] must come about as a result of the learner’s experience and interaction with the world” (p. 11). This definition encompasses many of the attributes commonly associated with behaviorism, cognitivism, and constructivism—namely, learning as a lasting changed state (emotional, mental, physiological (i.e., skills)) brought about as a result of experiences and interactions with content or other people.

Driscoll (2000, pp. 14–17) explores some of the complexities of defining learning. Debate centers on:

- Valid sources of knowledge—Do we gain knowledge through experiences? Is it innate (present at birth)? Do we acquire it through thinking and reasoning?
- Content of knowledge—Is knowledge actually knowable? Is it directly knowable through human experience?
- The final consideration focuses on three epistemological traditions in relation to learning: Objectivism, Pragmatism, and Interpretivism
    - **Objectivism** (similar to behaviorism) states that reality is external and is objective, and knowledge is gained through experiences.
    - **Pragmatism** (similar to cognitivism) states that reality is interpreted, and knowledge is negotiated through experience and thinking.
    - **Interpretivism** (similar to constructivism) states that reality is internal, and knowledge is constructed.

All of these learning theories hold the notion that knowledge is an objective (or a state) that is attainable (if not already innate) through either reasoning or experiences. Behaviorism, cognitivism, and constructivism (built on the epistemological traditions) attempt to address how it is that a person learns.

Behaviorism states that learning is largely unknowable, that is, we can’t possibly understand what goes on inside a person (the “**black box theory**”). Gredler (2001) expresses behaviorism as being comprised of several theories that make three assumptions about learning:

1. Observable behaviour is more important than understanding internal activities
2. Behaviour should be focused on simple elements: specific stimuli and responses
3. Learning is about behaviour change

Cognitivism often takes a computer information processing model. Learning is viewed as a process of inputs, managed in **short term memory**, and coded for long-term recall. Cindy Buell details this process: "In cognitive theories, knowledge is viewed as symbolic mental constructs in the learner's mind, and the learning process is the means by which these symbolic representations are committed to memory."

Constructivism suggests that learners create knowledge as they attempt to understand their experiences (Driscoll, 2000, p. 376). Behaviorism and cognitivism view knowledge as external to the learner and the learning process as the act of internalizing knowledge. Constructivism assumes that learners are not empty vessels to be filled with knowledge. Instead, learners are actively attempting to create meaning. Learners often select and pursue their own learning. Constructivist principles acknowledge that real-life learning is messy and complex. Classrooms which emulate the "fuzziness" of this learning will be more effective in preparing learners for life-long learning.

Learning Check

What model does cognitivism take?

- ☐ A "black box" model. We can't understand what goes on inside someone's head.
- ☐ A perpetual creation model. Knowledge and meaning are created as learners strive to understand the experiences they have.
- ☐ A computer information processing model. Learning is a continuous process of managing, then coding, various inputs.

How do the epistemological traditions relate to the three learning theories discussed in this chapter?

- ☐ Objectivism is similar to cognitivism, pragmatism is similar to constructivism, and interpretivism is similar to behaviorism.
- ☐ Objectivism is similar to behaviorism, pragmatism is similar to cognitivism, and interpretivism is similar to constructivism.

☐ Objectivism is similar to constructivism, pragmatism is similar to behaviorism, and interpretivism is similar to cognitivism.

Limitations of Behaviorism, Cognitivism, and Constructivism

A central tenet of most learning theories is that learning occurs inside a person. Even social constructivist views, which hold that learning is a socially enacted process, promotes the principality of the individual (and her/his physical presence—i.e., brain-based) in learning. These theories do not address learning that occurs outside of people (i.e., learning that is stored and manipulated by technology). They also fail to describe how learning happens within organizations.

Learning theories are concerned with the actual process of learning, not with the value of what is being learned. In a networked world, the very manner of information that we acquire is worth exploring. The need to evaluate the worthiness of learning something is a meta-skill that is applied before learning itself begins. When knowledge is subject to **paucity**, the process of assessing worthiness is assumed to be intrinsic to learning. When knowledge is abundant, the rapid evaluation of knowledge is important. Additional concerns arise from the rapid increase in information. In today's environment, action is often needed without personal learning—that is, we need to act by drawing information outside of our primary knowledge. The ability to synthesize and recognize connections and patterns is a valuable skill.

Many important questions are raised when established learning theories are seen through technology. The natural attempt of theorists is to continue to revise and evolve theories as conditions change. At some point, however, the underlying conditions have altered so significantly, that further modification is no longer sensible. An entirely new approach is needed.

Some questions to explore in relation to learning theories and the impact of technology and new sciences (chaos and networks) on learning:

- How are learning theories impacted when knowledge is no longer acquired in the linear manner?
- What adjustments need to be made with learning theories when technology performs many of the cognitive operations previously performed by learners (information storage and retrieval).
- How can we continue to stay current in a rapidly evolving information ecology?
- How do learning theories address moments where performance is needed in the absence of complete understanding?
- What is the impact of networks and **complexity theories** on learning?
- What is the impact of chaos as a complex pattern recognition process on learning?

- With increased recognition of interconnections in differing fields of knowledge, how are systems and **ecology theories** perceived in light of learning tasks?

An Alternative Theory

Including technology and connection making as learning activities begins to move learning theories into a digital age. We can no longer personally experience and acquire learning that we need to act. We derive our competence from forming connections. Karen Stephenson states:

> *Experience has long been considered the best teacher of knowledge. Since we cannot experience everything, other people's experiences, and hence other people, become the surrogate for knowledge. 'I store my knowledge in my friends' is an* ***axiom*** *for collecting knowledge through collecting people (undated).*

Chaos is a new reality for knowledge workers. ScienceWeek (2004) quotes Nigel Calder's definition that chaos is "a cryptic form of order." Chaos is the breakdown of predictability, evidenced in complicated arrangements that initially defy order. Unlike constructivism, which states that learners attempt to foster understanding by meaning making tasks, chaos states that the meaning exists—the learner's challenge is to recognize the patterns which appear to be hidden. Meaning-making and forming connections between specialized communities are important activities.

Chaos, as a science, recognizes the connection of everything to everything. Gleick (1987) states: "In weather, for example, this translates into what is only half-jokingly known as the Butterfly Effect—the notion that a butterfly stirring the air today in Peking can transform storm systems next month in New York" (p. 8). This analogy highlights a real challenge: "sensitive dependence on initial conditions" profoundly impacts what we learn and how we act based on our learning. Decision making is indicative of this. If the underlying conditions used to make decisions change, the decision itself is no longer as correct as it was at the time it was made. The ability to recognize and adjust to pattern shifts is a key learning task.

Luis Mateus Rocha (1998) defines self-organization as the "spontaneous formation of well organized structures, patterns, or behaviors, from random initial conditions." (p.3). Learning, as a self-organizing process requires that the system (personal or organizational learning systems) "be informationally open, that is, for it to be able to classify its own interaction with an environment, it must be able to change its structure . . ." (p.4). Wiley and Edwards acknowledge the importance of self-organization as a learning process: "Jacobs argues that communities self-organize is a manner similar to social insects: instead of thousands of ants crossing each other's pheromone trails and changing their behavior accordingly, thousands of humans pass each other on the sidewalk and change their behavior accordingly." Self-organization on a personal level is a micro-process of the larger self-organizing knowledge **constructs** created within corporate or institutional environments. The capacity to form connections between sources of information, and thereby create useful information patterns, is required to learn in our knowledge economy.

Networks, Small Worlds, Weak Ties

A network can simply be defined as connections between entities. Computer networks, power grids, and social networks all function on the simple principle that people, groups, systems, **nodes**, entities can be connected to create an integrated whole. Alterations within the network have ripple effects on the whole.

Albert-László Barabási states that “nodes always compete for connections because links represent survival in an interconnected world” (2002, p. 106). This competition is largely dulled within a personal learning network, but the placing of value on certain nodes over others is a reality. Nodes that successfully acquire greater profile will be more successful at acquiring additional connections. In a learning sense, the likelihood that a concept of learning will be linked depends on how well it is currently linked. Nodes (can be fields, ideas, communities) that specialize and gain recognition for their expertise have greater chances of recognition, thus resulting in cross-pollination of learning communities.

Weak ties are links or bridges that allow short connections between information. Our small world networks are generally populated with people whose interests and knowledge are similar to ours. Finding a new job, as an example, often occurs through weak ties. This principle has great merit in the notion of serendipity, innovation, and creativity. Connections between disparate ideas and fields can create new innovations.

Learning Check

(True/False) Constructivism suggests that learners create meaning, whereas chaos suggests that learners uncover preexisting meaning.

- ☐ True
- ☐ False

Connectivism

Connectivism is the integration of principles explored by chaos, network, and complexity and **self-organization theories**. Learning is a process that occurs within nebulous environments of shifting core elements—not entirely under the control of the individual. Learning (defined as actionable knowledge) can reside outside of ourselves (within an organization or a database), is focused on connecting specialized information sets, and the connections that enable us to learn more are more important than our current state of knowing.

Connectivism is driven by the understanding that decisions are based on rapidly altering foundations. New information is continually being acquired. The ability to draw distinctions between important and unimportant information is vital. The ability to recognize when new information alters the landscape based on decisions made yesterday is also critical.

Principles of connectivism:

- Learning and knowledge rests in diversity of opinions.
- Learning is a process of connecting specialized nodes or information sources.
- Learning may reside in non-human appliances.
- Capacity to know more is more critical than what is currently known
- Nurturing and maintaining connections is needed to facilitate continual learning.
- Ability to see connections between fields, ideas, and concepts is a core skill.
- **Currency** (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
- Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision.

Connectivism also addresses the challenges that many corporations face in knowledge management activities. Knowledge that resides in a database needs to be connected with the right people in the right context in order to be classified as learning. Behaviorism, cognitivism, and constructivism do not attempt to address the challenges of organizational knowledge and transference.

Information flow within an organization is an important element in organizational effectiveness. In a **knowledge economy**, the flow of information is the equivalent of the oil pipe in an industrial economy. Creating, preserving, and utilizing information flow should be a key organizational activity. Knowledge flow can be likened to a river that meanders through the ecology of an organization. In certain areas, the river pools and in other areas it ebbs. The health of the learning ecology of the organization depends on effective nurturing of information flow.

Social network analysis is an additional element in understanding learning models in a digital era. Art Kleiner (2002) explores Karen Stephenson's "quantum theory of trust" which "explains not just how to recognize the collective cognitive capability of an organization, but how to cultivate and increase it." Within social networks, hubs are well-connected people who are able to foster and maintain knowledge flow. Their interdependence results in effective knowledge flow, enabling the personal understanding of the state of activities organizationally.

The starting point of connectivism is the individual. Personal knowledge is comprised of a network, which feeds into organizations and institutions, which in turn feed back into the network, and then continue to provide learning to individual. This cycle of knowledge development (personal to network to organization) allows learners to remain current in their field through the connections they have formed.

Landauer and Dumais (1997) explore the phenomenon that "people have much more knowledge than appears to be present in the information to which they have been exposed."

They provide a connectivist focus in stating “the simple notion that some domains of knowledge contain vast numbers of weak interrelations that, if properly exploited, can greatly amplify learning by a process of inference.” The value of pattern recognition and connecting our own “small worlds of knowledge” are apparent in the exponential impact provided to our personal learning.

John Seely Brown presents an interesting notion that the internet leverages the small efforts of many with the large efforts of few. The central premise is that connections created with unusual nodes supports and intensifies existing large effort activities. Brown provides the example of a Maricopa County Community College system project that links senior citizens with elementary school students in a mentor program. Because the children “listen to these ‘grandparents’ better than they do their own parents, the mentoring really helps the teachers . . . the small efforts of the many—the seniors—complement the large efforts of the few—the teachers” (2000). This amplification of learning, knowledge and understanding through the extension of a personal network is the epitome of connectivism.

Learning Check

(True/False) Connectivism suggests that learning is the process of creating and maintaining connections between information sources.

- [ ] True
- [ ] False

The author of this chapter suggests that, according to connectivism, learning is like maintaining what?

- [ ] A continually growing forest
- [ ] A meandering river
- [ ] A tumultuous ocean
- [ ] An unpredictable wind

Implications

The notion of connectivism has implications in all aspects of life. This paper largely focuses on its impact on learning, but the following aspects are also impacted:

- Management and leadership. The management and marshalling of resources to achieve desired outcomes is a significant challenge. Realizing that complete knowledge cannot exist in the mind of one person requires a different approach to creating an overview of the situation. Diverse teams of varying viewpoints are a critical structure for completely exploring ideas. Innovation is also an additional challenge. Most of the revolutionary ideas of today at one time existed as a fringe element. An organizations ability to foster, nurture, and synthesize the impacts of varying views of information is critical to knowledge economy survival. Speed of "idea to implementation" is also improved in a systems view of learning.
- Media, news, information. This trend is well under way. Mainstream media organizations are being challenged by the open, real-time, two-way information flow of blogging.
- Personal knowledge management in relation to organizational knowledge management
- Design of learning environments

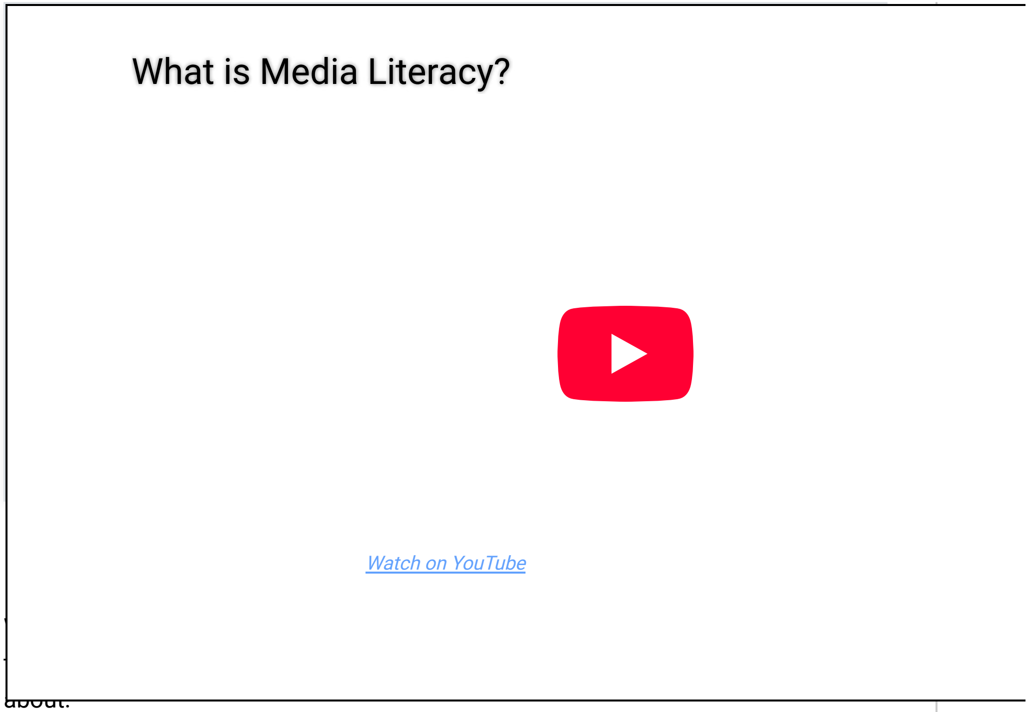
Conclusion

The pipe is more important than the content within the pipe. Our ability to learn what we need for tomorrow is more important than what we know today. A real challenge for any learning theory is to actuate known knowledge at the point of application. When knowledge, however, is needed, but not known, the ability to plug into sources to meet the requirements becomes a vital skill. As knowledge continues to grow and evolve, access to what is needed is more important than what the learner currently possesses.

Connectivism presents a model of learning that acknowledges the tectonic shifts in society where learning is no longer an internal, individualistic activity. How people work and function is altered when new tools are utilized. The field of education has been slow to recognize both the impact of new learning tools and the environmental changes in what it means to learn. Connectivism provides insight into learning skills and tasks needed for learners to flourish in a digital era.

LIDT in the World

With the constant evolution of technology comes the constant influx of information. Watch the video below to learn more about media literacy:



about.

- How does improving media literacy relate to the process of connecting nodes or information sources?
- How does the principle of "currency," as discussed in the chapter, relate to both connectivism and media literacy?

Application Exercises

- Use a comparison chart (such as a T-chart or Venn Diagram) to compare elements of Connectivism with elements of Behaviorism, Cognitivism, or Constructivism.
- According to connectivism, how has the rapid increase of access to knowledge affected the way we should view knowledge?
- Think of the most recent job you have held. How did the principles of connectivism affect the way you learned in that job?
- How would you summarize the main points of connectivism if you had to explain it to a friend with no background in this area?

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This content was previously published as follows:

Siemens, G. (2018). Connectivism. In R. E. West (Ed.), *Foundations of Learning and Instructional Design Technology*. EdTech Books. https://edtechbooks.org/-oCyT

Using the First Principles of Instruction to Make Instruction Effective, Efficient, and Engaging

Merrill, M. D.

Effective Instruction
Efficient Instruction
Engaging Instruction
First Principles of Instruction
Instructional Design

For over 50 years my career has been focused on one very important question: "What makes instruction effective, efficient, and engaging?" I decided that e-learning should refer to the quality of the instruction, not merely to how it is delivered, so I labeled effective, efficient, and engaging instruction as e3 instruction. In this brief presentation I will try to share a little of what I've learned. Perhaps the underlying message of my studies and this presentation is this simple statement: **"Information alone is not instruction!"**

In 1964, in our research lab at the University of Illinois, we were sending messages from one computer to another via ARPANET. Little did we realize the fantastic potential of this experimental communication from computer to computer. Unfortunately for our subsequent fortunes, none of us in that lab envisioned the Internet and the World Wide Web and the impact that this invention would have on communication, the availability of information, social interaction, commerce, education, and almost every other aspect of our lives.

"Information Alone is Not Instruction!"

In 1963, I was doing my student teaching in a junior high school; my subject was American history. Unfortunately for this experience, my major was psychology with a minor in mathematics. I never had an American history class in my entire college career. The students' textbook was woefully inadequate, so I spent my evenings poring through the American Encyclopedia, which fortunately was resident in my home. This paucity of information left me very underprepared for teaching these students. However, thanks to the ongoing presidential election (Nixon vs Kennedy), there was a debate on television that I could use as a springboard to teach a little about the electoral process, the Electoral College, and something about our two-party system of government.

But today, thanks to the Internet, interested learners can find information about almost anything in the world, whether current events or historical events. Teaching American history to junior high students today would be so much easier because of the almost unlimited amount of information in all different media that is available, including audio, video, animation, as well as text. But is access to this wealth of information instruction? What I've learned from my study of this question is that the answer is an emphatic NO! I repeat, **Information alone is not instruction**.

Motivation

All of us have heard the saying that "students didn't learn because they just weren't motivated." Or that "motivation is the most important part of learning." Or "we really need to find a way to motivate our students." What is it that causes motivation? People have often asked me, "Is motivation one of your first principles of instruction?" The answer is no; motivation is not something we can do, motivation is an outcome. So, if it is an outcome, what causes motivation? Motivation comes from learning; the greatest motivation comes when people learn. We are wired to learn; all of us love to learn; every student loves to learn. And, generally, we are motivated by those things that we find we are good at. For example, I'm not much of an athlete. I look back on my past and ask, "Why am I not an athlete?" I remember that I was very small as a child. In my elementary school we used to divide up into teams during recess to play softball. I always ended up as last shag on the girls' team. That was very embarrassing for me, so, I lost interest in sports; I did not want to be a sports person. Consequently, I never pursued sports. On the other hand, somewhere in my youth I was given a scale model train. I was very interested in trains, but in this case one of my father's friends showed me how to build scenery and how to make a model railroad that looked like the real world. I became very interested in building a model railroad. I have continued to follow this interest throughout my life. Why was I motivated to do this? Because I was good at it, because I learned things about how to build a realistic model. The more I learned, the more interested I became. We need to find ways to motivate our students, and that comes from promoting learning. Learning comes when we apply the effective and engaging principles of instruction.

Typical Instructional Sequence

In my experience I have had the opportunity to review many courses. Figure 1 illustrates a common instructional sequence that I have observed.

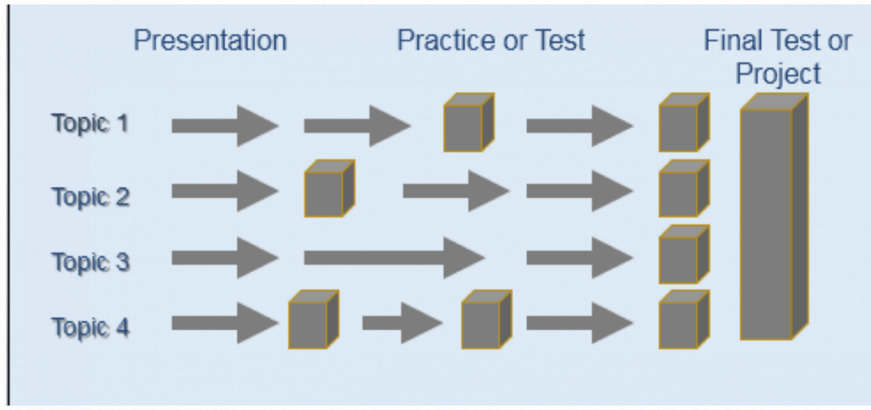

Figure 1. Typical Instructional Sequence

The course or module consists of a list of topics representing the content of the course. Information about the topic is presented, represented by the arrows. Occasionally a quiz or exercise is inserted to help illustrate the topic, represented by the boxes. The sequence is to teach one topic at a time. At the end of the course or module there is a culminating final test, or in some cases a final project, that asks the students to apply the topic to complete some t*ask* or solve some problem.

Sometimes this sequence is very effective in enabling students to gain skills or to learn to solve problems. Too often, however, this sequence is ineffective and not engaging for students. The effectiveness of this sequence and the degree of engagement it promotes for learners depends on the type of learning events that are represented by the arrows and the boxes in this diagram.

Instructional Events

There are many different types of instructional or learning events. Perhaps the most frequently used learning event is to present information or *Tell*. This *Tell* can take many forms, including lectures, videos, text books, and PowerPoint presentations.

The next most frequent instructional or learning event is to have learners remember what they were told, what they read, or what they saw. This remember instructional event we will label as *Ask*. Even though *Tell* and *Ask* are the most frequently used instructional events, if they are the only instructional events used then the *Tell–Ask* instructional sequence is the least effective instructional strategy.

If the arrows in Figure 1 represent *Tell* learning events and the boxes represent *Ask* learning events, then this module is not going to be very effective and most likely will not prepare learners to adequately complete a project using the information taught. If the culminating learning activity is an *Ask* final exam, learners may be able to score well on this exam. However, a good score on an *Ask* exam does little to prepare learners to apply the ideas taught to the solution of a complex problem or completion of a complex t*ask*.

A little history is in order. In 1999 Charles Reigeluth published a collection of papers on Instructional Design Theories and Models. In the preface to this book he indicates that there are many different kinds of instructional theories and that instructional designers need to be familiar with these different approaches and select the best approach or combination of approaches that they feel are appropriate for their particular instructional situation. I challenged Dr. Reigeluth, suggesting that while these different theories stressed different aspects of instruction and used different vocabulary to describe their model and methods, that fundamentally, at a deep level, they were all based on a common set of principles. Dr. Reigeluth kindly suggested that he didn't think that my assumption was correct, but if I felt strongly about it that perhaps I should try to find evidence for my assumption.

I took the challenge and spent the next year or two studying these various instructional theories. The result was the publication in 2002 of my often-referenced paper on First principles of Instruction (Merrill, 2002). I have spent the time since in refining my proposition in a series of papers and chapters on First Principles. In 2013, I finally published my book *First Principles of Instruction* (Merrill, 2013) that elaborated these principles, provided a set of suggestions for how these principles might be implemented in various models of instruction, and provided a variety of instructional samples that illustrate the implementation of First Principles in a range of content areas and in different educational contexts, including training, public schools, and higher education.

First Principles of Instruction

Principles are statements of relationships that are true under appropriate conditions. In instruction these relationships are between different kinds of learning events and the effect that participating in these learning events has on the acquisition of problem-solving skills. I identified five general principles that comprise First Principles of Instruction. As I reviewed the literature on instructional design theories and models, I tried to be as parsimonious as possible by selecting only a few general principles that would account for the most fundamental learning activities that are necessary for effective, efficient, and engaging instruction.

Activation: Learning is promoted when learners activate a mental model of their prior knowledge as a foundation for new skills. A frequently cited axiom of education is to start where the learner is. Activation is the principle that attempts to activate a relevant mental model already acquired by the learner in order to assist him or her to adapt this mental model to the new skills to be acquired.

Demonstration: Learning is promoted when learners observe a demonstration of the skills to be learned. I carefully avoided the word presentation for this principle. Much instruction consists largely or entirely of presentation. What is often missing is demonstration, show me. Hence, the demonstration principle is best implemented by *Tell–Show* learning events where appropriate information is accompanied by appropriate examples.

Application: Learning is promoted when learners engage in application of their newly acquired knowledge or skill that is consistent with the type of content being taught. Way too much instruction uses remembering information as a primary assessment tool. But remembering information is insufficient for being able to identify newly encountered instances of some object or event. Remembering is also insufficient to be able to execute a set of steps in a procedure or to grasp the events of a process. Learners need to apply their newly acquired skills to actually doing a t*ask* or actually solving a problem.

Integration: Learning is promoted when learners share, reflect on, and defend their work by peer-collaboration and peer-critique. Deep learning requires learners to integrate their newly acquired skills into those mental models they have already acquired. One way to insure this deep processing is for learners to collaborate with other learners in solving problems or doing complex tasks. Another learning event that facilitates deep processing is when learners go public with their knowledge in an effort to critique other learners or to defend their work when it is critiqued by other learners.

Problem-centered: Learning is promoted when learners are engaged in a problem-centered strategy involving a progression of whole real-world *task*s. The eventual purpose of all instruction is to learn to solve complex problems or complete complex tasks, either by themselves or in collaboration with other learners. This is accomplished best when the problem to be solved or the *task* to be completed is identified and demonstrated to learners early in the instructional sequence. Subsequent component skills required for problem solving or for completing a complex task are best acquired in the context of trying to solve a real instance of the problem or complete a real instance of the task.

Support for First Principles of Instruction

Do First Principles of Instruction actually promote more effective, efficient, and engaging instruction?

A study conducted by NETg (Thompson Learning, 2002), a company that sells instruction to teach computer applications, compared their off-the-shelf version of their Excel instruction, which is topic-centered, with a problem-centered version of this course that was developed following First Principles. Participants in the experiment came from a number of different companies that were clients of NETg. The assessment for both groups consisted of developing a spreadsheet for three real-world Excel problems. The problem-centered group scored significantly higher, required significantly less time to complete the problems, and expressed a higher level of satisfaction than the topic-centered group. All differences were statistically significant beyond the .001 level.

A doctoral student at Florida State University completed a dissertation study comparing a topic-centered course teaching Flash programing with a problem-centered course (Rosenberg-Kima, 2011). This study was carefully controlled so that the variable was merely the arrangement of the skill instruction in the context of problems or taught skill-by-skill. The learning events for both groups were identical except for the order and context in which they were taught. On a transfer Flash problem that required students to apply their Flash programing skills to a new problem, the problem-centered group scored significantly higher than the topic-centered group and felt the instruction was more relevant and resulted in more confidence in their performance. There was no time difference between the two groups for completing the final project.

A professor at Indiana University designed a student evaluation questionnaire that had students indicate whether the course being evaluated included First Principles of Instruction (Frick, Chadha, Watson, & Zlatkovska, 2010). The correlations all showed that the extent to which First Principles are included in a course correlates with student rating of instructor quality and their rating of satisfaction with the course. Students also spent more time on task and were judged by their instructors to have made more learning progress when the courses involved First Principles of Instruction. This data was collected in three different studies.

The conclusion that can be drawn from these three different and independent studies of First Principles clearly shows that courses based on First Principles do facilitate effectiveness, efficiency, and learner satisfaction.

Demonstration Principle

When I'm asked to review course material, my approach is to immediately turn to Module 3 of the material. By then the course is usually into the heart of the content, and the introductory material is finished. What do I look for first? Examples. Does the content include examples, demonstrations, or simulations of the ideas being taught? Adding demonstration to a course will result in a significant increment in the effectiveness of the course.

Do most courses include such demonstration? MOOCs are a recent very popular way to deliver instruction. How well do these *Massive Open Online Courses* implement First Principles of Instruction? Anoush Margaryan and her colleagues (Margaryan, Bianco, Littlejohn, 2015) published an important paper titled Instructional Quality of Massive Online Courses (MOOCs) that addresses this question. They carefully analyzed 76 MOOCs representing a wide variety of content sponsored by a number of different institutions to determine the extent that these courses implemented First Principles of Instruction. Their overall conclusion was that most of these courses failed to implement these principles.

The demonstration principle, providing examples of the content being taught, is fundamental for effective instruction and engaging instruction. How many of these MOOCs implemented this principle? Only 3 out of the 76 MOOCs analyzed included appropriate demonstration. The effectiveness and engagement in these MOOCs could be significantly increased by adding relevant and appropriate demonstration.

Application Principle

When I'm asked to review a course, the second type of learning event I look for is application that is consistent with and appropriate for the type of learning involved. Remembering a definition or series of steps is not application. There are two types of application that are most important but too often not included. *DOid* or *DOidentify* requires learners to recognize new divergent examples of an object or event when they encounter it. *DOidentify* is also the initial application required when learning the steps of a procedure or process. The learner must first recognize a correctly executed step when they see it, and they must also recognize the consequence that resulted from the execution of the step. Once they can recognize appropriate steps and appropriate consequences for these steps, then *DOexecute* is the next level of application. *DOexecute* requires learners to actually perform or execute the steps of a procedure. When appropriate application is missing, the effectiveness of a course is significantly increased when appropriate application learning events are added.

MOOCs are often about teaching learners new skills. Did the MOOCs in the study cited above include appropriate application for these skills? They fared better than they did for demonstration. At least 46 of the 76 MOOCs did include some form of application. This still leaves 30 MOOCs in this study without application of any kind. However, on careful analysis of the sufficiency and appropriateness of the application included, it was found that only 13 of the MOOCs in this study had appropriate and sufficient application.

Learning Events

While *Tell* and *Ask* are the most frequently used learning events, as we have seen, a strategy that uses only these two learning events is not an effective or engaging strategy. Learning to solve problems and to do complex tasks is facilitated when a *Tell* instructional strategy is enhanced by adding demonstration or *Show* learning events. A *Tell-Show* sequence is more effective than a *Tell* only sequence.

Learning to solve problems and to do complex tasks is facilitated even more when a *Tell-Show* strategy is further enhanced by adding *Do* instructional events. These *Do* learning events are most appropriate when they require learners to identify unencountered instances of some object or event (*DOidentify* learning events) and when they require learners to execute the steps in a procedure or observe the steps in a process (*DOexecute* learning events). A *Tell-Show-Do* sequence is even more effective than a *Tell-Show* instructional sequence.

Much existing instruction can be considerably enhanced by the addition of appropriate *Show* and *Do* learning events. If the arrows in Figure 1 consist of *Tell* and *Show* learning events and the boxes consist of *Do* learning events and if the final project is not merely a remember or *Ask* assessment but the opportunity for learners to apply the skills they have acquired from the *Tell-Show-Do* instruction to a more complete problem or task, then the resulting learning will be more effective, efficient, and engaging for learners. Much existing instruction can be significantly enhanced by converting from *Tell-Ask* learning events in this typical instructional sequence to *Tell-Show-Do* learning events.

How to Revise Existing Instruction

Much existing instruction is primarily *Tell-Ask* instruction. This instruction can be significantly enhanced by the demonstration of appropriate examples (*Show* learning events) and even further enhanced by the addition of appropriate application activities (*Do* learning events).

The fundamental instructional design procedure to enhance existing instruction is fairly straightforward. Start by identifying the topics that are taught in a given module. Create a matrix and list these topics in the left column of a matrix. Across the top of the matrix list the four primary learning event types: *Tell, Ask, Show, and Do.*

Second, identify the *Tell* information for each topic and reference it in the *Tell* column. Review this information to ensure that each topic is accurate and sufficient for the goals of the instruction.

Third, identify existing *Show* learning events for each topic. If the existing instruction does not include appropriate or sufficient examples of each of the concepts, principles, procedures, or processes listed, then identify or create appropriate examples for inclusion in the module. Creating a matrix to use as a cross reference for the new content examples can help identify areas where new activities need to be placed in the course.

Fourth, identify existing *Do* learning events for each topic. If the existing instruction does not include appropriate or sufficient *Do* learning events, then identify or create appropriate *Do-identify* or *Do-execute* learning events for inclusion in the module.

Finally, assemble the new demonstrations and applications into the module for more effective, efficient, and engaging instruction.

The Context Problem

Even after appropriate demonstration and application learning events are added to this traditional instructional sequence, there is still a potential problem that keeps this instructional sequence from being as effective, efficient, and engaging as possible. In this sequence topics are taught one-on-one. The demonstration and application learning events added to a *Tell* sequence are usually examples that apply to only a single component skill and are merely a small part of solving a whole problem. Too often learners fail to see the relevance of some of these individual skills learned out of context. We have all experienced the often used explanation: “You won’t understand this now, but later it will be very important to you.” If “later” in this situation is several days or weeks there is a good possibility that the learners will have forgotten the component skill before they get to actually use this skill in solving a whole problem or doing a whole task. Or, if learners do not see the relevance of a particular skill they may fail to actually learn the skill or they are unable to identify a mental model into which they can incorporate this skill. Then, when it is time to use this skill in the solution of a whole problem, learners are unable to retrieve the skill because it was merely memorized rather than understood. Furthermore, if solving a whole problem or doing a whole task is the final project for a module or course, there may be no opportunity to get feedback and revise the project.

Is there a better sequence that is more effective, efficient, and engaging than this typical sequence?

Problem-centered

To maximize engagement in learning a new problem solving skill, learners need to acquire these skills in the context of the problem they are learning to solve or the task they are learning to complete. If learners first activate a relevant mental model (activation principle) and then are shown an example of the problem they will learn to solve and how to solve this problem, they are more likely to see the relevance of each individual component skill when it is taught, and they will have a framework into which they can incorporate this new skill, greatly increasing the probability of efficient retrieval and application when they are confronted with a new instance of the problem.

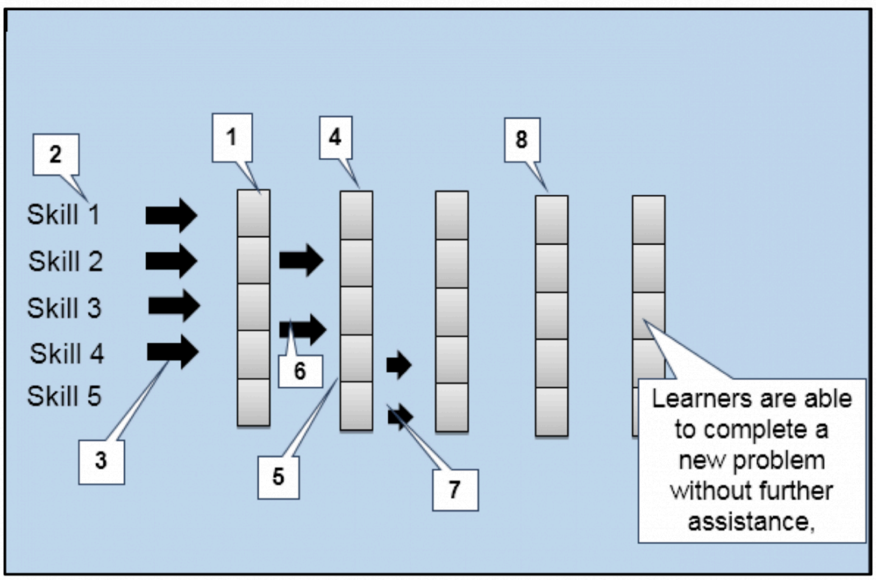

Figure 2. Problem-Centered Instructional Sequence

Does existing instruction use a problem-centered sequence in instruction? Even though many MOOCs are designed to facilitate problem solving, Margaryan and her colleagues found that only 8 of the 76 MOOCs they analyzed were problem-centered. Several previous surveys of existing instruction in a variety of contexts found that most courses do not use a problem-centered instructional sequence or even involve students in the solution of real-world problems as a final project.

A typical instructional sequence is topic-centered; that is, each topic is taught one-by-one, and then at the end of the module or course learners are expected to apply each of these topics in the solution of a final problem or the completion of a final task. Figure 2 illustrates a problem-centered sequence that turns this sequence around. Rather than telling an objective for the module, which is a form of information, the (1) first learning activity is to show a whole instance of the problem that learners are being taught to solve. This demonstration also provides an overview of the solution to the problem or the execution of the task. (2) Students are then told information about the component skills necessary for the solution of this instance of the problem and (3) shown how each of these component skills contributes to the solution of the problem. (4) After this *Tell–Show* demonstration for the first instance of the problem is complete, a second problem instance is identified and shown to learners. (5) The learner is then required to apply the previously acquired component skills to this second problem (*Do*). (6) Some of the component skills may require some additional information or a different way of using the skill to solve this second instance of the problem. Learners are then told this new information and (7) shown its application to another instance of the problem. Note that the *Tell-Show-Do* for each component skill or topic is now distributed across different instances of the problem. The first instance of the problem was primarily *Tell-Show*. The second instance of the problem is a combination of *Tell-Show* for new parts of each component skill and *Do* for those component skills already acquired. (8) Additional instances of the problem are identified. Learners apply those skills already acquired (*Tell-Show*) and apply those skills already acquired (*Do*) for each new instance of the problem. The sequence is complete when learners are required to solve a new instance of the problem without additional guidance.

In a problem-centered instructional sequence learners are more likely to see the relevance of each new component skill. This sequence will provide multiple opportunities for learners to apply these newly acquired component skills in the context of real instances of the problem. It enables learners to see the relationship among the individual component skills in the context of each new instance of the problem. It also provides gradually diminishing guidance to learners until they are able to solve a new instance of the problem with little guidance.

Instruction that is revised to include a *Tell-Show-Do* sequence of learning events all in the context of solving a progression of instances of a whole problem or a whole task has the potential ofmaximally engaging students while providing efficient and effective learning activities.

Recommendation

In summary: Designers may want to analyze their courses. Perhaps the effectiveness, efficiency, and especially the engagement of a course may be enhanced by adding appropriate demonstration and application and by using a problem-centered instructional sequence. Does the course include appropriate and adequate demonstration? Does it include appropriate and adequate application? Are the skills taught in the context of an increasingly complex progression of instances of the problem?

Conclusion

Motivation is an outcome, not a cause. What promotes engagement and hence motivation? Effective, efficient, and engaging instruction. What promotes effective, efficient, and engaging instruction? First Principles of Instruction: Activation, Demonstration, Application, Integration, and Problem-centered. In this paper we have emphasized the demonstration and application principle and a problem-centered instructional sequence.

To learn more, see *First Principles of Instruction: Revised Edition*, authored by

David Merrill and Theodore Frick, and available on Amazon.

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Bloom's Taxonomy

Benjamin Bloom and his associates developed a taxonomy of different kinds of thinking and learning. The taxonomy is divided into three parts: the cognitive, affective, and the psychomotor domains. In this chapter, we will address how the taxonomy was developed, how it evolved, and how educators use it for teaching purposes.

Is the mental effort required to recall a definition the same as the mental effort needed to write an essay—what about recalling multiplication tables versus solving an equation? In both cases the latter will involve greater mental processing than the former, right? Benjamin Bloom and his associates recognized this and developed a taxonomy of different kinds of thinking and learning, which is popularly known as Bloom's taxonomy. In this chapter, we will address how the taxonomy was developed, how it evolved, and how educators use it for teaching purposes.

Evolution of the Taxonomy

The Taxonomy of Educational Objectives handbook (Bloom et al., 1956) is a book that explains how students learn and details the cognitive domain. It was published in 1956 (a first volume focused on cognitive objectives) after a series of conferences from 1949 to 1953 in which Benjamin S. Bloom was ably assisted by his colleagues, Max D. Engelhart, Edward J. Furst, Walker H. Hill, and David R. Krathwohl. The conferences sought to improve communication between educators about the design of curricula and educational examinations. In 1964, the second volume in the series (Krathwohl et al., 1964), focusing on affective outcomes, was published. Around eight years later in1972, Elizabeth Simpson built the taxonomy of the psychomotor domain based on the work of Bloom and others (Simpson, 1966). A revised version of the taxonomy for the cognitive domain was later created in 2001 (Krathwohl, 2002).

Figure 1. *Evolution of Bloom's Taxonomy*

Purpose of the Taxonomy

Why was the taxonomy developed? In the handbooks, the authors explained that the taxonomy was created to

- ensure precise communication when educators, administrators, and research workers communicate about educational goals;
- create a common ground between schools for exchanging information about curriculum and evaluation devices;
- provide teachers with a framework to identify whether the educational goals that they have identified are lower or higher-order thinking goals, and
- help teachers define objectives in such a manner that it becomes easy to plan learning experiences and develop evaluation devices (Bloom et al., 1956).

The team had been previously concerned about the presence of "nebulous" terms and a lack of common understanding amongst educators regarding educational objectives. As they stated in the handbook: "For example, some teachers believe their students should "really understand," others want their students to internalize knowledge; still others want their students to "grasp the core or essence," or "comprehend." Do they all mean the same thing?" (p. 1).

Things to Consider

Bloom's taxonomy is an excellent framework that differentiates between lower-order thinking skills and higher-order thinking skills. However, the following points must be kept in mind when we use Bloom's taxonomy.

Bloom’s taxonomy was developed after going through many educational outcomes that existed across various schools in America (Bloom et al., 1956). In that sense, the group worked backwards, identifying existing educational outcomes and then the taxonomy based on these outcomes.

Though referred to as a taxonomy, the framework is more of a classification of student behaviors that represent the intended educational outcomes (Kompa, n.d.). A taxonomy is evidence-based, while classification is a method to communicate ideas in a way that is useful and suggests potential actions.

The Taxonomy

The taxonomy is divided into three parts: the cognitive, affective, and the psychomotor domains. The handbook published in 1956 described the three domains but detailed only the cognitive domain.

- The **cognitive domain** refers to knowledge attainment, and mental or intellectual processes, such as the ability to solve a mathematical problem or write an essay. Let’s consider this example from mathematics: “Students will be able to understand that perimeter and area have a relationship and recognize and apply their new knowledge in real-life situations.” To achieve this learning outcome, a student must recall the definitions of perimeter and area, understand how the two differ, recall the formula to calculate these, and use this information to find out the perimeter and area of something in real life (e.g. a playground).These are mental processes that take place in the brain; hence, they fall within the ambit of the cognitive domain.
- The **affective domain** addresses emotional aspects reflected via learners' beliefs, values, and interests, such as the ability to appreciate and/or empathize. An example of the learning outcome in this domain for the mathematics topic on area and perimeter could be the following: “Students will value the need for learning about area and perimeter. They will demonstrate this by listening to the teacher, responding to their questions, and clarifying doubts.”
- The **psychomotor domain** addresses skills that are cultivated through neuromuscular motor activities, such as the ability to write, or wield a scalpel with precision. In our mathematics example, the learning outcome on the topic of area and perimeter may be, “Students will be able to draw a rectangle for a given area and perimeter using geometry tools.” This task requires motor coordination and will fall in the purview of the psychomotor domain.

Cognitive Domain

In the cognitive domain, Bloom and his collaborators (Bloom et al., 1956) identified and defined six levels of cognitive complexity: knowledge, comprehension, application, analysis, synthesis, and evaluation. These levels were arranged hierarchically on a continuum ranging from simple to complex and from concrete to abstract. Each category also had sub-categories, as displayed in the following table, recreated from their original work (Bloom et al., 1956):

Levels	**Categories as sub-categories**

Knowledge	• Knowledge of specifics
	  ◦ *Knowledge of terminology*
	  ◦ *Knowledge of specific facts*
	• Knowledge of ways and means of dealing with specifics
	  ◦ *Knowledge of conventions*
	  ◦ *Knowledge of trends and sequences*
	  ◦ *Knowledge of classifications and categories*
	  ◦ *Knowledge of criteria*
	  ◦ *Knowledge of methodology*
	• Knowledge of universals and abstractions in a field
	  ◦ *Knowledge of principles and generalizations*
	  ◦ *Knowledge of theories and structures*

Comprehension	• Translation • Interpretation • Extrapolation
Application	Note: The original taxonomy had no sub-categories under Application
Analysis	• Analysis of elements • Analysis of relationships • Analysis of organizational principles
Synthesis	• Production of a unique communication • Production of a plan or a proposed set of operations • Derivation of a set of abstract relations
Evaluation	• Evaluation in terms of internal evidence • Judgements in terms of external **criteria**

Table 1. Structure of the Original Taxonomy

Since the categories are arranged hierarchically, the taxonomy implies that higher levels of cognition are built upon the lower levels. Intellectual operations increase in complexity from the first level, that is "Knowledge", to the last level, which is "Evaluation". There's often a misunderstanding that lower levels are less desirable than higher levels. This is not true because unless you master the lower levels, you cannot achieve the higher levels. As is stated in the handbook: "While it is recognized that knowledge is involved in the more complex major categories of the taxonomy (2.00 to 6.00), the knowledge category differs from the others in that remembering 'is the major psychological process involved here, while in the other categories the remembering is only one part of a much more complex process of relating, judging, and reorganizing" (Bloom et al., 1956, p. 62).

The higher-level thinking skills involve utilizing knowledge and understanding in new situations, or in a form that is very different from how it was learned initially. In short, the taxonomy was divided into two parts: (a) the simple behavior of remembering or recalling knowledge, and (b) the more complex behaviors of the abilities and skills.

Learning Check

A student recites the poem, "Stopping by Woods on a Snowy Evening" by Robert Frost. What is the cognitive level of this task?

- ☐ Remember
- ☐ Analyze
- ☐ Understand

A teacher gives her Grade 2 class a worksheet of multiplication tables to complete. Which domains will be involved in completing this task?

- ☐ Affective
- ☐ Cognitive
- ☐ Psychomotor

Kindergarten students practice writing the English alphabet using stencils. Which domain does this task address?

- ☐ Cognitive
- ☐ Affective
- ☐ Psychomotor

A Grade 10 class is tasked with discussing the historical importance of the novel *Pride and Prejudice* and its importance to the development of English literature. Which cognitive level does this address?

- [ ] Evaluate
- [ ] Create
- [ ] Apply

A student is working on a presentation using presentation software. The topic of the presentation is "Sustainable Living and Reducing Carbon Footprints." Which domains will be addressed through this task?

- [ ] Cognitive
- [ ] Affective
- [ ] Psychomotor

Criticism Of the Taxonomy

The taxonomy was designed to help educators state educational objectives, develop evaluation devices, and identify instructional strategies (Bloom et al., 1956). Thus, the taxonomy was meant to be used as a cognitive tool or job-aid for educators. However, a problem with cognitive tools is that they are representations of thought, and that is inherently problematic. While the creators of such tools may take into consideration how users will comprehend and use the tool, it is not possible to anticipate all the ways in which they will understand and use the tool. A common refrain of educators was that the taxonomy was mired in ambiguity, and a consensus on the levels was difficult to achieve (Soozandehfar & Adeli, 2016, p. 3). For example, an educational objective may be classified into either of the two lowest levels (knowledge or comprehension) or into any of the four highest levels (application, analysis, synthesis, or evaluation) by different educators (Soozandehfar & Adeli, 2016, p. 5). In addition, critics argued that the taxonomy was not based on research and evidence (Kompa, n.d.). The taxonomy is also criticized for the creation of a hierarchy (lower-order thinking to higher-order thinking), which according to some educationists is not how the human brain works (Kompa, n.d.). For instance, we may analyze content in order to understand it. Lastly, there have been a number of articles, which propagate the view that the lowest level, “remember” is not important, and educators must strive to achieve the higher-order learning outcomes (Soozandehfar & Adeli, 2016, p. 5). In other words, lower-order skills (i.e., knowledge and comprehension) are considered less critical and invaluable, which is not true.

Revised Taxonomy

Because of some of the criticism of the taxonomy, the framework was revised 45 years later by David R. Krathwohl, professor at the Syracuse University. This work is published in the journal, *Theory into Practice*, Volume 41, Number 4, Autumn 2002. The main revisions included the following: (a) change in terminology and in structure, (b) emphasis on subcategories, and (c) one-dimensional to two-dimensional.

Change in Terminology and in Structure

Verbs are now used to refer to all the levels: "Remember" (in place of "Knowledge"), "Understand" (in place of "Comprehension"), "Apply," "Analyze," "Evaluate" and "Create." The levels "Synthesis" and "Evaluate" have been interchanged, with "Evaluate" at level five, while "Synthesis" (Create) is at level six.

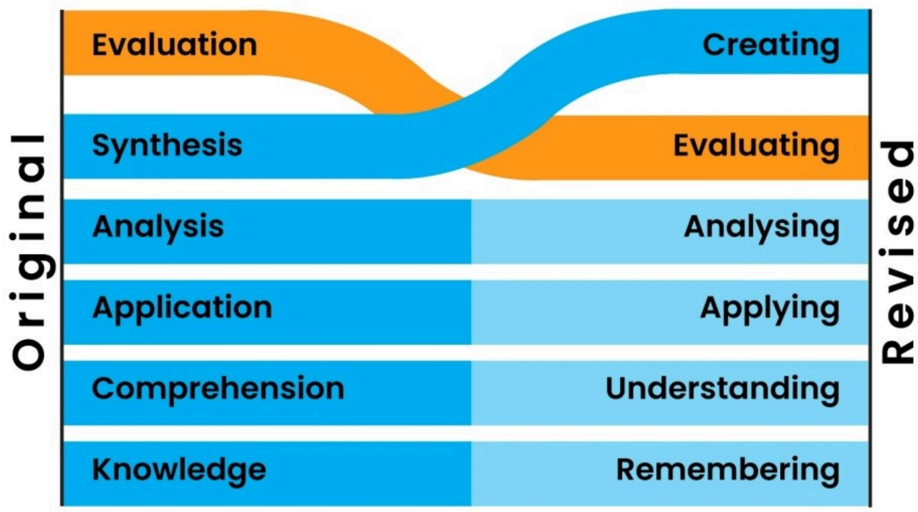

Figure 2. *Revised Taxonomy*

Emphasis on Subcategories

While the earlier taxonomy placed emphasis on the main categories, that is the levels, the revised taxonomy is placed on the sub-categories.

Level	Sub-categories
Level 1: Remember	Recognizing Recalling
Level 2: Understand	Interpreting Exemplifying Classifying Summarizing Inferring

Level	Sub-categories
	Comparing Explaining
Level 3: Apply	Executing Implementing
Level 4: Analyze	Differentiating Organizing Attributing
Level 5: Evaluate	Checking Critiquing
Level 6: Create	Generating Planning Producing

One-Dimensional and Two-Dimensional

This is a major structural change that was introduced in the revised taxonomy. The new "Knowledge" dimension was reorganized, and the number of sub-categories under this was increased to four. The increase in sub-categories was a result of a better understanding of cognitive psychology. Metacognition, a fourth category, was added to the Knowledge category. The table below depicts the Knowledge dimension and the sub-categories.

Category (Knowledge)	Sub-categories	Description
Knowledge Dimension	Factual Knowledge	Factual knowledge refers to knowing isolated bits of information in the form of discrete facts. Some examples are knowing the capital of countries, significant historical dates, components of the food pyramid, names of American Presidents, major battles of WWII, etc.
	Conceptual knowledge	Conceptual knowledge involves understanding relationships between various elements within a larger structure, such as classification and categories.

Category (Knowledge)	Sub-categories	Description
		For example, species of animals, different kinds of arguments, geological eras, Newton's laws of motion, principles of democracy, the theory of evolution, and so on.
	Procedural knowledge	The knowledge of a specific methodology, or sequence of steps required to complete a task, is known as procedural knowledge. Some examples are knowing how to solve equations, how to create and save a document using Microsoft Word, or the procedure to perform chemical experiments in a lab.
	Metacognitive knowledge	Metacognition refers to the learner's ability to be aware of their own thinking processes. Knowing how to memorize facts quickly and easily or adopt strategies for comprehending new and complex material are examples of metacognitive knowledge.

Read and Reflect

In a literature class, when teaching the poem, "The Daffodils", by William Wordsworth, the following tasks are set:

After reading the poem together as a class, students are asked to recite the first stanza of the poem followed by a question prompt such as, "What is the poet comparing the daffodils with and what resemblance does he find?" This is then followed by a task where students are told to describe the scene in the poem in their own words. Next, the students are asked to analyze the mood of the poem and poet. Finally, the students are tasked with writing a poem on nature, similar to the theme of "The Daffodils."

1. Which levels of Bloom's taxonomy in the cognitive domain can you identify?
2. Is the psychomotor domain being addressed in any way in this example? If yes, how?

Applying Bloom's Taxonomy

Though it was developed in 1956, Bloom's taxonomy is still relevant to educators. In current times, curriculum developers, teachers, and instructional designers apply the revised version of the taxonomy in the following ways:

1. **Content Structuring:** As per Bloom's taxonomy, learners must complete the initial levels of thinking before moving to the higher ones. When designers plan to teach a concept, this framework can help them present learning materials in a simple to complex sequence. Basically, the designer will introduce simple facts, then move on to concepts, before addressing more complex thinking tasks such as application, analysis, evaluation, and synthesis. For instance, if the person using the taxonomy were a teacher, they would first introduce the components of a story (plot, characters, conflict, and resolution) before asking their students to write a story. Typically, in lower grades within K-12, information recall is the focus; in the middle grades, understanding and application of concepts is emphasized; and in the higher grades, students work on analyzing, evaluating, and synthesizing concepts and principles.
2. **Teaching and reinforcing:** An understanding of the different levels in Bloom's taxonomy helps instructors decide whether a previously taught concept needs to be reinforced. To continue with our example, if learners can recall the components of a story but are struggling to write one, the teacher may select examples from different stories to highlight each component so that the students develop an understanding of the components. In addition, the teacher may also ask students to read a story and identify these components on their own, and then provide feedback.
3. **Assessing:** A very good application of Bloom's taxonomy is the mapping of questions to the level at which the learning outcomes are set. If the learning outcome is set at a recall level, then teachers must create questions that test learners for recall to ensure that the assessment is valid (a valid test is one that measures what it claims to measure). For example, if the learning outcome is to recall and understand the components of a story, the test should not assess students' abilities to write a story. This would be inappropriate and a misalignment between the learning objective, the teaching, and the assessment; this may cause students to feel frustrated. But, if the learning outcome is to develop the ability to write a story, and the instruction focused on developing skills for this learning outcome, then the assessment must test if learners can write a story.

Note: It's important to remember that it may not be possible in certain disciplines to map all the levels because different disciplines require different types of thinking. For instance, a pilot being trained is not typically expected to be "creative"; rather they are expected to follow standard operating procedures. On the other hand, the discipline of "art" will require high levels of creativity. In short, the value and priority of the levels will differ across disciplines. Further, the interpretation of levels changes across grades. For example, writing a story will be "synthesis" in the primary grades, but for a college-going student, pursuing a creative-writing course, synthesis may involve coming up with a new genre of story.

Applying the Taxonomy: Case Study

LIDT in the World: "Using Teaching Cases for Achieving Bloom's High-Order Cognitive Levels: An Application in Technically Oriented Information Systems Course" (Tan, 2017)

This research demonstrates how case studies were used to connect theory with real-world examples in teaching a computing course. This course is taken by students pursuing the undergraduate degree program in Information Systems at the Singapore Management University. As part of this initiative, three types of case studies were used to teach how to design an **Enterprise Web Portal**. These case studies were used to accomplish different learning outcomes mapped to the various cognitive levels in the revised Bloom's taxonomy. This initiative was tracked over two academic years through surveys. The outcome revealed that teaching in this way helped students achieve higher-order cognitive levels, such as evaluating and creating.

In this research initiative, the three types of case studies, which were introduced by the researchers, were: a storytelling case, a design-and-problem-solving case, and a create-design-implement case as part of the course. This is how the researchers described the three cases:

1. Cases where problems and solutions (or options) are described within the case and do not involve technical tasks are storytelling cases. This type of case study addresses the remembering, understanding, and applying cognitive levels.
2. Cases where students analyze scenarios in order to design a solution to address the stated needs are problem-solving cases. These scenarios are not real, but mimic **conditions** in the real world. This type of case aims to

address the analysis level along with remembering, understanding, and applying.
3. Cases in which students are provided with real-world situations and are expected to create a scenario and identify needs in order to design a solution by configuring the features of packaged software, and customizing it are create-design-implement cases. This type of case addressed the applying, analyzing, evaluating, and creating cognitive levels.

Through this study, the researchers gathered empirical evidence that proved how, by using case studies, students achieved outcomes at higher cognitive levels of the revised Bloom's taxonomy. The initiative gave students an opportunity to see their solutions in action, and the implications of their design decisions. In addition, it helped to prepare students for a career in the real world.

Reflect: What role did an understanding of Bloom's taxonomy play in helping this case-based learning to be successful?

Robert Mager

A chapter on learning outcomes is not complete without mentioning Robert Mager and his seminal work in this area. Mager came up with a format for writing learning outcomes. He referred to learning outcomes as behavioral objectives and proposed that a well-written behavioral objective has three parts (Mager, 1962, p. 41):

- **Terminal Behavior:** what the learner will be able to do after the instruction
- **Condition:** the situation under which the **performance** will be assessed
- **Criteria:** the standards for measuring the performance

Here is an example of a learning outcome written using Mager's format with a breakup of the three components:

Example

Learning outcome: Write an original, compelling, and engaging story in the fantasy genre.

Terminal Behavior: Write a story

Condition: Fantasy genre

Criteria: Original, compelling, and engaging

Writing learning outcomes using this format makes the outcomes verbose and complex. Hence, most educators apply the performance part and drop the condition and criteria. The condition is stated if there are multiple ways to complete a task and only one of these is being taught and assessed. In our example above, there are many genres of story-writing, so it is important to specify which one is being taught and assessed—hence, it is useful to describe the condition. Criteria are stated as part of the learning outcome for subjective content, where a rubric is to be used to evaluate. If the learners are being assessed through objective questions, then the passing score becomes the criteria and does not need to be specifically stated in the learning outcome statement (Tucker, 2023).

Of the three components, Mager emphasized terminal behavior, which he stated must be written using specific and measurable verbs. The emphasis on verbs was placed because Mager considered that they helped to measure the success or failure of the learner in completing a learning task. He advised that the use of ambiguous verbs, such as “know” and “understand” be avoided when writing behavioral objectives (Mager, 1962, p. 11).

Summary

Similar to other teaching-learning frameworks, Bloom’s taxonomy has advantages and disadvantages. The strength in the taxonomy lies in how it structures the thinking process and connects it with learning. Educators who use the taxonomy thoughtfully can make informed decisions while teaching and ensure that they plan and design learning events that will help develop different thinking skills. However, there is also the possibility that teachers may select learning outcomes that they think are desirable without much thinking or planning. This will do more harm than good. To summarize, it is important to understand that Bloom’s taxonomy is a descriptive framework that illustrates the complex nature of the thinking process and provides a structure for understanding it. It must not be used as a prescriptive framework (a template) where designers pick verbs from a readily available list without giving much thought to whether the learning outcome is applicable in the given context or not.

Learning Check Explanations

1. A student recites the poem, “Stopping by Woods on a Snowy Evening” by Robert Frost. What is the cognitive level of this task?
   This task is at the Remember level, since the student is recalling the poem from memory.
2. A teacher gives her Grade 2 class a worksheet of multiplication tables to complete. Which domains will be involved in completing this task?

Cognitive and psychomotor, since the students will recall the times tables (cognitive) and use a pencil to complete the activity (psychomotor).

3. Students practice writing the English alphabet using stencils. Which domain does this task address?
This task will address the psychomotor domain because the focus is on motor skills.
4. A Grade 10 class is tasked with discussing the historical importance of the novel Pride and Prejudice and its importance to the development of English literature. Which cognitive level does this address?
This task will involve evaluating the novel on certain parameters (historical importance and importance in the development of English literature) and is thus at the Evaluate level.
5. A student is working on a presentation using presentation software. The topic of the presentation is "Sustainable Living and Reducing Carbon Footprints". Which domains will be addressed through this task?
Cognitive, Affective & Psychomotor domains will be involved. Knowing, understanding, analyzing and applying information on sustainable living (Cognitive); knowing how to use software (cognitive); appreciating the need to live sustainably (Affective) and using computer peripherals, such as mouse or touchpad and keyboard (Psychomotor).

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Suggested Readings

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long as you properly attribute it.

III. Design

Instructional Design Models

Dousay, T. A. & Stefaniak, J. E.

Design Instructional Design Instructional Design Models

Phases of rapid development in the field of learning and instructional design technology have given way to dozens of instructional design models. These models often form the foundation of instructional design courses, introducing students to the field. However, broad and specific misconceptions often drive new designers to overly rely on models to guide them through an applied instructional design process. In this chapter, we explore a brief history of instructional design models, common components of models, commonly referenced models, and resources and advice for instructional designers as they engage in the instructional development process.

Researchers and practitioners have spent the past 60 years attempting to define and create models of design with the intent to improve instruction. As part of a joint, inter-university project, Barson (1967) defined instructional development as the systematic process for improving instruction. While the project report provides a guiding definition to frame and study instructional design (ID), it also cautions that many different conditions influence learning, including the use of media and the hazards of generalizing any sort of model. This caution continues to serve as a limitation on ID practice and research, as evidenced by current and past ID models.

Soon after World Wars I and II, experts in the field recognized that systematic approaches to developing instruction were a popular idea, highlighting that ID methods vary from simple to complex (Twelker et al., 1972). These historical observations predicted the reality where every instructional design project is always unique, with no two projects progressing through the design process the same way. The differences, sometimes subtle while at other times significant, have given way to dozens of different models used with varying popularity in a wide variety of learning contexts.

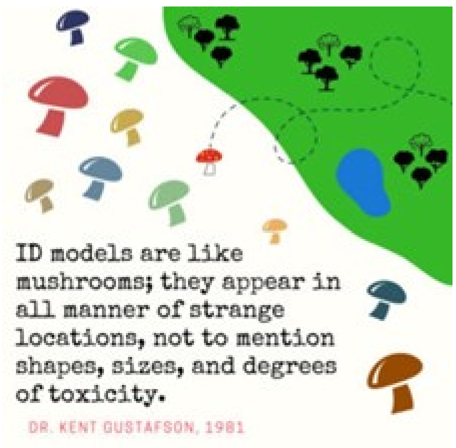

Figure 1. *Mushrooms*

In the midst of an explosion of models and theories, Gustafson (1991) drafted his first monograph that would become the Survey of Instructional Development Models, now in its fifth edition (Branch & Dousay, 2015). The book provides brief overviews of instructional design models, classifying them within the context of classroom-, product-, and process-oriented instructional problems. Also known as "the pencils book," this resource provides a concise summary to help novice instructional designers visualize different design approaches. It also assists more advanced instructional designers with an annotated bibliography on current practice and research. However, this text is just one of many often used in the study and practice of instructional design. Those seeking to expand their knowledge of design processes can learn much from the rich history and theoretical development over decades in the field. (See the Additional Resources section for suggestions.)

In this chapter, we explore a brief history of instructional design models, common components of models, commonly referenced models, and resources and advice for instructional designers as they engage in the instructional design process.

Historical Context

The field of Learning and Instructional Design Technology (LIDT) has experienced many periods of rapid development. Reiser (2001) noted that training programs during World War II sparked the efforts to identify efficient, systematic approaches to learning and instructional design. It would be another 20 years before the first models emerged, but the 1960s and 1970s gave way to extracting instructional technology and design processes from conversations about multimedia development (Reiser, 2017), which in turn produced more than three dozen different instructional design models referenced in literature between 1970 and 2005 (Branch & Dousay, 2015; Gustafson, 1991; Gustafson & Branch, 1997, 2002).

These models help designers, and sometimes educational **stakeholders**, simplify the complex reality of instructional design and apply generic components across multiple contexts (Gustafson & Branch, 2002), thus creating standardized approaches to design within an organization. However, Molenda (2017) observed that standardization of processes and terminology triggered interest in the field. This presents an interesting relationship between defining the field of instructional design and perpetuating its existence. As designers seek to justify their role in education—whether K-12, higher education, or industry—they often refer to existing models or generate a new model to fit their context. These new models then become a reference point for other designers and/or organizations. This relationship contributes to contentions when teaching and practicing ID.

Industry vs. Academic Expectations

Differences exist between academic instructional design and industry expectations when it comes to how instructional design models are referenced and used. Many introductory instructional design courses introduce students to models and rely on models to guide students through an applied instructional design process. Within these introductory courses, students who are new to the field have an opportunity to navigate the instructional design process in a scaffolded manner led by their instructor.

More specifically, coursework can use models as a mechanism to explore ID aptitudes. Several studies conducted over the last decade examined competencies expected of instructional designers (Ritzhaupt & Kumar, 2015; Ritzhaupt & Martin, 2014). These studies support the need for instructional designers to be knowledgeable of design and commonly recognized design processes. Further, context analysis studies of instructional design job postings reveal that employers expect instructional designers to be knowledgeable about a variety of processes and models such as ADDIE, Agile, SAM, Rapid deployment, Bloom's taxonomy, ARCS, and Gagne's Conditions of Learning (Kang & Ritzhaupt, 2015; Klein & Kelly, 2018; Raynis, 2018; Wang et al., 2021). Recognizing that job postings explicitly ask instructional designers to demonstrate knowledge and application of instructional design models, we suggest that instructional design programs prepare students to recognize multiple instructional design models in addition to understanding how to navigate through the instructional design process while using a systemic lens.

Learn More

Listen to Dr. Jill Stefaniak discuss the systemic consequences of the models designers use in the real world:

https://open.spotify.com/episode/303XBqCaMKGNV0YkEwKplz

Systemic Nature

In addition to criticisms that ID models do not accurately convey the iterative nature of design, others denounce models for a lack of systemic implications. In a systematic review examining the systemic reach of ID models, Stefaniak and Xu (2020) found that a majority of studies did not address the interrelationships between instructional processes and activities related to instructional design. Rather, applications rely heavily on using a model to guide the design and development of a product. Thus, we must attend to the systemic implications of learning and applying models.

Systems are dynamic, in nature, and constantly changing as new information and inputs to the system become available (Richardson & Chemero, 2014). Gibbons (2003) argued that the field's existing ID models focus on the medium rather than the design process. Treating models in this way places emphasis on the product, relegating the steps conveyed within an ID model to **prescriptive** or procedural-based actions or steps. However, such an approach does not reflect the complexities that exist with systems, including **learning design** (Gibbons, 2014).

The pencils book emphasizes that models should be used to "serve as conceptual, management, and communication tools" (Branch & Dousay, 2015, p. 23) for supporting instructional design efforts. Thus, we strongly recommend that instructional designers approach the use of ID models by thinking of them as blueprints to frame design activities within the overarching system. By shifting focus on the design process as opposed to the development of a product, instructional designers may be more apt to embrace the iterative nature of design and integrate design decisions that consider the dynamic complexities of the system.

Think About It!

Consider the blueprint analogy described here and pretend that you are a builder who has been contracted to design and build a single-story house for a multigenerational family. The preliminary meeting with the client reveals a need for a four-bedroom/two-bathroom home with a kitchen, living area, and detached garage. Based on these needs, your architect produces a blueprint of a two-story residence. The bathrooms are designed for shower-bathtub combinations using curtains and rods. One bedroom is located on the main floor while the other three are located on the second floor. Notes for flooring indicate using tile or hardwood throughout the residence.

As your crew raises the exterior and interior walls and supports, you share the blueprint with the clients and invite them to walk through the home. During the conversation, you learn that the eldest member of the family has accessibility needs. They are unable to walk without assistance and do not do well on slippery surfaces. Their bedroom will need to be on the main floor, and they need an Americans with Disabilities Act (ADA)-compliant bathroom with space for a walker to turn around and an open entry shower.

What do you do? How do you modify the blueprint to account for these accommodations?

Reflect on how the builder has to modify their blueprint to accommodate the needs of their client and meet ADA standards. Think about how this might relate to how an instructional designer may be required to adapt and modify their instructional design blueprints as information becomes available throughout a design project.

Process vs. Models

The process of analyzing, designing, developing, implementing, and evaluating (ADDIE) forms the basic underlying procedure (illustrated in Figure 2) that is a distinct component of instructional design regardless of which model is used (Gustafson & Branch, 1997). Branch (2009) said it well when he conceptualized the phases of the ADDIE process as follows:

Figure 2. *The ADDIE Process*

1. Analyze – Identify the probable causes for a performance gap.
2. Design – Verify the desired performances and appropriate testing methods.
3. Develop – Generate and validate the learning resources.
4. Implement – Prepare the learning environment and engage the students.
5. Evaluate – Assess the quality of the instructional products and processes, both before and after implementation (p. 3).

Learn More

Watch Dr. Rob Branch chat with *Off-the-Cuff*: ADDIE is not a model:

https://www.youtube.com/watch?v=DfQvTMxTDds

Notice the use of the term "process" rather than "model." For ID purposes, we define a process as a series of steps necessary to reach an end result. Similarly, we define a model as the specific instance of a process that can be imitated or emulated. In other words, a model seeks to personalize the generic into distinct functions for a specific context. Thus, when discussing the instructional design process, we often refer to ADDIE as the overarching **paradigm** or framework by which we can explain individual models. The prescribed steps of a model can be mapped or aligned back to the phases of the ADDIE process.

This discussion might also be facilitated with a business example. Consider the concept of process mapping; it helps organizations assess operational procedures as they are currently practiced (Hunt, 1996). Analytically mapping the process to identify the steps carried out in practice leads to process modeling, an exercise in optimization. In other words, modeling helps move processes to the desired state tailored to the unique needs of an organization. Many businesses of a similar type find that they have similar processes. However, through process modeling, their processes are customized to meet their needs.

The relationship between ADDIE and instructional design models functions much like this business world scenario. As instructional designers, we often follow the same process (i.e., ADDIE). However, through modeling, we customize the process to meet the needs of our instructional context and of our learners, stakeholders, resources, and modes of delivery. Models assist us in selecting or developing appropriate operational tools and techniques as we design.

Modeling the Process

Consider the following examples. The plan, implement, evaluate (PIE) model from Newby, Stepich, Lehman, and Russell (1996) encourages designers to consider how technology assists with instructional design, focusing on the what, when, why, and how. This phase produces an artifact or plan that is then put into action during implementation, followed by evaluating learner performance and instruction effectiveness. During planning, designers work through a series of questions related to the teacher, learner, and technology resources. The questions are answered while also taking into consideration the implementation and evaluation components of the instructional problem. When considered through the lens of the ADDIE process, PIE combines the analyzing, designing, and developing phases into a singular focus area, which is somewhat illustrated by the depiction in Figure 3.

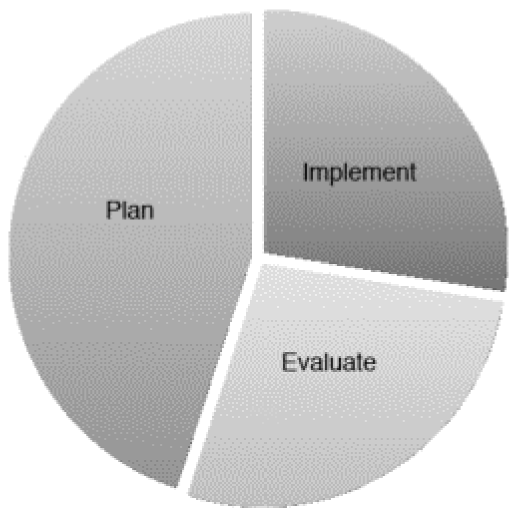

Figure 3. *The PIE Model*

Similarly, the Diamond (1989) model prescribes Phase I "Project Selection and Design" and Phase II "Production, Implementation, and Evaluation for Each Unit." Phase I of the Diamond model combines analyzing and designing, while Phase II combines developing, implementing, and evaluating. Robert Diamond placed an emphasis on the second phase of the model by prescribing an in-depth, parallel development system to write objectives, design evaluation instruments, select instructional strategies, and evaluate existing resources. As a result, new resources consider previously designed evaluation instruments. The evaluation is again consulted during the implementation, summative evaluation, and revision of the instructional system. These two examples help demonstrate what meaning is behind ADDIE being the general process and models being specific applications. (For further discussion of how aspects of specific models align with the ADDIE process, see Dousay and Logan, 2011.)

ID Models in Practice

Models serve as a source of research questions as we seek to develop a comprehensive theory of instructional development. Rarely are these models tested through a rigorous assessment of their results against predetermined criteria. Rather, ID models with wide distribution and acceptance gain their credibility by being found useful by practitioners who frequently adapt and modify them to match specific conditions (Branch & Dousay, 2015, p. 24). Thus, popularity serves as a form of validation for these design models. However, a wise instructional designer knows when to use, adapt, or create a new model of instructional design to fit their purposes.

Because there are so many different ID models, how do we choose which one to use? In framing this conversation, the Survey of ID Models (Branch & Dousay, 2015) serves as a foundation, but by no means should be the sole reference. A total of 36 different instructional design models (see Table 1 for a summary) have been covered in the pencils book since its first edition, and this list does not include every model created or used. Still, this list of models is useful in providing a concise guide to some of the more common approaches to instructional design.

Model Name[a]	**1st Ed 1981**	**2nd Ed 1991**	**3rd Ed 1997**	**4th Ed 2002**	**5th Ed 2015**	**6th Ed 2022**
Organization Development[b]						
Blake & Mouton (1971)	x					
Blondin (1977)	x					
Model Name[a]	**1st Ed 1981**	**2nd Ed 1991**	**3rd Ed 1997**	**4th Ed 2002**	**5th Ed 2015**	**6th Ed 2022**
Classroom-Oriented						
3PD (Sims & Jones, 2002)					x	
4C/ID (van Merriënboer, 1997)					x	x
ASSURE (Heinich, Molenda, & Russell, 1982)		x	x	x	x	x
Briggs (1970)	x					
DeCecco (1968)	x					

Model Name[a]	**1st Ed 1981**	**2nd Ed 1991**	**3rd Ed 1997**	**4th Ed 2002**	**5th Ed 2015**	**6th Ed 2022**
Dick & Reiser (1989)		x	x			
Gerlach & Ely (1971)	x	x	x	x	x	x
Learning Systems Design (Davis, Alexander, & Yelon, 1974)	x					
Morrison, Ross, Kemp, & Kalman (Kemp, 1977)	x	x	x	x	x	x
PIE (Newby et al., 1996)				x	x	
UbD (Wiggins & McTigue, 2000)					x	x
Model Name[a]	**1st Ed 1981**	**2nd Ed 1991**	**3rd Ed 1997**	**4th Ed 2002**	**5th Ed 2015**	**6th Ed 2022**
Product-Oriented						
Agile (Beck et al., 2001)					x	x
Baker & Schutz (1971)	x					
Banathy (1968)	x					
Bates (1995)				x	x	

Model Name[a]	1st Ed 1981	2nd Ed 1991	3rd Ed 1997	4th Ed 2002	5th Ed 2015	6th Ed 2022
Bergman & Moore (1990)		x	x	x	x	
CASCADE (Nieveen, 1997)				x	x	
de Hoog, de Jong, & de Vries (1994)				x	x	
Leshin, Pollock, & Reigeluth (1992)		x	x			
Van Patten (1989)		x	x			
Model Name[a]	**1st Ed 1981**	**2nd Ed 1991**	**3rd Ed 1997**	**4th Ed 2002**	**5th Ed 2015**	**6th Ed 2022**
Systems-Oriented						
Courseware Development Process (Control Data Corporation, 1979)	x					
Culture Based Model (Young, 2008)						x
Diamond (1989)		x	x	x	x	x
Dick, Carey, & Carey		x	x	x	x	x

Model Name[a]	1st Ed 1981	2nd Ed 1991	3rd Ed 1997	4th Ed 2002	5th Ed 2015	6th Ed 2022
(Dick & Carey, 1978)						
Gilbert (1978) Front End Analysis	x					
Instructional Development Institute (Twelker et al., 1972)	x	x	x			
ILDF (Dabbagh & Bannan-Ritland, 2004)					x	
IPISD (Branson, Rayner, Cox, Furman, & King, 1975)	x	x	x	x	x	x
IPDM (Gentry, 1993)			x	x	x	x
ISD Model 2 (Seels & Glasgow, 1997)		x		x	x	x
Layers of Necessity (Tessmer & Wedman, 1990)						x
Pebble in the Pond (Merrill, 2002)					x	x

Model Name[a]	1st Ed 1981	2nd Ed 1991	3rd Ed 1997	4th Ed 2002	5th Ed 2015	6th Ed 2022
Rapid Collaborative Prototyping (Dorsey, Goodrum, & Schwen, 1997)				x	x	
Smith & Ragan (1993)			x	x	x	x
TOTAL	**13**	**12**	**13**	**15**	**21**	**15**

Table 1. Instructional Design Models included in editions of the Survey text
[a] All references refer to the original or first edition of a model; however, the current name of the model as well as current scholars affiliated with the model may vary from the original iteration.
[b] Organization development was removed from the pencils book in the 2nd edition.
[b] The orientation categories (classroom, product, and systems) were removed from the pencils book in the 6th edition.

Determining which ID model to use might best be decided by taking into account a few factors. First, what is the anticipated delivery format? Will the instruction be **synchronous** online, synchronous face to face, **asynchronous** online, or some combination of these formats? Additionally, some models are better tailored for online contexts, such as Dick and Carey (1978); Bates (1995); Dabbagh and Bannan-Ritland (2004); or Morrison, Ross, Kemp, Kalman, and Kemp (2012).

Another way to think about how to select a model involves accounting for the context or anticipated output. Is the instruction intended for a classroom? In that case, consider 3PD (Sims & Jones, 2002); 4C/ID (van Merriënboer, 1997); ASSURE (Heinich et al., 1982); Briggs (1970); DeCecco (1968); Dick & Reiser (1989); Gerlach & Ely (1971); learning systems design (Davis et al., 1974); Morrison, Ross, Kemp, & Kalman (Kemp, 1977); PIE (Newby et al., 1996); or UbD (Wiggins & McTigue, 2000). Perhaps the instructional context involves producing an instructional product handed over to another organization or group. In this case, consider Agile (Beck et al., 2001); Baker & Schutz (1971); Banathy (1968); Bates (1995); Bergman & Moore (1990); CASCADE (Nieveen, 1997); de Hoog, de Jong, & de Vries (1994); Leshin, Pollock, & Reigeluth (1992); or Van Patten (1989). Lastly, perhaps your context prescribes developing a system, such as a full-scale curriculum. These instructional projects may benefit from the courseware development process (Control Data Corporation, 1979); culture based model (Young, 2008); Diamond (1989); Dick, Carey, & Carey (Dick & Carey, 1978); Gilbert (1978) front end analysis; Instructional Development Institute (Twelker et al., 1972); ILDF (Dabbagh & Bannan-Ritland, 2004); IPISD (Branson et al., 1975); IPDM (Gentry, 1993);

ISD model 2 (Seels & Glasgow, 1997); layers of necessity (Tessmer & Wedman, 1990); pebble in the pond (Merrill, 2002); rapid collaborative **prototyping** (Dorsey et al., 1997); or Smith & Ragan (1993) models.

Conclusion

This chapter synthesizes nearly 60 years of practice and study of ID models. From K-12 to higher education and industry, dozens of models continue to guide efforts that systematically design learning. However, when learning and practicing ID, it is easy to become constrained by models or lose sight of their role in systemic applications. Thus, we strongly recommend developing ID competencies indicative of design processes. Deciding which model to use does not need to be a cumbersome or overwhelming process. So long as a designer can align components of an instructional problem with the priorities of a particular model, they will likely be met with success through a systems thinking approach.

Think About It!

- While processes and models can be useful, why do you think it is important to maintain flexibility in designing instruction?
- What are some things to consider when selecting an instructional design model? Are there particular models you have used for specific projects?
- Think about a recent instructional design project you completed. Make a list of items you were required to modify or adjust throughout the project. How many times did you have to revisit certain phases of the instructional design process?

Editor's Note

To read more on this topic, see the chapter titled "Instructional Design Models" published in the first edition of this textbook.

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Additional Resources

The following resources represent a broad collection of discussion, debate, and research in the field of learning and instructional design. The list has been compiled from resources such as the Survey of Instructional Design Models (Branch & Dousay, 2015), reading lists from graduate programs in LIDT, and publications sponsored by the Association for Educational Communications & Technology. However, the list should not be considered exhaustive. It is provided here as a starting point for individuals or organizations seeking to learn more about the field and how models are developed and implemented.

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How Do We Solve a Problem Like Media and Methods?

Honebein, P. C. & Reigeluth, C. M.

confounded variables
Culture of Instructional Design
instructional framework theory
instructional methods
instructional priorities
Media
research to improve
research to prove

Media and instructional methods have had a problematic history in the instructional design field. In the 1990s, the "media vs. methods" debate exploded across influential issues of journals, including Educational Technology Research and Development, led by thinkers such as Richard Clark and Robert Kozma. This chapter discusses this historical debate and its insights, and updates it for our time, providing examples of how many designers still struggle with focusing on the media of a design, over the instructional methods.

Imagine that you are an instructional designer who needs to teach whitewater-river rafters how to tie a knot, specifically a double fisherman's knot (Wikipedia, 2022). The *designer* instructional objective (Reigeluth & An, 2021) for the task is as follows:

> *Given two, 2-foot or greater lengths of rope, tie a double fisherman's knot from memory. Knot must be tied in less than 20 seconds and must be appropriately dressed.*

For the content, you are primarily teaching a rote procedure, with a few concepts like "knot" and "dressed" (Bloom, 1956; Merrill, 1983). You engage a subject-matter expert to show you how to tie the knot and explain what "dressed" means. You take photographs of the procedure.

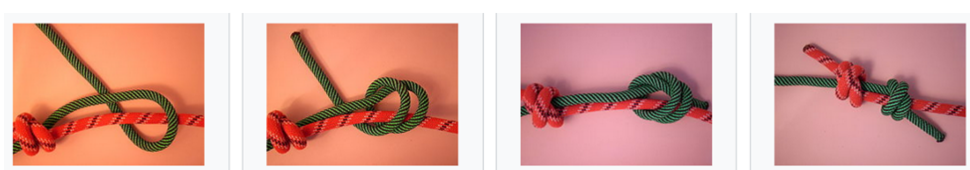

Figure 1. *Photo sequence for tying a double fisherman's knot. (Wikipedia public domain photo credit: Markus Bärlocher)*

You then add words beneath each image, like "Step 1, Step 2," and so on, that explain what the learner should do with the rope for each of the steps.

The instructional design field calls the photo sequence and the text in the example above *media* (a visual medium and a verbal medium, of which there are many types); photo and text are just two of many other types of media described by Heinich, Molenda, and Russell

(1989). The photos and text communicate the message: in this case, the subject-matter content. Yet, these photos and text alone do not enable a learner to master the specified instructional objective. Think about it: from memory (which means the learner cannot look at the photos or words when performing the task), do you think a learner could tie this knot to meet the standard specified in the instructional objective on the first try?

It is very likely that the learner could not. Why? Because a medium only carries the *message* to the learner. For the learner to *learn* the message (specified by the instructional objective), the message must contain *instructional methods, specific features* that facilitate actual learning (Reigeluth & Carr-Chellman, 2009; Reigeluth & Keller, 2009). Instructional methods have a hierarchical classification that includes *instructional approaches*, *instructional components*, and *sequencing* of both content and instructional components.

For example, for a physical task like knot tying, we recommend the approach of *hands-on learning*, which is characterized by "mastery of skills through activity and direct experience", i.e., actually trying to tie the knot (Reigeluth & Keller, 2009). We further recommend that this instructional approach be customized by using the well-researched, primary instructional components of tell (generality), show (example), and do (practice with feedback) (Merrill, Reigeluth & Faust, 1979). As a rote procedure, the practice should involve repetitive memorization of how to tie the knot (called drill and practice) and automatization (learning to tie it quickly without really thinking about it). The sequence should involve simultaneous telling and showing, followed by doing with immediate feedback.

To summarize the key terminology described in the example above:

- Media include words, diagrams, pictures, narration, motion pictures (videos), computers/smartphones, and real objects (like rope) that transport messages (content).
- Instructional methods include hands-on learning, instructional games, instructional simulations, tell, show, do, feedback, and easy-to-difficult sequencing.

Learning Check

Classify the following examples as either **Media** or **Instructional Method**:

YouTube Video

- [ ] Media
- [ ] Instructional Method

Demonstration

- [ ] Media

- [ ] Instructional Method

Closed-captioning

- [ ] Media
- [ ] Instructional Method

Analogy

- [ ] Media
- [ ] Instructional Method

Authentic task

- [ ] Media
- [ ] Instructional Method

Exhibit in a museum

- [ ] Media
- [ ] Instructional Method

Podcast

- [ ] Media
- [ ] Instructional Method

Teamwork

- [ ] Media
- [ ] Instructional Method

Flight simulator

- [ ] Media
- [ ] Instructional Method

Zoom Meeting

- ☐ Media
- ☐ Instructional Method

(Explanations for answers can be found at the end of the chapter.)

However, media and instructional methods have had a problematic history in the instructional design field. Simply stated, the problem is that designers and researchers often attribute the learning effectiveness (mastery of the instructional objective) of their design to media when it is really due to instructional methods. This problem was first noticed in the 1960s with media comparison studies (Clark, 1983), but received even more significant attention when computer-based instruction (CBI) gained popularity in the 1980s. Clark (1985) was an early researcher who challenged the media mindset that was evolving:

> *The result of the analysis strongly suggests that achievement gains found in these CBI studies are overestimated and are actually due to the uncontrolled but robust instructional methods embedded in CBI treatments. It is argued that these [instructional] methods may be delivered by other media [methods] with achievement gains comparable to those reported for computers (p. 1).*

The purpose of this chapter is to bring you up-to-speed on this topic so you can advise current or future clients, managers, and other stakeholders about its implications for instructional design. If you plan to base your instructional designs on research, or conduct your own research, this chapter will help you understand appropriate research for media and instructional methods. We start by introducing you to *effectiveness*, *efficiency*, and *appeal*, three key measures for judging the success of instruction (Reigeluth & Carr-Chellman, 2009). Next, we chronologically summarize various perspectives about media and instructional methods between 1980 and the present. We conclude with ideas for both research and practice, focusing on the value of *research-to-improve* versus *research-to-prove* and "Culture Five" design principles.

Effectiveness, Efficiency, and Appeal

Instructional designers, teachers, clients, parents, and a host of other instructional stakeholders want to know how well a learning experience works. To measure this, the instructional design field focuses on three measures embedded in the instructional theory framework: *effectiveness*, *efficiency*, and *appeal* (Honebein & Reigeluth, 2021; Reigeluth & Carr-Chellman, 2009).

Effectiveness measures learner mastery of an instructional objective, which is also known as student achievement (Reigeluth, 1983). An example of an effectiveness measure is a test, which is typically an objective measure. Another example is a rubric, which is usually a subjective measure.

Efficiency measures the time, effort, and costs put in by teachers, learners, and other stakeholders to deliver and complete a learning experience (Reigeluth, 1983). An example is the number of hours a learner puts in to master an instructional objective. Another example is the cost of instructional materials that deliver the learning experience.

Appeal measures how well learners, teachers, and other stakeholders enjoy the learning experience, especially in terms of media and instructional methods. An example is having students answer a survey question like, "I would recommend this course to others." Another example is an evaluator interviewing teachers about their experiences teaching a learning experience. These appeal measures are synonymous with Merrill's (2009) terminology of "engaging" and the first level of the Kirkpatrick-Katzell model, "reaction" (Katzell, 1952; Kirkpatrick, 1956, 1959).

Effectiveness, efficiency, and appeal form what is called an "Iron Triangle" (Honebein & Honebein, 2015; Honebein & Reigeluth, 2021). The iron triangle represents sacrifices a designer must make during the design process. The left side of Figure 2 is what the designer initially desires, where the double fisherman's knot instruction balances all three outcomes. However, during development, the designer experiences various situational issues and constraints that impact the design. This forces the designer to sacrifice—or "trade-off"—media, instructional methods, or both in their design. This effect is illustrated on the right side of Figure 2. For example, learner feedback favors keeping the hands-on learning instructional method because it boosts effectiveness. Learner feedback also advises the designer to sacrifice efficiency by using a more expensive and more time-consuming media—video— rather than still photographs to increase appeal (for example, see https://www.youtube.com/watch?v=9glfeKvEuyo).

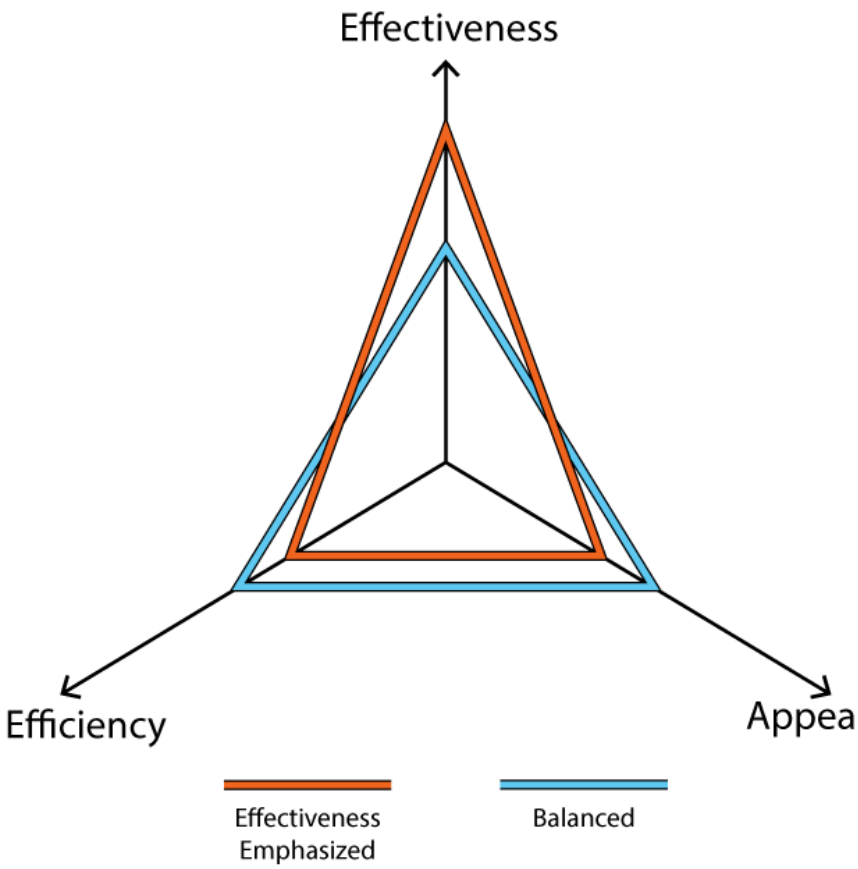

Figure 2. *The Instructional Design Iron Triangle depicts the three outcomes (or constraints) associated with instructional methods: effectiveness, efficiency, and appeal. The blue triangle shows equal priority for the three outcomes. The orange triangle shows priority for effectiveness, which requires some sacrifice in efficiency and appeal.*

Many designers believe that media only affects two of the three effectiveness-efficiency-appeal measures:

- Instructional methods influence (and therefore require measurement of) all three outcomes: effectiveness, efficiency, and appeal (Clark, 1994).
- Media, on the other hand, influence (and therefore require measurement of) just two outcomes: efficiency and appeal.

Read and Reflect

As the two authors were finalizing this manuscript, Reigeluth threw out this idea:

"I think video can improve effectiveness by showing the actual motions (an affordance of the video medium) for teaching a task that entails movement. Do you think we should acknowledge that affordances of media can, for some kinds of content (perhaps using a motion medium for a motion task or a sound medium for a sound task), influence effectiveness?"

Honebein was skeptical, reiterating that it is the message and instructional method that drive effectiveness. He responded: "Video without a message is essentially a blank screen, thus how can it, alone, be effective?"

Reigeluth then replied that perhaps some messages can be communicated more effectively through one medium than another, just like different kinds of goods (like livestock versus gasoline) can be delivered more effectively by one kind of truck than another.

What do you think? Could a media "affordance", like motion or sound, influence effectiveness?

Why are media likely limited to efficiency and appeal? Clark (1994) wrote, "When learning gains [effectiveness] are found, we attribute them to the delivery medium, not to the active ingredient in instruction [instructional methods]. When learning gains are absent, we assume we have chosen the wrong mix of media" (p. 27). What Clark is saying is that since media are not the active ingredient for effectiveness, it is impossible for a medium to claim it delivers learning effectiveness (mastery of the instructional objective). What a medium can claim is that it contributes to making learning more efficient and appealing.[1]

Application Exercise

What if we give a learner with no knot-tying experience a photograph of a completed double fisherman's knot (Figure 3) and some rope? All the learner has is media, the photo and realia. If the learner is able tie the knot, wouldn't it prove that media has learning effectiveness qualities? Why don't you try it out with your husband, wife, boyfriend, girlfriend, or some random person off the street.

Figure 3. *An appropriately-dressed double fisherman's knot. Could you tie this knot based solely on this photograph? Could you do it in 20 seconds or less on the first try? (Wikipedia public domain photo credit: Malta,*

https://commons.wikimedia.org/wiki/File:N%C5%93ud_de_p%C3%AAcheur_double_serr%C3%A9.jpg, no changes made).

Let's explore this thought experiment: the photograph (*media*) communicates the *message* (the end-state of a properly dressed double fisherman's knot). The *message* is embedded in an instructional method, likely *self-paced hands-on learning* and/or *discovery-based learning* (Reigeluth & Keller, 2009). These types of instructional methods require learners to apply their own experience and knowledge to figure out the solution. In other words, it is the learner who invents or appropriates these, and perhaps other instructional methods to master the task based upon their experience—probably similar to what the person who originally invented the double fisherman's knot did when inventing the knot.

Instructional designers and researchers should always collect data for all three outcomes: effectiveness, efficiency, and appeal. Honebein and Reigeluth (2021) advised that:

> *Without data for effectiveness, efficiency, and appeal, it is difficult to know when an instructional medium or method is preferable compared to another, given that different priorities are valued by different stakeholders in different situations. This is a huge gap in our field's research practice (p. 17).*

To summarize, the three primary measures for evaluating learning experiences are effectiveness, efficiency, and appeal. Instructional methods enable measurement of all three outcomes. Media enable measurement of two outcomes, efficiency and appeal. The Instructional Design Iron Triangle guides how designers make trade-offs and sacrifices in their designs, which can then be measured by always collecting data about effectiveness, efficiency, and appeal. So, as a designer, it is important that you understand the priorities for effectiveness, efficiency, and appeal in your particular project.

A Cold Bucket of Water: The Great Media vs. Instructional Method Debates

Generally, each new medium seems to attract its own set of advocates who make claims for improved learning and stimulate research questions which are similar to those asked about the previously popular medium. Most of the radio research approaches suggested in the 1950s (e.g., Hovland, Lumsdaine, & Sheffield, 1949) were very similar to those employed by the television movement of the 1960s (e.g., Schramm, 1977) and to the more recent reports of the computer-assisted instruction studies of the 1970s and 1980s (e.g., Dixon & Judd, 1977). Clark (1983), p. 447

In 1990, the first author of this chapter (Honebein) arrived at Indiana University as a first-year graduate student in the School of Education, intent upon righting the wrongs of his K-12 education via the computer revolution. He had a Macintosh IIcx, copies of Hypercard, Supercard, and Macromedia Director (which were the latest and greatest multimedia software development tools of that time to create computer-based learning experiences), and a vision to prove the efficacy of computer-based instruction over all other mediums. He was one of those advocates Clark described.

Read and Reflect

Given that you are likely new to the instructional design field, you are probably an advocate for some new kind of instructional media. Gibbons (2003) interprets this type of behavior as "centrisims." New designers tend to start out media-centric, then evolve to embrace message, strategy, and model centrisms. Newcomers go through this process because media technologies attract people, like you, to the instructional design field. What media technology are you an advocate for? How do you think you will evolve across Gibbon's "centrisims"?

The first author's dreams of glory started to moderate in a class taught by the second author, who introduced the idea that situation drives methods. Another media-focused class clarified the difference between media and instructional methods, and how they interact. And a third hypermedia class re-imagined the relationship between media and instructional methods via a constructivist perspective. Somewhere in the massive amount of reading for each of these classes was the Clark (1983) paper, an excerpt of which we included at the start of this section. Clark's paper was a paradigm shift. It shattered the first author's dream. Attempting to prove the efficacy of computer-based instruction now seemed to be a complete waste of time.

After publication of the 1983 paper, Clark's follow-up papers on this topic (Clark, 1984, 1985, 1986) appear to be rebuttals and elaborations to other academics. Clark had touched a nerve in the instructional design community, especially Clark's (1983) analogy that referred to media as being "mere vehicles that deliver instruction" (p. 445), leading Ross (1994) to refer to media as "delivery trucks" (p. 1). For example, Petkovich and Tennyson (1984, 1985) challenged Clark's ideas about the relationship between media and methods, specifically from an encoding perspective. Clark's rebuttal suggested, among other ideas, that any media research should focus on "delivery issues (cost, efficiency, equity, and access)" (p. 240).

Hannifin (1986) (and, later, Driscoll & Dick, 1999), on the other hand, opined that the small size of the instructional design field, combined with tenure and promotion processes, created conditions for "quick and dirty publications" (p. 14) that are mostly experimental and focused only on learning outcomes (effectiveness). In this context, Hannifin cautioned academics to heed Clark's (1983) ideas about the primary suspect: confounded, comparative media research. Ross and Morrison (1989) added the comment that media "… does not directly affect learning, [yet media] serves as influential moderating variables" (p. 29-30).

Kozma (1991), in his first rebuttal to Clark (1983), agreed with the idea that traditional experimental designs involving media that focused on cued recall measures were confounded and therefore not useful. However, Kozma pressed on to provide media research examples that were supposedly unconfounded in his view. These included four studies that focused on comprehension and learning with text and pictures (similar to our knot-tying example above).

LIDT in the World: The Stone & Glock Study, as cited in Kozma (1991)

The Stone & Glock (1981) research study is particularly instructive in understanding the relationship between media and instructional methods. It also shows how to identify potential experimental research methodology flaws that contribute to media/instructional method confounding and poor instructional designs.

The study was straight-forward: subjects in three different groups were asked to assemble a hand-truck. All groups received hand-truck parts. All groups received a job aid (assembly instructions) in three different media forms:

- Group 1 received just text.
- Group 2 received text and illustrations.
- Group 3 received just illustrations.

The result was that text and illustration produced "significantly more accurate performance" (p. 1). Or did it? We argue that the causes for this performance were (a) the instructional methods, and (b) the amount of time spent using those instructional methods.

The Method section of the study neglected to mention differences in instructional methods across treatment groups. The researchers described details of the media —the text and illustrations. However, the researchers mentioned nothing about the instructional methods. To discover what instructional methods were present, we carefully read the study's methods and procedure. This enabled us to reverse-engineer the likely instructional objectives (which the researchers didn't specify, but should have):

- *From memory and given 10 types of hand-truck parts, name each part with 100% accuracy.*
- *Given hand-truck parts and job aids, assemble the hand-truck with 100% accuracy.*

Based on the instructional objectives and the research procedure, we deduced the likely instructional methods. First, we applied Merrill's (1983) Component Display Theory, specifically its primary presentation forms, to analyze the situation.

- Group 1 used *generalities* (G), an instructional method category that describes *concepts*, *procedures*, and *principles* in the form of *text*.
- Group 3 used *instances* (E), an instructional method category that includes *examples* in the form of illustrations.
- Group 2 included both *generalities* and *instances* (G+E).

These instructional method differences represent the confounding. The researchers should have identified them in the Method section.

Second, we used Reigeluth and Keller (2009) and Reigeluth (1999) to name the likely instructional methods: *presentation, practice*, *hands-on learning*, *easy-to-difficult sequencing*, and *procedural sequencing*. The researchers did not specify these instructional methods in the Method section, and it is unclear how subjects applied these methods.

Another criticism is that researchers used inadequate *outcome measures*. The researchers:

- Collected *effectiveness* data (number of errors) for all three groups.
- Collected *efficiency* data (time subjects looked at media) but only for Group 2 (text and illustration) and Group 3 (illustration only).
  - Did not collect *total time to complete the task* data for all three groups. This is an important outcome measure for instructional method selection.
- Did not collect *appeal*

The efficiency data suggests the presence of *time-on-task confounding*. Group 2 had significantly fewer errors than Groups 1 and 3. However, Group 2 spent 375.24 seconds looking at the job aid (309 seconds for text; 66.24 seconds for illustration), while Group 3 spent 160.33 seconds looking at just the illustration job aid. The difference was 214.91 seconds (researchers did not collect time data for Group 1). Could the performance difference be only that Group 2 spent a lot more time *learning* than the other groups?

Perhaps Kozma's choice of Stone and Glock (1981) and other studies were potentially more confounded than originally thought. This example demonstrates just how tenuous experimental research can be in terms of media /instructional-method confounding, inadequate outcome measures, and time-on-task confounding.

A few years after Kozma (1991) published his first response to Clark's (1983) paper, Ross (1994) organized a special issue in *Educational Technology Research and Development* (*ETR&D*) spearheaded by two papers, one from Kozma (1994) and one from Clark (1994). This became known as the "Clark/Kozma debate". This debate included perspectives by reviewers of Kozma's paper (Jonassen, Campbell, & Davidson, 1994; Morrison, 1994; Reiser, 1994; Shrock, 1994), as well as an overall synthesis by Tennyson (1994).

There was no definitive agreement on whether media could influence learning. Tennyson's (1994) scorecard essentially showed a 3/3 tie. However, within Kozma's and several other contributors' papers, an interesting theme emerged, that of media having complex properties, such that a learning experience might be considered a complex system (Honebein & Reigeluth, 2020). As Tennyson wrote, "learning is a complex phenomenon, requiring the interaction of many variables including the learner and environmental factors" (p. 16). Shrock (1994) picked up on this, suggesting research methods that "would allow the investigation of complex, simultaneous variables" (p. 52). Reiser (1994) cited Ullmer (1994) to explain that "traditional experimental research methods and their attendant controlling mechanisms may fail to fully assess the complex effects that modern multimedia systems may have on learners" (p. 48). Jonassen et. al (1994) got very specific about the complex systems association:

> *When we consider the role of media, we should realize that [media] vehicles are not "mere." They are complex entities with multiple sets of affordances that are predicated on the perceptions of users and the context in which they are used (p. 38).*

Researcher and designer perspectives on the 1994 Clark/Kozma debates have persisted over the years since 1994. Lockee, Burton, and Cross (1999) reported the rise of distance education media comparison studies, calling media comparison studies in this context "inappropriate" (p. 1). Kozma (2000), as a commentator for several articles in a special *ETR&D* issue, wrote that "as both Richey (1998) and Discroll and Dick (1999) point out, the messy, uncontrolled context of real-world educational technology R&D demands alternative research methodologies. Traditional experimental designs often are not able to accommodate the complexity of these real-world situations" (p. 10).

Richey (2000) responded to Kozma's comments in a "yes…, and…" way, suggesting that "other views of the field describe a more complex enterprise with a more complex knowledge base" (p. 16). Richey continued to differentiate the needs in K-12 environments compared to the needs in corporate environments, where many instructional designers work. Richey wrote, "[Corporate practitioners'] primary concern is not technology-based delivery, nor is it even learning. Instead, they are typically concerned with organizational problem solving" (p. 17). This idea is somewhat supported when Nathan and Robinson (2001) wrote that "media and method, while separable in theory, cannot be separated in practice" (p. 84). Surry and Ensminger (2001) suggested using other research methods for media research, such as intra-medium studies and aptitude treatment interactions. Then, Hastings and Tracey (2005) took one last look in the rear-view mirror as the Clark/Kozma debate further faded in the distance:

> *We believe that after 22 years it is time to reframe the original debate to ask, not if, but how media affects learning. We agree that media comparison studies are inherently flawed and support the argument that we must identify research designs that will provide answers to this question in significantly less time (p. 30).*

Fast forward to 2019. Between 2005 and 2018, not much was written or said about the relationship between media and instructional methods. However, Sickel (2019), observing the significant rise of new media, suggested that technical pedagogical and content knowledge (TPACK) could be a “modern framework for teaching with technology” (p. 157). This led to reinforce the idea that “methods take advantage of media attributes” and “media enable certain methods” (p. 161).

Yet Kozma’s statement that “traditional experiments often are not able to accommodate the complexity of these real-world situations” (p. 10) had led the instructional design field to new and more accepted research methods that, instead of trying to prove, focused on trying to improve. These research-to-improve methods (Honebein & Reigeluth, 2021, 2020; Reigeluth & An, 2009) recognized that learning experiences were a complex system where media and instructional methods and other elements exist as systemic components. These components provide value when stakeholders (learners, designers, clients, etc.) say they do. Such research methods include action research (Efron & Ravid, 2020; Stringer, 2008; Stringer & Aragon, 2021), design experiments (Cobb et al. 2003), design-based research (Barab & Squire, 2004; Collins et al., 2004; Design-Based Research Collective, 2003; Wang & Hannafin, 2005), evaluation research (Phillips et al., 2012), and formative research (Reigeluth & An, 2009; Reigeluth & Frick, 1999).

Research-to-Prove or Research-to-Improve?

Around 2017, Honebein & Reigeluth (2020) noticed a concerning trend: it seemed that there was a rise in experimental, media comparison-type studies in various instructional design journals. They further investigated the phenomenon by reviewing comparative research papers in *ETR&D* between 1980 and 2019. Thirty-nine papers from *ETR&D* met their criteria (Study 1). Another forty-one papers focused on flipped instruction from non-*ETR&D* journals also met the criteria (Study 2) (Al-Samarraie et al. (2019).

The results showed a significant rise of experimental, research-to-prove papers. These papers appeared to (a) confound media and instructional methods, (b) not include sufficient information about the instructional objective, (c) omit one or more of the effectiveness, efficiency, and appeal outcomes, and (d) not report whether or not the researchers conducted formative evaluation. The results also showed a significant rise in comparative studies between 2010 and 2019 (Figure 4):

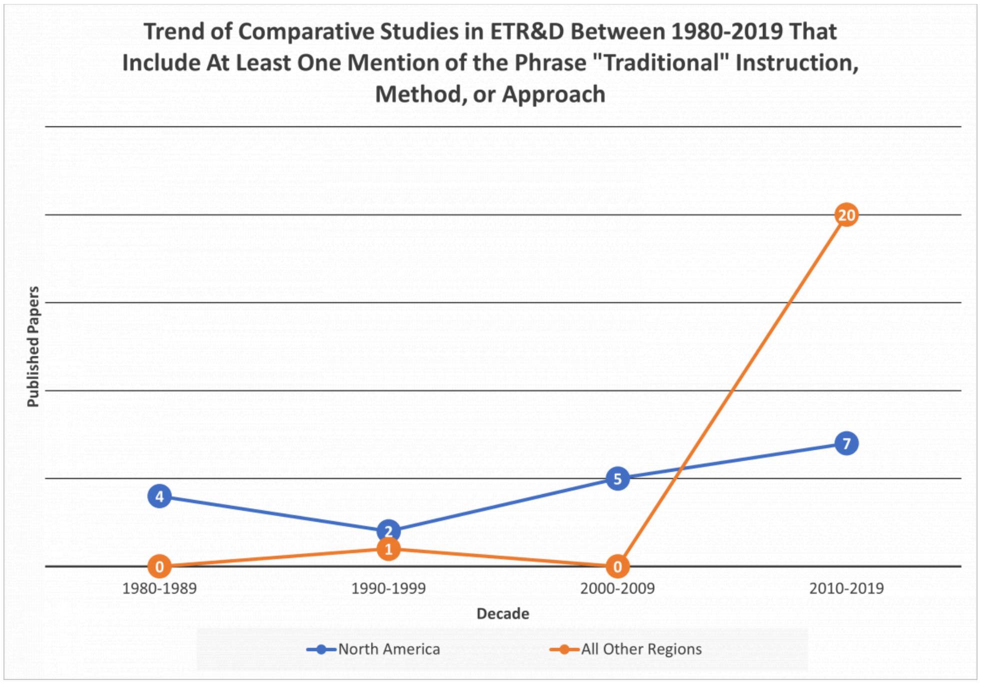

Figure 4. *Distribution of published articles comparing North America with all other regions. The number of articles published from non-North American regions increased substantially between 2010 and 2019.*

In Study 1, the 2010 to 2019 rise in research-to-prove journal articles was attributed to non-North American sources (75%), primarily from China (41%). This increase of non-North American journal articles was likely caused by a change in *ETR&D* editorial policies around 2008 which, according to Spector (2017), “encouraged more international contributions from outside North America” (p. 1416). In Study 2, North American sources (63%) were the primary contributor of research-to-prove journal articles. Honebein and Reigeluth (2021) summarized the situation this way:

> *The studies introduce significant confounding variables involving the mixture of instructional methods and media. The instructional design field has vigorously debated these issues (see Clark, 1983, 1994; Kozma, 1994, 2000; Tennyson, 1994). By eliminating the comparison group (traditional learning experience) and focusing on research to improve, a researcher eliminates the problem of confounding variables (p. 18).*

What Should Future Instructional Designers and Researchers Take Away from This Chapter?

The Clark/Kozma debates have a lot to unpack, in terms of how such ideas impact and provide guidance to future practitioners and researchers. Here we provide some advice for how you should think about applying media and instructional methods in your coursework, professional work, or research work.

1. Be cautious of experimental, research-to-prove comparison studies that include media or combine media and instructional methods. In other words, buyer beware. This research is not useful because it might:
    - Suggest that learning effectiveness is improved by the media, when in fact it is improved by the instructional method.
    - Influence practitioners to choose media that likely won't work for their situation.
    - Represent quick and dirty publications that are intentionally or unintendedly meant to pad a researcher's portfolio for promotion, salary increase, and tenure. In other words, the paper benefits the author, not the reader.
2. When designing a learning experience, follow the processes associated with the instructional theory framework (Honebein & Reigeluth, 2020, 2021) (Figure 5). This framework helps you systematically and logically synthesize possible media and instructional method options that fit your specific instructional-design situation.

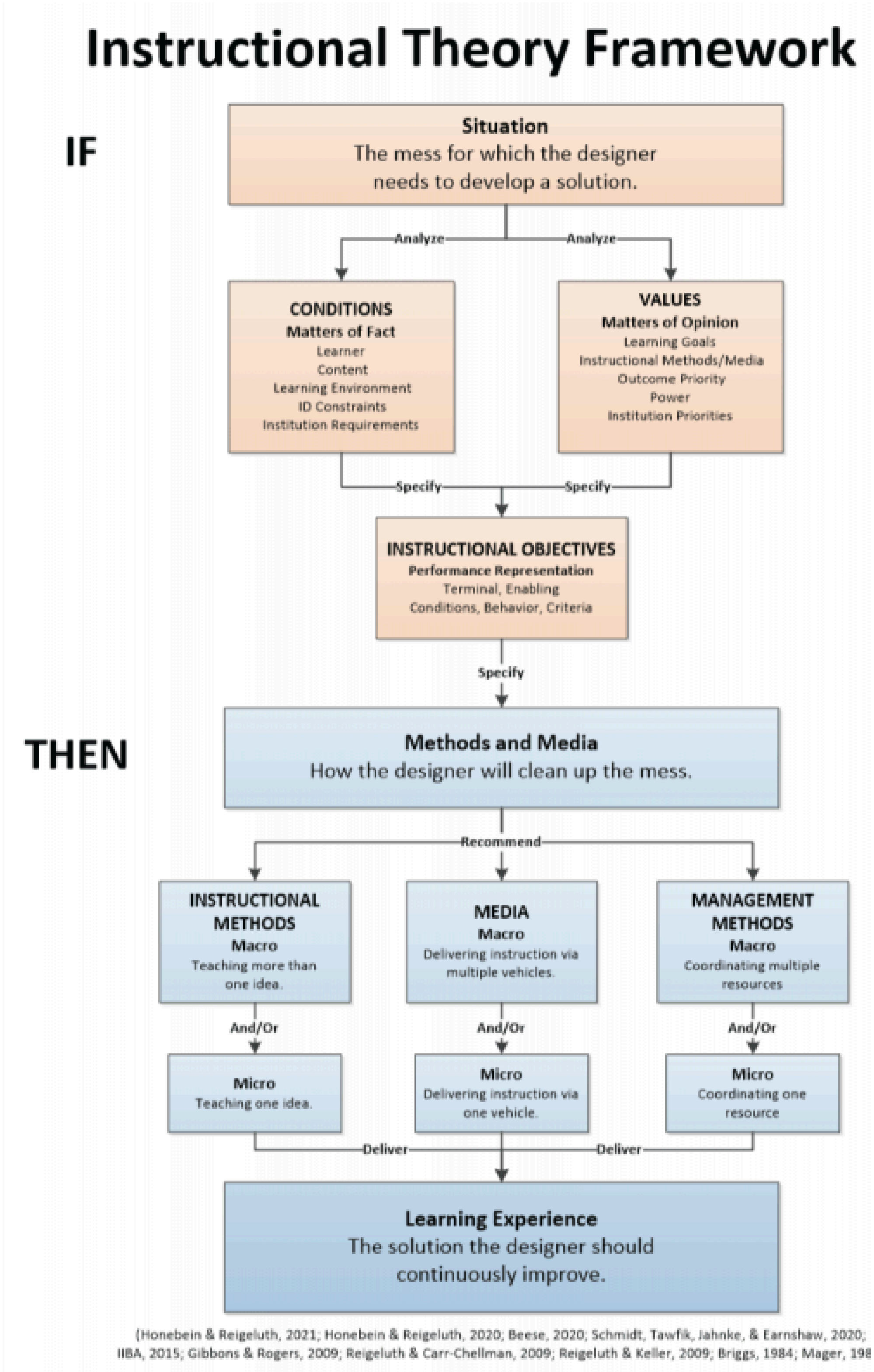

Figure 5. *A revised version of the instructional theory framework.*

3. Think of a learning experience as a systemic, complex system (Honebein & Reigeluth, 2021, 2020). Formative evaluation or research-to-improve is your best option for

determining whether or not your learning experience (which likely blends media and instructional methods in interesting ways) meets the needs of your stakeholders in your particular situation. For these types of evaluation/research, you must collect effectiveness, efficiency, and appeal data. With this data, you will be able to advise your team, manager, or clients about the benefits and pitfalls of a learning experience.

Kozma (2000), in what was likely his last paper about the media versus instructional method debate, planted a seed where he called for building a "Fifth Culture" of instructional design practice—the Forth Culture was put forth by Leslie Briggs in 1984 (Briggs, 1984). In Kozma's Fifth Culture, designers and researchers embed themselves within their client's world, as co-designers or "co-producers" (Honebein & Cammarano, 1995, p. 5), where designers learn to "understand their [client's] needs, goals, problems, issues, and practices" (Kozma, 2000, p. 13). By doing this, it refocuses designers to create "learning environments" (which the authors like to call "learning experiences"), where "learning outcomes are owned by the learners" (p. 13).

Summary of Kozma's (2000) Fifth Culture Principles:

1. Embed research designs in the "real world" and embed ourselves in the contexts of our client base. Deeply understand our clients' needs, goals, problems, and issues, and embed these, in turn, into our theories, research, and practices.
2. Shift the focus of our work from the design of instruction to the design of learning environments. Learning outcomes are owned by the learners. Learners set the objectives for learning, not the designers.
3. Understand that the relationship between media, design, and learning should be the unique contribution of our field to knowledge in education. This understanding is the base of our practice, our theory, and our research.

Summary of Honebein and Reigeluth's (2021) additions to Kozma's (2000) Fifth Culture ideas:

1. Accurately specify the desired learning outcomes based upon the conditions and values of the situation elicited from stakeholders, and supply requirements and instructional objectives that include conditions, behaviors, and criteria, along with assessments that align with the situation.

2. Describe students' real learning experiences in detail, including improvements suggested by data, made over time.
3. Describe how learning experiences are systematically designed and formatively evaluated, using good design judgment, prior to conducting research or evaluation.
4. Make sure that tests and data really measure effectiveness, efficiency, and appeal. (p. 17)

Footnotes

[1] Perhaps there is an exception when a particular medium's affordances match a particular feature of the content, as in the affordance of sound for teaching musical chords, pictures for teaching colors and hues, and motion for teaching dance moves.

Chapter 33 Learning Check Explanations

YouTube Video: Videos, moving pictures, etc. are media.

Demonstration: Demonstration is an instructional method that one can deliver through various media.

Closed-captioning: Closed-captioning is a medium that converts narration to text.

Analogy: Analogy is an instructional method that one can deliver through various media.

Authentic task: Authentic task is an instructional method that one can deliver through various media.

Exhibit in a museum: An exhibit is a medium that illustrates a phenomenon, like a skeleton of a dinosaur.

Podcast: Podcast is a medium that delivers narrated messages that may be enhanced by other media, such as music, sound effects, ambient sounds, and multiple narrators.

Teamwork: Teamwork is an instructional method that one can deliver through various media (i.e., in person or by phone).

Flight simulator: Flight simulator is a medium, as it includes realia (the controls and instruments for flying a plane).

Zoom Meeting: Zoom meeting is a medium, as it enables the presentation of voice, text, graphics, photos, and videos.

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The Learner-Centered Paradigm of Education

Watson, S. L. & Reigeluth, C. M.

Learner-centered Design
Learner-centered Paradigm
Learner-centered Theory
Learning Theory
Technology-Driven Change
Theory of Change

This chapter begins by discussing the need for paradigm change in education and for a critical systems approach to paradigm change. It then examines current progress toward paradigm change. Next, the chapter explores what a learner-centered, Information-Age educational system should be like, including the APA learner-centered psychological principles, the National Research Council's findings on how people learn, the work of McCombs and colleagues on learner-centered schools and classrooms, personalized learning, differentiated instruction, and brain-based *instruction. Finally, one possible vision of a learner-centered school is described.*

Editor's Note

The following article was originally published in *Educational Technology* and is used here by permission of the editor.

Watson, S. L. & Reigeluth, C. M. (2008). The learner-centered paradigm of education. *Educational Technology*, *54*(3), 42–48.

Introduction

The dissatisfaction with and loss of trust in today's schools are clear indications of the need for change in our school systems. The strong push for a learner-centered paradigm of instruction in today's schools reflects our society's changing educational needs. We educators must help our schools transition into the new learner-centered paradigm of instruction that better meets the needs of individual learners, their workplaces and communities, and society in general. It is also important that we educators help the transformation occur as effectively and smoothly as possible. This article begins by addressing the need for transforming our educational systems to the learner-centered paradigm and describes the critical systems approach for carrying out such change. It then describes the nature of the learner-centered paradigm and provides examples of it in practice.

The Need for Change and the (critical) Systems Approach to Educational Change

Information-age vs. Industrial-age Education

Whereas society has shifted from the Industrial Age into what many call the 'Information Age' (Toffler, 1984; Reigeluth, 1994; Senge, Cambron-McCabe, Lucas, Smith, Dutton, & Kleiner, 2000), current schools were established to fit the needs of an Industrial-Age society (see Table 1). This factory-model, Industrial-Age school system has highly compartmentalized learning into subject areas, and students are expected to learn the same content in the same amount of time (Reigeluth, 1994). The current school system strives for standardization and was not designed to meet individual learners' needs. Rather it was designed to sort students into laborers and managers (see Table 2), and students are forced to move on with the rest of the class regardless of whether or not they have learned the material, and thus many students accumulate learning deficits and eventually drop out.

Table 1. Key markers of Industrial vs. Information Age education (Reigeluth, 1994).

Industrial Age Bureaucratic Organization	Information Age Team Organization
Autocratic leadership	Shared leadership
Centralized control	Autonomy, accountability
Adversarial relationships	Cooperative relationships
Standardization (mass production, mass marketing, mass communications, etc.)	Customization (customized production, customized marketing, customized communications, etc.)
Compliance	Initiative
Conformity	Diversity
One-way communications	Networking
Compartmentalization (division of labor)	Holism (integration of tasks)

Table 2. Key features: Sorting vs. learning.

Sorting Based Paradigm of Education	Learning Based Paradigm of Education
Time-based	Attainment-based
Group-based	Person-based
Teacher-based	Resource-based

Norm-based assessment	Criterion-based assessment

Learning Check

In your own words, explain the benefits of transforming educational systems to the learner-centered paradigm.

The (critical) Systems Approach to Educational Change

Systemic educational transformation strives to change the school system to a learner-centered paradigm that will meet all learners' educational needs. It is concerned with the creation of a completely new system, rather than a mere retooling of the current system. It entails a paradigm shift as opposed to piecemeal change. Repeated calls for massive reform of current educational and training practices have consistently been published over the last several decades. This has resulted in an increasing recognition of the need for systemic transformation in education, as numerous piecemeal approaches to education reform have been implemented and have failed to significantly improve the state of education. Systemic transformation seeks to shift from a paradigm in which time is held constant, thereby forcing achievement to vary, to one designed specifically to meet the needs of Information-Age learners and their communities by allowing students the time that each needs to reach proficiency.

Systemic educational change draws heavily from the work on critical systems theory (CST) (Flood & Jackson, 1991; Jackson, 1991a, 1991b; Watson, Watson, & Reigeluth, 2008). CST has its roots in systems theory, which was established in the mid-twentieth century by a multi-disciplinary group of researchers who shared the view that science had become increasingly reductionist and the various disciplines isolated. While the term system has been defined in a variety of ways by different systems scholars, the central notion of systems theory is the importance of relationships among elements comprising a whole.

CST draws heavily on the philosophy of Habermas (1973, 1984, 1987). The critical systems approach to social systems is of particular importance when considering systems wherein inequality of power exists in relation to opportunity, authority, and control. In the 1980s, CST came to the forefront (Jackson, 1985; Ulrich, 1983), influencing systems theory into the 1990s (Flood & Jackson, 1991; Jackson, 1991a, 1991b). Liberating Systems Theory uses a post-positivist approach to analyze social conditions in order to liberate the oppressed, while also seeking to liberate systems theory from tendencies such as self-imposed insularity, cases of internal localized subjugations in discourse, and liberation of system concepts from the inadequacies of objectivist and subjectivist approaches (Flood, 1990). Jackson (1991b) explains that CST embraces five key commitments:

- critical awareness of examining values entering into actual systems design;
- social awareness of recognition in pressures leading to popularization of certain systems theories and methodologies;
- dedication to human emancipation for full development of all human potential;
- informed use of systems methodologies; and
- informed development of all alternative positions and different theoretical systems approaches.

Banathy (1991) and Senge *et al.* (2000) apply systems theory to the design of educational systems. Banathy (1992) suggests examining systems through three lenses: a "still picture lens" to appreciate the components comprising the system and their relationships; a "motion picture lens" to recognize the processes and dynamics of the system; and a "bird's eye view lens" to be aware of the relationships between the system and its peers and suprasystems. Senge et al. (2000) applies systems theory specifically to organizational learning, stating that the organization can learn to work as an interrelated, holistic learning community, rather than functioning as isolated departments.

Learning Check

In your own words, explain what the critical systems theory approach to educational change is.

Current Progress of Systemic Change in Education

While systemic educational transformation is a relatively new movement in school change, there are currently various attempts to advance knowledge about it. Examples include: The Guidance System for Transforming Education (Jenlink, Reigeluth, Carr, & Nelson, 1996, 1998), Duffy's Step-Up-To-Excellence (2002), Schlechty's (1997, 2002) guidelines for leadership in school reform, Hammer and Champy's (1993, 2003) Process Reengineering, and Ackoff's (1981) Idealized Systems Design.

There are also stories of school districts making fundamental changes in schools based on the application of systemic change ideas. One of the best practices of systemic transformation is in the Chugach School District (CSD). The students in CSD are scattered throughout 22,000 square miles of remote area in South-central Alaska. The district was in crisis twelve years ago due to low student reading ability, and the school district committed to a systemic transformation effort. Battino and Clem (2006) explain how the CSD's use of individual learning plans, student assessment binders, student learning profiles, and student life-skills portfolios support and document progress toward mastery in all standards for each learner. The students are given the flexibility to achieve levels at their own pace, not having to wait for the rest of the class or being pushed into learning beyond their developmental level. Graduation standards exceed state requirements as students are allowed extra time to achieve that level if necessary, but must meet the high rigor of the graduation level. Student accomplishment in academic performance skyrocketed as a result of these systemic changes (Battino & Clem, 2006).

Caine (2006) also found strong positive changes through systemic educational change in extensive engagement on a project called “Learning to Learn” in Adelaide, South Australia, an initiative of the South Australian Government that covered a network of over 170 educational sites. From preschool to 12th grade, brain-based, learner-centered learning environments were combined with a larger set of systemic changes, leading to both better student achievement and significant changes in the culture and operation of the system itself.

More recently, several studies have found research support for personalized learning and competency-based education, including two Rand Corporation studies (Pane, Steiner et al. 2015, Pane, Steiner et al. 2017), a Hanover Research study (Hannover Research 2015), three studies by the American Institutes for Research (Haynes, Zeiser et al. 2016, Surr, Zeiser et al. 2018, Zeiser, Scholz et al. 2018), a study by Marzano Research (Haystead 2010), one by the Education Development Center (Shakman, Foster et al. 2018), another by the Wisconsin Evaluation Collaborative (Marlin, Good et al. 2019), and one by Indiana University (Lee, Huh et al. 2021).

Imagining Learner-centered Schools

Given the need for paradigm change in school systems, what should our schools look like in the future? The changes in society as a whole reflect a need for education to focus on learning rather than sorting students (McCombs & Whisler, 1997; Reigeluth, 1997; Senge et al., 2000; Toffler, 1984). A large amount of research has been conducted to advance our understanding of learning and how the educational system can be changed to better support it. There is solid research about brain-based learning, learner-centered instruction, and the psychological principles of learners that provide educators with a valuable framework for the Information-Age paradigm of education (Alexander & Murphy, 1993; Bransford, Brown, & Cocking, 1999; Hannum & McCombs, 2008; Lambert & McCombs, 1998; McCombs & Whisler, 1997).

APA Learner-centered Psychological Principles

With significant research showing that instruction should be learner-centered to meet all students’ needs, there have been several efforts to synthesize the knowledge on learner-centered instruction. First, the American Psychological Association conducted wide-ranging research to identify learner-centered psychological principles based on educational research (American Psychological Association’s Board of Educational Affairs, 1997; Lambert &

McCombs, 1998). The report presents 12 principles and provides the research evidence that supports each principle. It categorizes the psychological principles into four areas: (1) cognitive and metacognitive, (2) motivational and affective, (3) developmental and social, and (4) individual difference factors that influence learners and learning (see Table 3).

Table 3. Learner-Centered Psychological Principles (American Psychological Association's Board of Educational Affairs, Center for Psychology in Schools and Education, 1997).

APA Learner-Centered Psychological Principles	
Cognitive and Metacognitive Factors	• Nature of the learning process. The learning of complex subject matter is most effective when it is an intentional process of constructing meaning from information and experience. • Goals of the learning process. The successful learner, over time and with support and instructional guidance, can create meaningful, coherent representations of knowledge. • Construction of knowledge The successful learner can link new information with existing knowledge in meaningful ways. • Strategic thinking The successful learner can create and use a repertoire of thinking and reasoning strategies to achieve complex learning goals. • Thinking about thinking. Higher-order strategies for selecting and monitoring mental operations facilitate creative and critical thinking. • Context of learning. Learning is influenced by environmental factors, including culture, technology, and instructional practices.
Motivational and Affective Factors	• Motivational and emotional influences on learning. What and how much is learned is influenced by the learner's motivation. Motivation to learn, in turn, is influenced by the individual's emotional states, beliefs, interests and goals, and habits of thinking. • Intrinsic motivation to learn. The learner's creativity, higher-order thinking, and natural curiosity all contribute to motivation to learn. Intrinsic motivation is stimulated by tasks of optimal novelty and difficulty, relevant to personal interests, and providing for personal choice and control. • Effects of motivation on effort. Acquisition of complex knowledge and skills requires extended learner effort and guided practice. Without learners'

	motivation to learn, the willingness to exert this effort is unlikely without coercion.
Developmental and Social Factors	• Developmental influences on learning. As individuals develop, there are different opportunities and constraints for learning. Learning is most effective when differential development within and across physical, intellectual, emotional, and social domains is taken into account. • Social influences on learning. Learning is influenced by social interactions, interpersonal relations, and communication with others.
Individual Differences Factors	• Individual differences in learning. Learners have different strategies, approaches, and capabilities for learning that are a function of prior experience and heredity. • Learning and diversity Learning is most effective when differences in learners' linguistic, cultural, and social backgrounds are taken into account. • Standards and assessment. Setting appropriately high and challenging standards and assessing the learner as well as learning progress—including diagnostic, process, and outcome assessment—are integral parts of the learning process.

National Research Council's "How People Learn."

Another important line of research was carried out by the National Research Council to synthesize knowledge about how people learn (Bransford *et al.*, 1999). A two-year study was conducted to develop a synthesis of new approaches to instruction that "make it possible for the majority of individuals to develop a deep understanding of important subject matter" (p. 6). Their analysis of a wide range of research on learning emphasizes the importance of customization and personalization in instruction for each individual learner, self-regulated learners taking more control of their own learning, and facilitating deep understanding of the subject matter. They describe the crucial need for, and characteristics of, learning environments that are learner-centered and learning-community centered.

Learner-centered Schools and Classrooms

McCombs and colleagues (Baker, 1973; Lambert & McCombs, 1998; McCombs & Whisler, 1997) also address these new needs and ideas for instruction that supports all students.

They identify two important features of learner-centered instruction:

> *. . . a focus on individual learners (their heredity, experiences, perspectives, backgrounds, talents, interests, capacities, and needs) [and] a focus on learning (the best available knowledge about learning, how it occurs, and what teaching practices are most effective in promoting the highest levels of motivation, learning, and achievement for all learners). (McCombs & Whisler, 1997, p. 11)*

This twofold focus on learners and learning informs and drives educational decision-making processes. In learner-centered instruction, learners are included in these educational decision-making processes, the diverse perspectives of individuals are respected, and learners are treated as co-creators of the learning process (McCombs & Whisler, 1997).

Personalized Learning

Personalized Learning is part of the learner-centered approach to instruction, dedicated to helping each child to engage in the learning process in the most productive and meaningful way to optimize each child's learning and success. Personalized Learning was cultivated in the 1970s by the National Association of Secondary School Principals (NASSP) and the Learning Environments Consortium (LEC) International, and was adopted by the special education movement. It is based upon a solid foundation of the NASSP's educational research findings and reports as to how students learn most successfully (Keefe, 2007; Keefe & Jenkins, 2002), including a strong emphasis on parental involvement, more teacher and student interaction, attention to differences in personal learning styles, smaller class sizes, choices in personal goals and instructional methods, student ownership in setting goals and designing the learning process, and technology use (Clarke, 2003). Leaders in other fields, such as businessman Wayne Hodgins, have presented the idea that learning will soon become personalized, where the learner both activates and controls her or his own learning environment (Duval, Hodgins, Rehak, & Robson, 2004).

Differentiated Instruction

The recent movement in differentiated instruction is also a response to the need for a learning-focused (as opposed to a sorting-focused) approach to instruction and education in schools. Differentiated instruction is an approach that enables teachers to plan strategically to meet the needs of every student. It is deeply grounded in the principle that there is diversity within any group of learners and that teachers should adjust students' learning experiences accordingly (Tomlinson, 1999, 2001, 2003). This draws from the work of Vygotsky (1986), especially his "zone of proximal development" (ZPD), and from classroom researchers. Researchers found that with differentiated instruction students learned more and felt better about themselves and the subject area being studied (Tomlinson, 2001). Evidence further indicates that students are more successful and motivated in schools if they learn in ways that are responsive to their readiness levels (Vygotsky, 1986), personal interests, and learning profiles (Csikszentmihalyi, 1990; Sternberg, Torff, & Grigorenko, 1998). The goal of differentiated instruction is to address these three characteristics for each student (Tomlinson, 2001, 2003).

Brain Research and Brain-based Instruction

Another area of study that gives us an understanding of how people learn is the work on brain research which describes how the brain functions. Caine and colleagues (1997, 2005, 2006) provide a useful summary of work on how the brain functions in the process of learning through the 12 principles of brain-based learning. Brain-based learning begins when learners are encouraged to actively immerse themselves in their world and their learning experiences. In a school or classroom where brain-based learning is being practiced, the significance of diverse individual learning styles is taken for granted by teachers and administrators (Caine & Caine, 1997). In these classrooms and schools, learning is facilitated for each individual student's purposes and meaning, and the concept of learning is approached in a completely different way from the current classrooms that are set up for sorting and standardization.

Learning Check

In your own words, explain:

- what the key features in the learner-centered paradigm are,
- what systemic interdependencies exist among those features, and
- what evidence there is that those features benefit students.

An Illustration of the New Vision

What might a learner-centered school look like? An illustration or synthesis of the new vision may prove helpful.

Imagine that there are no grade levels for this school. Instead, each of the students strives to master and check off their attainments in a personal "inventory of attainments" (Reigeluth, 1994) that details the individual student's progress through the district's required and optional learning standards, kind of like merit badges in Scouting. Each student has different levels of progress in every attainment, according to his or her interests, talents, and pace. The student moves to the next topic as soon as she or he masters the current one. While each student must reach mastery level before moving on, students also do not need to wait for others who are not yet at that level of learning. In essence, now, the schools hold time constant and student learning is thereby forced to vary. In this new paradigm of the learner-centered school, it is the pace (learning time) that varies rather than student learning. All students work at their own maximum pace to reach mastery in each attainment. This individualized, customized, and self-paced learning process allows the school district to realize high standards for its students.

The teacher takes on a drastically different role in the learning process. She or he is a guide or facilitator who works with the student for at least four years, building a long-term, caring relationship (Reigeluth, 1994). The teacher's role is to help the student and parents to decide upon appropriate learning goals and to help identify and facilitate the best way for the student to achieve those goals—and for the parents to support their student. Therefore, each student has a personal learning plan in the form of a contract that is jointly developed every two months by the student, parents, and teacher.

This system enhances motivation by placing greater responsibility and ownership on the students, and by offering truly engaging, often collaborative work for students (Schlechty, 2002). Teachers help students to direct their own learning through the contract development process and through facilitating real-world, independent or small-group projects that focus on developing the contracted attainments. Students learn to set and meet deadlines. The older the students get, the more leadership and assisting of younger students they assume.

The community also works closely with schools, as the inventory of attainments includes standards in service learning, career development, character development, interpersonal skills, emotional development, technology skills, cultural awareness, and much more. Tasks that are vehicles for such learning are authentic tasks, often in real community environments that are rich for learning (Reigeluth, 1994). Most learning is interdisciplinary, drawing from both specific and general knowledge and interpersonal and decision-making skills. Much of the focus is on developing deep understandings and higher-order thinking skills.

Teachers assess students' learning progress through various methods, such as computer-based assessment embedded in simulations, observation of student performances, and analysis of student products of various kinds. Instead of grades, students receive ratings of "emerging," "developing," "proficient" (the minimum required to pass), or "expert."

Each teacher has a cadre of students with whom she or he works for several years—a developmental stage of their lives. The teacher works with 3–10 other teachers in a small learning community (SLC) in which the learners are multi-aged and get to know each other well. Students get to choose which teacher they want (stating their first, second, and third choice), and teacher bonuses are based on the amount of demand for them. Each SLC has its own budget, based mainly on the number of students it has, and makes all its own decisions about hiring and firing of its staff, including its principal (or lead teacher). Each SLC also has a school board made up of teachers and parents who are elected by their peers.

While this illustration of a learner-centered school is based on the various learner-centered approaches to instruction reviewed earlier and the latest educational research, this is just one of many possible visions, and these ideas need revision, as some are likely to vary from one community to another, and most need further elaboration on details. Nonetheless, this picture of a learner-centered paradigm of schooling could help us to prevail over the industrial-age paradigm of learning and schools so that we can create a better place for our children to learn.

Learning Check

In your own words, explain why it is important that there be no single "model" for the learner-centered paradigm of education.

LIDT in the World

There are many examples of systemic transformation to the learner-centered paradigm of education. To date, more than 1,000 schools are well into the transformation process. Reigeluth and Karnopp (2013) provide a list of 145 such schools in their Appendix A. Reigeluth and Karnopp (2020) provide in their Appendix B a brief summary of 11 schools to consider visiting to see what learner-centered schools look like, as well as a list of organizations in their Appendix D that are assisting school systems to transform.

Lindsay Unified School District (2017) provides an in-depth description of an entire school district that is well into transformation to the learner-centered paradigm. The school district offers a complete set of videos to portray their progress on their model of learner-centered education (see https://www.youtube.com/channel/UCT-KpkqgDM54vz8kdrtkVMA).

Conclusion

Our society needs learner-centered schools that focus on learning rather than on sorting (McCombs & Whisler, 1997; Reigeluth, 1997; Senge et al., 2000; Toffler, 1984). New approaches to instruction and education have increasingly been advocated to meet the needs of all learners, and a large amount of research has been conducted to advance our understanding of learning and how the educational system can be changed to better support it (Alexander & Murphy, 1993; McCombs & Whisler, 1997; Reigeluth, 1997; Senge *et al.*, 2000). Nevertheless, transforming school culture and structure is not an easy task.

Isolated reforms, typically at the classroom and school levels, have been attempted over the past several decades, and their impact on the school system has been negligible. It has become clear that transforming the paradigm of schools is not a simple job. Teachers, administrators, parents, policy-makers, students, and all other stakeholder groups must work together, as they cannot change such a complex culture and system alone. In order to transform our schools to be truly learner-centered, a critical systems approach to transformation is essential.

The first article in this series (Reigeluth & Duffy, 2008) described the FutureMinds approach for state education departments to support this kind of change in their school districts. The second article (Duffy & Reigeluth, 2008b) described the School System Transformation

(SST) Protocol, a synthesis of current knowledge about how to help school districts use a critical systems approach to transform themselves to the learner-centered paradigm of education. Hopefully, with state leadership through FutureMinds, the critical systems approach to educational change in the SST Protocol, and the new knowledge about learner-centered instruction, we will be able to create a better place for our children to learn and grow. However, this task will not be easy. One essential ingredient for it to succeed is the availability of powerful tools to help teachers and students in the learner-centered paradigm. The fourth article in this series will address this need.

Application Exercises

- Review the author's theoretical learner centered school. What do you see as the strengths of this format? What are its weaknesses?
- The authors of this article suggest giving students authentic tasks in the community to help them achieve their academic goals. What authentic, community project would you have designed for yourself as a high school student? Now?
- Do a little bit of research and share what tools are available to aid instructors in becoming more learner centric. What limitations do these tools have? What do they do well? What factors of the learner environment must change to make these tools more effective?
- How would you design a learner-centered school that may be different from the version that are discussed in this article?

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ISD and Functional Design Layering

Gibbons, A. & McDonald, J. K.

This chapter has two purposes. First, we contrast two approaches to instructional design—the traditional Instructional Systems Design (ISD) process and an alternative view known as Functional Design Layering (FDL). In our review, we describe the background of each approach, the problem(s) each approach attempts to solve, and the types of decisions each approach prepares instructional designers to make. Second, we show how these different approaches play complementary roles in the practice of instructional design. When considered together, they offer a more robust conception of how instructional designs can be created. Essentially, ISD focuses on design process at the expense of internal design structure, whereas FLD focuses on internal design structure and proposes a naturalistic view of design decision order that is more closely aligned with actual designer practice. Considered together, these contrasting approaches become mutually strengthening, providing the designer with a wider range of design questions and design process options.

Instructional Systems Design: Origins

The focus of Instructional Systems Design (ISD) is on ensuring instructional designers follow a process that will enable them to create powerful instructional (or learning) systems. Its foundations can be traced to the book *Psychological Principles in System Development* (Heretofore referenced to as *PPSD*) (Gagné, 1965). Here, Gagné described training and education systems as "man-made 'synthetic' organisms, whose components, subsystems, and interactive mechanisms have analogous functions to those of biological organisms . . . " (Gagné, p. 12). If there was an enduring idea in the original expression of *PPSD*, it was the concept of a system as an organic, adaptive entity, with the system's functions being the point of departure for design.

> *Planning for the development of a system begins with a series of decisions regarding the functions to be performed by various parts of the system in their*

> *subordinate contributions to a total complex which will accomplish system goals. (Gagné, p. 34)*

Gagné was proposing that the basis for system design was an inventory of the functions the designed system would perform. However, a gradual shift in the interpretation of the term "function" that occurred over time was pivotal in shaping the eventual form of ISD. Chapters of *PPSD* were weighted heavily in terms of design processes, so it became accepted that *design* functions—as opposed to *system* functions—should be the more central concern. Processes like target population analyses, task analyses, and the selection of media came to predominate the design approach; the study of internal instructional artifact functionalities such as content and strategy structuring, message and learner control design, and message representation became secondary.

The theme of "systems development" from *PPSD* was amplified over several decades by Gagné and many of his colleagues, morphing over time into the "systems approach" to instructional design. What resulted was a body of design process prescriptions that is still the dominant approach taught in graduate-level instructional design programs and commercial industrial training manuals (Curry et al., 2021; Etmer et al., 2013; Gagné, 2004).

ISD design models based on this interpretation of design "function" rather than system "function" were published over time in multiple, individualistic versions by textbook authors, and this definition remains today the basis for an entire instructional design industry (Briggs et al., 1991; Dick et al., 2009; Gustafson, 1981; Gustafson & Powell, 1991; Heinich et al., 1996; Kemp, Morrison, & Ross, 1994; Reiser & Dick, 1996; Smith & Ragan, 1999). To aid widespread dissemination of ISD models, it became necessary to simplify them for a variety of non-academic audiences. For example, the multi-volume *Interservice Procedures for Instructional Systems Development* (Branson et al., 1975) attempted to place instructional design practice in the hands of untrained military and government designers. This, and other likeminded process descriptions, were used to train a large number of novice designers in military and government service who, after gaining a degree of experience, eventually found career paths leading to general commerce and industry.

There were many beneficial outcomes from the widespread dissemination of ISD models: project management became more predictable because design was packaged as a set of standard processes; design projects became more schedulable and manageable; designers with minimum training could gain entry to a career path with a reasonable threshold that did not require a specialized degree; and the training function itself could be assimilated by large training organizations as a source of improved workforce performance. Design defined as a collection of processes proved to have many uses, and the domination of the field by an engineering frame of mind—unbalanced by alternative views—lasted until the 1980s and 1990s, when a more searching view of design processes independent of disciplines became a topic of intensive study.

Alternative Approaches to Design Emerge

ISD emerged in an environment where many design fields (e.g. architecture, product design; see Cross, 2007), not just instructional design, were dominantly focused on a process-centric approach to systems development (Banathy, 1968; Briggs, 1967; Diamond, 1997; Hamreus, 1968; Gerlach & Ely, 1980). However, in many of these fields, alternative ways of thinking about design started to emerge and found popularity as process models were found to be inflexible in some applications and generally untrue to the natural decision-making patterns of designers in practice. Systematic design models logically begin with multiple analyses for a complete survey of the design and implementation environment, including user demographics, existing resources, resource constraints, and even organizational politics. But, in practice, designers don't wait for analysis results before they begin to hypothesize the broad outlines of one or more possible design configurations. Moreover, designers found that these design hypotheses feed back into the analysis process, leading to further analysis to support or cancel a particular design hypothesis. Schön (1987) refers to this as the "conversation" (p. 43) between the designer and the design problem: a back-and-forth exchange between analysis findings and design hypotheses, with hypotheses leading to further analysis.

Alternative approaches to design became a current topic in many design fields in the 1980s and 1990s, as design itself became a topic of study, promoted by the work of Simon (1999), Alexander (1964, 1977), Jones (1970), Darke (1979), Schön (1987), Kelley (2005), Dorst (2011), Cross (2018), and others. Even in engineering fields such as aviation design, researchers like Vincenti (1990) recognized that the exact nature of design questions and goals was refined in the process of making designs that worked. Schön's description of the reflective practitioner showed the designer studying the internal structures and functions of designed artifacts in terms of design languages describing artifact functions rather than design process functions.

The foregrounding of *artifact* functions and design thinking not only raised questions about how designers solve problems, but also questions about the nature of designs themselves. Darke (1979) proposed the concept of the "primary generator" of a design, a structural concept around which the remainder of the design could coalesce. Schön (1987) and Reinfrank & Evenson (1996) described the concept of design language and suggested that function-specific design languages existed within the "layers" of a design. Separation of functional layers in the design of computers, software, and architecture (Brand, 1994) echoed this concept, describing how the modularization of designs made possible by layer structures gave the designed artifact a longer service life, since changes could be made to layer designs with minimal disruption of other layers. An extended case study of layered design by Baldwin and Clark (2000) showed that layered or modularized designs made the escape from computers with monolithic designs possible, ushering in the day of the personal computer with swappable components. Banathy (1996) described the impact of a layered form of design thinking in the design of social systems that could change and adapt over time. The concept of design layering based on artifact functionality is found today in virtually all design fields and provides major economic benefits. Today, fields that do not consider design layers and the modularity they afford are denied access to product maintainability and the attendant economic value.

Revisiting the Interpreting of “Function” in Instructional Systems (Functional Design Layering)

Fresh ideas about design and design theory have been slow to reach the instructional design field. There have been critical reviews of ISD and its dominance (Bichelmeyer et al, 2006; Gibbons et al, 2010, 2013, 2014; Gordon & Zemke, 2000; Merrill et al., 1990; Smith, 2008; Smith & Boling, 2009), but alternatives to ISD as the sole approach to design have been slow to emerge and find a place in academic literature and academic design programs. This may be due to an early (mis) interpretation in the field, where the term “function” was used to refer to “design” function. Revisiting Gagné’s original description of “function” as expressed in *PPSD* would lead to a much different view of instructional design today, if it referred to the functional elements of the artifact being designed as well as the functions of designing. The ISD model focuses the designer’s attention on functions performed by the designer; instead, we might also consider the functions carried out as subprocesses within the artifact being designed.

Gagné originally suggested that:

> *Because of the nature of a synthetic organism, the functioning of its parts and subsystems may be studied directly, thus providing a means of developing systematic accounts of the processes of interaction within the system as well as their effects on total system functioning. (Gagné, 1965, p. 12)*

Focus on the functions of the “organism” opens a new perspective on instructional design and the act of designing instructional experiences.

A functional (or architectural) theory of instructional design proposed by Gibbons (2009, 2014) takes this approach. To create organic designs—designs that can change and adapt dynamically with changes in external conditions—one must consider the functions performed by the “organism” itself—the artifact being designed. Brand (buildings) demonstrates that buildings possess life-extending properties if they have been designed according to a separation of functional “layers,” each layer being a functional design subproblem: exterior skin layer design, separate from an interior spaces design; the separation of services design (electrical systems, plumbing) from the design of supporting structures and foundational elements (Figure 1).

A functional approach of this kind does not preclude the parallel use of a process-centered design process model; it enhances it by offering the designer a more flexible approach to the ordering of design decisions and analyses.

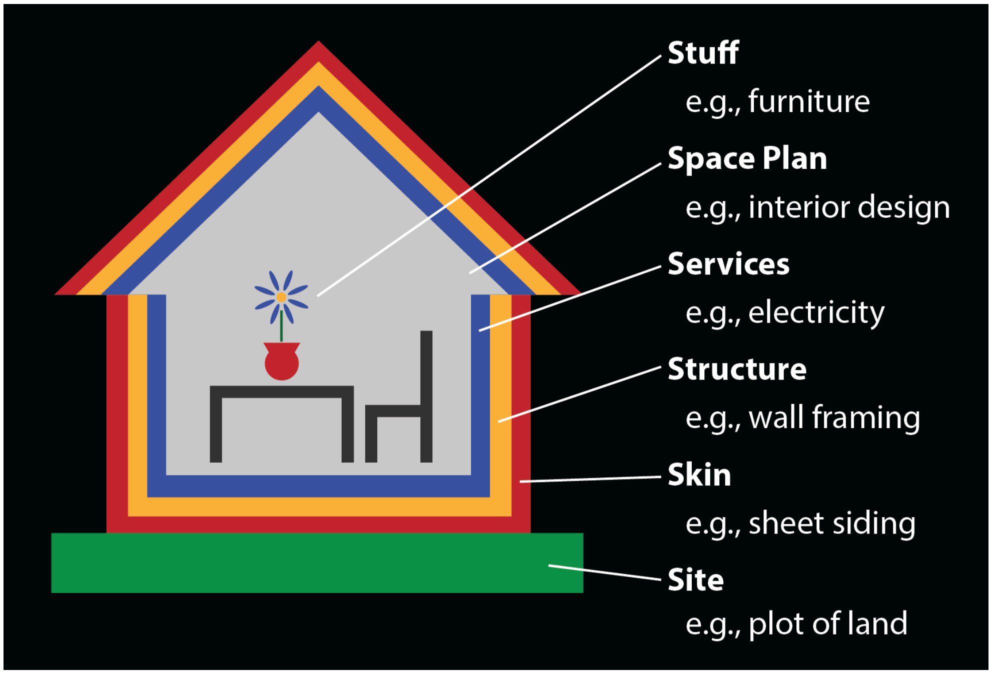

Figure 1. *The Layers of a Building's Design (adapted from Brand, 1994).*

An automotive design team will approach the design of a new car with a process model in one hand and a description of the functions of the automotive product in the other. The process model makes design manageable, while the functional artifact model points out the very substance of the design. Functions of an automobile artifact design include certain essentials such as propulsion systems, traction systems, braking systems, and steering systems. Each of these systems is supplied with the language terms related to each layer of the design: "engine," "wheel," "brake." These are designable artifact elements, and a specialist in designing one part will know the language of that part's design. Each layer design over time decomposes into subsystems (e.g., "brake pad" or "caliper") to be designed. This artifact-focused approach is equally valuable and equally as valid as the process approach. The approaches complement each other with their strengths.

Gibbons (2014) proposes a list of generic instructional functions as a minimal set for instructional artifacts. These include:

- The forming of sensory **representations** that can be projected to learners through media devices (a Representation Layer)
- The formation of sequenced packages of elemental **message** packets to provide substance for the formation and projection of representations (a Message Layer)
- The description of the **device means** and a **device-related language** for use by the learner in communication of messages back to the instructional source (a Control Layer)
- The definition of instructional/experiential **events** and a plan for their sequencing (a Strategy Layer)
- A system for describing and capturing constituent parcels of **"knowables" and "performance expertise"** (a Content Layer)

- A system for **recording and analyzing** interactions and learner action patterns (a Data Management Layer)
- Directions for operating the experience-enacting **delivery platform** or mechanism (human or computerized) capable of bringing together and coordinating events, content parcels, message and control elements, representations, recordings, and analyses (a Media-Logic Layer).

Seven Basic Layers for Instructional Systems

Each instructional function in an artifact can be described in terms of a layer, or a specific design problem to be addressed. Gibbons (2014) proposed seven basic layers for instructional systems.

Representation layer – The parts of instruction that learners directly see, hear, touch, etc. (seeing an image on the screen; hearing a voice explain a concept).

Message layer – The underlying instructional intentions that are given concrete shape by various representations (the intention behind explaining a procedure; the intention behind presenting possible actions and consequences).

Control layer – The ways learners act in the instructional environment (using a keyboard to enter text into an online form; raising a hand to alert a teacher they want to speak).

Strategy layer – The plans for instructional events and interactions, along with the sequence of how learners experience those events/interactions (explanation-demonstration-practice; solving authentic problems).

Content layer – The underlying subject matter that forms the “raw material” of instruction (a skill to be performed; a body of knowledge to master).

Data management layer – How information about the instruction is gathered, stored, analyzed, and reported (how much time learners spent in a system; students’ scores on a test).

Media-logic layer – How all the other layers are brought together, coordinated, and adjusted throughout instruction (learning management systems; computer operating systems).

It is proposed that this list of functions represents an essential abstract of the instructional artifact. These functions are performed to facilitate instructional experiences, regardless of the delivery medium chosen by the designer, the designer's instructional philosophy or strategy preference, or their preferred theoretical stance. Therefore, they represent a core of artifact functions to be designed. As in the automobile design example, each layer of the design poses questions and choices. This makes available to the designer a variety of design language options for each layer and associated theories of representation design, message formation and interaction, control design, and so forth. Most importantly, it makes the designer aware of a host of design questions that under a process design approach are defaulted because they do not always appear to the designer as choices.

Scientific theory, instructional theory, and best practice can inform designs within each layer (and sublayer). Advances in theory and technology can lead to the identification of new layer structures and arrangements. Layer design, being theory agnostic, accommodates the designer's preference for instructional theory. The basic inventory of layers (and sublayers) described above does not change with advances in theory and technology as much as it is added to, detailed, and subdivided by them. New discoveries may add new sublayers and design specialties, but there is always the need for a representation function, a message formation function, a control function, a strategic function, and a function that parcels out elements of the knowledge and action constituents.

The Relationship of ISD and Functional Layer Design (FLD)

ISD & Functional Layer Design (FLD) differ in the way they define the design problem. ISD refracts system design functions through a process prism, breaking the problem down in terms of *design process* functions; FLD refracts system design through the artifact's prism, breaking the problem down in terms of the artifact functions to be designed (Figure 2).

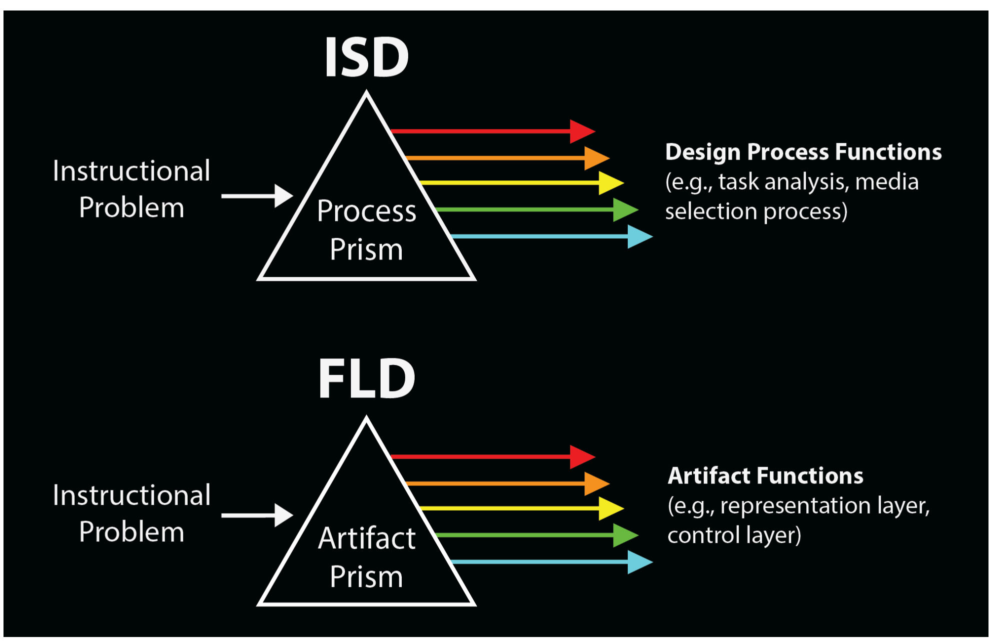

Figure 2. *The Differing Lenses of ISD and FLD*

For example, whereas ISD specifies a general logical order to design processes, the order of design decision making in layered designs is not sequential in the same sense. It is not necessary—and in some cases may be counterproductive—to adhere to a strict delineation of analysis, design, development, implementation, and evaluation phases. Instead, design can proceed according to and within the most important constraints and fortunate opportunities (Baldwin & Clark, 2000; Gross et al., 1987; Norman, 2002). The design decisions to be considered first depend on the constraints given with the design problem. Often design decisions related to a particular layer come ready-made, as in the case of a media constraint or a client's preference for strategy.

Design decisions within multiple layers may be advanced (after a sufficient amount of analysis) at the same time as joint hypotheses and tested and then modified and retested. New constraints result from the making firm of a particular configuration of layer properties. These in turn limit the range of choices left open for the designer. Design proceeds in this manner by posing and refining hypothetical combinations of decisions that are not yet firm. Innovative approaches and new applications for old theories can result. A design is complete when there are no more decisions to be made at the level of detail the designer selects. This is an especially useful principles that allows higher levels of the design to be completed by a designer, leading to additional design details to be filled in by layer specialists (e.g., artists, programmers, writers, experience designers, and editors). During this unfixed order of decision making, principles of design thinking can be explored, and the order for making decisions becomes tailored to the problem's context.

However, because of these contrasting approaches, ISD and FLD are actually mutually strengthening. The process view of design leads to the exploration and improvement of design processes; it reminds the designer that the creative process must be, at the same time, manageable. The artifact view leads to the exploration of the inner structures of artifacts and reminds the designer that the details of designs interact at many levels with theories of cognitive processes and instructional theory. These seemingly antagonistic approaches should together redefine our approach to designing and open new avenues to the design thinking of other design fields to sharpen and clarify the concepts we pass on to a new generation of designers.

Activity – Applying Functional Design Layering

Understanding the functional layers within an instructional design offers you conceptual resources to describe at a great level of precision how and why the design works as it does. The purpose of this activity is to practice analyzing a design from the perspective of the layers of which it is composed. It will also help you explain the different kinds of decisions ISD and FDL allow designers to make.

1. Identify an instructional design you are currently working on or that you have worked on recently. This could be a class project or an assignment from your

place of employment. If you do not have a ready design to analyze, identify one with which you are reasonably familiar (perhaps a piece of instructional software or an online course you have recently completed).
2. Consider the design from the perspective of ISD, or, as discussed in the chapter above, the "functions performed by the designer." In a brief list, specify the decisions that ISD has helped, or could help, you make in service of completing this design. If you need assistance making your list, see this chapter on instructional design models elsewhere in this book.
3. Now consider the design from the perspective of FDL, or the "functions carried out as subprocesses within the artifact designed." Create another list that identifies at least one meaningful function in each of the seven layers described in this chapter. Also consider: are there other layers in this design that perform a function distinct from the basic set? If so, identify them and the function they are performing.
4. Compare your two lists. What are the differences? Are there any similarities?
5. In a short reflection (2–3 paragraphs), summarize what this activity illustrated about the purposes and benefits of FDL. Take into account questions like: What does examining a design from the perspective of FDL offer that other perspectives (like ISD) do not? What do you think it means that, together, ISD and FDL "offer a more robust conception of how instructional designs can be created"? How can you include FDL in your personal design practice? How can it help you create more complete, coherent, and effective designs?

For Further Thought

As part of this activity, you may also want to carry out some thought experiments such as:

1. What would happen to the overall design if you changed the function performed by one of the layers you identified? Speculate on how the design might be more or less effective by making a change.
2. How do the functions within each layer work together to contribute towards a whole? Can you find any elements you (or the designer) did to make the connections between layers work better, or somehow be more meaningful?

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Design Thinking and Agile Design

New Trends or Just Good Design Practice?

Svihla, V.

Design Design Thinking

While most instructional design courses and much of the instructional design industry focus on ADDIE (Analysis, Design, Development, Implementation, Evaluation), approaches such as design thinking, human-centered design, and agile methods like SAM (Successive Approximation Model), have drawn attention. This chapter unpacks what we know about design thinking and presents a concise history of design thinking to situate it within the broader design research field. It then traces its emergence in other fields. The chapter considers lessons for instructional designers and concludes by setting an agenda to address issues for scholarship, teaching, and practice.

Many depictions of design process, and a majority of early design learning experiences, depict design as rather linear, or "waterfall," view of design (Figure 1). This depiction was originally proposed as a flawed model in 1970 (Royce, 1970), yet it is still relatively common. It also contrasts with what researchers have documented as expert design practice.

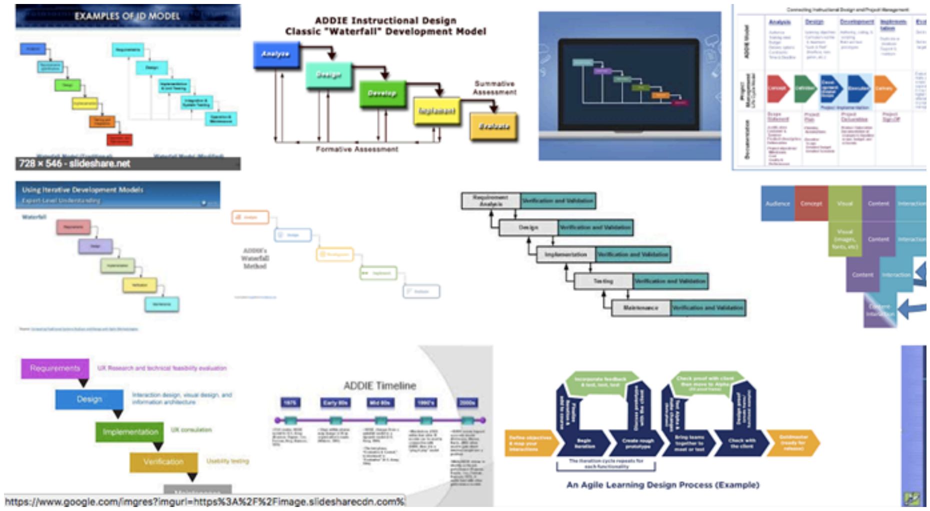


Figure 1. *Google Image search results of design as a waterfall model*

Fortunately, as instructional and learning designers, we have many models and methods of design practice to guide us. **ADDIE** is ubiquitous and sometimes depicted as if it involves a specific set of steps that must be carried out in order. Yet, when we look at what experienced designers do, we find they tend to use **iterative** methods that sometimes appear a bit messy or magical, leveraging their past experiences as precedent. Perhaps the most inspiring approaches that reflect this are agile methods, **human-centered design**, and **design thinking**. However, most of us harbor more than a few doubts and questions about these approaches, such as the following:

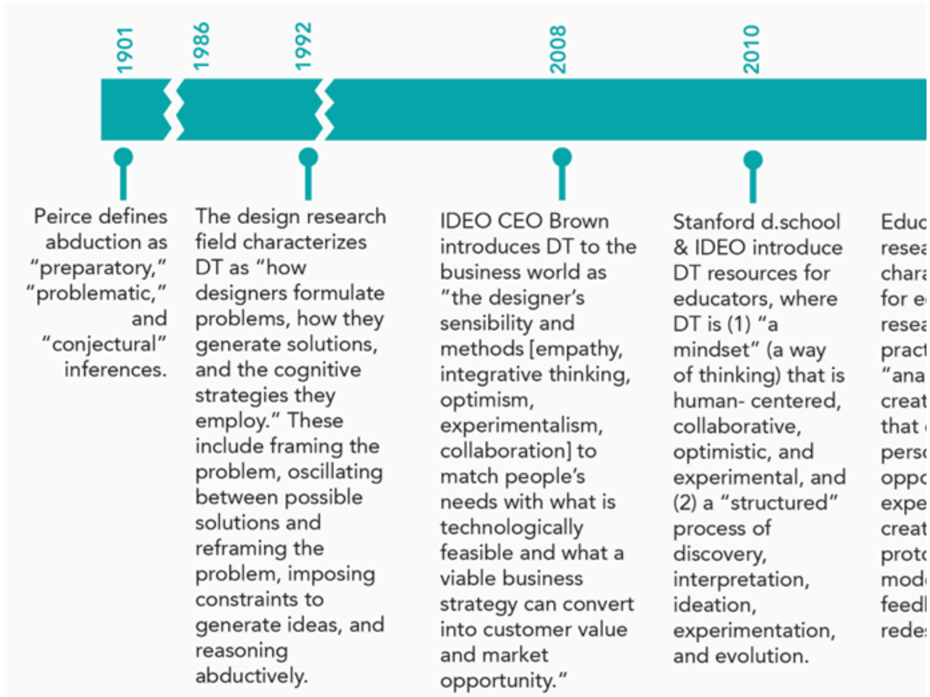
- Design thinking seems both useful and cool, but I have to practice a more traditional approach like ADDIE or waterfall. Can I integrate agile methods and design thinking into my practice?
- Design thinking—particularly the work by **IDEO**—is inspiring. As an instructional designer, can design thinking guide me to create instructional designs that really help people?
- Given that design thinking seems to hold such potential for instructional designers, I want to do a research study on design thinking. Because it is still so novel, what literature should I review?
- As a designer, I sometimes get to the end of the project, and then have a huge insight about improvements. Is there a way to shift such insights to earlier in the process so that I can take advantage of them?
- If design thinking and agile design methods are so effective, why aren't we taught to do them from beginning?

To answer these questions, I explore how research on design thinking sheds light on different design methods, considering how these methods originated and focusing on lessons for instructional designers. I then share a case to illustrate how different design methods might incorporate design thinking. I close by raising concerns and suggesting ways forward.

What is Design Thinking?

There is no single, agreed-upon definition of design thinking. Further, there is not even agreement on what the outcomes might be if a designer is adept at design thinking (Rodgers, 2013). If we look at definitions over time and across fields (Figure 2), we notice most researchers reference design thinking as methods, practices or processes (Rowe, 1987). A few others reference cognition, mindset (ways of thinking), or values (e.g., practicality, empathy) (Cross, 1982). This reflects the desire to understand both what designers do and how and when they know to do it (Adams et al., 2011). In later definitions, design thinking is more clearly connected to creativity and innovation (Wylant, 2008); while mentioned in early design research publications (e.g., Buchanan, 1992), innovation was treated as relatively implicit.

Figure 2. A timeline of key developments in characterizations of design thinking (DT) across fields, authors, and over time (Brown, 2008; Cross et al., 1992; d.school, 2012; IDEO, 2011; Peirce Edition Project, 1998; Razzouk & Shute, 2012; Rodgers, 2013).



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Design thinking has only recently become a topic in instructional design and educational technology (Stefaniak & Xu, 2020). Indeed, we can identify four primary ways that design thinking has been used in prominent instructional design journals (i.e., *TechTrends*, *Educational Technology Research and Development*, *The British Journal of Educational Technology*, and *The Journal of Applied Instructional Design*) (Figure 3). Papers most commonly reference the IDEO approach as an aspirational practice for instructional design. Next, papers reference design thinking in order to investigate how instructional designers approach designing. Some papers reference the idea that teachers are designers who engage in design thinking; these papers tend to reference Chai et al. (2011), who define design thinking as "the mode of thinking which is concerned more with improving ideas into useful artefacts or processes rather than the belief mode of thinking which is predominantly concerned with the true value of knowledge claims" (p. 1191). Finally, a couple papers investigate design thinking as a learning outcome for students, typically in STEM. Thus, of the 35 papers that cite design thinking, about half use design thinking in line with the field that created the term, and about half reference the idea as popularized by IDEO. This suggests that the former may be more useful for those doing research, while the latter may provide inspiration to designers seeking alternatives to ADDIE. But let's take a more nuanced look at design thinking to consider how research on design thinking can also inspire practice.

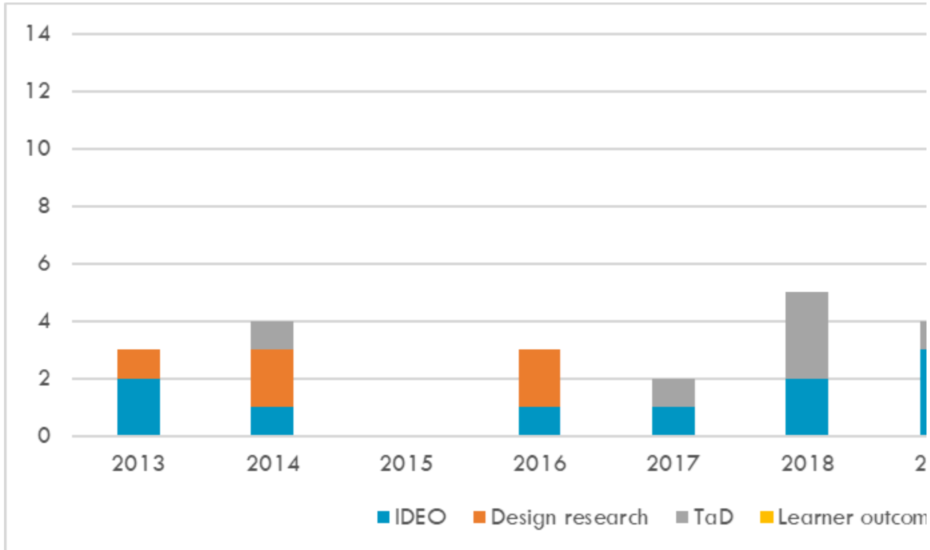


Figure 3. Number of papers in prominent instructional design journals that cite design thinking.

Where Did Design Thinking Come From? What Does it Mean for Instructional Designers?

Design thinking emerged from the **design research** field[1] —an interdisciplinary field that studies how designers carry out their work. Initially, design thinking was proposed because of a desire to differentiate the work of designers from that of scientists. As Nigel Cross explained, "We do not have to turn design into an imitation of science, nor do we have to treat design as a mysterious, ineffable art" (Cross, 1999, p. 7). By documenting what accomplished designers do and how they explain their process, design researchers argued that while scientific thinking can be characterized as reasoning **inductively** and **deductively**, designers reason *abductively* (Dorst, 2011; Kolko, 2010). When designers think abductively, they fill gaps in knowledge about the problem and about the kinds of solutions that can solve it, drawing inferences based on precedent—their past design work, their preferences, and experiences with designs—and on what they understand the problem to be.

LIDT in the World: Lesson #1

Research on design thinking should inspire us to critically consider how we use precedent to fill in gaps as we design. Precedent includes our experiences as learners, which may be saturated with uninspired and ineffective instructional design.

Example: Jeff and Paloma are instructional designers working with a client, Mr. Yazzie, who represents a coalition of tribal nations across the American Southwest. The coalition has requested a supplemental training on research ethics with Indigenous communities. Jeff's initial idea seamlessly matches the style of the existing training supplied by the Collaborative Institutional Training Initiative (CITI) program, consisting of text and multiple-choice questions. What precedent shapes both the CITI training and Jeff's idea?

A critical difference between scientific thinking and design thinking is the treatment of the problem. In scientific thinking, the problem is treated as solvable through empirical reasoning, whereas in design thinking, problems are tentative—sometimes irrational—conjectures (Diethelm, 2016). This type of thinking is suppositional, meaning the designer explores if-then and what-if scenarios to **iteratively** frame the problem (Dorst, 2011). As designers do this kind of work, they jointly frame the problem and pose possible solutions, checking to see if their solutions satisfy the identified requirements (Cross et al., 1992; Kimbell, 2012). From this point of view, we don't truly know what the design problem is until it is solved! This means that when doing design iteratively, we are changing the design problem multiple times. But how can we manage such changes efficiently? One answer is agile design.

Learning Check

Which of the following best characterizes design thinking, as defined by the design research community?

- [ ] A sequence of steps (Empathize, Define, Ideate, Prototype, Test) that is an alternative to ADDIE
- [ ] Using inductive reasoning systematically
- [ ] Using abductive reasoning in framing and reframing problems
- [ ] Using deductive reasoning to fill in gaps in understanding

Agile design, with its emphasis on rapid prototyping, testing and iteration, was proposed to improve software design processes. Later canonized in the *Manifesto for Agile Software Development* (Beck et al., 2001), early advocates argued that this change in software design process was urgently needed in "the living human world" that was affected by "increasingly computer-based systems […] while the existing discipline of software engineering has no way of dealing with this systematically" (Floyd, 1988, p. 25). With the influence of new technologies on educational settings, it was natural for instructional designers to look to software design for inspiration. Indeed, Tripp and Bichelmeyer introduced instructional designers to rapid prototyping methods while these same methods were still being developed in the software design field (1990). They explained that traditional ID models were based on "naive idealizations of how design takes place" (p. 43) and that ID practice already included similar approaches (e.g., **formative evaluation** and **prototyping**), suggesting that agile design could be palatable to instructional designers, particularly when the context or learning approach was relatively new or unfamiliar.

LIDT in the World: Lesson #2 for ID

Our use of instructional designs tends to be short-lived, making them subject to iteration and adaptation to meet emergent changes in learning needs, context, or learning goals. Each new solution is linked to a reframing of the problem. As agile designers, we can embrace this iteration agentively, reframing the problem as we work based on insights gained from testing early, **low fidelity prototypes** with **stakeholders**.

Example: Jeff and Paloma, uncertain whether Mr. Yazzie will prefer a training that matches the existing CITI training, develop five design ideas as hand-drawn sketches, annotated with notes. They share these with Mr. Yazzie and a few of the intended learners. In doing so, they realize that matching the CITI training holds some appeal for the learners, but Mr. Yazzie and the designers realize it seems unlikely to support the complex learning needs.

In addition to presenting annotated sketches, what do you think Jeff and Paloma did to reach an understanding with Mr. Yazzie that matching the CITI training might not suffice? In other words, how can designers bring their low-fidelity prototypes to life for clients and learners?

Imagine instead that the designers did not share any design ideas that matched the CITI training. How do you think Mr. Yazzie and the learners might have responded?

Sometimes, presented with low-fidelity prototypes, clients feel concern about the lack of professional quality. What do you think Jeff and Paloma did to avoid this?

As they are practiced, agile methods, including SAM (Allen, 2012), frequently involve stakeholders in the design process (Fox et al., 2008). Working contextually and iteratively can help clients see the value of a proposed design solution and understand better how—and if—it will function as needed (Tripp & Bichelmeyer, 1990). One challenge designers encounter is that stakeholders may react to sketches and prototypes in unexpected ways. They may think low fidelity versions are unprofessional, but may consider polished representations are more functional and finalized, and then be unsure about what can still be changed, and focus feedback on superficial or aesthetic aspects.

Other design methods that engage stakeholders early in the design process, such as participatory design (Muller & Druin, 1993; Schuler & Namioka, 1993) and human-centered design (Rouse, 1991), have also influenced research on design thinking. While these approaches differed in original intent, these differences have been blurred as they have come into practice. Instead of defining each approach, let's consider design characteristics made relevant by comparing them with more traditional methods like ADDIE, which as we have noted, is often depicted as a linear process. Like agile design, these methods tend to be iterative. Whereas in ADDIE, the designer is responsible for collecting information about stakeholders, in agile methods, designers tend to include stakeholders in more varied ways, even inviting stakeholders to generate possible design ideas and help frame the design problem.

When designing with stakeholders, we gain access to their perspectives and give them more ownership over the design. However, it can be difficult to help them be visionary. Consider early smartphone design. Early versions had keyboards and very small screens. Each new version was incrementally different from the prior version. If we had asked stakeholders what they wanted, most would have suggested minor changes in line with the kinds of changes they were seeing with each slightly different version. Likewise, traditional approaches to instruction should help inspire stakeholder expectations of what is possible in a learning design.

LIDT in the World: Lesson #3 for ID

Inviting stakeholders into instructional design process early can lead to more successful designs, but we should be ready to support them to be visionary while considering how research on how people learn might inform the design. For instance, rather than asking for improvements on known, existing designs, designers can inquire about other meaningful learning experiences that they value.

Example: Jeff and Paloma share the CITI training and ask Mr. Yazzie and the intended learners to describe what they would prefer in a training. Their ideas include making the CITI training more accessible, such as increasing the font size on the resources, adding more pictures, and creating offline versions.

Why might sharing an existing design, like the CITI training, prompt clients and learners to focus on incremental improvements?

Are these incremental improvements likely to result in a design that meets the learning needs?

Having asked for their participation, what are possible consequences of ignoring their ideas?

How could Jeff and Paloma have made better use of their time with Mr. Yazzie and the learners?

Designers who engage with stakeholders must also pay attention to **power dynamics** (Kim et al., 2012). As instructional designers, when we choose to include learners in the design process, they may be uncertain about how honest they can be with us. This is especially true when working with children or adults from marginalized communities or unfamiliar cultures. For instance, an instructional designer who develops a basic computer literacy training for women fleeing abuse may well want to understand more about learner needs, such as whether they need support with typical tasks like email, word processing, file management, and so forth, or more specific tasks, like using privacy settings on social media to reduce an abuser's access to information about these women. Equally important, the designer needs to know about contextual needs, like transportation, child care, and learning disabilities, that if not taken into account in the design process could result in a solution that fails to meet learning needs. In order to gather such information, the instructional designer should consider carefully the situations in which learners will feel safe sharing. A focus group coordinated by someone the women trust might be better than holding one-on-one interviews. The instructional designer could supplement the focus group with a survey or comment cards to collect ideas anonymously.

LIDT in the World: Lesson #4 for ID

With a focus on understanding human need, design thinking and agile methods should also draw our attention to inclusivity, diversity, justice, and participant safety.

Example: Jeff, a white man, and Paloma, a Latina, both with graduate degrees, recognize that their experiences differ from the tribal members they are designing for. They acknowledge that a long history of oppression and injustice will likely make stakeholders cautious about sharing their thoughts and feelings. Because they don't trust their own precedent, they seek out information about Indigenous and decolonizing instructional design (DeLorme, 2018) and consult with Mr. Yazzie about the appropriateness of using a **talking circle** to gather stakeholder feedback. Mr. Yazzie is supportive because he has observed other outsiders take this approach. However, he advises them to allow him to identify a tribal member to lead the circle.

To further illustrate these design thinking practices in tandem, consider what design thinking might look like across different instructional design practices.

Learning Check

Which statement is most accurate regarding benefits and challenges designers encounter in agile and human centered design methods?

- [ ] While stakeholders feedback ensures the design will meet the needs, it is more work overall.
- [ ] Power dynamics can prevent stakeholders from engaging in the design process. By mitigating the impacts of power dynamics, designers are liklier to get honest feedback.
- [ ] Stakeholders typically intuitively understand that sketches and low fidelity prototypes are intentionally drafty, so there is no need to set expectations about such representations.

Design Thinking in ID Practice

To understand how design thinking might play out in different instructional design methods, let's consider another case with the following four different instructional design practices:

- Waterfall design proceeds in a linear, stepwise fashion, treating the problem as known and unchanging
- ADDIE design, in this example, often proceeds in a slow, methodical manner, spending time stepwise on each phase
- Agile design proceeds iteratively, using low fidelity, rapid prototyping to get feedback from stakeholders early and often

- Human-centered design prioritizes understanding stakeholder experiences, sometimes co-designing with stakeholders

A client—a state agency—issued a call for proposals that addressed a design brief for instructional materials paired with new approaches to assessment that would "be worth teaching to." They provided information on the context, learners, constraints, requirements, and what they saw as the failings of current practice. They provided evaluation reports conducted by an external contractor and a list of 10 sources of inspiration from other states.

They reviewed short proposals from 10 instructional design firms. In reviewing these proposals, they noted that even though all designers had access to the same information and the same design brief, the solutions were different, yet all were *satisficing*, meaning they met the requirements without violating any constraints. They also realized that not only were there 10 different solutions, there were also 10 different problems being solved! Even though the client had issued a design brief, each team defined the problem differently.

The client invited four teams to submit long proposals, which needed to include a clear depiction of the designed solution, budget implications for the agency, and evidence that the solution would be viable. Members of these teams were given a small budget to be spent as they chose.

Team Waterfall, feeling confident in having completed earlier design steps during the short proposal stage, used the funds to begin designing their solution, hoping to create a strong sense of what they would deliver if chosen. They focused on details noted in the mostly positive feedback on their short proposal. They felt confident they were creating a solution that the client would be satisfied with because their design met all identified requirements; because they used their time efficiently; and because as experienced designers, they knew they were doing quality, professional design. Team Waterfall treated the problem as adequately framed and solved it without iteration. Designers often do this when there is little time or budget[2], or simply because the problem appears to be an another-of problem—thinking, "this is just another of something I have designed before." While this can be an efficient way to design, it seldom gets at the problem behind the problem, and does not account for changes in who might need to use the designed solution or what their needs are. Just because Team Waterfall used a more linear process does not mean that they did not engage in design thinking. They used design thinking to frame the problem in their initial short proposal, and then again as they used design precedent—their past experience solving similar problems—to deliver a professional, timely, and complete solution.

Team ADDIE used the funds to conduct a traditional needs assessment, interviewing five stakeholders to better understand the context, and then collecting data with a survey they created based on their analysis. They identified specific needs, some of which aligned to those in the design brief and some that demonstrated the complexity of the problem. They reframed the problem and created a low fidelity prototype. They did not have time to test it with stakeholders, but could explain how it met the identified needs. They felt confident the investment in understanding needs would pay off later, because it gave them insight into the problem. Team ADDIE used design thinking to fill gaps in their understanding of context, allowing them to extend their design conjectures to propose a solution based on a reframing of the design problem.

Team Agile used the budget to visit three different sites overseen by the state agency. They shared a low fidelity prototype with multiple stakeholders at the first site. In doing so, they realized they had misunderstood key aspects of the problem from one small but critical stakeholder group. They revised both their framing of the problem and their idea about the solution significantly and shared a revised prototype with stakeholders at the remaining sites. They submitted documentation of this process with their revised prototype. In their work, Team Agile prioritized iteration and diversity of point of views. They committed to treating their solution ideas as highly tentative, but gave stakeholders something new and different to react to. This strategy helped the team reframe the problem, but could have failed had they only sought feedback on improvements, rather than further understanding of the problem. They used design thinking to reframe their understanding of the problem, and this led them to iterate on their solution. Design researchers describe this as a co-evolutionary process, in which changes to the problem framing affect the solution, and changes to the solution affect the framing (Dorst & Cross, 2001).

Team Human-centered used the budget to hold an intensive five-day co-design session with a major stakeholder group. Stakeholders shared their experiences and ideas for improving on their experience. Team Human crafted three personas based on this information and created a prototype, which the stakeholder group reviewed favorably. They submitted this review with their prototype. Team Human-centered valued stakeholder point of view above all else, but failed to consider that an intensive five-day workshop would limit who could attend. They used design thinking to understand differences in stakeholder point of view and reframed the problem based on this; however, they treated this as covering the territory of stakeholder perspectives. They learned a great deal about the experiences these stakeholders had, but failed to help the stakeholders think beyond their own experiences, resulting in a design that was only incrementally better than existing solutions and catered to the desires of one group over others.

The case above depicts ways of proceeding in design process and different ways of using design thinking. These characterizations are not intended to privilege one design approach over others, but rather to provoke the reader to consider them in terms of how designers fill in gaps in understanding, how they involve stakeholders, and how iteratively they work. Each approach, however, also carries potential risks and challenges (Figure 4). For instance, designers may not have easy access to stakeholders, and large projects may make agile approaches unwieldy to carry out (Turk et al., 2002).

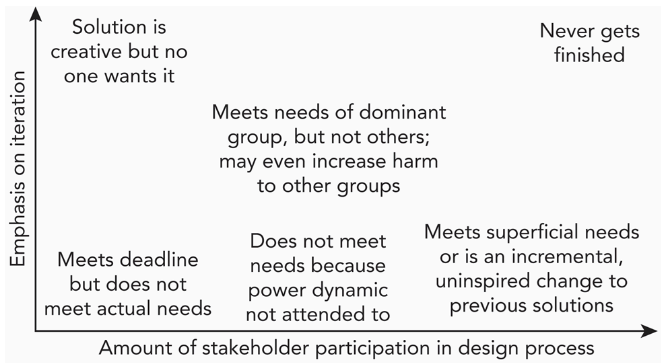


Figure 4. *Risks and pitfalls associated with different levels of stakeholder participation and iteration*

Critiques of Design Thinking

While originally a construct introduced by design researchers to investigate how designers think and do their work, design thinking became popularized as a set of methods, first in the business world (Brown, 2008) and later in education. Given this popularity, design thinking was bound to draw critique in the public sphere. To understand these critiques, it is worth returning to the definitions cited earlier (Figure 2). Definitions outside of the design research field tend to be based in specific techniques and strategies aimed at innovation; such accounts fail to capture the diversity of actual design practices (Kimbell, 2011). They also tend to privilege the designer as a savior, an idea at odds with the keen focus on designing *with* stakeholders, a practice that is central in the design research field (Kimbell, 2011). As a result, some have raised concerns that design thinking can be a rather privileged process—e.g., upper middle class white people drinking wine in a museum while solving poverty with sticky note ideas—that fails to lead to sufficiently multidimensional understandings of complex processes (Collier, 2017). Still others argue that much of design thinking is nothing new (Merholz, 2009), to which researchers in the design research field have responded: design thinking, as represented externally might not be new, but the rich body of research from the field can inform new practices (Dorst, 2011).

These critiques should make us cautious about how we, as instructional designers, take up design thinking and new design practices. Below, I raise a few concerns for new instructional designers, for instructional designers interested in incorporating new methods, for those who teach instructional design, and for those planning research studies about new design methods.

My first concern builds directly on critiques from the popular press and my experience as a reviewer of manuscripts. Design thinking is indeed trendy, and of course people want to engage with it. But as we have seen, it is also complex and subtle. Whenever we engage with a new topic, we necessarily build on our past understandings and beliefs as we make connections. It should not be surprising, then, that when our understanding of a new concept is nascent, it might not be very differentiated from previous ideas. Compare, for example, Pólya's "How to Solve it" from 1945 to Stanford's d.school representation of design thinking (Table 2). While Pólya did not detail a design process, but rather a process for solving mathematics problems, the two processes are superficially very similar. These general models of complex, detailed processes are *zoomed out* to such a degree that we lose detail. These details matter, whether you are a designer learning a new practice or a researcher studying how designers do their work. For those learning a new practice, I advise you to attend to the differences, not the similarities. For those planning studies of design thinking, keep in mind that "design thinking" is too broad to study effectively as a whole. Narrow your scope and *zoom in* to a focal length that lets you investigate the details. As you do so, however, do not lose sight of how the details function in a complex process. For instance, consider the various approaches being investigated to measure design thinking; some treat these as discrete, separable skills, and others consider them contextualized to the particular process and as occurring in iterative or overlapping ways (Carmel-Gilfilen & Portillo, 2010; Dolata et al., 2017; Lande et al., 2012; Razzouk & Shute, 2012).

Pólya, 1945 How to solve it	Stanford's d.school design thinking representation
Understand the problem	Empathize, Define
Devise a plan	Ideate
Carry out the plan	Prototype
Look back	Test

Table 2. Similarities between "How to Solve it" and a representation of design thinking

My second concern is that, as a field, we tend to remain naïve about the extant and extensive research on design thinking and other design methods in part because many of these studies were conducted in other design fields (e.g., architecture, engineering) and published in journals such as *Design Studies* (which has seldom referenced instructional design). Not attending to past and current research, and instead receiving information about alternative design methods filtered through other sources is akin to the game of telephone. By the time the message reaches us, it can be distorted. While we need to adapt alternative methods to our own ID practices and contexts, we should do more to learn from other design fields, and also contribute our findings to the design research field. As designers, we would do well to learn from fields that concern themselves with human experience and focus somewhat less on efficiency.

My third concern is about teaching alternative design methods to novice designers. The experience of learning ID is often just a single pass, with no or few opportunities to iterate. As a result, agile methods may seem the perfect way to begin learning to design, because there is no conflicting traditional foundation to overcome. However, novice designers tend to jump to solutions too quickly—a condition no doubt brought about in part by an emphasis in schooling on getting to the right answer using the most efficient method. Methods like agile design encourage designers to come to a tentative solution right away, then get feedback by testing low fidelity prototypes. This approach could exacerbate a new designer's tendency to leap to solutions. And once a solution is found, it can be hard to give alternatives serious thought. Yet, I argue that the solution is not to ignore agile and human-centered methods in early instruction. By focusing only on ADDIE, we may create a different problem by signaling to new designers that the ID process is linear and tidy, when this is typically not the case.

Instead, if we consider ADDIE as a scaffold for designers, we can see that its clarity makes it a useful set of supports for those new to design. Alternative methods seldom offer such clarity, and have far fewer resources available, making it challenging to find the needed supports. To resolve this, we need more and better scaffolds that support novice designers to engage in agile, human-centered work. For instance, I developed the *Wrong Theory Design Protocol* (http://www.vanessasvihla.org/wrong-theory-protocol.html) (Svihla & Kachelmeier, 2022) that helps inexperienced designers get unstuck, consider the problem from different points of view, and consider new solutions. Such scaffolds could lead to a new generation of instructional designers who are better prepared to tackle complex learning designs, who value the process of framing problems *with* stakeholders, and who consider issues of power, inclusivity, and diversity in their designing.

Concluding Thoughts

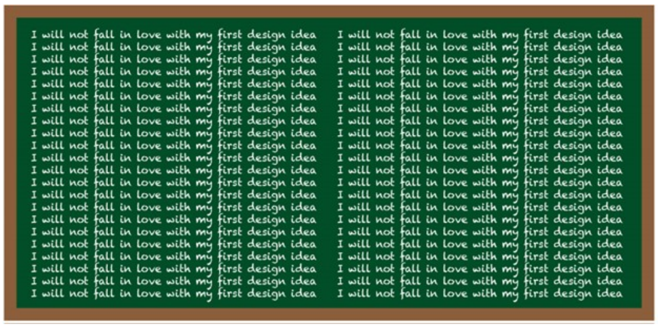
I encourage novice instructional designers, as they ponder the various ID models, practices and methods available to them, to be suspicious of any that render design work tidy and linear. If, in the midst of designing, you feel muddy and uncertain, unsure how to proceed, you are likely exactly where you ought to be.

In such situations, we use design thinking to fill in gaps in our understanding of the problem and to consider how our solution ideas might satisfy design requirements. While experienced designers have an expansive set of precedents to work with in filling these gaps, novice designers need to look more diligently for such inspiration. Our past educational experiences may covertly convince us that just because something is common, it is best. While a traditional instructional approach may be effective for some learners, I encourage novice designers to consider the following questions to scaffold their evaluation of instructional designs:

- Does its effectiveness depend significantly on having *compliant learners* who do everything asked of them without questioning why they are doing it?
- Is it a design *worth* engaging with? Would you want to be the learner? Would your mother, child, or next-door neighbor want to be? If yes on all counts, consider who *wouldn't*, and why they wouldn't.
- Is the design, as one of my favorite project-based teachers used to ask, "provocative" for the learners, meaning, will it provoke a strong response, a curiosity, and a desire to know more?
- Is the design "chocolate-covered broccoli" that tricks learners into engaging?

To be clear, the goal is not to make all learning experiences fun or easy, but to make them worthwhile. And I can think of no better way to ensure this than using iterative, human-centered methods that help designers understand and value multiple stakeholder perspectives. And if, in the midst of seeking, analyzing, and integrating such points of view, you find yourself thinking, "This is difficult," that is because it is *difficult.* Providing a low fidelity prototype for stakeholders to react to can make this process clearer and easier to manage, because it narrows the focus.

However, the success of this approach depends on several factors. First, it helps to have forthright stakeholders who are at least a little hard to please. Second, if the design is visionary compared to the current state, stakeholders may need to be coaxed to envision new learning situations to react effectively. Third, designers need to resist the temptation to settle on an early design idea.



Finally, I encourage instructional designers—novice and expert alike—to let themselves be inspired by the design research field and human-centered approaches, and then to give back by sharing their design work as design cases (such as in the *International Journal of Designs for Learning*) and by publishing in design research journals.

Resources in the Design Research Field

Want to know more about the **Design Research** field so you can contribute or locate resources?

The Design Society publishes several relevant journals:

- Design Science
- CoDesign: International Journal of CoCreation in Design and the Arts
- International Journal of Design Creativity and Innovation
- Journal of Design Research

The Design Research Society (DRS) has conferences and discussion forums.

There are other prominent journals in the design research field:

- Design Studies, 1979-2023 (Note: In July 2023, the journal editors resigned in protest over changes made by the publisher that threatened the quality; the DRS has plans to develop a new journal)
- Design Issues
- The Design Journal
- She Ji: The Journal of Design, Economics, and Innovation
- Design and Culture

Sign up for monthly emails from Design Research News to find out about conferences, calls for special issues, and job announcements.

Acknowledgments

This material is based in part upon work supported by the National Science Foundation under Grant EEC 1751369. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

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[1] For those interested in learning more, refer to the journal, *Design Studies*, and the professional organization, *Design Research Society*. Note that this is not a reference to educational researchers who do design-based research, which is sometimes, confusingly, referred to as "design research."

[2] Waterfall might also be used when designing a large, expensive system that cannot be tested and iterated on as a whole and when subsystems cannot easily or effectively be prototyped.

Designing for Creative Learning Environments

Putting Pedagogical Principles into Action

Henriksen, D. , Woo, L. , & Mishra, P.

Creativity Innovation Instructional Design Learning

learning environments

In this chapter, we discuss fundamental principles that define a creative learning environment and how these can be integrated into pedagogical design. Utilizing research, a creative environment instrument, and diverse learning settings as a springboard, we emphasize the link between a learning environment's design and how it nurtures creativity. We propose the use of the SCALE (Support for Creativity in a Learning Environment) instrument (Richardson & Mishra, 2018) as a frame for understanding and evaluating the characteristics of creative learning environments.

Using the SCALE's constructs—characteristics of the environment, learning climate, and learner engagement—as benchmarks, we consider how these offer criteria to build into the design of learning environments. We examine the theoretical underpinnings of creativity, creative environments, and learning, identifying gaps in classroom research that the SCALE instrument can bridge. This chapter discusses applications of these principles across various environments, including online and blended spaces, acknowledging that different environments present distinctive affordances, opportunities, constraints, and possibilities. Our implications take a future-oriented perspective on online creative learning environment design in both research and practice.

Creativity is one of the most coveted qualities of thinking, (Lewis, 2009) bringing social, emotional, cognitive, and professional benefits (Sternberg, 2006). While education has increasingly framed creativity as a key element of teaching and learning, this rhetoric has rarely been realized in formal learning settings, partly due to traditional school limitations. In schools, the steady march of standardized testing restricts teachers' and students' creativity. Even in higher education, traditional structures and assumptions still permeate learning settings and designs. Creativity is not a discrete subject matter to be taught, memorized, or drilled—rather, it develops when the learning environment is deliberately designed to encourage and nurture it. Most of the attention on classroom creativity has focused on pedagogical practices or curricula. Teachers' roles in designing learning environments to support creative expression are often overlooked. This gap becomes starker when we consider the design of online/virtual learning environments, where even less scholarship exists on the design of creative spaces.

In this chapter, we delve into the fundamental principles that define a creative learning environment and how these can be integrated into pedagogical design. Utilizing research, a creative environment instrument, and diverse learning settings as a springboard, we underscore the pivotal link between a learning environment's design and the nurturing of creativity. We propose the use of the SCALE (Support for Creativity in a Learning Environment) instrument (Richardson & Mishra, 2018) as a frame for understanding and evaluating the characteristics of creative learning environments. Using the SCALE's core constructs—characteristics of the environment, learning climate, and learner engagement—as benchmarks, we consider how the constructs might be seen as criteria to be embedded in the design of learning environments. We examine the theoretical underpinnings of creativity, creative environments, and learning, identifying gaps in classroom research that the SCALE instrument can bridge. Then, we share applications of these principles across various environments, including online and blended spaces, acknowledging that different environments present distinctive affordances, opportunities, constraints, and possibilities. Our implications take a future-oriented perspective on online creative learning environment design in both research and practice.

Theoretical Foundations

Creativity: The Myths and Realities

Creativity is often defined as the process of creating ideas, artifacts, processes, and solutions, that are novel and effective (Cropley, 2003); or, as Runco and Jaeger (2012) articulated as “original” and “effective” in their standard definition. This two-part definition is deceptively simple. The very notion of creativity intimidates many people, as it is often seen as only available to the special or gifted. But, this view of creativity, as only for a select few, is problematic. According to Starko (2013), learning is integral to the creative process, and Guilford (1950) argued that creativity is a form of learning. Creative learning goes beyond academic knowledge and skills to help address the ever-evolving challenges of a changing world. It emphasizes learning creatively and applying knowledge in uncertain contexts (Beghetto, 2021), rejecting the notion of one correct answer. Allowing for uncertainty cultivates creative identities that embrace the complexity of creative processes (Craft et al., 2007).

This complexity can be daunting. When faced with creative thinking or problem-solving challenges, people often hesitate to self-identify as “creative” or are uncomfortable engaging in intellectual risk-taking and open-endedness (Weisberg, 2006). The inherent uncertainty and open-endedness of creative work can be emotionally and mentally taxing, requiring environments that are psychologically safe and supportive as well as dynamic and interesting.

The hesitancy that many feel about identifying as “creative” may relate to how creativity has historically been mythologized as an inherent trait, rather than a developed habit of mind or approach to the world (Cropley, 2016). For thousands of years, creativity has been seen as enigmatic, with Plato once attributing it to the influences of “the muse” (Rothenberg & Hausman, 1976). This myth contrasts with views of many creativity researchers today, who see it as an ability that may grow, flex, and expand through intentional development. Yet, popular myth still views creativity as innate—impervious to development or augmentation (Henriksen et al., 2017). Despite rhetoric about the importance of fostering creativity, most education systems still default to an instrumentalist view of teaching and learning. Prevailing policy tends to constrain or offer no support for teacher creativity, leaving many people uncertain about their individual creative potential. By viewing teachers as empowered designers of creative learning environments, rather than enactors of pre-set content, we might create the conditions for creativity to thrive in education (Benedek et al., 2021)—especially in the design of online learning environments, which are sometimes seen as more remote, removed, and less creative. However, we need to be aware of conditions that support learner creativity—e.g., what does creativity research suggest about creative learning environments?

Creative Environments

Creative environment refers to how a particular context or setting facilitates or influences creativity (Richardson & Mishra, 2018). This includes the psychological, pedagogical, and physical factors of a formal learning environment (in-person or online) or non-traditional learning spaces like museums or gardens (Jindal-Snape et al., 2013). Considering the architecture of an environment, we are influenced by Latour's (2005) actor-network-theory (ANT), Gibson's affordance theory (1979), and Dirkin and Mishra's (2010) idea of "zone of possibility." Though closely aligned, these frameworks differ subtly in emphasis. ANT suggests that all elements within a network, including non-human entities like the physical environment or technology, play an active role in shaping interactions and outcomes. Gibson's affordance theory emphasizes the interaction between the possibilities an environment offers (i.e., its "affordances"), and the resulting effect on individuals' capabilities within that space. Finally, Dirkin and Mishra suggest that every technology works within the "zone of possibility"—or the range of potential actions, behaviors, or outcomes that are achievable within a given context or set of conditions. Each of these theories or approaches is neutral regarding the nature of the "space," whether physical, online, or blended. The key is that the architecture of the environment can facilitate or hinder communication, collaboration, exploration, and innovation, influencing the quality and nature of learning and creative outcomes.

Creative environments support the pursuit of interests and passions, engage students in co-creation/collaboration, value students' ideas, and embrace mistakes as a part of learning (Chan & Yuen, 2014). Curiosity-driven activities like exploring new media technologies, fantasy play, outdoor activities, model making, building, planning, and engaging in other design tasks can also foster creativity. Creative environments benefit students in many ways, including increasing personal achievement, GPAs, reasoning abilities, confidence, resilience, motivation, engagement, critical thinking, and problem-solving skills (Jindal-Snape et al., 2013). Such environments promote cooperation and encourage students to take reasonable risks and learn from mistakes. A learning environment is a community, and the values embodied within that community influence members' behaviors. Values, such as those that support creativity, can be operationalized and embedded within explicit roles, norms, and designed elements of a community. Learning designers, teachers, and students have a part to play in supporting or constraining creativity (Peppler & Solomou, 2011).

The role of the environment encompasses the physical space, interpersonal relationships, and the availability of resources and support (Beghetto & Kaufman, 2014). But, despite the growing interest in creativity research, creativity assessment tools have often overlooked the impact of environments, focusing instead on personality factors or psychological elements, which teachers have less influence over. For instance, in a review of creativity instruments, Henriksen et al. (2015) found that only 3% of existing creativity instruments measured creative environments, which is surprisingly low considering the environment's influence on creativity (Beghetto & Kaufman, 2014). Moreover, less than 20% of the already small portion of creative environment measures were specifically designed for K-12 students. Speaking to this gap, Richardson and Mishra (2018) designed a tool known as the SCALE, which identifies and evaluates the elements of creativity within learning environments. This tool has become a highly cited and widely used measure for assessing creative learning environments, offering a structure of constructs that pinpoint creative environment characteristics that teachers and learning designers can focus on to support creativity (Cullingford, 2007; Cheng, 2019; Hamid & Kamarudin, 2021; Huang, 2020; Jaatinen & Lindfors, 2019; Katz-Buonincontro & Anderson, 2020; Ovbiagbonhia et al., 2019). Since practitioners can benefit from clear principles or a frame to guide their efforts in the design of creative learning spaces, we outline key principles from the SCALE. From there, we consider how they might be applied to more varied learning settings.

Framing the Principles of Creative Learning Environments: The SCALE

What is the SCALE?

The Support for Creativity in a Learning Environment (SCALE) is a practical tool that assists education professionals in designing creative learning environments by identifying and measuring aspects of the physical environment, learning climate, and learner engagement (Richardson & Mishra, 2018). The SCALE tool consists of 14 items related to the (a) physical space and available resources and materials (4 items), (b) classroom atmosphere and relationships (4 items), and (c) tasks and activities that students are engaged in (6 items) (see Table 1). These items are rated on a four-point Likert scale from “no evidence” (0) to “high evidence” (3).

Although the SCALE instrument was developed in the context of K-12 education, we believe the underlying principles apply across contexts and learner ages—i.e., in-person, online and blended; and for learners in K-12, higher education, and adult education spaces. Context and setting clearly matter, but we believe that these principles are adaptable and flexible. Although their instantiations may vary across settings and contexts, the core ideas are transferable and applicable beyond K-12. These broader principles hold true, even while playing out differently in a 4th grade math class or a college English course, or in-person classrooms versus online/blended contexts. In various settings from K-12 to higher education, cases’ contextual variables may influence or constrain the implementation of the core ideas. However, the core ideas provide a valuable foundation for teachers and learning designers to create, build on, and contextualize environments that support creativity.

SCALE Components	
Physical Environment:	• A variety of resources/supplies are available and accessible to students. • Examples of student work appear in the space. • A variety of workstations or areas are available to students.

SCALE Components	
	• The furniture allows for multiple arrangements and configurations.
Learning Climate:	• Students are involved in discussions among themselves, with or without the teacher, that deepen their understanding. • The students are caring, respectful, and value differences. • The teacher is a facilitator, co-learner, explorer, or inquirer with students. • Mistakes, risk-taking, and novel ideas are valued or encouraged.
Learner Engagement:	• Students are involved in tasks that are open-ended and/or involve choice. • Students are involved in activities that may include inquiry, project-based learning, or interdisciplinary tasks. • Students use multiple perspectives/viewpoints/ways of knowing or various modes of investigation/problem solving. • Students demonstrate interest in or enthusiasm for the activity beyond being "on task." • Students spend time developing ideas for deeper understanding and/or reflecting on their learning. • Students work at their own pace and/or time is used flexibly.

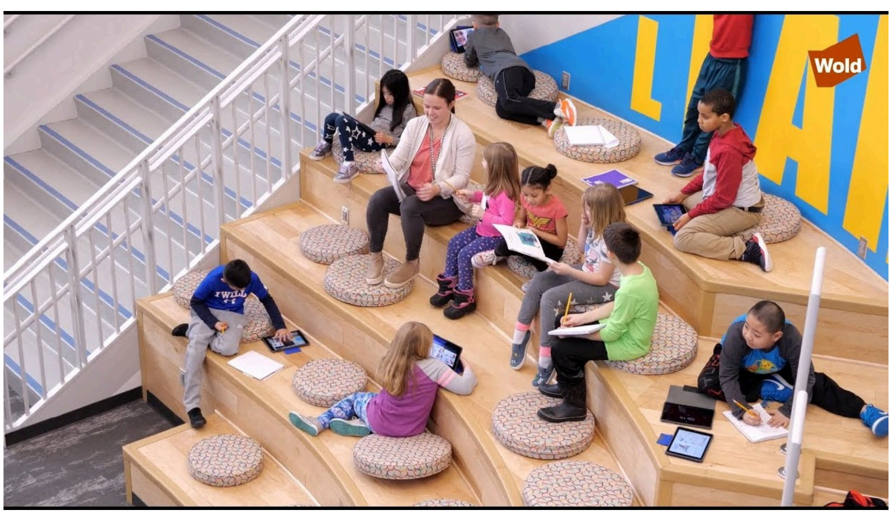
SCALE ComponentsTable 1. SCALE Tool Components and Rating Scale
Note. From "Learning environments that support student creativity: Developing the SCALE," by C. Richardson and P. Mishra, 2018, *Thinking Skills and Creativity*, 27. Copyright 2017 by Elsevier Ltd.

Key Ideas Supporting the SCALE Principles

The SCALE tool aims to assist teachers and administrators in identifying, measuring, and adjusting learning environmental variables that directly impact creativity as well as individuality, independence, and risk-taking (Lilly & Bramwell-Rejskind, 2004).

The first component of the SCALE tool consists of four items that identify and measure specific aspects of physical environments. In related literature, examples of environmental variables include “lighting, color, decorations, furniture, resources, sensory variables, space configurations, and class size” (Warner & Myers, 2009, p. 30). One of the environmental variables emphasizes the need to make a variety of resources available and accessible, including tools and materials to experiment with ideas and information to creatively solve problems (Peterson & Harrison, 2005). For instance, hyper-content textbooks—which connect content in books to online learning resources through links, barcodes, and augmented reality—have been used to enrich learning experiences and facilitate differences in learning characteristics (Surahman et al., 2021). Also, furniture designs should be psychologically appealing and provide a sense of comfort and safety. Space configurations should be flexible with areas for students to move around and communicate (Warner & Myers, 2009). For example, classrooms have been redesigned to enable active communication and interaction among students, with wheeled lecterns and chairs, round tables, and LCD screens connected to docking systems on tables (Park & Choi, 2014). Additionally, decorations, such as displays of student work, may prompt creativity and lead to new ideas by offering opportunities for reflection and metacognitive thinking (Eckhoff, 2019; Warner & Myers, 2009).

Learn More About Designing Physical Environments that Support Creativity



Wold Architects and Engineers. (2019, May 24). Innovative learning spaces for the next generation: Centerview Elementary School [Video]. YouTube. https://www.youtube.com/watch?v=uUisTKQFDho

[Watch on YouTube](https://www.youtube.com)

The second component of the SCALE tool consists of four items that identify and measure aspects of learning climates. These items focus on the influence that classroom atmosphere and teacher-student/student-student relationships have on creativity. Students need opportunities to explore and express ideas in learning climates that encourage "mistakes, risk-taking, innovation, and uniqueness, along with a certain amount of mess, noise, and freedom" (Edwards & Springate, 1995, p. 4). In these climates, teachers can become powerful aids in fostering creativity by exploring alongside students while facilitating meaningful activities with open-ended discussions (Craft, 2001; Edwards & Springate, 1995). For example, in STEM classrooms, teachers have designed and implemented problem-based learning activities (based on engineering design processes) where students reflect on and productively learn from their successes and failures (Henriksen et al., 2021). Moreover, as students often model the behaviors of their teachers (Gillies, 2006), teachers can encourage students to be caring, respectful, and appreciative of differences by (a) making them feel worthy and loved, (b) showing respect for their ideas, and (c) searching for connections between different ideas and ways of knowing (Craft, 2001; Esquivel, 1995). For instance, teachers can promote critical thinking and enhanced engagement in whole-class discussions on controversial questions by prompting reciprocal interactions and respectful exploration of differences (Henriksen et al., 2022).

Learn More About Designing Learning Climates that Encourage Risk-taking and Creativity

TEDx Talks. (2018, June 1). Take Beautiful Risks|Ron Beghetto|TEDxManchesterHighSchool [Video]. YouTube. https://www.youtube.com/watch?v=toIJHDxx99A

[Watch on YouTube]

The third component of the SCALE tool consists of six items that identify and measure aspects of learner engagement. With a focus on the design of tasks that students are involved in, these items examine pedagogical practices, techniques, and methods that can be used to support creativity. As learning is a fundamentally social activity, teachers need to utilize constructivist-based pedagogical practices that enable students to frame and generate meaning with others (Dawson & McWilliam, 2008). Research on creativity in early childhood education has demonstrated that students benefit from long-term, open-ended projects that integrate different subject areas and lead to exploration (Edwards & Springate, 1995). For instance, in STEAM classrooms, teachers have used project-based learning processes to guide students through conducting in-depth research on real-world issues and drawing on information from multiple disciplines to brainstorm possible solutions (Henriksen et al., 2019).

In project-based learning processes, creativity can be supported by giving students more choices regarding what problems they will solve and how much time they will be given to complete work. This support may increase interest, engagement, and learning (Craft, 2001; Greenberg, 1992; Patall et al., 2010). For instance, virtual labs have been designed to let students work at their own pace and address teaching challenges related to (a) simultaneously facilitating learning at preferred paces and (b) maintaining learning motivation and engagement (Lynch & Ghergulescu, 2017). Further, the Creative Problem-Solving method (an active learning process embodying collaborative inquiry concepts within a constructivist paradigm) has been used to foster ingenuity and creativity and enhance motivation. This method utilizes critical reflection, critical thinking, and exploration of possible perspectives and solutions (Samson, 2015). Craft (2001) noted various ways to foster creativity in classrooms—viewing practices, techniques, and methods as an adaptable toolbox to craft each learning environment.

Learn More About Designing Tasks to Increase Learner Engagement

Edutopia. (2016, January 27). STEAM + project-based learning: Real solutions from driving questions [Video]. YouTube. https://www.youtube.com/watch?v=H7LHsL0iB_w

[*Watch on YouTube*](https://www.youtube.com/watch?v=H7LHsL0iB_w)

The SCALE tool was designed to assess student creativity in learning environments and guide teachers in supporting and facilitating creativity (Richardson & Mishra, 2018). Its principles have been applied to diverse learning environments, including teacher education, online education, and STEAM programs (de la Peña et al., 2021; Ozkan & Topsakal, 2021; Wahyudi & Winanto, 2018). The SCALE tool has also been used to better understand ways to enhance creativity-fostering practices with emerging technologies (e.g., virtual/augmented reality, 3D design software) (Bereczki & Kárpáti, 2021; Chen et al., 2022). We propose key implications that can transfer to online environments while also supporting creativity within those same environments.

Implications for Practice

The SCALE is not just a measurement tool. It also embodies, in its structure, a set of principles that can help design environments that support creativity—these principles could be used from a pedagogical design standpoint to shape creative learning environments, both in physical and online/blended spaces. That said, we must recognize that affordances and constraints offered by technologically mediated online or blended spaces can differ significantly from those offered by physical spaces. In the sections below, we take each of the three main constructs of the SCALE instrument (Physical Environment, Learning Climate, and Learner Engagement) and discuss how teachers and learning designers might factor these into online and blended learning.

Physical Environment

The meaning of the “physical environment” changes when we consider online and blended learning spaces. One might argue that online and blended spaces offer greater flexibility to designers since they are relatively unconstrained by the geography of space, the materiality of objects, and maybe even the laws of physics. This gives designers of online/blended systems more flexibility to create a “conceptual” playground for students to engage with each other and with ideas. Yet, designers of online and blended environments are often constrained by capabilities of current technological systems and contextual factors outside of their control, such as the students’ physical surroundings, possible distractions, and disruptions. Thus, online and blended setups may be freeing in some respects and limiting in others. An additional constraint may also be the instructor or learning designers’ inability to imagine possibilities and opportunities in existing technologies. For instance, they may seek to replicate existing processes/structures of in-person learning that may not transfer effectively to technologically mediated contexts. This was evident when teachers were forced to teach online during the pandemic. There was a strong urge to replicate conventional structures instead of opening the classroom to the lived world of students and engaging in more project-based learning experiences and innovative practices.

The underlying principle of adaptability and configurability could be translated into the design of online and blended learning environments, creating digital spaces that allow multiple arrangements and configurations to suit diverse needs and preferences. Yet, many existing online learning tools/platforms or modes offer limited adaptable features and opportunities to completely redesign spaces or rethink assumptions. Ideally, platforms could allow users (i.e., not just learning designers but also teachers and students) to rethink and play with layouts in ways that align with their own preferences or needs, including flexible organization of resources and adjustment of accessibility features.

One of the benefits of online or blended learning environments is that students can easily be given a wide array of readily accessible digital resources and supplies. The goal is to include elements that allow a wider range of creative experimentation, help students appreciate the achievements of peers, and make the learning environment a space for fostering collaboration and improvement. A few suggestions in this regard include:

- utilizing diverse digital resources (e.g., software applications, digital libraries, and creative tools) to give students creative options to explore and experiment;
- offering different areas, discussion spaces, or online workspaces that cater to different modes of creativity; and
- seeking opportunities for students to share their digital work within learning spaces and, potentially, externally with others in the community and the wider world (e.g., creating blogs, videos, portfolio websites, or public digital articles)

Learning Climate

A learning climate that supports creativity depends on the nature of the relationship between teachers and students. This relationship cannot be based on power and fear but should instead be based on trust and respect. The norms of learning spaces should emphasize that the creative process can be messy and nonlinear, and mistakes and failures are to be expected. Teachers and students must be present—physically, cognitively, and emotionally. In this, online and blended spaces have a fundamental disadvantage. Online tools often do not afford the kind of social presence that being in a physical space with other people provides. Online and blended spaces lack the breadth and depth of communication modalities that physical presence provides, which in turn deepens social and emotional distance between participants. Individuals in learning communities need ways to convey their social and emotional selves as authentic beings engaged in shared tasks.

There are a variety of strategies that teachers and learning designers can utilize to address this limitation of technologically mediated educational spaces. These may include the following:

- providing opportunities for the affective aspect of learning to emerge through meaningful discussions and prompts
- using video tools to help enhance social presence—e.g., online office hours, video announcements/messages, or video conferenced meetings (though the mere utilization of video as a communication medium is rarely enough)
- establishing norms for respectful and empathetic communication where difference and play are encouraged and valued
- ensuring students realize it is okay to take risks, explore unconventional solutions, and think divergently—without punishment for mistakes
- experimenting with formative activities (e.g., ungrading or providing multiple opportunities to generate solutions)

Learner Engagement

Social presence is as important to learner engagement as it is to classroom climate. Assuming that the instructor is focused on enhancing and supporting the learner presence, the next thing to factor in is the design of the tasks and activities. Students are autonomous agents who drive their own learning—they want to learn *with* rather than be taught *to* (or *at*). Thus, student choice becomes important in designing learning environments that support creativity. This often takes the shape of open-ended tasks where students have some autonomy in selecting the tasks (or aspects of tasks) and the ways they would like to approach them. Engaging students in inquiry-based, project-based, and interdisciplinary activities promotes their creativity, encouraging them to delve deeper, make connections, and generate innovative solutions. Students who engage in activities that encourage a deep dive into a topic, exploring connections across disciplines and developing their own questions and hypotheses, become genuinely interested and are more likely to invest in their creativity and produce meaningful and innovative work.

One advantage of online and blended learning environments is the flexibility that lets students work at their own pace and manage their time effectively during more in-depth projects. Online settings allow students to structure their workflow and pace themselves, with the (possible) ability to customize deadlines to meet individual needs. That said, there must be a balance between structure and flexibility, providing clear expectations that allow students to plan and manage their learning. Several ways teachers can factor these ideas into their teaching include the following:

- designing projects, challenges, and problem-solving activities that allow students to explore different possibilities and leverage their strengths

- embracing multidisciplinary approaches, letting students apply their creativity to real-world problems, deep investigations, and innovative solutions
- showing genuine interest and enthusiasm through activities that tap into students' passions through self-directed projects
- integrating multimedia elements, increasing opportunities for students to pursue projects related to their interests
- providing time for idea development, reflection, and flexible pacing to enhance students' understanding, connections, and insights

Conclusion

We tend to think of teaching and learning as processes that take place in the minds of students, teachers, and ourselves. Thus, we often think about educational design in terms of how pedagogy influences learning as a mental process. Certainly, cognition is central to learning, but it is important to also consider how human thoughts and behaviors are influenced and driven by the environments we create; and environments are inherently a human construction. At some level, the human environment is "made up," in that it is constructed by people for a purpose and thus can be remade or shaped differently to fulfill different purposes—like learner creativity. Environments can be changed, shifted, redesigned, recreated, and reimagined.

Think About It!

Consider How Education is Designed and Could Be Redesigned

TED Talks. (2023, June 9). How to Design a School for the Future|Punya Mishra|TED [Video]. YouTube. https://www.youtube.com/watch?v=YYRI164Y-_M

[Watch on YouTube]

In doing design or redesign work, learning designers need thoughtful principles framed by a sense of the environmental factors that influence learning and creativity. This is where we suggest the application of an environmental frame, such as the principles found in the SCALE instrument, to guide the design and construction of creative learning environments from a comprehensive physical/virtual, cognitive, behavioral, and perceptual lens. One of the ultimate goals of education is to prepare students for the future, which is inherently uncertain and requires creativity. In that sense, building creative learning spaces is one of the most important tasks we can undertake toward that fundamental creative purpose of teaching and learning.

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Learning Experience Design

Schmidt, M. , Earnshaw, Y. , Tawfik, A. A. , & Jahnke, I.

This chapter elucidates on learning experience design (LXD), a philosophical approach to instructional that draws from various perspectives including human-computer interaction and design thinking. LXD aims to guide the design and development of digital learning technologies, emphasizing on creating highly usable and satisfying digital learning experiences. The chapter outlines specific human-centered design techniques, their goals, and the ideal stage of application during the design and development of digital learning experiences.

Author's Note

This chapter is a companion to the chapter entitled *Evaluation Methods for Learning Experience Design*, also available in this volume.

Various theories and models have been published that guide the design and development of digital learning technologies. While these approaches can be useful for promoting cognitive or affective learning outcomes, user-centered design methods and processes from the field of human-computer interaction can also be of value to those in the learning/instructional design and technology community. In this chapter, we present user-centered design techniques and processes derived from human-computer interaction, human-centered computing, user experience design, and design thinking. These techniques can lead to highly usable and satisfying digital learning experiences. We begin with foundational theories particularly relevant to the field of learning experience design. We then outline specific, human-centered design techniques that can be applied during the design and development of digital learning experiences. The descriptions of these techniques include both the goals of the techniques, as well as the ideal stage in which to apply them.

Introduction

Educators and learners are increasingly reliant on digital tools to facilitate learning. However, educators and learners often use technology in ways that are different than developers originally intended (Straub, 2017). For instance, educators may be challenged with trying to determine how to assess student learning within their learning management system (LMS), so they use a different tool than the one provided in the LMS and then copy/paste the results. Or they might spend time determining workarounds to administer lesson plans because the LMS does not directly support a particular pedagogical approach or learning strategy. From the perspective of learners, experiencing the challenges of navigating an interface or finding homework details might result in frustration or even missed assignments. When an interface is not easy to use, users tend to develop alternative paths to complete a task to accomplish a learning goal. Long recognized in the field of **human-computer interaction (HCI)**, such adjustments, accommodations, and improvisations are the result of design flaws (cf. Orlikowski, 1996; Grudin, 1988). These design flaws are often the result of the software development team failing to consider the user (or in this case, the learner) sufficiently in the design process. This extends to the field of learning/instructional design and technology (collectively LIDT) and can create barriers to effective instruction (Jou et al., 2016; Rodríguez et al., 2017).

The principles of human-computer interaction (HCI) and **user-centered design (UCD)** have implications for the design of learning experiences in digital environments. While the field of LIDT has focused historically on theories that guide learning design (e.g., **scaffolding**, **sociocultural theory**), less emphasis has been placed on learning technology design from the view of HCI and UCD (Okumuş et al., 2016). Increasingly, **user experience design (UXD)** and usability research are being accepted as particularly useful in supporting positive, enjoyable, or memorable learning experiences. This has emerged as a focus area in the field of LIDT and is referred to as ***learning experience design***. Adoption of such techniques occurred alongside the field differentiating *instructional design* (Mor & Craft, 2012) from ***learning design*** (Saçak et al., 2022). At the same time, usability and user experience methods emerged from the field of software engineering (Hassenzahl, 2013), and practitioners of learning design began adopting these methods in their own design practice (Kilgore, 2016). Hence, the term *learning experience designer* was born (Georgiou & Ioannou, 2021; Harrati et al., 2016; Korkmaz, 2018; Minichiello et al., 2018) to describe designers engaging in the practice of **learning experience design** (LXD; Schmidt & Huang, 2022).

LXD is a relatively novel phenomenon in the field of LIDT. We recently published an edited volume titled *Learner and User Experience Research: An Introduction for the Field of Learning Design & Technology* (Schmidt et al., 2020). In our introduction to this book, we identified three areas in need of further articulation. Firstly, there is little agreement in terminology within our discipline. Secondly, LXD as an emerging area of research and practice has made neither substantial nor sufficient connections to the theoretical foundations of LIDT. Thirdly, although learning designers are applying methods and processes of UCD in their design contexts, there are as of yet no guidelines for this in LIDT. Since publishing this edited volume, some progress has been made in terms of defining LXD (as discussed in the following paragraph). However, progress elaborating theoretical foundations of LXD remains limited. In this chapter, we approach this issue by situating LXD within theories of cognitive load, distributed cognition, and activity theory. Finally, guidance regarding design techniques and evaluation methods for aspiring learning experience designers has yet to emerge. The current chapter (and its companion chapter in this volume, titled *Evaluation Methods for Learning Experience Design*) speaks to this need, focusing primarily on design techniques for learning experience designers.

Learn More About Learner and User Experience Research

To learn more about learner and user experience research in the field of LIDT, we recommend the open access edited volume *Learner and User Experience Research: An Introduction for the Field of Learning Design & Technology*, provided here in EdTech Books!

Schmidt, M., Tawfik, A. A., Jahnke, I., & Earnshaw, Y. (2020). *Learner and User Experience Research: An Introduction for the Field of Learning Design & Technology*. EdTech Books. https://edtechbooks.org/ux

Learning experience design (LXD) is defined as "a human-centric, theoretically-grounded, and socioculturally sensitive approach to learning design, intended to propel learners towards identified learning goals, and informed by UXD methods" (Schmidt & Huang, 2022, p. 151). LXD is concerned with learners' interactions with the learning environment, as well as with their interactions with the learning space (Tawfik et al., 2022). Importantly, the term LXD does not suggest that learning or experiences themselves can be designed or engineered, but instead that opportunities *for* learning can be designed so that positive and enjoyable learning experiences can happen. The practice and theories of LXD suggest it is a multidimensional construct that considers aspects of the individual learner's experience across three separate dimensions:

(a) the technological dimension, which includes learner-computer interaction with a given learning technology;

(b) the pedagogical dimension, which includes learner interaction with designed materials, instructions, activities, assessments, etc.; and

(c) the sociocultural dimension, which includes digitally-mediated social relationships, digital communication, and online social presence (Jahnke et al., 2020; Marell-Olsson & Jahnke, 2019), as detailed in Figure 1.

Learn More

For further details, we recommend reading Schmidt and Huang's (2022), *Defining Learning Experience Design: Voices from the Field of Learning Design & Technology* here:

https://link.springer.com/article/10.1007/s11528-021-00656-y

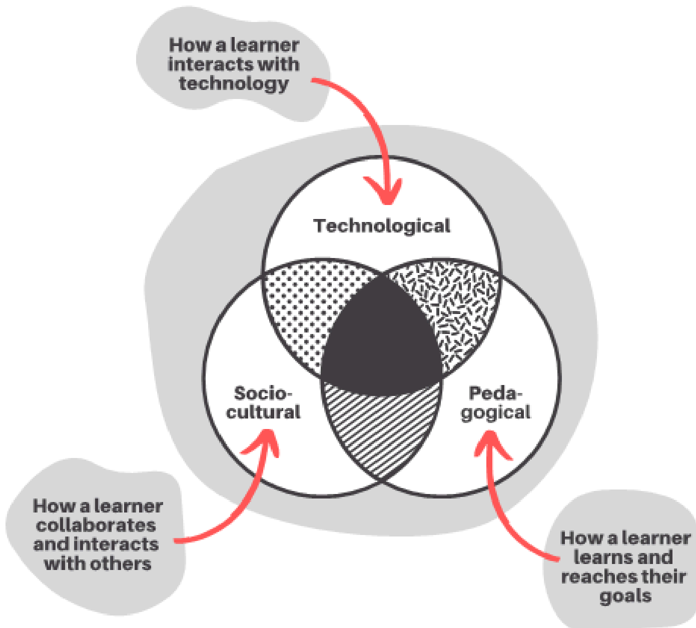


Figure 1. *Technological, socio-cultural, and pedagogical dimensions of learning experience design.*

LIDT in the World

What is LXD? Is it the new ID? Is it UX for e-learning? Earnshaw and colleagues (2021) seek to provide clarity around these questions in their blog post *Understanding the complexity of Learning Experience Design* here: https://medium.com/ux-of-edtech/understanding-the-complexity-of-learning-experience-design-a5010086c6ee

Summarize your thoughts in a paragraph or two as you reflect on how these questions were addressed in the blog post.

Learning Check

(True/False) Learning experience design is the same as instructional design.

- [ ] True
- [ ] False

Learning experience design is a multidimensional construct that considers the following dimensions (select all that apply):

- [ ] Sociocultural
- [ ] Technological
- [ ] Theoretical
- [ ] Pedagogical

Theoretical Foundations

Usability and HCI principles are often situated in established theories such as **cognitive load theory**, **distributed cognition**, and **activity theory**. LIDT is a sibling of these disciplines; hence, these theories also have ramifications for the design and development of learning technologies. In the following sections, we discuss each theory and the importance for conceptualizing UCD, usability, and UX from the LIDT perspective.

Human-Computer Interaction

Understanding how educators and learners interact with learning technologies is key to avoiding and remediating design flaws. HCI seeks to understand the interaction between technology and the people who use it from multiple perspectives (Rogers, 2012)—two of which are user experience (UX) and **usability**. UX describes the broader context of technology usage in terms of "a person's perceptions and responses that result from the use or anticipated use of a product, system, or service" (International Organization for Standardization [ISO], 2010, Terms and Definitions section, para 2.15). UX considers all aspects of a user's interaction with technology, including how pleasing and usable the technology is. More specifically, usability describes how easy or difficult it is for users to interact with a user interface in the manner intended by the software developer (Nielsen, 2012). Highly usable user interfaces are easy for users to become familiar with, efficiently support users achieving their goals, and are easy to remember. From the perspective of learning design, these design factors are used strategically to focus cognitive resources primarily on the task of learning.

Learn More about Usability in LXD

For details on usability in the field of LXD, we recommend reading Jahnke et al. (2021), *Sociotechnical-pedagogical Usability* at:

https://edtechbooks.org/ux/sociotechnical_pedagogical_usability

Cognitive Load Theory

Cognitive load theory (CLT) contends that learning is predicated on effective cognitive processing; however, an individual only has a limited number of resources needed to process the information (Mayer & Moreno, 2003; Paas & Ayres, 2014). The three categories of CLT include: (a) intrinsic load, (b) extraneous load, and (c) germane load (Sweller et al., 1998) (see Figure 2).

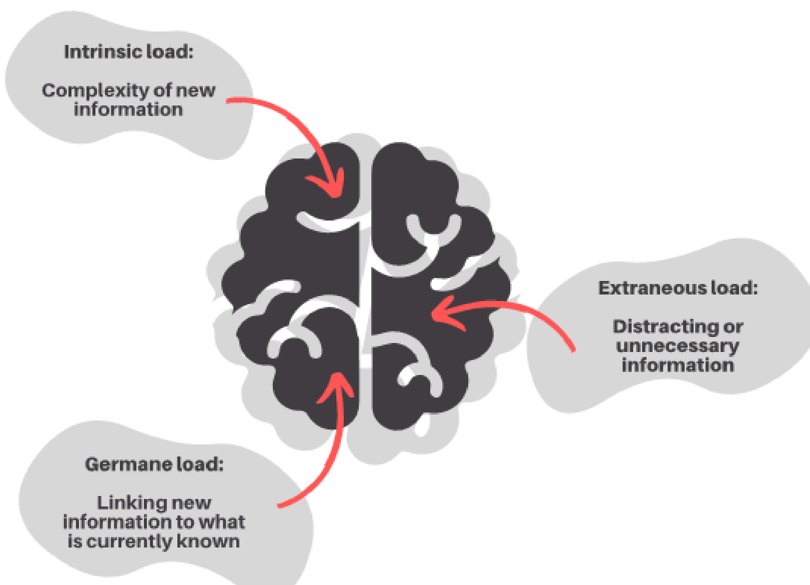


Figure 2. *The three categories of cognitive load.*

Firstly, **intrinsic load** describes the active processing or holding of verbal and visual representations within working memory, while also considering their complexity and relationships, referred to as *element interactivity*. Secondly, **extraneous load** includes the elements that are not essential for learning but are still present for learners to process

(Korbach et al., 2017). Thirdly, **germane load** describes the relevant load imposed by the effective instructional/learning design of learning materials (hereafter referred to simply as learning design). Germane cognitive load is therefore relevant to **schema** construction as information is incorporated into **long-term memory** (Paas et al., 2003; Sweller et al., 1998; van Merriënboer & Ayres, 2005). It is important to note that the elements of CLT are additive, meaning that if learning is to occur, the total load cannot exceed available **working memory** resources (Paas et al., 2003).

Extraneous load is of particular importance for UCD. Extraneous cognitive load can be directly manipulated by a designer (van Merriënboer & Ayres, 2005) through improved usability. When an interface is not designed with usability in mind, the extraneous cognitive load is increased, which impedes meaningful learning. From a learning design perspective, poor usability might result in extraneous cognitive load in many forms. For instance, a poor navigation structure in an online course might require the learner to extend extra effort to click through the learning modules to find relevant information. Further, when an instructor uses unfamiliar terms in digital learning materials that do not align with a learner's mental model or the different web pages in a learning module are not consistently designed, the learner must exert additional effort toward understanding the materials. Another example of extraneous cognitive load is when a learner does not know how to progress in a digital learning environment, resulting in an interruption of learning flow. Although there are many other examples, each depicts how poor usability taxes finite cognitive resources. Creating highly usable digital environments for learning can help reduce extraneous cognitive load and allow mental resources to remain focused on germane cognitive load for building schemas (Sweller et al., 1998).

Distributed Cognition and Activity Theory

While CLT helps describe the individual experience of user actions and interactions, other theories and models focus on broader conceptualizations of HCI. Among the most prominent are **distributed cognition** and **activity theory**, which take into account the social context of learning and introduce the role of collaboration between various individuals. Distributed cognition suggests that knowledge is present both within the mind of an individual and across artifacts (Hollan et al., 2000). The theory focuses on the understanding of the coordination "among individuals and artifacts, that is, to understand how individual agents align and share within a distributed process" (Nardi, 1996, p. 39). From the perspective of LIDT, individual agents (e.g., learners, instructors) operate within a **distributed process** of learning, as facilitated by various artifacts (such as content, messages, and media). The distributed process of learning is mediated by intentional interaction and communication with learning technologies (e.g., learning management systems, web conferencing platforms) in pursuit of learning objectives (Boland et al., 1994; Vasiliou et al., 2014). For example, two learners collaborating on a pair of programming problems might write pseudo-code and input comments into a text editor. In this case, distributed cognition is evident in collaborating on the programming problem and by conceptualizing various solutions mentally but also by using a tool (the text editor) to extend their memory. Cognition in this case is distributed between people and tools; distributed cognition, therefore, would focus on the function of the tool within the broader learning context (Michaelian & Sutton, 2013). In contrast with the more narrow perspective of CLT that considers the degree to which a specific learner's limited cognitive resources are affected when interacting with a technology system, distributed cognition adopts a broader cognitive, social, and organizational perspective (Rogers & Ellis, 1994).

Activity theory, on the other hand, is a systems-based, **ecological framework** that that shares some similarities with distributed cognition but distinguishes itself in its specific focus on activity and the dynamic interaction of actors, artifacts, and **sociocultural** factors within an interconnected system. Given its ecological lens, activity theory can be a useful framework for describing and understanding how a variety of factors can influence human activity. Central to activity theory is the concept of **mediation**. In activity theory, activity is mediated by tools, also called artifacts (Kaptelinin, 1996). From a technological perspective, the concept of tools is often in reference to digital tools or software. These technological tools mediate human activity within a goal-directed hierarchy of (a) activities, (b) actions, and (c) operations (Jonassen & Rohrer-Murphy, 1999). Firstly, activities describe the top-level objectives and fulfillment of motives (Kaptelinin et al., 1999). Secondly, actions are the more specific goal-directed processes and smaller tasks that must be completed in order to complete overarching activities. Thirdly, operations describe the automatic cognitive processes that group members complete (Engeström, 2000). However, operations do not maintain their own goals but are rather the unconscious adjustment of actions to the situation at hand (Kaptelinin et al., 1999). Engström's (2000) sociocultural activity theory framework is commonly depicted as an interconnected system in the shape of a triangle, as depicted in Figure 3.

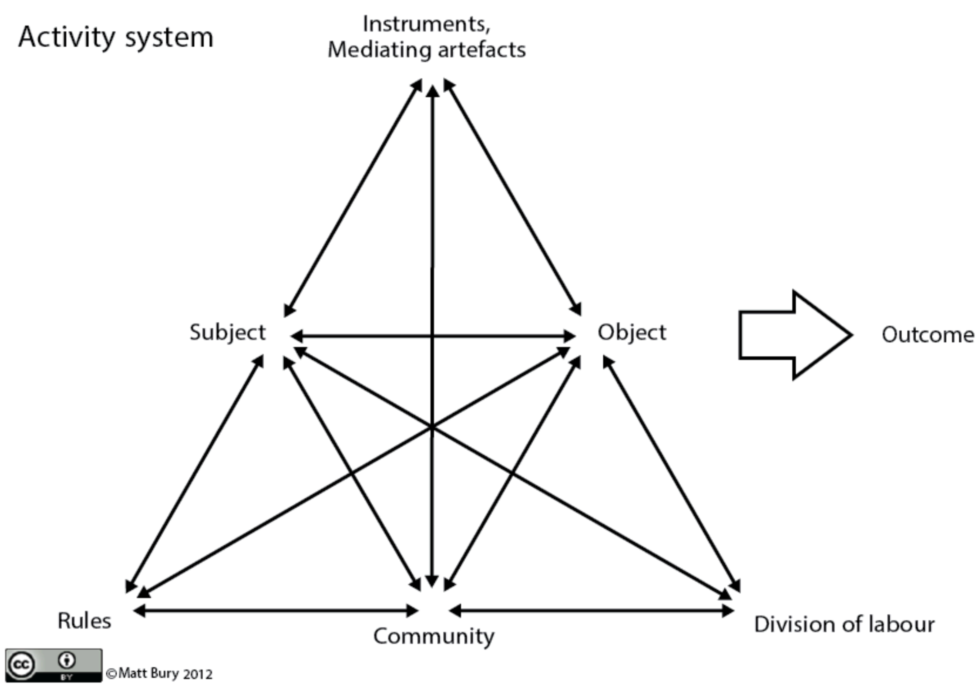


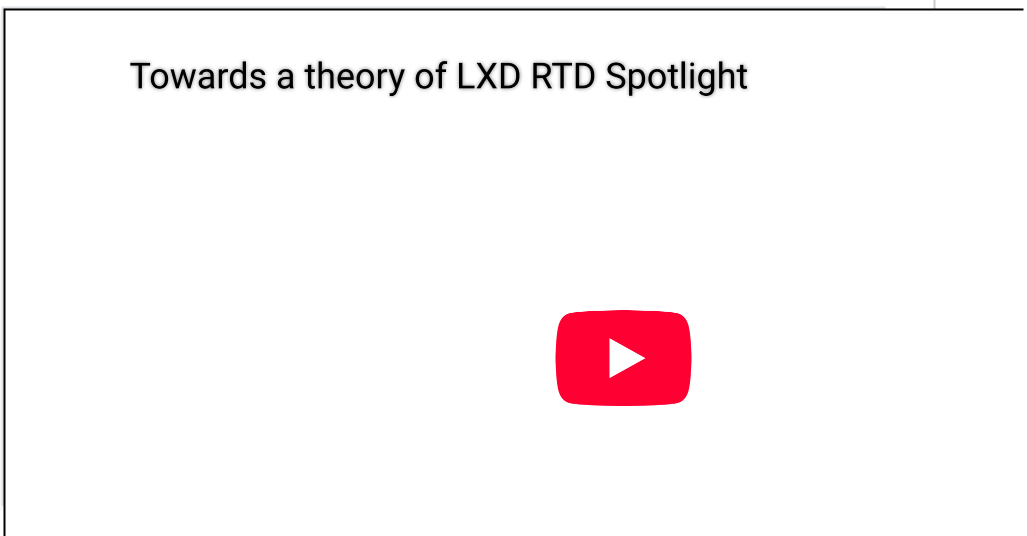
Figure 3. *Activity system diagram. Adapted from "Activity Theory as a Framework for Analyzing and Redesigning Work," by Y. Engeström, 2000, Ergonomics, 43(7), p. 962.*

Activity theory is especially helpful for LXD because it provides a framework to understand how objectives are completed within a learning context. Nardi (1996) highlights the centrality to activity theory of mediation via tools/artifacts. These artifacts are created by individuals to control their own behavior and can manifest in the form of instruments, languages, or technology. Each carries a particular culture and history that stretches across time and space (Kaptelinin et al., 1999) and serves to represent ways in which others have solved similar problems. As applied to learning contexts, activity theory suggests that tools not only mediate the learning experience but that learning processes are often altered to accommodate the new tools (Jonassen & Rohrer-Murphy, 1999).

This belief in the role tools play in learning processes and experiences underscores the importance of considering the influence of novel learning technologies (e.g., LMSs, educational video games) from within a broader context of social activity when implemented by schools and/or organizations (Ackerman, 2000). The technological tools instituted in a particular workgroup should not radically change work processes but should present solutions on the basis of needs, constraints, history, etc. of that workgroup (Barab et al., 2002; Yamagata-Lynch et al., 2015). As learning is increasingly collaborative through technology (particularly online learning), activity theory and distributed cognition can provide important insights for learning designers into the broader sociocultural aspects of HCI.

LIDT in the World

For details on theoretical perspectives that influence LXD, the authors of this chapter created a video (10 minutes) on *Toward a Theory of Learning Experience Design*.



Watch on YouTube

Matthew S. (2021, December 15). Toward a Theory of Learning Experience Design. [Video]. YouTube. https://www.youtube.com/watch?v=FYTouzHwKt0&t=1s

What did you learn from this video that was new?

How would like you encorporate what you learned into your own designs?

Learning Check

Learning experience design is situated in established theories such as the following (select all that apply):

- [ ] Cognitive load theory
- [ ] Attribution theory
- [ ] Activity theory
- [ ] Distributed cognition

Learning Experience Design Techniques

The brief overview of theoretical foundations provided in the previous sections highlights how theories of cognition and human activity in sociocultural contexts can be useful in the design of digital learning experiences. However, the question remains as to how one designs highly usable, engaging, and effective digital learning experiences on the basis of these theories. Answering this question is difficult because these theories are not **prescriptive**. Specific guidance for how they can be applied is lacking, meaning that how best to design theoretically inspired, highly usable, and pleasing learning environments is ultimately the prerogative of the designer. **Iterative design approaches** can be useful for confronting this challenge.

While the field of LIDT has recently begun to shift its focus to more iterative design and user-driven development models, there is a need to more intentionally bridge learning design and user experience design approaches to support effective, efficient, and satisfying learning experiences in digital environments. To this end, a number of existing learning design methods can be used or adapted to fit iterative approaches. For example, identifying learning needs has long been the focus of a front-end analysis. **Ideation** and prototyping are frequently used methods from UX design, and **rapid prototyping** (see Tripp & Bichelmeyer, 1990) is a typical design process. In addition, evaluation in learning design has a rich history of formative and summative methods. By applying these specific design methods within iterative design processes, learning experience designers can advance their designs in such a way that they can focus not only on intended learning outcomes but also on the learning experience and usability of their designs.

In the following sections, LXD techniques are considered for incorporation into one's learning design processes through (1) identifying user needs, (2) project **requirements gathering**, and (3) **prototyping**.

Developing Project Requirements Based on Learners' Needs

One potential pitfall of any design process is when designers create systems based on assumptions of what users want. Only after designers have begun to understand the user should they begin to identify what capabilities or conditions a system must be able to support to meet the identified needs. These capabilities or conditions are known as "requirements." The process a designer undertakes to identify these requirements is known as "requirements gathering." Generally, requirements gathering involves gathering and analyzing user data (e.g., surveys, **focus groups**, interviews, observations) and assessing user needs (Sleezer et al., 2014).

In the field of LIDT, assessing learner needs often begins with identification of a gap (the need) between actual performance and optimal performance (Rossett, 1987; Rossett & Sheldon, 2001). Needs and performance can then be further analyzed and learning interventions can be designed to address those needs. Assessing user (and learner) needs can yield important information about performance gaps and other problems. However, knowledge of needs alone is insufficient to design highly usable and satisfying learning environments. Further detail is needed regarding the specific context of use for a given tool or system. Context is defined by the learners (and others who will use the tool or system such as administrators or instructors), the tasks (what will learners do with the tool or system), and the environment (the local context in which learners use the tool or system).

Based on identified learner needs, a set of requirements is generated to define what system capabilities must be developed to meet those needs. Requirements are not just obtained for one set of learners, but for all learner types and **personas** (including instructors and administrators) that might utilize the system. Data-based requirements help learning designers avoid the pitfall of applying ready-made solutions to assumed learner needs, but instead position the learner and learner needs centrally in the design process, allowing for creation of design guidelines targeting an array of various learner needs.

Requirements based on learner data are therefore more promising in supporting a positive learning experience. However, given the iterative nature of UXD, requirements might change as a design evolves. Shifts in requirements vary depending on design, associated evaluation outcomes, and contextual considerations. Two methods commonly used in UXD for establishing requirements are persona and scenario development. Personas provide a detailed description of a fictional user whose characteristics represent a specific user group—thus helping designers approach design based on the perspective of the user. Meanwhile scenarios situate the learner in an authentic context by presenting narratives that describe user activity in an informal story format (Carroll, 2000).

Learn More About Activity Theory and Learning Experience Design

Schmidt and Tawfik (2022) provide examples of how activity theory can be used to inform learning experience design in their article *Activity Theory as a Lens for Developing and Applying Personas and Scenarios in Learning Experience Design.* You can read the article here:

https://edtechbooks.org/jaid_11_1/activity_theory_as_a

Prototyping Digital Learning Experiences

Gathering data and designing and developing digital learning experiences is an iterative process. Based on personas and identified requirements, an initial prototype of the user interface or the online learning environment will be created. Prototyping is central to learning experience design practice and tends to follow a trajectory of development over time from low fidelity to high fidelity (Walker et al., 2002). **Fidelity** refers to the degree of precision, attention to detail, and functionality of a prototype. A LXD designer progresses in prototype levels towards greater and higher fidelity, testing each prototype with learners. Examples of the range of prototyping encouraged include:

- **Low-fidelity prototypes**, which include the proverbial "sketch on a napkin" and paper prototypes, which can then be annotated/enhanced with digital tools These are typically evaluated through peer and expert review of the prototype.
- **Medium-fidelity prototypes**, such as wireframes, that visually convey structure but lack the functionality and visual elements of high-fidelity prototypes. **Wireframing** commonly occurs early in the design process after paper prototyping and allows designers to focus on things that paper prototyping does not, such as layout of content. These prototypes are typically evaluated through testing/feedback with small groups of target learners.
- **High-fidelity prototypes**, which can include non-functional "dummy" graphical mockups of interfaces and interfaces with limited functionality that allow for more refined user evaluation with target learners or can represent a full manifestation of a design. These can be evaluated through field testing, **heuristic evaluation** using established heuristic guidelines, and learner feedback from usage tests.

Typically, lower fidelity prototypes do not take much time to develop, and higher fidelity prototypes take longer because prototypes become more difficult to change as more details and features are added. Prototyping is a crucial skill for all learning experience designers, including those who create online courses by arranging various content, media, and interactive experiences to those who develop educational software such as educational video games or mobile apps.

LIDT in the World

For further information, we recommend the AECT Design & Development Webinar (56 minutes) on *Agile Project Management for Instructional Designers*:

[Watch on YouTube](https://www.youtube.com/watch?v=hm_pMeXs0xs)

AECT Design and Development. (2022, February 22). AECT D&D Webinar - Agile Project Management for Instructional Designers. [Video]. YouTube. https://www.youtube.com/watch?v=hm_pMeXs0xs

How does agile methodology differ from traditional instructional design project management approaches?

Learn More About Paper Prototyping

For further information on paper prototyping, refer to Snyder (2003) and the following link:

https://www.usability.gov/how-to-and-tools/methods/prototyping.html

To reiterate, the goal of UCD is to approach systems development from the perspective of the end-user. Using tools such as personas and prototypes, the learning design process becomes iterative, dynamic, and more responsive to learner needs. Learning designers often use these tools in conjunction with a variety of evaluation methods to better align prototype interface designs with learners' mental models, thereby reducing cognitive load and improving usability.

Conclusion

As digital tools for learning have gained in popularity, there is a rich body of literature that has focused on designing learning experiences with and through these tools. Indeed, a variety of principles and theories (e.g., cognitive load theory, distributed cognition, activity theory) provide valuable insight to situate the learning design process. In this chapter, we have illustrated how the fields of HCI and UX intersect with the field of LIDT and have provided specific examples of how theories from within and outside the field of LIDT influence learning experience design. Moreover, we have provided a brief description of iterative design processes that can be employed to advance usable and pleasing learning designs. A design approach that connects the principles of UXD and HCI with theories and processes of LXD can help ensure that digital environments for learning are constructed to support learners' achievement of their learning goals in ways that are effective, efficient, and satisfying.

Think About It!

LXD focuses on the three dimensions: sociocultural, technical and pedagogical. What will happen to your design if you neglect one of the three dimensions?

You want to design a mobile microlearning unit. Starting with requirements gathering, what type of data would you collect and analyze to understand more about the learner? How would you iterate on the design?

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Evaluation Methods for Learning Experience Design

Schmidt, M. , Earnshaw, Y. , Tawfik, A. A. , & Jahnke, I.

This chapter addresses the methodological vacuum in evaluating LXD practices. It elucidates common evaluation methods for LXD, providing a structured approach amidst the existing challenges in terminology, theoretical foundation, and method-application from user experience design (UXD) in learning design contexts. This chapter aims to bridge the gap by offering methodological guidance, thus fostering a more robust framework for evaluating LXD initiatives.

Author's Note

This chapter is a companion to the chapter entitled *Learning Experience Design*, also available in this volume.

Learning experience design (LXD) is being practiced as a modern manifestation of learning design at an increasing rate (Schmidt & Huang, 2022; Schmidt & Tawfik, 2022). However, given the recency of LXD, a range of challenges present themselves when learning designers desire to apply LXD in their own design practice. Of these, Schmidt and colleagues (2020) identified three major, troublesome issues: (a) there is little agreement in terminology (i.e., what is it?), (b) no substantial efforts have been made to connect LXD practice with the theoretical foundations of learning design and technology (i.e., how does it work?), and (c) there are no guidelines for applying methods and processes derived from user experience design (UXD) in learning design contexts (i.e., how do you do it?). In response to the lack of methodological guidance in this area, the current chapter seeks to introduce evaluation methods that are commonly used for LXD.

Learning experience design has been characterized as encompassing two broad forms of interaction: (a) interaction with the learning space and (b) interaction with the learning environment, which Tawfik and colleagues (2022) describe as follows:

> *[Interaction with the learning environment is] focused on UX elements and includes learner's utility of the technology in terms of customization, expectation of content placement, functionality of component parts, interface terms aligned with existing mental models, and navigation. Interaction with the learning space describes how*

> *the student perceives the interface elements, including engagement with the modality of content, dynamic interaction, perceived value of technology features to support learning, and scaffolding. Rather than see these as mutually exclusive, [they represent a] confluence of these design constructs. (p. 331)*

This characterization of LXD highlights the importance of human-computer interaction (HCI) to **technology-mediated learning**. It is therefore unsurprising that many of the evaluation methods of LXD center around learner-computer interaction, that is, how learners actually use a digital learning technology product or service. However, learning designers cannot know a priori how learners will actually interact with a product (Gregg et al., 2020). Therefore, evaluation methods are critical to explore not only learners' perceptions of **prototypes** and fully developed products, but also to gain insight into learners' needs, preferences, and values related to envisioned products. In the following sections, we present various evaluation methods that are commonly used in UXD and usability research, as well as recommendations for when these evaluation methods are most appropriate.

Learn More About LXD and UXD Research in LIDT

To learn more about learner and user experience research in the field of LIDT, we recommend the open access edited volume *Learner and user experience research: An introduction for the field of learning design & technology*, provided here in EdTech Books!

Schmidt, M., Tawfik, A. A., Jahnke, I., & Earnshaw, Y. (2020). *Learner and user experience research: An introduction for the field of learning design & technology*. EdTech Books. https://edtechbooks.org/ux

Evaluation Methods

In LXD, knowing when and under what conditions to apply evaluation methodologies is a challenge. In the following sections, several evaluation methodologies commonly used in LXD are described, with descriptions of how these evaluation methodologies can be used in a learning design context. These can be applied during various phases across the learning design and development process (i.e., **front-end analysis**, low fidelity to high-fidelity prototyping). While a case can be made that any of the approaches can be applied to a given design phase, some evaluation methodologies are more appropriate to the overall learning experience, while others focus more on usability. Table 1 provides an overview of methods, the associated design phases in which they can most optimally be implemented, and their associated data sources.

Method	**Design phase**				**Data source**
		Prototyping			
	Front-end analysis	**Paper (low fidelity)**	**Wireframe (medium fidelity)**	**Functional (high fidelity)**	
Ethnography	x				Single user or users
Focus groups	x	x			Group of users
Card sorting	x	x			Single user, multiple users, or group fo users
Cognitive walkthrough		x	x	x	Expert
Heuristic evaluation		x	x	x	Experts
A/B testing		x	x	x	Multiple users
Think-aloud		x	x	x	Multiple users
EEG/Eye Tracking				x	Multiple users
Analytics				x	Multiple users

Table 1. Evaluation Methodologies, Design Phases, and Data Sources

Ethnography

A method that is used early in the front-end analysis phase, especially for requirements gathering, is **ethnography**. Ethnography is a qualitative research method in which a researcher studies people in their native setting (not in a lab or controlled setting). During data collection, the researcher observes the group, gathers artifacts, records notes, and performs interviews. In this phase, the researcher is focused on unobtrusive observations to fully understand the phenomenon in situ. For example, in an ethnographic interview, the researcher might ask open-ended questions but would ensure that the questions were not **leading**. The researcher would note the difference between what the user is doing versus what the user is saying and take care not to introduce their own bias. Although this method has its roots in the field of cultural anthropology, **UCD**-focused ethnography can support thinking about design from activity theory and **distributed cognition** perspectives (Nardi, 1996). This allows the researcher to gather information about the users, their work environment, their culture, and how they interact with the device or website in context (Nardi, 1997). This information is particularly valuable when writing user personas and **scenarios**. Ethnography is also useful if the researcher cannot conduct user testing on systems or larger equipment due to size or security restrictions.

A specific example of how ethnography can be applied in learning design is in the development of learner personas. Representative learners can be recruited for key informant interviews with the purpose of gathering specific data on what a learner says, thinks, does, and feels, as well as what difficulties or notable accomplishments they describe. The number of participants needed depends on the particular design context but does not need to be large. Indeed, learning designers can glean critical insights from just a few participants, and there is little question that even small numbers of participants is better than none. For example, to develop online learning resources for parents of children with traumatic brain injuries, a learning designer might interview two or three parents and ask them to relay what their typical day looks like, tell a story about a particular challenge they have encountered with parenting their child, or describe how they use online resources to find information about traumatic brain injuries. The interviews could then be transcribed, and the learning designer could use a variety of analysis techniques to categorize the interview data thematically. This information from thematic categories could then be generalized into the development of learner personas that are illustrative of themes derived from the key informant interviews.

Learn More About Conducting Thematic Analysis

For information on how to conduct a thematic analysis on interviews, refer to Mortensen (2020).

Learning Check

(True/False) Ethnography can be used to gather information about users' work environment and culture.

- ☐ True
- ☐ False

Focus Groups

Focus groups are often used during the front-end analysis phase. Rather than the researcher going into the field to study a larger group as is done in ethnography, a small group of participants (n = 5–10) are recruited based on shared characteristics. Focus group sessions are led by a skilled moderator who uses a semi-structured set of questions. For instance, a moderator might ask what challenges a user faces at work (i.e., **actuals vs. optimals gap**), suggestions for how to resolve them, and provide feedback on present technologies. The participants are then asked to discuss their thoughts on products or concepts that the moderator/group of learning designers propose. The moderator may also present a low-fidelity prototype to the prospective user and ask for feedback. The role of the researcher in a focus group is to ensure that no single person dominates the conversation in order to hear everyone's opinions, preferences, and reactions. This helps to determine what users want and keeps the conversation on track. It is preferred to have multiple focus group sessions to ensure various perspectives are heard in case a conversation gets side-tracked. Analyzing data from a focus group can be as simple as providing a short summary with a few illustrative quotes for each session. The length of the sessions (typically 1–2 hours) may include some extraneous information, so it is best to keep the report simple.

For example, a learning designer developing an undergraduate-level introduction to nuclear engineering course invited a group of nuclear engineers, radiation protection technicians, and undergraduate-level nuclear engineering students to participate in a focus group. Before meeting with the focus group, the learning designer created a semi-structured set of questions to guide the session. These questions focused on issues such as the following: the upcoming challenge of an aging workforce on the brink of retirement and with no immediate replacements, the stigma of nuclear power, and the perceived difficulty of pursuing a career in nuclear engineering that the designer had gleaned from discussions with SMEs and from a document analysis. These issues were then explored with the focus group participants during a focus group session, with the designer acting as a facilitator. Sticky notes were used to document key ideas and posted around the room. Participants were asked to use sticky notes to provide brief responses to facilitator questions. The facilitator then asked the participants to find the sticky notes posted on the walls that best aligned with the responses they had provided and post their sticky notes near those sticky notes. These groups of notes were then reviewed by the participant groups, refined, and then named. The entire process took two hours. These categorized groups of sticky notes served as the foundation for the content units in the online course, covering topics like the application of nuclear medicine in cancer diagnosis and treatment, as well as the use of irradiation to extend the shelf life of food.

Learning Check

(True/False) Analyzing data from a focus group should involve providing a detailed report with extensive quotes for each session.

- ☐ True
- ☐ False

Card Sorting

Aligning designs with users' **mental models** is important for effective UX design. A method used to achieve this is **card sorting**. Card sorting is used during **front-end analysis** and paper prototyping. Card sorting is commonly used in psychology to identify how people organize and categorize information (Hudson, 2012). In the early 1980s, card sorting was applied to organizing menuing systems (Tullis, 1985) and information spaces (Nielsen & Sano, 1995).

Card sorting can be conducted physically using tools like index cards and sticky notes or it can be conducted electronically. It can involve a single participant or a group of participants. With a single participant, they group content (individual index cards) into categories, allowing the researcher to evaluate the information architecture or navigation structure of a website. For example, a participant might organize "Phone Number" and "Address" cards together. When a set of cards is placed together by multiple participants, this suggests to the designer distinct pages that can be created (e.g., a "Contact Us" page). When card sorting with a group of participants instead of just one person, the same method is employed, but the group negotiates how they will sort content into categories. How participants arrange cards provides insight into mental models and how they group content.

No-cost tools like Lloyd Rieber's (2017) Q Sort (http://lrieber.coe.uga.edu/qsort/index.html) can be used for card sorting.

There are two types of card sorting methods: open and closed. In an open card sort, a participant or group of participants will first group content (menu labels on separate notecards) into piles and then name the category. Participants can also place the notecards in an "I don't know" pile if the menu label is not clear or may not belong to a designated pile of cards. In a closed card sort, the categories will be pre-defined by the researcher. It is recommended to start with an open card sort and then follow-up with a closed card sort (Wood & Wood, 2008). As the arrangement of participants are compared, the designer designs a new prototype where the menu information and other features align with how the participants organize the information within their mind.

Learn More About Card Sorting Best Practices

For card sorting best practices, refer to "Card sort analysis best practices" (Righi et al., 2013).

Card sorting is particularly useful for learning designers who are creating courses in learning management systems. After identifying the various units, content categories, content sections, and so on, the learning designer can write what they identified on cards (or use other methods discussed above), present them to a SME, course instructor, or student, and ask them to arrange the cards into what they perceive to be the most logical sequence or organization. This approach can be particularly informative when comparing how instructors feel a course should be organized with how a learner feels a course should be organized, which can sometimes be quite different. Findings can then be used to inform the organization of the online course and potential navigational structures that are important to LXD.

Learning Check

What is the main difference between open card sorting and closed card sorting?

- [ ] Open card sorting allows participants to create their own categories, while closed card sorting provides predefined categories.
- [ ] Open card sorting involves using digital tools, while closed card sorting uses physical index cards.
- [ ] Open card sorting is conducted with a group of participants, while closed card sorting is done individually.
- [ ] Open card sorting requires paid technology tools, while closed card sorting can be performed using low-cost or no-cost tools.

Cognitive Walkthroughs

Cognitive walkthroughs (CW) can be used during all prototyping phases. CW is a hands-on inspection method in which an evaluator (not a user) evaluates the interface by walking through a series of realistic tasks (Lewis & Wharton, 1997). CW is not a user test based on data from users, but instead is based on the evaluator's judgments.

During a CW, a UX or LXD expert evaluates specific tasks and considers the user's mental processes while completing those tasks. For example, an evaluator might be given the following task: Recently you have been experiencing a technical problem with software on your laptop and you have been unable to find a solution to your problem online. Locate the place where you would go to send a request for assistance to the Customer Service Center. The evaluator then identifies the correct paths to complete the task but does not make a prediction as to what a user will actually do. In order to assist designers, the evaluator also provides reasons for making errors (Wharton et al., 1994). The feedback received during the course of the CW provides insight into various aspects of the user experience including

- first impressions of the interface,
- how easy it is for the user to determine the correct course of action,
- whether the organization of the tools or functions matches the ways that users think of their work,
- how well the application flow matches user expectations,
- whether the terminology used in the application is familiar to users, and
- whether all data needed for a task is present on screen.

LIDT in the World

CW is particularly valuable when working in teams that consist of senior and junior learning experience designers. Junior learning experience designers can develop prototype learning designs (e.g., learning modules, screencasts, infographics), which can then be presented to the senior designer to perform a cognitive walkthrough. For example, a junior designer creates a series of five videos and sequences them in the LMS logically so as to provide sufficient information for a learner to correctly answer a set of corresponding informal assessment questions (e.g., a knowledge check). The junior designer then presents this to the senior designer with the following scenario: "You don't know the answer to the third question in the knowledge check, so you decide to review what you learned to find the answer." The senior designer then maps out the most efficient path to complete this task but finds that videos cannot be easily scrubbed by moving the playhead rapidly across the timeline. Instead, the playhead resets to the beginning of the video when it is moved. The senior designer explains to the junior designer that learners would have to completely rewatch each video to find the correct answer. The junior designer then has specific feedback that can be used to improve the learning experience for this learning module.

Heuristic Evaluation

Heuristic evaluation is an inspection method that does not involve working directly with the user. In a heuristic evaluation, it is recommended that at least two evaluators work independently to review the design of an interface against a predetermined set of usability principles (heuristics) before communicating their findings. Ideally, each evaluator will work through the interface at least twice: once for an overview of the interface and the second time to focus on specific interface elements (Nielsen, 1994). The evaluators then meet and reconcile their findings. This method can be used during any phase of the prototyping cycle.

Many heuristic lists exist that are commonly used in heuristic evaluations. The most well-known heuristic checklist was developed over 25 years ago by Jakob Nielsen and Rolf Molich (1990). This list was later simplified and reduced to 10 heuristics which were derived from 249 identified usability problems (Nielsen, 1994). In the field of LIDT, researchers have embraced and extended Nielsen's 10 heuristics to make them more applicable to the evaluation of eLearning systems (Mehlenbacher et al., 2005; Reeves et al., 2002). Not all heuristics are applicable in all evaluation scenarios, so UX designers tend to pull from existing lists to create customized heuristic lists that are most applicable and appropriate to their local context, as do LX designers.

Nielsen's 10 Heuristics

1. Visibility of system status
2. Match between system and the real world
3. User control and freedom
4. Consistency and standards

5. Error prevention
6. Recognition rather than recall
7. Flexibility and efficiency of use
8. Aesthetic and minimalist design
9. Help users recognize, diagnose, and recover from errors
10. Help and documentation

Schmidt provides this easy-to-use learning design heuristics worksheet (MS Excel format) at no cost, based on Mehlenbacher et al. (2005) task-oriented usability heuristics for web -based instruction design and evaluation.

https://docs.google.com/spreadsheets/d/1cmqopfqgc-ejhCCBtvEkVLkWn86UOcKi/

An approach that bears similarities with a heuristic evaluation is the **expert review**. In an expert review, the expert is knowledgeable about usability principles and has worked directly with users in the past. Expert reviewers do not always use a set of heuristics, but instead they may produce a document that details the overall issues, ranks them in order of severity, and then provides recommendations on how to mitigate the issues. This more informal approach allows for more flexibility than using a heuristic list. As is the case with the heuristic evaluation, multiple experts should be involved and data from all experts should be aggregated. This is because expert review is particularly vulnerable to the expert's implicit biases. Different experts will have different perspectives and therefore will uncover different issues. Involving multiple experts helps ensure that implicit bias is minimized and that problems are not overlooked.

For learning designers developing online courses, established quality metrics such as Quality Matters (QM) can be used for guiding heuristic evaluations (Zimmerman et al., 2020). QM provides evaluation rubrics for certified evaluators to assess the degree to which an online course meets QM standards. The aggregate QM score can then be used as a quality benchmark for that course. However, when applied in the context of a heuristic evaluation, the QM materials should only be used to evaluate prototypes for making improvements—not for establishing a quality benchmark for a finalized course. A QM-guided heuristic evaluation performed by a skilled evaluator can provide tremendously valuable insights along the dimensions of learning experience that are outlined above. These can serve as the basis for subsequent design refinements to an online course. These insights, in turn, promote a more positive learning experience.

Learn More About Heuristics

For details on heuristics, we recommend reading Jahnke et al. (2021)'s article titled "Advancing sociotechnical-pedagogical (STP) heuristics for the usability evaluation of online courses for adult learners," https://olj.onlinelearningconsortium.org/index.php/olj/article/view/2439

Learning Check

Select the most appropriate response to complete the following statement: Usability testing and Nielsen's heuristics are for . . .

- [ ] Testing the user's ability to effectively and efficiently complete a task
- [ ] Evaluating the user's interaction with the digital technology, product, or service

A/B Testing

A/B testing or **split-testing** compares two versions of a user interface; because of the nature of this method, all three prototyping phases can be employed at the same time. The different interface versions might utilize different screen elements (such as the color or size of a button), typefaces, textbox placements, or overall general layouts. During A/B testing, it is important that the two versions are tested at the same time by the same user. For instance, Version A can be a control and Version B should only have one variable that is different (e.g., navigation structure). A randomized assignment, in which some participants receive Version A first and then Version B (versus receiving Version B and then Version A), should be used.

LIDT in the World

Learning experience designers do not frequently have access to large numbers of learners for A/B testing, and therefore need to consider how to adapt this approach to specific design contexts. For example, a design team building a **case library** for a case-based learning environment is struggling with the design of the cases themselves. One learning experience designer has created a set of cases that highlight the central theme of the different cases (i.e., constant responsibilities, preparatory activities, recruitment, training, and the selection process); however, the chosen texts are fairly text heavy. Another learning experience designer has taken a different design approach and created a comic book layout for the cases, which has visual appeal. However, the central theme of the cases is not emphasized. The design team asks six students to review the designs. Three students review the more thematically focused cases and three review the comic book cases. The students are then asked to create a concept map that shows the central themes of the cases and how those themes are connected. The design team learns that students who used the thematically focused cases spent much less time reviewing the cases, and their concept maps show a very shallow understanding of the topic—although, they did appropriately identify thematic areas of the cases (i.e., constant responsibilities, recruitment, etc.). The students who used the comic book cases spent more time reviewing the cases. Their concept maps are richer and show a more nuanced understanding of the topic but are missing the specific names of the thematic areas (although they describe the areas in their own words). With this information, the team decides to continue to iterate prototypes of the comic book design while focusing on better emphasizing the central themes within those cases. On this basis, a potentially more effective learning experience was uncovered.

Learn More About A/B Testing

To learn more about A/B Testing, we recommend reading Kimmons (2021).

Think-Aloud User Study

Unlike A/B testing, a **think-aloud** study is only used during the functional prototyping phase. According to Jakob Nielsen (1993), "thinking aloud may be the single most valuable usability engineering method" (p. 195). In a think-aloud user study, a single participant is tested at any given time. The participant narrates what he or she is doing, feeling, and thinking while looking at a prototype (or fully functional system) or completing a task. This method can seem unnatural for participants, so it is important for the researcher to encourage the participant to continue verbalizing throughout a study session.

Learn More About Think-Aloud Usability Studies

To view an example of a think-aloud usability study, we recommend the video (24 minutes) from Peachpit TV (2010) on *Rocket Surgery Made Easy by Steve Krug: Usability Demo*.

Krug (n.d.) also provides useful scripts that are freely available for you to download and adjust.

A great deal of valuable data can come from a think-aloud user study (Krug, 2009). Sometimes participants will mention things they like or dislike about a user interface. This is important to capture because their opinions may not be discovered in other methods. However, the researcher needs to also be cautious about changing an interface based on a single comment.

Users do not necessarily have to think aloud while they are using the system. The retrospective think aloud is an alternative approach that allows a participant to review the recorded testing session and talk to the researcher about what he or she was thinking during the process. This approach can provide additional helpful information, although it may be difficult for some participants to remember what they were thinking after some time. Hence, it is important to conduct retrospective think aloud user testing as soon after a recorded testing session as possible.

Learn More About Conducting Think-Aloud User Testing

For a primer on how to conduct think-aloud user testing, refer to the U.S. government's online resources for usability at https://www.usability.gov (U.S. Dept. of Health and Human Services, n.d.)

Think-aloud testing does not test the user but the interaction of the user with the technology, product, or service. It is the most widely used method of usability evaluation in practice, including in the field of LIDT. Indeed, usability testing has long been recognized as a useful evaluation method in the design of interactive learning systems (cf. Reeves & Hedberg, 2003). Increasingly, usability testing is gaining acceptance in LIDT as a viable and valuable evaluation method for informing research related to advanced or novel learning technologies, for which existing research is neither substantial nor sufficient, such as 360-video based virtual reality (Schmidt et al., 2019) or digital badging (Stefaniak & Carey, 2019). Given the limited resources provided to learning designers, think aloud user testing is particularly attractive because it can be conducted with relatively small numbers of participants (5–12 users depending on the complexity of the system) and with open source or free-to-use tools.

LIDT in the World

Learn how learning designers apply think-aloud techniques in the AECT Design & Development Webinar (58 minutes) on "Think-Aloud Methods: Just-in-Time & Systematic Methods to Improve Course Design" by Gregg et al. (2022). https://edtechbooks.org/dd_chronicles/lxd_tao

Further details can be found in the chapter "Think-Aloud Observations to Improve Online Course Design: A Case Example and "How-to" Guide" by Gregg et al. (2020).

Learning Check

When is the best time for a think-aloud user study to be conducted in the design and development process?

- [ ] During the initial brainstorming phase.
- [ ] Only during A/B testing.
- [ ] Primarily during the functional prototyping phase.
- [ ] At any phase of the design process.

Eye-Tracking

Similar to the think-aloud user study, **eye-tracking** is an evaluation method that involves the user during the functional prototype phase. Eye-tracking is a psychophysiological method used to measure a participant's physical gaze behavior in responses to stimuli. Instead of relying on self-reported information from a user, these types of methods look at direct, objective measurements in the form of gaze behavior. Eye-tracking measures saccades (eye movements from one point to another) and fixations (areas where the participant stops to gaze at something). These saccades and fixations can be used to create heat maps and gaze plots, as shown in Figures 1–3, or for more sophisticated statistical analysis.

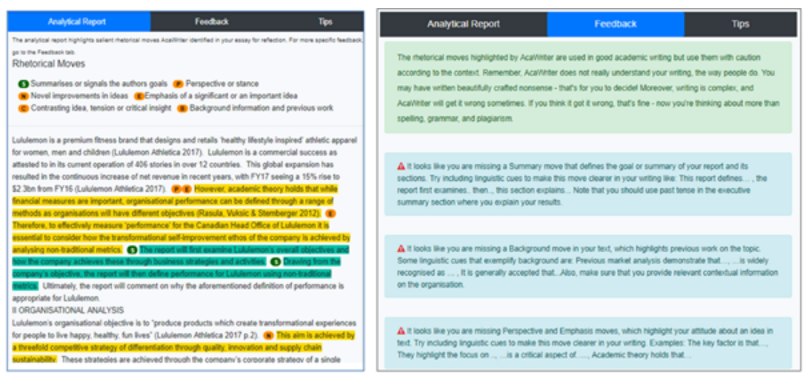

Figure 1. Heat map of a functional prototype's interface designed to help learners with Type 1 Diabetes learn to better manage their insulin adherence; here, eye fixations are shown with red indicating longer dwell time and green indicating shorter dwell time. Photo courtesy of the Advanced Learning Technologies Studio at the University of Florida. Used with permission.

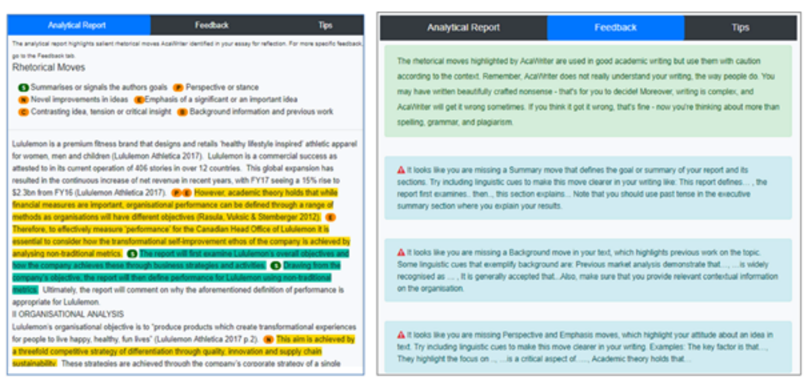

Figure 2. Heat map of a three-dimensional interface showing eye fixations and saccades in real-time, with yellow indicating longer dwell time and red indicating shorter dwell time. Adapted from "The best way to predict the future is to create it: Introducing the holodeck mixed-reality teaching and learning environment," by M. Schmidt, J., Kevan, P. McKimmy, and S. Fabel, 2013, Proceedings of the 2013 International Convention of the Association for Educational Communications and Technology, Anaheim, CA. Reprinted with permission.

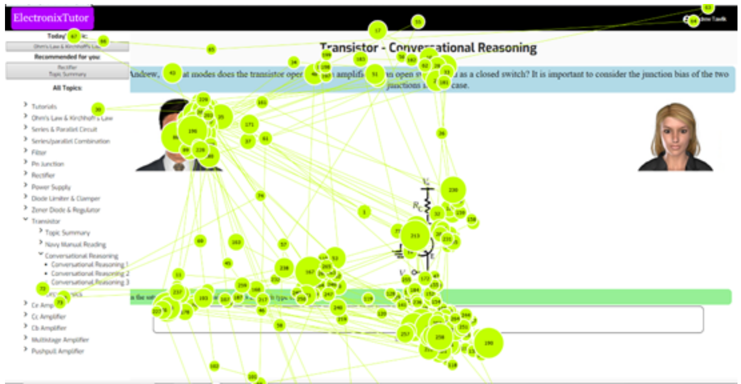

Figure 3. *Gaze plot of a learner engaged with the ElectronixTutor learning environment adapted from Tawfik et al. (2022). Photo courtesy of the Instructional Design Studio at the University of Memphis. Used with permission.*

LIDT in the World

Conley et al. (2020) used eye-tracking to examine two different layouts (functional and chronological) in Blackboard in their article “Examining course layouts in Blackboard: Using eye-tracking to evaluate usability in a learning management system,” https://doi.org/10.1080/10447318.2019.1644841

Electroencephalogy

Another psychophysiological method used to directly observe participant behavior is **electroencephalogy (EEG)**. EEG measures participant responses to stimuli in the form of electrical activity in the brain. An EEG records changes in the brain’s electrical signals in real-time. A participant wears a skull cap (Figure 4) with tiny electrodes attached to it. While viewing a prototype, EEG data such as illustrated in Figure 5 can show when a participant is frustrated or confused with the user interface (Romano Bergstrom et al., 2014).

From the perspective of learning design, eye tracking and EEG-based user testing are typically reserved for very large training programs (i.e., for large corporations like Apple or Facebook) or for learning designs that are more focused on research than on practical application. It is not very common for small learning design teams to have access to EEG and eye tracking resources. Nonetheless, these approaches can serve as a way to understand when learners find something important, distracting, disturbing, etc., thereby informing learning designers of factors that can impact extraneous cognitive load, arousal, stress, and other factors relevant to learning and cognition. A disadvantage of this type of data, for example, is that it might not be clear why a learner was fixated on a search box, why a learner showed evidence of stress when viewing a flower, or if a fixation on a 3D model of an isotope suggests learner interest or confusion. In these situations, a retrospective think-aloud can be beneficial. After the eye-tracking data have been collected, the learning designer can sit down with a participant and review the eye-tracking data while asking about eye movements and particular focus areas.

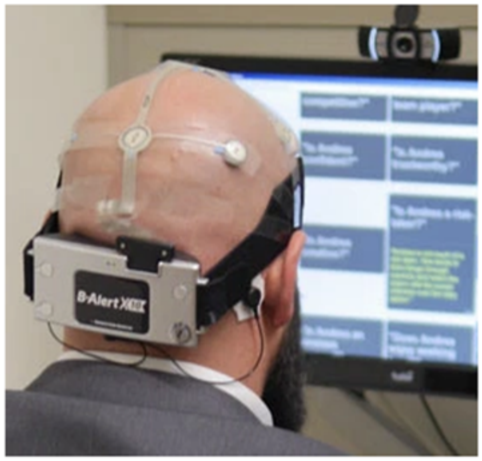

Figure 4. *A research study participant wears an EEG while viewing an interface. Photo courtesy of the Neuroscience Applications for Learning (NeurAL Lab) at the University of Florida's Institute for Advanced Learning Technologies (IALT). Used with permission.*

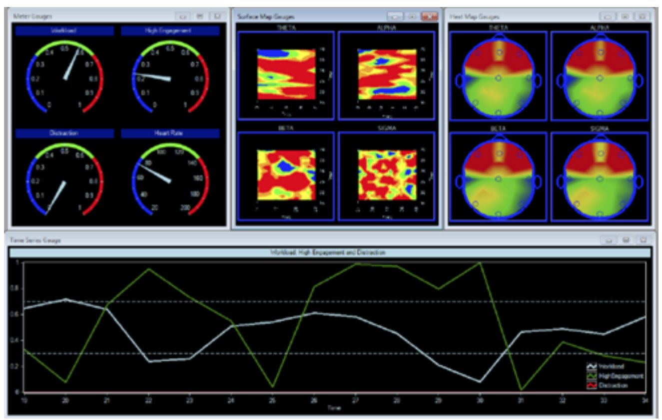

Figure 5. *Output from an EEG device in a data dashboard displaying a variety of psychophysiological measures (e.g., workload, engagement, distraction, heart rate). Photo courtesy of the Neuroscience Applications for Learning (NeurAL Lab) at the University of Florida's Institute for Advanced Learning Technologies (IALT). Used with permission.*

Analytics

A type of evaluation method that is gaining significant traction in the field of learning design due to advances in machine learning and data science is **analytics** (e.g., learning analytics). Analytics are typically collected automatically in the background while a user is interfacing with a system and sometimes without the user even being aware the data is being collected. An example of analytics data is a clickstream analysis in which the participants' clicks are captured while browsing the web or using a software application (see Figure 6). This information can be beneficial because it can show the researcher the path the participant was taking while navigating a system. Typically, these data need to be triangulated with other data sources to paint a broader picture.

Where can we find the data?

Student Information System	Learning Environment	Research Instruments	Multimodal	Social Medi
• demographics • timetables • enrolment • attendance • previous assessment results	• trace data • simulation data • assessment data • social interaction • content interaction • intelligent tutoring systems • educational context data	• surveys • questionnaires • interviews • focus groups • observations	• video • audio • gesture • gaze • psychophysiological data • EEGs • fMRI	• Twitter • Instagram • Facebook • blogs

Figure 6. *An example of a clickstream, showing users' paths through a system. Adapted from "Transforming a problem-based case library through learning analytics and gaming principles: An educational design research project," by M. Schmidt and A. Tawfik, 2017, Interdisciplinary Journal of Problem-Based Learning. Reprinted with permission.*

Increasingly, learning analytics and data dashboards such as LMSs, video conferencing suites, video hosting providers, and more are being incorporated into the tools of the learning design trade. Indeed, the massive collection of learners' personal usage data has become so ubiquitous that it is taken for granted. However, analytics and data dashboards remain novel tools that learning designers do not necessarily have the training to use for making data-based decisions for improving learning designs. That said, data dashboards are maturing quickly. Less than a decade ago, only the most elite learning designers could incorporate learning analytics and data dashboards into their designs, whereas today these tools are built-in to most tools. Clearly, these tools have enormous potential in the field of LIDT; for example, these tools could be beneficial for creating personalized learning environments, providing individualized feedback, improving motivation, and so-on. With advances in machine learning and artificial intelligence (AI), learning analytics hold great promise. However, privacy concerns, questions of who owns and controls learner data, and other issues remain. Learning designers are encouraged to carefully review the data usage agreements of the software used for developing and deploying digital environments for learning. LXD considers the entire experience of the learner when using a technology, which includes their experiences with the collection of personal data. Carefully safeguarding this data and using it judiciously is paramount for a positive learning experience.

Learning Check

What is one of the primary benefits of analytics data, such as clickstream analysis, in the context of learning design?

- ☐ Analytics data can replace the need for user testing.
- ☐ Analytics data are collected manually by users during their interactions.
- ☐ Analytics data provide insights into the path participants take while navigating a system.
- ☐ Analytics data are typically used as the sole source of information for decision-making.

Evaluating the Educational Impact of Digital Learning Experiences

A range of evaluation techniques can be used to evaluate the educational impact of digital learning experiences, including pre/posttests and **concept maps**. Pre/posttests help answer the question of whether the learning design is effective. Pre/poststests are performed with an identical set of measurement items before and after the learning design. In the pretest, the learner's knowledge is captured as baseline, and in the posttest, the difference between the pre- and posttest scores indicates the level of learning growth. This technique is quick and easy to apply; however, it is limited in that it typically is only able to measure lower-order learning outcomes such as memorization/recall. For more intricate higher-order learning objectives, such as synthesis and problem-solving, alternative methods prove more suitable. These may include collaborative design, simulation tasks, or more advanced pre/posttest designs that extend beyond mere information recall. For example, concept mapping allows learners to represent their understanding of concepts using **line-and-node visualizations** (Borrego et al., 2009). A concept mapping task might ask learners to map out all of the things they know about a particular content area (i.e., different kinds of poems, how the animal kingdom is classified, etc.). This is done both before and after the learning experience, after which researchers can compare the differences.

Learn More About Evaluating the Educational Impact of Digital Learning Experiences

For further details, we suggest two case studies of learning experience design that give practical insights into iterative development and testing of the LXD including effectiveness, efficiency and appealing:

Lee et al. (2021), "Mobile microlearning design and effects on learning efficacy and learner experience," https://doi.org/10.1007/s11423-020-09931-w

Li et al. (2021), "Digital learning experience design and research of a self-paced online course for risk-based inspection of food imports," https://doi.org/10.1016/j.foodcont.2021.108698

Conclusion

In this chapter, we have provided examples of commonly used evaluation methodologies that can be employed to advance usable and pleasing learning designs, along with illustrative examples of how these methods can be used in practice. A design approach that connects the evaluation methods of UX and HCI with LXD can help ensure that digital environments for learning are constructed to support learners' achievement of their learning goals in ways that are effective, efficient, and satisfying.

Think About It!

1. In your role as a learning experience designer, reflect on a project you are currently involved in. How can you strategically combine different evaluation methods discussed in this chapter to maximize the effectiveness of your evaluation process for this project? Explain your rationale for selecting specific evaluation methods and their potential synergies.
2. In the context of the evaluation methods discussed in this chapter, how might you adapt and combine different evaluation approaches to gain a deeper understanding of the impact of a learning design? Consider the potential challenges and benefits of combining quantitative and qualitative data, user testing, and analytics in your evaluation process.
3. Evaluating learning experiences often involves collecting and analyzing user data. What ethical considerations should learning designers and evaluators keep in mind when working with user data for evaluation purposes? How can you ensure that the collection and use of data respect the privacy and rights of learners while still providing valuable insights?

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Human Performance Technology for Instructional Designers

Stefaniak, J. E. & Bagdy, L.

Human Performance Technology
Instructional Design
Instructional Designers
Performance
Technology

The overarching goal for instructional designers is to enhance learning and performance outcomes, often achieved through needs assessments, learner analyses, and the development of targeted instructional materials. This chapter delves into the foundational principles of HP and differentiates between HPT and instructional design. The role of performance analysis is explored, focusing on organizational, environmental, and cause analyses to identify performance gaps and root causes. The role of non-instructional interventions, such as organizational design, job analysis, and feedback systems to support infrastructure are discussed. Recommendations for integrating HPT principles

into instructional design through a systems approach are also provided.

The goal for all instructional designers is to facilitate learning and improve performance regardless of learning environments and assigned tasks. When working within professional organizations particularly, the goal is often to develop interventions that yield measurable outcomes in improving employee performance. This may be accomplished through conducting needs assessments and learner analyses, designing and developing instructional materials to address a gap in performance, validating instructional materials, developing evaluation instruments to measure the impact of learning, and conducting evaluations to determine to what extent the instructional materials have met their intended use.

Depending on their level of involvement in implementing change within their organization, instructional designers may need to apply concepts from the field of human performance technology. By definition, "human performance technology (HPT) is the study and ethical practice of improving productivity in organizations by designing and developing effective interventions that are results-oriented, comprehensive, and systemic" (Pershing, 2006, p. 6). The purpose of this chapter is to provide an overview for how instructional designers can integrate aspects of human performance technology into their instructional design activities. We differentiate between human performance technology and instructional design and provide examples of HPT applications in the real world. We conclude with an overview of professional resources available related to the topic of human performance technology.

Differentiating Between Human Performance Technology and Instructional Design

Human performance technology emerged in the 1960s with publications and research promoting systematic processes for improving performance gaining traction in the 1970s. The foundations of human performance technology are grounded in behaviorism, with the *father of HPT*, Thomas Gilbert, being a student of B. F. Skinner. Seminal works of human performance technology include Gilbert's (1978) Behavioral Engineering Model; Rummler's (1972) anatomy of performance, Mager and Pipe's (1970) early introduction of measurable learning objectives, and Harless' (1973) approach to systematic instruction in the workplace. All of these contributions were grounded in behaviorism and sought to create a systematic approach to measuring employee performance in the workplace. While these concepts can be applied to school settings, the majority of research exploring the application of human performance technology strategies has been predominant in workplace environments.

When differentiating between human performance technology and instructional design, HPT focuses on applying systematic and systemic processes throughout a system to improve performance.

Emphasis is placed on analyzing performance at multiple levels within an organization and understanding what processes are needed for the organization to work most effectively. Systemic solutions take into account how the various functions of an organization interact and align with one another. Through organizational analyses, performance technologists are able to identify gaps in performance and create systematic solutions (Burner, 2010).

While instruction may be one of the strategies created as a result of a performance analysis, it is often coupled with other non-instructional strategies. Depending on an instructional designer's role in a project or organization, they may not be heavily involved in conducting performance assessments. When given the opportunity, it is good practice to understand how performance is being assessed within the organization in order to align the instructional solutions with other solutions and strategies.

While human performance technology and instructional design have two different emphases, they do share four commonalities: (1) evidence-based practices, (2) goals, standards, and codes of ethics, (3) systemic and systematic processes, and (4) formative, summative, confirmative evaluations (Foshay et al., 2014). Table 1 provides an overview of how these four commonalities are applied in human performance technology and instructional design.

Commonalities	**Human Performance Technology**	**Instructional Design**
Evidence-based practices	Organizational analyses are conducted to collect data from multiple sources to evaluate workplace performance.	Emphasis is placed on learner assessment to ensure instruction has been successful.
Goals, standards, and codes of ethics	ISPI and ATD are two professional organizations that have created workplace standards and professional certification programs.	AECT and ATD are two professional organizations that have created standards for learning and performance.
Systematic and systemic processes	Systematic frameworks have been designed to conduct needs assessments and other performance analyses throughout various	Systematic instructional design models have been designed to guide the design of instruction for a variety of contexts.

Commonalities	Human Performance Technology	Instructional Design
	levels of an organization.	
Formative, summative, and confirmative evaluations	Multiple evaluation methods are utilized to measure workplace performance throughout the organization.	Multiple assessments are conducted throughout the design phase of instruction as well as afterwards to ensure the instructional solutions have been successful.

Table 1. Four commonalities shared across human performance technology and instructional design

The Role of Systems in Instructional Design Practice

Instructional designers understand that anytime they are designing, they are operating within a system. Many of our instructional design models, for example, promote a systematic process and take into account a variety of elements that must be considered for design (Dick et al., 2009; Merrill, 2002; Smith & Ragan, 2005). Similarly, human performance technology originates from behavioral psychology but also general systems theory. "General systems theory refers to one way of viewing our environment" (Richey et al., 2011, p. 11). Through this theoretical lens, instructional designers or performance technologists must take into account the whole environment and organization in which they are working.

In general terms, a "system is a set of objects together with relationships between the objects and between their attributes" (Hall & Fagen, 1975, p. 52). Systems can be open or closed (Bertalanffy, 1968). Open systems operate in a manner where they rely on other systems or can be modified based on actions occurring outside of a system. Closed systems are contained and can demonstrate resistance to changes or actions occurring outside the system in order to keep their value (Richey et al., 2011). Examples of systems could include the instructional design or training department within a larger organization. While the department is a system, it is also viewed as a subsystem functioning within something much larger. In addition, those receiving human performance training also work within systems. For example, an instructional designer may be asked to provide training based on values espoused by the CEO, but which may conflict with culture within an individual department in the organization. Other times, they may be asked to identify other instructional solutions to address performance gaps identified in a needs assessment. Or they may seek to improve employees' performance in one area, when that performance depends on the success of another department in the organization—something outside of the employees' control. Thus, seeking to improve organizational performance requires a broader understanding of the organization than is sometimes typical in instructional design practices.

Systems thinking impacts instructional design practices by promoting systematic and systemic processes over narrower solutions. A systems view has three characteristics:

1. “It is holistic.
2. It focuses primarily on the interactions among the elements rather than the elements themselves.
3. It views systems as “nested” with larger systems made up of smaller ones” (Foshay et al., 2014, p. 42).

These characteristics affect instruction design practices in a variety of ways. Designers must take the holistic nature of the system and consider the effects on learning from all elements that exist within the system. Not only does this consider the specific instructional design tasks that learners are currently completing, but also various layers of the organization including the people, politics, organizational culture, and resources—in other words, the inputs and outputs that are driving the development and implementation of a project (Rummler & Brache, 2013). Regardless of their role on a project, the instructional designer must be aware of all the various components within their system and how it affects the instruction they create. For example, an instructional designer may be asked by senior leadership of an organization to develop health and safety training for employees working on the frontline of a manufacturing plant. It would be advantageous to understand the unique tasks and nuances associated with the frontline work responsibilities to ensure they are developing training that will be beneficial to the employees. Another example where it would be important for an instructional designer to be aware of an organization’s system or subsystems would be if they were asked to design instruction for a company that has multiple locations across the country or world. The instructional designer should clarify whether or not there are distinct differences (i.e., organizational culture, politics, processes) among these various locations and how these differences may impact the results of training.

Think About It!

Think about an organization that is familiar to you. What is its purpose? Who are the people that belong to that organization? What are the functions of that organization? How do the various people and functions interact?

In addition, considering that the fundamental goals of instructional design are to facilitate learning and improve performance, the instructional designer working within organizations should strive to create design solutions that promote sustainability. As stated by the second system characteristic, it is important to not only be aware of the various elements within a system, but also develop an understanding of how they interact with each other. The instructional designer should be aware of how their work may influence or affect, positively or negatively, other aspects of the organization. For example, if an organization is preparing to launch training on a new organizational philosophy, how will that be perceived by other departments or divisions within the organization? If an organization is changing their training methods from instructor-led formats to primarily online learning formats, what considerations must the instructional design team be aware of to ensure a smooth transition?

LIDT in the World

Emma is a principal at a public middle school. Teacher turnover has steadily increased over the last three years at Emma's school. After reviewing personnel files, Emma found that most teachers who left were in their first or second year of teaching. Given that most of the teachers who left Emma's school were new teachers, what factors might have contributed to teacher turnover? What other systemic factors could Emma consider?

Does the organization have the infrastructure to support online learning for the entire organization? Is the information technology department equipped with uploading resources and managing any technological challenges that may arise over time? Does the current face to face training provide opportunities for relationship-building that may not seem critical to the learning, but are important to the health and performance of the organization? If so, how can this be accounted for online? These are examples of some questions an instructional designer may ask in order to take a broader view of their instruction besides just whether it achieves learning outcomes.

Performance Analysis

Regardless of context or industry, all instructional design projects fulfill one of three needs within organizations: (1) addressing a problem; (2) embracing quality improvement initiatives; and (3) developing new opportunities for growth (Pershing, 2006). The instructional designer must be able to validate project needs by effectively completing a performance analysis to understand the contextual factors contributing to performance problems. This allows the instructional designer to appropriately identify and design solutions that will address the need in the organization—what is often called the performance gap or opportunity.

The purpose of performance analysis is to assess the desired performance state of an organization and compare it to the actual performance state (Burner, 2010; Rummler, 2006). If any differences exist, it is important for the performance improvement consultant (who may sometimes serve as the instructional designer as well) to identify the necessary interventions to remove the gap between the desired and actual states of performance.

Performance analysis can occur in multiple ways, focusing on the organization as a whole or one specific unit or function. Organizational analysis consists of "an examination of the components that strategic plans are made of. This phase analyzes the organization's vision, mission, values, goals, strategies and critical business issues" (Van Tiem et al., 2012, p. 133). Items that are examined in close detail when conducting an organizational analysis include organizational structure, centrally controlled systems, corporate strategies, key policies, business values, and corporate culture (Tosti & Jackson, 1997). All of these can impact the sustainability of instructional design projects either positively or negatively.

An environmental analysis not only dissects individual performance and organizational performance, it also expands to assess the impact that performance may have outside the system. Rothwell (2005) proposed a tiered environmental analysis that explores performance through four lenses: workers, work, workplace, and world. The worker level dissects the knowledge, skills, and attitudes required of the employee (or performer) to complete the tasks. It assesses the skill sets that an organization's workforce possesses. The work lens examines the workflow and procedures; how the work moves through the organizational system. The workplace lens takes into account the organizational infrastructure that is in place to support the work and workers. Examples of items taken into consideration at this phase include checking to see if an organization's strategic plan informs the daily work practices, the resources provided to support work functions throughout the organization, and tools that employees are equipped with to complete their work (Van Tiem et al., 2012). World analysis expands even further to consider performance outside of the organization, in the marketplace or society. For example, an organization might consider the societal benefits of their products or services.

While instructional designers do not have to be experts in organizational design and performance analysis, they should be fluent in these practices to understand how various types of performance analyses may influence their work. Whether an analysis is limited to individual performance, organizational performance, or environmental performance, they all seek to understand the degree to which elements within the system are interacting with one another. These analyses vary in terms of scalability and goals. Interactions may involve elements of one subsystem of an organization or multiple subsystems (layers) within an organization. For example, an instructional design program would be considered a subsystem of a department with multiple programs or majors. The department would be another system that would fall under a college, and a university would be composed of multiple colleges, each representing a subsystem within a larger system.

Cause Analysis

A large part of human performance technology is analyzing organizational systems and work environments to improve performance. While performance analysis helps to identify performance gaps occurring in an organization, it is important to identify the causes that are contributing to those performance gaps. The goal of cause analysis is to identify the root causes of performance gaps and identify appropriate sustainable solutions.

While conducting a cause analysis, a performance technologist will consider the severity of the problems or performance gaps, examine what types of environmental supports are currently in place (i.e. training, resources for employees) and skill sets of employees (Gilbert, 1978). The performance technologist engages in troubleshooting by examining the problem from multiple viewpoints to determine what is contributing to the performance deficiencies (Chevalier, 2003).

Non-instructional Interventions

Once a performance technologist has identified the performance gaps and opportunities, they create interventions to improve performance. “Interventions are deliberate, conscious acts that facilitate change in performance” (Van Tiem et al., 2012, p. 195). Interventions can be classified as either instructional or non-instructional. As mentioned in the discussion of general systems theory, it is imperative that the instructional designer is aware of how they interact with various elements within their system. In order to maintain positive interactions between these organizational elements, non-instructional interventions are often needed to create a supportive infrastructure. Considering politics within an organization and promoting an organizational culture that is valued by all departments and individuals within the system and carried out in processes and services are examples of infrastructural support needed for an organization (or system) to be successful. While there are a variety of different strategies that may be carried out to promote stability within an organization, the non-instructional strategies most commonly seen by instructional designers include job, analysis, organizational design, communication planning, feedback systems, and knowledge management. Table 2 provides examples of how non- instructional strategies may benefit the instructional design process.

Non-Instructional Strategies	Benefit to the Instructional Design Process
Job analysis	Up to date job descriptions with complete task analyses will provide a detailed account for performing tasks conveyed in training.
Organizational design	A plan that outlines the organizational infrastructure of a company. Details are provided to demonstrate how different units interact and function with one another in the organization.
Communication planning	Plans that detail how new initiatives or information is communicated to employees. Examples may include listervs, performance reviews, and employee feedback.

Non-Instructional Strategies	Benefit to the Instructional Design Process
Feedback systems	Detailed plans to provide employees feedback on their work performance. This information may be used to identify individual training needs and opportunities for promotion.
Knowledge management	Installation of learning management systems to track learning initiatives throughout the organization. Electronic performance support systems are used to provide just-in-time resources to employees.

Table 2. Non-instructional strategies

Organizational design and job analysis are two non-instructional interventions that instructional designers should be especially familiar with especially, if they are involved with projects that will result in large scale changes within an organization. They should have a solid understanding of the various functions and departments within the organization and the interactions that take place among them. Organizational design involves the process of identifying the necessary organizational structure to support workflow processes and procedures (Burton et al., 2015). Examples include distinguishing the roles and responsibilities to be carried out by individual departments or work units, determining whether an organization will have multiple levels of management or a more decentralized approach to leadership, and how these departments work together in the larger system.

Job analyses are another area that can affect long term implications of instructional interventions. A job analysis is the process of dissecting the knowledge, skills, and abilities required to carry out job functions listed under a job description (Fine & Getkate, 2014). Oftentimes, a task analysis is conducted to gain a better understanding of the minute details of the job in order to identify what needs to be conveyed through training (Jonassen et al., 1999). If job analyses are outdated or have never been conducted, there is a very good chance that there will be a misalignment between the instructional materials and performance expectations, thus defeating the purpose of training.

Feedback systems are often put in place by organizations to provide employees with a frame of reference in regards to how they are performing in their respective roles (Schartel, 2012). Feedback, when given properly, can “invoke performance improvement by providing performers the necessary information to modify performance accordingly” (Ross & Stefaniak, 2018, p. 8). Gilbert’s (1978) Behavioral Engineering Model is a commonly referenced feedback analysis tool used by practitioners to assess performance and provide feedback as it captures data not only at the performer level but also at the organizational level. This helps managers and supervisors determine the degree of alignment between various elements in the organization impacting performance (Marker, 2007).

The most recognizable non-instructional interventions may be electronic performance support systems (EPSSs) and knowledge management systems. These are structures put in place to support the training and performance functions of an organization. Oftentimes EPSSs are used as a hub to house training and supports for an employee. Examples extend beyond e-learning modules to also include job aids, policies and procedures, informative tools or applications, and other just-in-time supports that an employee may need to complete a task. Knowledge management systems serve as a repository to provide task-structuring support as well as guidance and tracking of learning activities assigned or provided to employees (Van Tiem et al., 2012).

Other examples of supportive systems could also include communities of practice and social forums where employees can seek out resources on an as needed basis. Communities of practice are used to bring employees or individuals together who perform similar tasks or have shared common interests (Davies et al., 2017; Wenger, 2000; Wenger et al., 2002). When selecting an intervention, it is important to select something that is going to solve the problem or address a particular need of the organization. Gathering commitment from leadership to implement the intervention and securing buy-in from other members of the organization that the intervention will work is also very important (Rummler & Brache, 2013; Spitzer, 1992; Van Tiem et al., 2012).

LIDT in the World

Ilona is the Training and Development Manager for a Fortune 500 medical informatics company. In her role, she leads a team of instructional designers that provide training and resource materials for their customers. The company is finalizing a new mobile technology product that they intend to launch in the next six months.

The majority of training materials have been designed for on-site instructor-led tutorials as health care organizations implement the new software package. Ilona's director of strategic projects has asked Ilona to create a plan for implementing instructor-led and asynchronous training that can be accessed on a mobile platform. What should Ilona consider as she maps out her plan for her team?

Whether the intervention to improve performance is instructional or non-instructional, Spitzer (1992) identified 11 criteria for determining whether an intervention is successful. Table 3 shows these criteria and provides examples of questions instructional designers should ask when selecting or designing interventions.

Spitzer's (1992) 11 Criteria	**Questions to Ask**
Design should be based on a comprehensive understanding of the situation.	• Will the intervention align with the performance gaps and opportunities identified by the cause analysis?
Interventions should be carefully targeted.	Will the intervention target... • The right people, • In the right setting, • At the right time?
An intervention should have a sponsor.	• What individual or groups within the organization will champion this intervention?
Interventions should be designed with a team approach.	• Will stakeholders be involved in designing this intervention? • Will the intervention consider the expertise of other individuals within the organization?
Intervention design should be cost-sensitive	• Will the intervention be the most cost-effective option? • Will all costs (finances, time, labor-force, etc.) be considered?
Interventions should be designed on the basis of comprehensive, prioritized requirements, based on what is most important to both the individual and the organization.	• Will there be alignment between the intervention and the priorities of the organization and stakeholders at various levels?
A variety of intervention options should be investigated because the creation of a new intervention can be costly.	• Will various intervention options be considered before a decision is made?
Interventions should be sufficiently powerful.	• What will be the short-term effectiveness of the intervention? • What will be the long-term effectiveness of the intervention?

Spitzer's (1992) 11 Criteria	Questions to Ask
Interventions should be sustainable.	• How will this intervention be embedded in the organizational culture over time?
Interventions should be designed with viability of development and implementations in mind.	• What human and organizational resources will support this intervention throughout implementation and over time?
Interventions should be designed using an iterative approach.	• What formative strategies will be used to evaluate the intervention? • How many revisions will be necessary?

Table 3. Examples of questions to ask when selecting or designing interventions

Leveraging Human Performance Technology to Support Inclusive Design

One particular challenge in the field of learning, design, and technology is that not all instructional designers are aware of the impact that HPT strategies can have on their design work. Not all instructional design training programs incorporate human performance technology coursework. Oftentimes, the extent that instructional design students may be introduced to needs assessment and evaluation does not extend beyond the learner analysis and an evaluative assessment at the end of an e-learning module.

HPT strategies can be used to help instructional designers support and promote inclusive design. If an instructional designer adheres to Spitzer's (1992) criteria for designing a performance intervention, they will develop a sufficient understanding of the situation and be able to prioritize their design practices accordingly.

To date, researchers have been to look at how HPT can be leveraged to support instructional design through the adoption of an organizational justice lens (Giacumo et al., 2021). By applying this lens on typical activities that occur in HPT (e.g., cause analysis, needs assessment, environmental analysis, organizational analysis, intervention selection and design, and evaluation), instructional designers are positioned to address issues such as fairness, equity, and ethical behavior in different contexts (Cropanzano & Stein, 2009; Stefaniak & Pinckney-Lewis, in press).

The processes of collecting and analyzing data to understand situations warranting instructional design support is fundamental in HPT practices. For several decades, strategies have been offered to provide recommendations for how best to approach and account for the layers and complexities inherent in more organizations. It is also important that individuals responsible for collecting data are collecting appropriate data that provides sufficient information pertaining to the cultural needs of their audience (Asino & Giacumo, 2019).

In an effort to triangulate data sources that capture and discrepancies within and amongst different cultures and populations that may exist with the system (organization) being examined, Peters and Giacumo (2020) proffer guidelines to support cross-cultural data collection. They recommend that individuals responsible for data gathering demonstrate respect for cultural beliefs, allow for the addition of time to gather information and understand the situation, build trust with members of the population, and take a participatory approach to include members of the population in the process. These cross-cultural HPT practices can extend to all facets of instructional design; thus promoting inclusive design environments where the learners have a significant role in the interventions being designed to support their needs.

Conclusion

While it is not necessary for instructional designers to engage in human performance technology, they may find themselves frequently in their careers working more like performance technologists than they originally supposed they would. In addition, those that use human performance technology thinking may be better positioned to design sustainable solutions in whatever their organization or system. Human performance technology offers a systems view that allows for the instructional designer to consider their design decisions and actions. By recognizing the systemic implications of their actions, they may be more inclined to implement needs assessment and evaluation processes to ensure they are addressing organizational constraints while adding value. With the growing emphasis of design thinking in the field of instructional design, we, as a field, are becoming more open to learning about how other design fields can influence our practice (i.e., graphic design, architecture, and engineering), and human performance, as another design field in its own right, is one more discipline that can improve how we do our work as instructional designers.

Recommended Readings

There are a variety of resources available for instructional designers who are interested in learning more about how they can utilize concepts of human performance technology in their daily practice. This section provides an overview of journals and important books related to the field.

Compared to other disciplines, the field of human performance technology is considered a relatively young field dating back to the early 1960s. The following is a list of books that may be of interest to individuals who are interested in learning more about human performance technology:

- Arrington, T. L., Moore, A. L., Steele, K., & Klein, J. D. (2022). The value of human performance improvement in instructional design and technology. In J. Stefaniak & R. Reese (Eds.), *The instructional design trainer's guide: Authentic practices and considerations for mentoring ID and ed tech professionals* (pp. 161-169). Routledge.
- Giacumo, L. A., & Asino, T. I. (2022). Preparing instructional designers to apply human performance technology in global context. In J. Stefaniak & R. Reese (Eds.), *The instructional design trainer's guide: Authentic practices and considerations for mentoring ID and ed tech professionals* (pp. 170-179). Routledge.
- Gilbert, T. F. (1978). *Human competence: Engineering worthy performance*. McGraw-Hill.
- Moseley, J. L., & Dessinger, J. C. (2010). *Handbook of improving performance in the workplace. Volume 3: Measurement and evaluation.* Pfeiffer.
- Pershing, J. A. (2006). *Handbook of human performance technology* (3rd ed.). Pfeiffer.
- Rossett, A. (1999). *First things fast: A handbook for performance analysis*. Pfeiffer.
- Rummler, G. A., & Brache, A. P. (2013). *Improving performance: How to manage the white space on the organization chart* (3rd ed.). Jossey-Bass.
- Silber, K.H., & Foshay, W.R. (2010). *Handbook of improving performance in the workplace. Volume 1: Instructional design and training delivery*. Pfeiffer.
- Stefaniak, J. (Ed.). (2015). *Cases on human performance improvement technologies*. IGI Global.
- Stefaniak, J. (2020). *Needs assessment for learning and performance: Theory, process, and practice*. Routledge.
- Stefaniak, J., Giacumo, L. A., & Villachica, S. (2022). Preparing instructional designers to scale needs assessment. In J. Stefaniak & R. Reese (Eds.), *The instructional design trainer's guide: Authentic practices and considerations for mentoring ID and ed tech professionals* (pp. 147-160). Routledge.
- Van Tiem, D., Moseley, J. L., & Dessinger, J. C. (2012). *Fundamentals of performance improvement: A guide to improving people, process, and performance* (3rd ed.). Pfeiffer.
- Watkins, R., & Leigh, D. (2010). *Handbook of improving performance in the workplace. Volume 2: Selecting and implementing performance interventions*. Pfeiffer.

Journals

While a number of instructional design journals will publish articles on trends related to the performance improvement, the following is a list of academic journals focused specifically on the mission of human performance technology:

- *Performance Improvement Journal* is published 10 times a year by the International Society for Performance Improvement and John Wiley & Sons, Inc. (Articles tend to be practitioner and application oriented.)
- *Performance Improvement Quarterly* is a peer-reviewed scholarly journal published by the International Society for Performance Improvement.
- *Human Resource Development Quarterly* is a peer-reviewed scholarly journal published byJohn Wiley & Sons, Inc.

- *International Journal of Training and Development* is a peer-reviewed scholarly journal published by John Wiley & Sons, Inc.
- *Journal of Applied Instructional Design* is a peer-reviewed scholarly journal published by the Association for Educational Communications and Technology.
- *Journal of Workplace Learning* is a peer-reviewed scholarly journal published by Emerald, HR, Learning and Organizational Studies eJournal Collection.
- *TD (Training + Development)* is a monthly magazine published by the Association for Talent Development.

Additional Reading

Another useful chapter on performance technology is available in *The Foundations of Instructional Technology*, available at https://edtechbooks.org/-cx

Stefaniak, J. (2018). Performance technology. In R.E. West (Ed.), *Foundations of learning and instructional design technology: The past, present, and future of learning and instructional design technology*. EdTech Books. https://edtechbooks.org/lidtfoundations/performance_technology

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Gamification and the Way It Can be Used to Influence Learning

&

Educational Games Gamification Motivation

This chapter presents an engaging discussion of the way that gamification and learning technology have developed over recent years, as well as examining some of the theoretical contestations in the field, mapping out avenues for future research and development, and providing clear advice for designers considering adopting gamified approaches. The chapter begins by defining the game and recognizing that gaming and gamification both have a long history. It notes that gamification is distinct from games, and uses Kapp's (2012) discussion of the elements of gamification to discuss this. From that point, a conversation is developed about the need to design gamification in such a way so that is fit for its intended purpose. This leads into a discussion about how various learning theories, including

behaviourism, and motivation theories, relate to gamification design. It notes the distinct advantages that have been lent to the development and adoption of gamification via mobile technology, and especially internet enabled devices. It will also recognize that some of the promises of gamification, especially as it relates to learning and instructional design, have failed to materialize. The chapter concludes with advice for designers to consider as they design their own gamification, including how they might leverage the most value on gamified resources. The chapter makes significant use of authentic examples and case studies drawn from a range of different industries and areas, thus ensuring that students of all backgrounds are able to access the material and apply it to their own experience.

Defining a Game

It should be no surprise that people love playing games and that they have done so for a very long time. For example, archaeologists have found chess sets that might be more than 1500 years old. Go (a Chinese abstract strategy game where players try to capture territory on a game board) is much older—dating back to 2000 BCE. For many, games of any form are a distraction from everyday life and are often dismissed as nothing more than that; however, that ignores the potential for learning that takes place in games. We, as learning designers and educators, need to be mindful of these opportunities, especially as **gamification** is a buzzword in education and training today.

It is easy to be distracted by new and innovative ideas. One of our challenges as educators is to look at these ideas through a critical lens and consider whether these new ideas are viable, sustainable, and actually contribute to learning—or whether they are educational flim-flam destined to go the way of interactive whiteboards!

So, what is a game, and how is that it to gamification? There are many definitions of what a game is, given the diverse forms and contexts in which games are played. Salen and

Zimmerman (2003, p. 5) proposed the following: "A game is a system in which players engage in artificial conflict, defined by rules, that results in a quantifiable outcome."

While this definition is a good fit for many board games, or even sporting games, it does not necessarily harmonize with other definitions. What about those games where there is little player involvement, such as the so-called idle genre (for an example, see Raid: Shadow Legends)? Modern interpretations of games need a more measured definition. One game designer defined a game as "a system in which players engage in an abstract challenge, defined by rules, **interactivity**, and **feedback**, that results in a quantifiable outcome often eliciting an emotional reaction" (Koster, 2003, p. 12). This is a much more comprehensive definition that includes a few new ideas, such as the emotional reaction that games produce.

Karl Kapp (2012) examined the **elements** that comprised both definitions (Salen and Zimmerman's, and Koster's) and created a new, workable definition. He said,

> *Together these disparate elements combine to make an event that is larger than the individual elements. A player gets caught up in playing a game because the instant feedback and constant interaction are related to the challenge of the game, which is defined by the rules, which all work within the system to provoke an emotional reaction and, finally, result in a quantifiable outcome within an abstract version of a larger system. (p. 9)*

Each of these elements of games in Kapp's framework are explained below (see Figure 1).

Figure 1. The Elements of Games

Defining What Gamification Is and Is Not

Using Kapp's (2012) elements of games, it is now possible to consider what gamification means in the context of learning. Kapp suggested that gamification involves using elements traditionally thought of as being part of games, or elements that are fun, to promote learning and engagement. He defined gamification as "using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems" (2012, p. 10). We will explore these elements in the next section.

Kapp (and others) are also firm about what gamification is not. This is important because being aware of some of these ideas will help us more critically determine which educational technology integrations are likely to be successful and which are not. Kapp argued that gamification is not just the implementation of badges, points, and rewards. While these implementations are elements or **mechanics** of gamification, they alone are not sufficient for true gamification–nor is gamification a trivialization of learning.

The debate about whether game-based learning is the same as gamification is a point of some contention. Serious games are described as complete experiences that use game mechanics and game thinking to educate individuals. On the other hand, gamification — the use of game mechanics to engage learners — is often seen as more limited. Gamification allows for meaningful learning in a range of contexts. The effectiveness of this learning and the application of gamification depends on embracing all the elements of gamification, not just the simple ones such as badges and rewards. These elements, such as storytelling, have much in common with those of serious games. Thus, the distinction between serious learning and the more effective applications of gamification is largely meaningless.

The field of game-based learning is a bit older (in terms of research) than gamification. One of the key researchers in the field has been James Paul Gee, who identified 16 principles of good game-based learning in 2013. He wrote mostly about video games, but many of the elements he identified as being central to game-based learning are also elements of gamification. For the purposes of our discussion, we will consider them to be essentially the same thing. These elements are incorporated into the discussion below (see Figure 2).

Another point to consider is that gamification is not new. We know that war games have been used to train soldiers since the 7th century. Similar games-based learning approaches are still used in military academies around the world (although they are more technology-enhanced). Gamification is also not new to learning professionals. Many educators have used elements of gamification for a very long time. Even the notion of bonuses for performance in corporate settings can be seen as an example of gamification.

Finally, Kapp (2012) indicated that gamification is neither perfect for every learning situation, nor easy to create. Good processes of gamification are time and resource intensive. Creating a learning activity that is both enjoyable and instructional is no easy task.

Elements of Gamification

We have probably all played games that we have found to be intensely interesting—almost becoming addicted to them, returning to them over and over again because we just want "one more go!" This can be the hallmark of a well-made game (although that, of course, depends on what you mean by "well made"). The elements that contribute to the making of that game are also important to designing a satisfactory gamified learning experience. These elements are presented in Figure 2 (adapted from Kapp, 2012).

Figure 2. The elements of gamification.

Some examples of these elements in action are presented in Table 1.

Elements of gamification	**Example learning activity**
Rules	Natural selection simulation This learning resource uses game-like mechanics to create a simulation of an ecosystem. Students can change the rules of the system and observe the outcome just like they do when playing a video game such as Minecraft.
Aesthetics	Fire and Evacuation VR Safety Training This video of a VR Fire safety training module shows how leveraging aesthetics such as full 360 vision, sound, and interactivity from games creates an engaging and immersive experience.
Conflict, competition, or cooperation	Communication puzzle In this activity, learners must work collaboratively, communicate, and problem solve to complete the activity.

Table 1. Examples of gamification

Think About It!

Try this simple gamification strategy.

1. Open the last multiple-choice quiz you created or completed.
2. Use this spinner to select an element of game to use.

3. Use this spinner to find out what tool you will use to apply your element of game.
4. Create a different version of the quiz by using the element of game and design tool.

Notes

- At first glance, some of these combinations of tools and elements may seem to be incompatible, but they are just an opportunity to stretch your creativity. For example, if you were assigned the game element of 'random' and the tool of 'branching scenario', you could create an assessment where the learner is randomly assigned different responses in a scenario, asked to explain whether these are the right or wrong choice in that situation, and instructed to justify their answer.

Ensuring Gamification Is Fit for Purpose

Not all gamification is created equal. As discussed earlier, gamification can be reduced to the trivial. For example, a learning designer can add points, badges, and/or multiple-choice questions to some presentation slides they turned into a video. They might even rank participant's scores on a leader board and claim the learning activity has been gamified. Ultimately, this will be a transient and unsatisfactory experience. It does technically meet the definition of being "gamified," as it incorporates several of the elements discussed above, and it may be slightly more engaging to some users, but it fails because it does not combine all, or most, of the elements of gamification into an event that is larger than its individual parts.

Choosing which activities to gamify and how to gamify them is a key part of **learning design**. Competitive elements of games such as scoring, recognizing winners and losers, or providing a league table can be motivating or engaging to certain types of learners but strongly de-motivating to others—particularly low-ability or low-interest learners. Similarly, adding a scenario to your learning activity may be very interesting to learners, but if your learning activity is one that must be repeated regularly, the story will rapidly become stale and demotivating.

A different pitfall that designers often fall into is the trap of seeking **engagement** over learning. A gamified learning activity can be fun to learners. In fact, usage statistics and feedback may tell you that your learners are engaged and motivated by the activity. However, if the assessment shows no appreciable improvement in learning or change in behavior, then the learning activity has not been a success. Good, gamified learning experiences should improve engagement—but not at the cost of learning.

Another concern that must be addressed when gamifying a learning activity is the lack of equity and accessibility. For example, a virtual reality experience could be wonderfully engaging to your learners but may be inaccessible and inequitable to learners with a range of disabilities. Equally, a gamified activity that requires an able body will exclude many adult learners in a workplace setting and should be chosen with caution.

Ideally, any application of gamification to a learning activity will begin with thoughtful consideration of your learners and their context to ensure that you are making choices that are fit for the intended learning objective. Table 2 showcases some poor examples of gamification.

Problematic gamification	**Example learning activity**
Too competitive	Kahoot is a very popular cooperative online quiz software. Kahoot! tournaments and similar tools are used by large companies to train and gather data on their employees. While this approach is touted as giving the company lots of useful data and a fun way to train large groups of employees, there is no consideration for the employees who may be alienated by this kind of competitive approach.
Engagement without learning	The Reading Eggs program is a very popular program designed to help children learn to read. Watch this video The key selling point in this video is how engaged the children are. However, in a classroom, teachers may see students rushing through their readings in order to earn points to be able to play games. The design of this program places emphasis on the rapid completion of reading tasks instead of children developing an intrinsic interest in reading.
Inaccessible	Gamification in learning design is not always about learning a skill or concept—it can be about changing behavior. This example of gamification is inaccessible to everyone who is not able bodied. If your learners cannot access the learning experience or activity you are offering, your design will be less successful.

Table 2. Poor Examples of Gamification (LIDT in the World)

LIDT in the World

Scenario-based learning is often an excellent tool of gamification, but just like the examples given above, it can fail if applied poorly.

Cathy Moore is an internationally recognized training designer who follows a specific approach to scenario-based learning. Her useful website includes a number of examples of scenarios to help you understand how to use or, in this case, not use her scenario-based learning approach.

- Complete the scenario [Classroom management by Cathy Moore](). Consider how these elements are present in the scenario:
  - feedback
  - storytelling/ engagement
  - problem solving
  - learning outcomes
- Can you think of a situation where this kind of scenario would be highly effective? When could it be a ineffective?

Gamification and Learning

One of the main criticisms of gamification is that, in most forms, it uses limited behaviorist theories to inform teaching and learning practices. While this concern might be the case when regarding the use of rewards and some forms of feedback, this mindset fundamentally misunderstands the wider applications of gamification and ignores the way other theories of learning have informed the development of gamified principles and approaches to learning. In this section, the links between gamification and some key ideas relating to learning and instruction are examined.

Conditioning

The ideas of conditioning (from the behaviorist approach to learning) are present in many forms of gamification—most often in the form of operant conditioning, where players are rewarded for demonstrating a particular behavior. This reward reinforces the behavior and increases the probably that it will be demonstrated again. The most effective mechanism for this is, somewhat counter-intuitively, a **variable interval schedule**, where a player is rewarded after demonstrating the behavior a certain number of times but on an uneven schedule that cannot be predicted.

Motivation

A key concept of gamified learning is encouraging **motivation**. The argument is that gamified learning is more effective because the learner is more motivated to complete the learning. This motivation comes because they are more engaged and are having fun. However, there are two different kinds of motivation, and good gamified models make use of both. The first type of motivation is extrinsic motivation—the motivation that comes from outside the learner and is often developed through rewards and punishments. The second type of motivation is intrinsic motivation, which is when a person undertakes an activity for its own sake, the feelings of enjoyment, learning, and accomplishment they receive from that activity. Kapp (2012) explained,

> *When people are intrinsically motivated, they tend to be more aware of a wide range of phenomena, while giving careful attention to complexities, inconsistencies, novel events, and unexpected possibilities. They need time and freedom to make choices, to gather and process information, and to have an appreciation of well-finished and integrated products, all of which may lead to a greater depth of learning and more creative output. Intrinsic motivation is when the rewards come from carrying out an activity rather than from the result of the activity. (p. 16)*

A good method of thinking about motivation is through John Keller's ARCS model (2009). Keller explained that motivation has four main characteristics:

Attention: Good learning must gain the attention of the learners to pique their interest in the content. There are different kinds of attention (or arousal). Perceptual arousal means gaining attention through specific relatable examples, incongruity or surprise. Inquiry arousal involves stimulating curiosity by presenting a question that the learner is interested in solving. Variability in delivery method is important too, as it can be used to hold the learner's attention.

Relevance: There are three different methods of ensuring relevancy: goal orientation, which means orienting the learner to the importance of achieving the goal and explaining how it will help in the future; familiarity, which is related to linking new knowledge to existing knowledge; and modelling the learning of new knowledge.

Confidence: If learners are confident that they can learn the material, they tend to be more motivated.

Satisfaction: If learners are satisfied with the experience and believe that the learning has value, they will perceive the experience as being worthy of continuing the effort.

Distributed Practice

An element of gamification related to cognitivist theories of learning is the idea of distributed practice. This element has different names. Sometimes, it is called “spaced learning” or “spaced practice.” It is the idea that learning is more efficient if it is spread over multiple shorter sessions, rather than in one long session. Distributed practice helps learners remember information over long periods of time because the spacing prompts deeper processing of the learned material.

Social Constructivism

Social constructivist theories of learning often refer to Vygotsky's Zone of Proximal Development (1978). This is the idea that we learn best when the learning is pitched at the right level. If it is too easy, we don't learn. If it is too hard, we often struggle or give up. Scaffolding is a pedagogical approach that is used to assist in structuring the learning to ensure that learners receive the appropriate level of support in the Zone of Proximal Development. Scaffolding is like the use of levels in games and gamified learning. As Kapp (2012) stated,

> *Scaffolding and the use of levels in games provide educational advantages but also maintain interest in the game as a player moves from level to level having different experiences and achieving success as he or she progresses toward the ultimate goal. The levels usually become more difficult and challenging as the players move toward the end of the game, and the skills they exhibit at the final level would not be possible without the experience of playing the preceding levels. (p. 67)*

Learn More About Social Learning Theory

To learn more about Social Learning Theory, we recommend reading another chapter from this textbook titled Sociocultural Perspectives on Learning by Allman, Casto, and Polly.

Social Learning Theory

Finally, Albert Bandura's social learning theories (1977) are sometimes present in gamification too, often in the form of cognitive apprenticeships and modelling. Modelling is the process by which people learn to behave through observing, reflecting upon, and then copying the behaviors of those who they perceive to be important. It is not only present among children but also among workplace employees and other professionals. The use of avatars is also a way to encourage desired behavior through modelling.

Advice for Using Gamification Effectively

As stated earlier, gamification is popular in many settings. However, this can sometimes work against educators, as learners might have had previous bad experiences with gamification. The overuse of some elements of gamification and poor gamification design has led to a level of mistrust in learners, subject matter experts, and content owners. Because of this mistrust, they are resistant when educators suggest gamification of a specific learning activity. Understanding good gamification and how it is different from what has gone before will help educators make a better case for these design approaches.

When poor quality examples of gamification are reviewed, the following elements of game design are often over-represented:

- conflict, cooperation, competition
- levels
- reward structure
- goals
- abstractions
- rules

There is a reason these elements are commonly overused, as they are cheaper and easier to apply to learning activities. They also link back to the discussion about creating activities that are suitable for learners and their contexts, as well as the idea of the elements being used to create something that is greater than the sum of its parts. Many of these elements, when used on their own, create activities that are overly competitive, lead to short-term engagement without learning, or are inaccessible to a variety of learners.

In contrast, the list of underused elements is shorter. It contains all the elements that are more difficult to apply, and yet lead to richer, more robust learning activities.

- feedback
- storytelling
- aesthetics
- replay or do-over opportunities
- time (when used as a motivator or distributed as a finite resource)

Not all elements of gamification can be considered equal. In fact, some elements are more impactful than others.

Figure 3 presents a framework developed by Seldon and Kolber (2017) about the relative importance of various gamification elements. For example, while rewards will provide slight gamification benefits, the strongest benefits and most transformational changes come from introducing strong storytelling and elements of discovery to the learning. It is not that rewards, competition, rules and so on are not useful in gamification. Rather, on their own and without higher order elements, the lower order elements risk alienating learners, driving engagement without actual learning, or simply being inaccessible to a reasonable percentage of your learners.

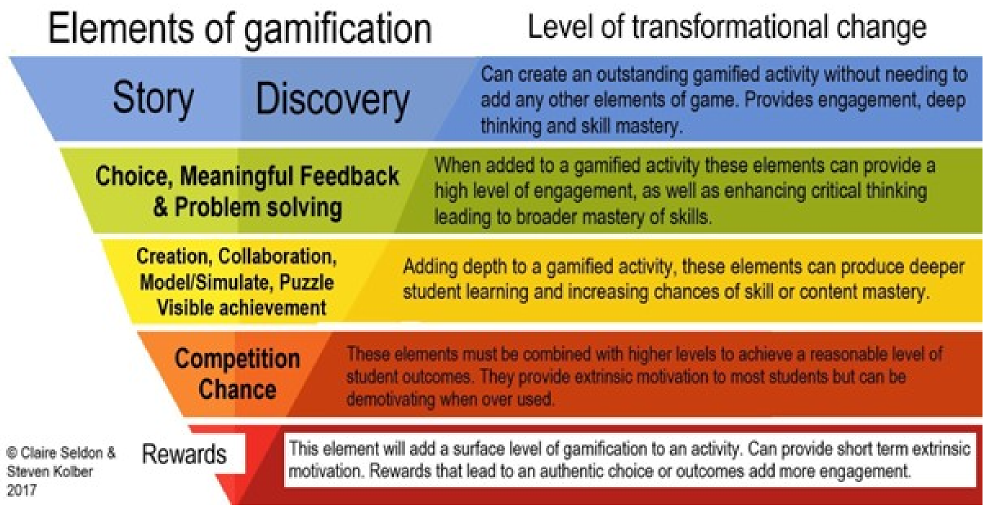


Figure 3. *Change and Gamification*

To gamify effectively, educators should start with a purposeful approach to these elements and choose them based on the specific learning outcome required as well as the strength, weaknesses, and contexts of the learners.

An Example of Effective Gamification

To see these elements in play, you may view the following example of a gamified learning resource. It is a VR experience of a bushwalk in the endangered Cumberland Plains woodland.

First, note that this resource is not a game. It is a virtual learning experience designed to provide information to school students who are 5–16 years old. It could have been created solely as an educational webpage with images and text about plants and animals, but the designer added elements of gamification to create a more fulfilling learning experience.

The resource displayed above has the elements of aesthetics, feedback and discovery, replay or do-over, and time (See Figure 2). As a learner moves through the space, they are able to explore a high-quality image with surround sound in an immersive way. The interaction icons are small and do not crowd the viewing space. Also, the map in the top right-hand corner helps to orientate the learner in the virtual environment.

The learner makes choices about where they visit and what they look at by selecting question marks to learn about the space and by using arrows to move around. Each question mark gives the learner feedback about what plants, animals, insects, and hazards they might find in that ecosystem. The question mark was chosen and used deliberately to increase the learner's motivation, attention, sense of discovery, and sense of choice. If the icons had been chosen to represent what was located at that point (e.g., a plant, animal, or insect), learners might only select what they think they are interested in instead of discovering all the different and interesting parts of a functioning ecosystem.

The ability for a learner to move through the walk as many times as they want, or even jump to a specific location using the map, gives them the opportunity to explore at their own pace. This feature also ensures they feel safe and confident to revisit places and information as many times as they like rather than pushing them through a linear experience.

Conclusion

This chapter introduced the concept of gamification, explored its relationship to games themselves, and discussed how the elements of gamification relate to the mechanics of games. It also briefly considered the history of games as tools for learning and noted that gamification is not something that must rely upon technology in order to be effective. This chapter also explored how gamification relates to some of the common theories about learning.

More importantly, this chapter also discussed which of the elements of gamification are most effective for learning. The notions of story, discovery, choice, and problem solving are harder to implement; however, but they are far more likely to produce meaningful learning outcomes than simpler elements such as rewards and competition. In order to demonstrate ways in which these more complex elements might be utilized, a number of examples from various contexts were discussed.

LIDT in the World

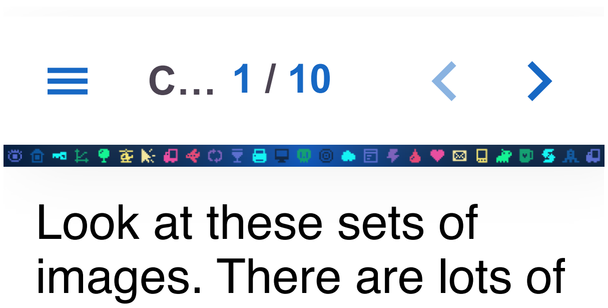
Academic integrity is an important topic at every university but is also the kind of boring mandatory training that students avoid or think they already know all about. It is therefore a learning situation that is ripe for the application of gamification.

1. Play through the scenario.
2. How has the designer used the following elements of gamification well?
    1. Feedback
    2. Storytelling
    3. Aesthetics
    4. Replay or do-over
    5. Time

3. How would you improve this example if you had an unlimited budget?

Think About It!

Encouraging a learner to discover something for themselves, rather than simply telling them a key information or guiding them through the steps of a skill, is a key part of constructivist pedagogy. This example of gamification turns away from the traditional short video and quiz format. Instead, it challenges high school students to discover the key parts of computational thinking and develop their own working definitions.



1. Complete the learning task.
2. Evaluate how this approach is different from watching a short video about computational thinking.
3. Explain how the gamification approach in the Learning Check above is more difficult to apply.
4. Imagine that you need to pitch or sell a gamified learning activity to your manager or supervisor. What talking points should you prepare to help explain why simplistic approaches of design are not always the best approach to gamification in instructional design?

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Design-Based Research: Research to Improve Design and Theory

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Design Research | Design-based Implementation Research | Design-based Research | Research | Research Methods

Not all design research has the same goals and purposes, and thus does not follow similar methods and processes. One way of defining different purposes of design research is by identifying the preposition in the relationship between research and design. Doing this, we identify three broad approaches to integrating design into research: research into design, research for design, and research through design. We use this to situate current discussions about design-based research. We then provide a historical view of design-based research, along with the key characteristics of design-based research and advice for writing and reviewing design-based research reports.

As Learning and Instructional Design Technology professionals, we seek to improve teaching and learning in all situations and for all people. Part of accomplishing that mission is to develop understanding of the world through research, both research that explores an idea (e.g., qualitative research) and research that explains the relationships/variables in a phenomenon (e.g., quantitative research).

However, because we are also trained as designers, there is a third method that we use to understand the world, and that is through designing interventions to change the learning in a situation (see Gibbons & Bunderson, 2005). By creating new learning designs, we develop deeply intimate understanding of a phenomenon. This is knowledge only a creator knows and understands about their creation—knowledge that is "inaccessible via other means" (Moore et al., 2024, p. 2680). This knowledge helps a designer be more effective, but can also be communicated to others to develop both generalized theory about teaching and learning, as well as contextualized, local theory about how teaching and learning happens for specific individuals in a unique setting.

In this chapter, we explain the history of design as a form of research and knowledge creation, briefly touch on different ways to document and share design knowledge, and then focus more specifically on design-based research as a dominant strategy within the field.

Situating Design Research

In this chapter, we use the term design research to broadly mean all the different methods of using research methods/strategies in conjunction with design processes and activities. A scholarly focus on design research fosters the development of design theories, which in turn improve the quality of design and design practice (Margolin, 2010).

The Approach Trinity

However, not all design research has the same goals and purposes, and thus does not follow similar methods and processes. One way of defining different purposes of design research is by identifying the preposition in the relationship between research and design. Doing this, we identify three broad approaches to integrating design into research: research into design, research for design, and research through design (Buchanan, 2007; Cross, 1999; Jonas, 2007; Schneider, 2007). In presenting this trilogy, we rely most heavily on Jonas (2007) who described this originally, but more recently Jacobsen and McKenney (2023) have argued for a similar framework. We will interweave their thoughts with Jonas'.

Jonas (2007) identified research into design as the most prevalent—and straightforward—form of design research. This approach separates research from design practice; the researcher observes and studies design practice from without, commonly addressing the history, aesthetics, theory, or nature of design (Schneider, 2007). We argue that research into design is not typically considered part of design-based research, but it is a valuable approach to understanding design professionals, design processes, and design practice, and studies of this nature are frequently published.

Research for design applies to complex, sophisticated projects, where the purpose of research is to support research and development, such as in market and user research (Jonas, 2007), or in smaller cases where the research creates understanding about users/learners to aid the designers. Here, the role of research is to build and improve the design, not contribute to theory or practice. Jacobsen and McKenney included this in their framework as well, and argued this research studies the original problem that led to the design, the context for the design, and the stakeholders impacted.

According to Jonas's (2007) description, research through design is where researchers work to shape their design (i.e., the research object) and establish connections to broader theory and practice. This approach begins with the identification of a research question and carries through the design process experimentally, improving design methods and finding novel ways of controlling the design process (Schneider, 2007). Jacobsen and McKenney divided this into two types of research: research on design, which focuses on the qualities of a design that helps to meet the learning goals, and research through design that focuses on the impacts that come from the design once implemented. We will call this approach research through design but recognize the distinctions that Jacobsen and McKenney had on the qualities of an intervention vs. the outcomes created.

Cross's-ologies

Cross (1999) conceived of design research approaches based on the early drive toward a science of design and identified three bodies of scientific inquiry: epistemology, praxiology, and phenomenology. Design epistemology primarily concerns what Cross termed "designerly ways of knowing" or how designers think and communicate about design (Cross, 1999; Cross, 2007). Design praxiology deals with practices and processes in design or how to develop and improve artifacts and the processes used to create them. Design phenomenology examines the form, function, configuration, and value of artifacts, such as exploring what makes a cell phone attractive to a user or how changes in a software interface affect user's activities within the application.

Buchanan's Strategies of Productive Science

Like Cross, Buchanan (2007) viewed design research through the lens of design science and identified four research strategies that frame design inquiry: design science, dialectic inquiry, rhetorical inquiry, and productive science (Figure 1). Design science focuses on designing and decision-making, addressing human and consumer behavior. According to Buchanan (2007), dialectic inquiry examines the "social and cultural context of design; typically [drawing] attention to the limitations of the individual designer in seeking sustainable solutions to problems" (p. 57). Rhetorical inquiry focuses on the design experience as well as the designer's process to create products that are usable, useful, and desirable. Productive science studies how the potential of a design is realized through the refinement of its parts, including materials, form, and function. Buchanan (2007) conceptualized a design research—what he termed design inquiry—that includes elements of all four strategies, looking at the designer, the design, the design context, and the refinement process as a holistic experience.

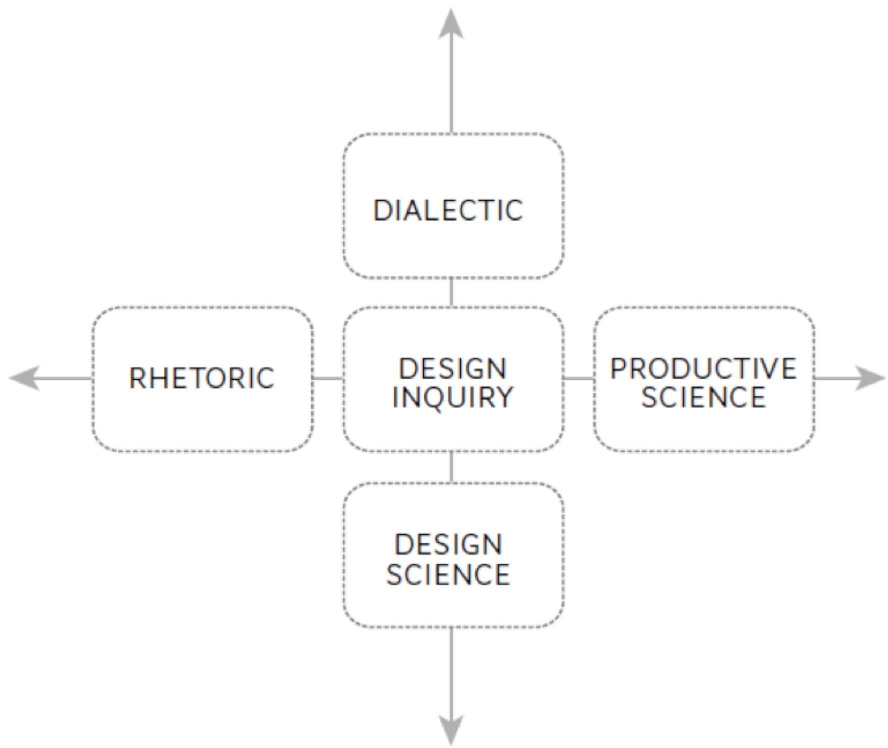


Figure 1. Buchanan's productive science strategies, adapted from Buchanan (2007)

History of Design Research

These frameworks from Jonas, Cross, and Buchanan help us understand the different ways that design and research can support each other as a holistic design research methodology. Design research has existed in primitive form—as market research and process analysis—since before the turn of the 20th century, and, although it served to improve processes and marketing, it was not applied as scientific research. John Chris Jones, Bruce Archer, and Herbert Simon were among the first to shift the focus from research for design (e.g., research with the intent of gathering data to support product development) to research on design (e.g., research exploring the design process). Their efforts framed the initial development of design research and science.

John Chris Jones

An electrical/industrial engineer, Jones (1970) felt that the design process was ambiguous and often too abstruse to discuss effectively. One solution, he offered, was to define and discuss design in terms of methods. By identifying and discussing design methods, researchers would be able to create transparency in the design process, combating perceptions of design being more or less mysteriously inspired. This discussion of design methods, Jones proposed, would in turn raise the level of discourse and practice in design, something he encouraged as an early leader in the Design Research Society.

Bruce Archer

Archer, an early leader in industrial design, worked with Jones and likewise supported the adoption of research methods from other disciplines. Archer (1965) proposed that applying systematic methods would improve the assessment of design problems and foster the development of effective solutions. Archer recognized, however, that improved practice alone would not enable design to achieve disciplinary status. In order to become a discipline, design required a theoretical foundation to support its practice. Archer (1981) advocated that design research was the primary means by which theoretical knowledge could be developed. He suggested that the application of systematic inquiry, such as existed in engineering, would yield knowledge about not only product and practice, but also the theory that guided each.

Herbert Simon

It was multidisciplinary social scientist Simon, however, that issued the clarion call for transforming design into design science. In The Sciences of the Artificial, Simon (1969) reasoned that the rigorous inquiry and discussion surrounding naturally occurring processes and phenomena was just as necessary for man-made products and processes. He particularly called for "[bodies] of intellectually tough, analytic, partly formalizable, partly empirical, teachable doctrine about the design process" (p. 132). This call for more scholarly discussion and practice resonated with designers across disciplines in design and engineering (Buchanan, 2007; Cross, 1999; Cross, 2007; Friedman, 2003; Jonas, 2007; Willemien, 2009). Design research sprang directly from this early movement and has continued to gain momentum, in engineering, design, and technology.

Design Experiments

Years later, in the 1980s, Simon's work inspired the first design-based research (DBR) efforts in education (Collins et al., 2004). Much of the DBR literature attributes its beginnings to the work of Ann Brown and Allan Collins (Cobb et al., 2003; Collins et al., 2004; Kelly, 2003; McCandliss, Kalchman, & Bryant, 2003; Oh & Reeves, 2010; Reeves, 2006; Shavelson et al., 2003; Tabak, 2004; van den Akker, 1999). Their work on design experiments focused on research and development in authentic contexts, and drew heavily on research approaches and development practices in the design sciences, including the work of these early design researchers such as Simon (Brown, 1992; Collins, 1992; Collins et al., 2004).

The Emergence of Design-Based Research

As more researchers and designers acknowledged the work of Brown and Collins in the 1990s and early 2000s and how design experiments could be useful in research and design practice, their ideas took off in education. With the uptake of design experiments, how they were applied changed as they were used. Education researchers saw design experiments as "both 'engineering' particular forms of learning and systematically studying those forms of learning within the context defined by the means of supporting them" (Cobb et al., 2003, p.

9). The focus with design experiments was on real-world contexts, outside of laboratory experiments, and testing and revising designs in those contexts. As an iterative process, design experiments transitioned into design-based research.

Formalizing DBR Processes and Definitions

While scholarly approaches to research into design and research for design are important, in the rest of this chapter we will focus on design-based research as an approach to doing research through design. But what is, exactly, design-based research? One of the most challenging characteristics of DBR is the quantity and use of terms that identify DBR in the research literature. According to van den Akker (1999), the use of DBR terminology and nomenclature varies by educational sub-discipline, with areas such as (a) curriculum, (b) learning and instruction, (c) media and technology, and (d) teacher education and didactics favoring specific terms that reflect the focus of their research (see Table 1).

Table 1.

Subdiscipline	Design Research Terms	Focus
Curriculum	Developmental research	To support product development and generate design and evaluation methods (van den Akker & Plomp, 1993).
Developmental Research	To inform decision-making during development and improve product quality (Walker & Bresler, 1993).	
Formative Research	To inform decision-making during development and improve product quality (Walker, 1992).	
Learning and Instruction	Design experiments	To develop products and inform practice (Brown, 1992; Collins, 1992).
Design-based Research	To develop products, contribute to theory, and inform practice (Bannan-Ritland, 2003; Barab & Squire, 2004; Sandoval & Bell, 2004).	
Formative Research	To improve instructional design theory and practice (Reigeluth & Frick, 1999)	
Media and Technology	Developmental research	To improve instructional design, development, and

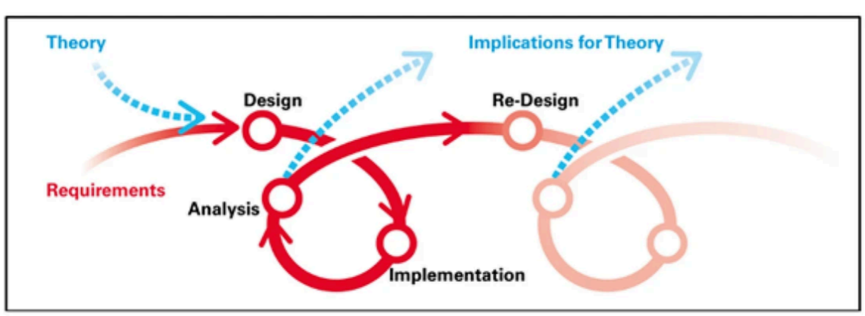
Subdiscipline	Design Research Terms	Focus
		evaluation processes (Richey & Nelson, 1996).
Teacher Education & Didactics	Developmental research	To create theory- and research-based products and contribute to local inst4ructional theory (van den Akker, 1999).

We will now briefly describe a few of these models, briefly.

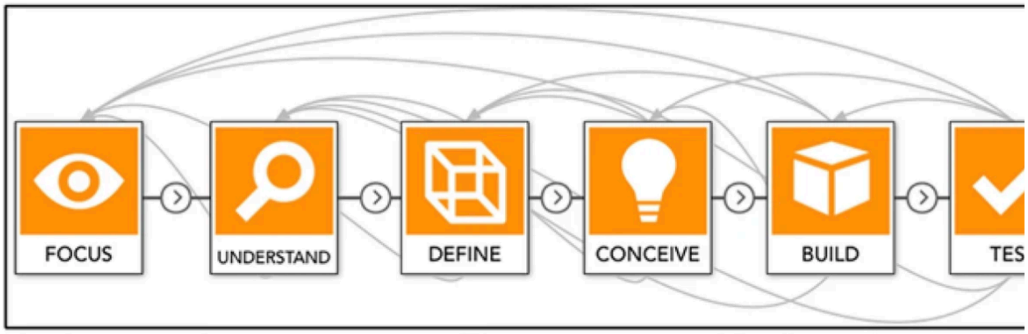
Design-based research. Barab (2014) defined DBR as an approach that "deals with complexity by iteratively changing the learning environment over time— collecting evidence of the effect of these variations and feeding it recursively into future designs" (p. 154). DBR addresses needs and issues, real problems in practice. But it also incorporates the process of design to address these problems, with a theoretical base and a research design to iteratively study the learning phenomena and refine the learning environment. All of these elements work together to develop products, contribute to theory, and inform or discover solutions to problems in practice (Bannan-Ritland, 2003; Barab & Squire, 2004; Sandoval & Bell, 2004).

Defining DBR and explaining the various models researchers had for it meant there were many articles written. A major initial description came from the Design-based Research Collective, a collection of researchers funded by the Spencer Foundation to study this "emerging paradigm." Their work was published in 2003 in Educational Researcher (DBRC, 2003—later revisted by the journal a decade later by Anderson & Shattuck, 2012). In 2004, the Journal of the Learning Sciences published a special issue on DBR (https://www.tandfonline.com/toc/hlns20/13/1?nav=tocList), followed by a special issue in 2005 in Educational Technology Magazine (https://www.jstor.org/stable/i40186159). Then in 2015 the Australasian Journal of Educational Technology published a special issue on educational design research (https://ajet.org.au/index.php/AJET/issue/view/114).

To help people understand the design-based research process as well as the various elements that are part of it, many visual models were created. The images are meant for novices to gain a better understanding of the nature of DBR. The various models attempt to represent the cyclical and messy nature of design-based research in a two-dimensional way (see images below). They are not all the same, some have more detail on the more granular level of the process and elements (see Easterday et al, 2014 and McKenney and Reeves, 2018); while Fraefel (2014) is more basic to the DBR process.

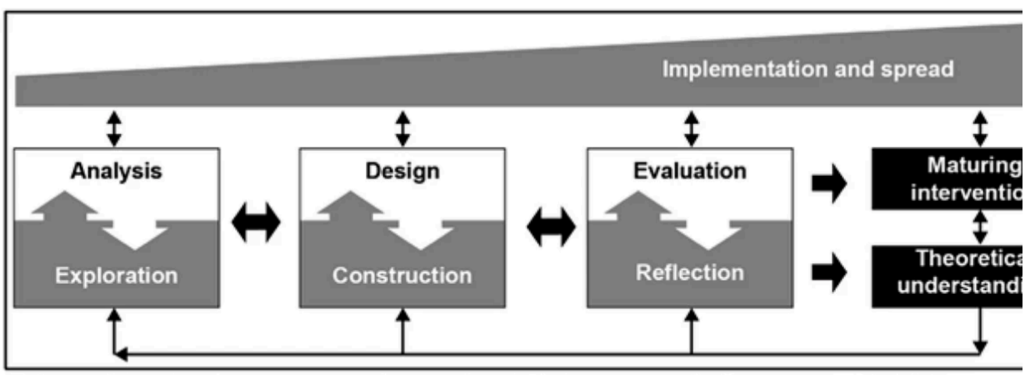


Design-based research model as a process for ongoing innovation (Fraefel, 2(



Design-based research model (Easterday et al., 2014)

Education Design Research. In contrast to design-based research, McKenney and Reeves (2018) called their model education design research (EDR) and defined it as “a genre of research in which the iterative development of solutions to practical and complex educational problems also provides the context for empirical investigations, which yields theoretical understanding that can inform the work of others” (p. 7, see Figure X). While a well-known model, the name educational design research is still well known, and in 2017 the Educational Design Research: An International Journal for Design-Based Research in Education published its first issue.



Education design research model (McKenney & Reeves, 2018)

Design-based Implementation Research. In 2014 a new variation emerged: design-based implementation research (DBIR). This variation emphasizes that DBIR is an approach to organizing research and development to problems and needs in practice. It is a collaborative and iterative approach grounded in systematic inquiry. The purpose of DBIR is to build the capacity of systems and engage in a continuous improvement process for the end goal of a transformation of teaching and learning (Fishman et al., 2013). DBIR is different from DBR in that it has a focus on developing capacity for sustaining change in systems. The DBIR process is explained in detail in published articles and on the Learn DBIR website (https://www.colorado.edu/research/learn-dbir/). DBIR pairs easily with Research-Practice Partnerships and some researchers argue that to do DBIR you must be in a research-practice partnership.

Key Characteristics of Design-Based Research

The proliferation of terminology among scholars and inconsistent use of these terms has created a sprawling body of literature, with these various splinter DBR groups hosting scholarly conversations regarding their particular brand of DBR. However, whatever design-based research is called, scholars agree that in order to do design-based research, you must do research that is:

Design driven. All literature identifies DBR as focusing on the evolution of a design (Anderson & Shattuck, 2012; Brown, 1992; Cobb et al., 2003; Collins, 1992; Design-Based Research Collective, 2003; Hoadley & Campos, 2022). While the design can range from an instructional artifact to an intervention, engagement in the design process is what yields the experience, data, and insight necessary for inquiry.

1. **Situated and problem-focused.** Recalling Brown's (1992) call for more authentic research contexts, nearly all definitions of DBR situate the aforementioned design process in a real-world context and problem, such as a classroom (Anderson & Shattuck, 2012; Barab & Squire, 2004; Cobb et al., 2003).
2. **Iterative.** Literature also appears to agree that a DBR process does not consist of a linear design process, but rather multiple cycles of design, testing, and revision (Anderson & Shattuck, 2012; Barab & Squire, 2004; Brown, 1992; Design-Based Research Collective, 2003; Shavelson et al., 2003). These iterations must also represent systematic adjustment of the design, with each adjustment and subsequent testing serving as a miniature experiment (Barab & Squire, 2004; Collins, 1992).
3. **Collaborative.** While the literature may not always agree on the roles and responsibilities of those engaged in DBR, collaboration between researchers, designers, and educators appears to be key (Anderson & Shattuck, 2012; Barab & Squire, 2004; McCandliss et al., 2003). Each collaborator enters the project with a unique perspective and, as each engages in research, forms a role-specific view of phenomena. These perspectives can then be combined to create a more holistic view of the design process, its context, and the developing product.
4. **Theory building**. Design research focuses on more than creating an effective design; DBR should produce an intimate understanding of both design and theory (Anderson & Shattuck, 2012; Barab & Squire, 2004; Brown, 1992; Cobb et al., 2003; Design-Based Research Collective, 2003; Joseph, 2004; Shavelson et al., 2003). According to Barab & Squire (2004), "Design-based research requires more than simply showing a particular design works but demands that the researcher . . . generate evidence-based claims about learning that address contemporary theoretical issues and further the theoretical knowledge of the field" (p. 6). DBR needs to build and test theory, yielding findings that can be generalized to both local and broad theory (Hoadley, 2004).
5. **Practical.** While theoretical contributions are essential to DBR, the results of DBR studies "must do real work" (Cobb et al., 2003, p. 10) and inform instructional, research, and design practice (Anderson & Shattuck, 2012; Barab & Squire, 2004; Design-Based Research Collective, 2003; McCandliss et al., 2003).
6. **Productive**. Not only should design research produce theoretical and practical insights, but also the design itself must produce results, measuring its success in terms of how well the design meets its intended outcomes (Barab & Squire, 2004; Design-Based Research Collective, 2003; Joseph, 2004; McCandliss et al., 2003).

In short, Moore et al. (2024) summarized the main characteristics of DBR as including the following:

The DBR process generally includes an exploration and then focus on the challenge or problem to tackle. Then, using a theoretical framework (e.g., inquiry-based learning, cognitive learning, cultural historical activity theory) and applying design principles, something is created with the various collaborators on the project. That might be designing curricula, a program, professional learning, or resources. The practitioners then implement what was created, and that implementation is rigorously studied through rigorous research and data collection. Iterative refinements use the evidence collected through a cycle of design, implementation, analysis, and redesign.

Writing Up & Evaluating DBR Reports

Because it is so difficult to define and conceptualize DBR, it is similarly difficult to replicate authentically. As yet, there is not a commonly accepted structure for writing up DBR studies nor a list of criteria for evaluating the quality of DBR reports. Oftentimes authors publish DBR studies using the same format as regular research studies, making it difficult to recognize DBR research and learn how other DBR scholars mitigate the challenges from simultaneously managing a design project and research study.

Our recommendation is that DBR scholars publish the messy findings resulting from their work and pull back the curtain to show how they balanced competing concerns to arrive at their results. We believe it would help if DBR scholars adopted more common frameworks for publishing studies. As discussed in this chapter, the following are common characteristics of DBR:

- DBR is design-driven and intervention-focused
- DBR is situated within an actual teaching/learning context
- DBR is iterative
- DBR is collaborative between researchers, designers, and practitioners
- DBR builds theory but also needs to be practical and result in useful interventions

One recommendation is that DBR scholars adopt these as the characteristics of their work that they will make explicit in every published paper so that DBR articles can be recognized by readers and better aggregated together to show the value of DBR over time. One suggestion is that DBR scholars in their methodology sections could adopt these characteristics as subheadings. So in addition to discussing data collection and data analysis, they would also discuss:

- **Design Research Type** (research into, through, or of design),
- **Description of the Design Process and Product,**
- **Design and Learning Context,**
- **Design Collaborations,**
- **Design Iterations,** perhaps by listing each iteration and then the data collection and analysis for each.
- Also in the concluding sections, in addition to discussing research results, scholars would discuss
- **Applications to Theory** (perhaps dividing into Local Theory and Outcomes and Transferable Theory and Findings) and
- **Applications for Practice.**

In addition, DBR papers that are too big could be broken up, with different papers reporting on different iterations but using the same language and formatting to make it easier to connect the ideas throughout the papers. Not all papers would have both local and transferable theory (the latter being more evident in later iterations), so it would be sufficient to indicate in a paper that local theory and outcomes were developed and met with some ideas for transferable theory that would be developed in future iterations. The important thing would be to refer to all of these main characteristics in each paper so that scholars can recognize the work as DBR, situate it appropriately, and know what to look for in terms of quality during the review process.

In addition, it is important that journal reviewers and editors understand how to review DBR papers. Rather than using a typical evaluation rubric, we recommend that journals ask reviewers to consider the following when reviewing DBR papers (which parallels guidelines for mentors of papers in the journal Educational Design Research:

1. Is there sufficient exploration and analysis of the initial problem?
2. Is the description of the design and its context sufficient to understand the design?
3. Are the design iterations described and reflected on sufficiently to enable an understanding of what was new in each iteration and its potential effects?
4. Does the research meet rigorous methodological criteria for qualitative, quantitative, or mixed methodologies? (see Jacobsen & McKenney, 2023).
5. Is there sufficient explanation of both local and broad theory, and evidence from the research of the design to support each type of theory? Does the broad theory provide novel and useful guidance for research or practice?
6. Is there evidence provided of the practical benefit of the design, and its impact on practice by meeting its objectives in both implementation and dissemination?

Other Design Scholarship Approaches

There are other scholarly approaches to design work or design knowledge that are different from design-based research and that focus more on research into design and research for design. This includes instructional design cases and formative evaluation of design. In recent years there has been some confusion about the differences among these three areas, along with case study research (Moore et al, 2024). This confusion became apparent when editors of different design journals were reviewing articles that clearly did not fit the scope of their journal or the methods used in the article were not clearly articulating the type of design work they were engaged in. For example, the Journal of Applied Instructional Design (JAID; https://jaid.edtechbooks.org/about_jaid) publishes instructional design cases, but this journal was frequently receiving design-based research or case studies articles. Other journals that publish design work include the International Journal of Designs for Learning (IJDL; https://scholarworks.iu.edu/journals/index.php/ijdl) and the Journal of Formative Design for Learning (JFDL; https://link.springer.com/journal/41686). Finally, Educational Technology Research and Development, in the Development Section of the journal, publishes robust research on the planning, implementation, evaluation, and management stages of instructional designs with a focus on developed technologies.

Conclusion

Design-based research is, to some degree, natural for scholars in our discipline who are trained as both designers, theorists, evaluators, and researchers. When we seek to improve teaching and learning, we naturally design interventions to solve problems and create opportunities. And when we design things, we recognize the need for research and evaluation evidence to make our work successful. Also, as we consider the research and evidence, we often find connections to theory that can benefit other practitioners and researchers. Thus, often the work we do naturally could be called design-based research. However, in this chapter we have endeavored to argue for a more explicit approach to our design-based research. By understanding the history of DBR, its various approaches and models, and the key characteristics required to do it well, you can more explicitly consider how to attend to your work in a way that meets the criteria of quality design and research—and thus be more likely to make an impact in both a local setting and the general discipline.

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Assessment in the Instructional Design Process

Davies, R. S.

Assessment | Authentic assessment | Formative Assessment
Inclusive Assessment | Needs Assessment | Online assessment

This chapter provides an overview of assessment practices in the instructional design process.

Assessment is an essential aspect of the instructional design process associated with the expected learning outcomes of an educational product. Reiser and Dempsey (2012) suggested that instructional design involves designing and developing educational products to facilitate learning and improve performance. However, how do we know we have accomplished this goal once we have created an instructional product? This is where assessment is needed!

Evaluation and Assessment

Before we explore the topic of assessment, we need to understand the difference between two terms: assessment and evaluation. These related terms are often used interchangeably, but they have distinct meanings and purposes.

Assessment refers to the process of gathering information about an individual's knowledge, skills, abilities, or other characteristics. Assessment often requires that we create instruments (e.g., tests) to measure these characteristics. However, assessment can take other forms, such as observations or interviews. The primary purpose of assessment is to gather accurate, often quantitative, information about an individual so we can communicate and compare results.

Evaluation, on the other hand, refers to the process of making judgments or decisions based on the results of an assessment. An evaluation aims to make value-based judgments about an individual's performance or cognitive ability; this often requires we establish evaluation criteria.

The difference between these two terms is subtle. Assessment is descriptive, while evaluation involves judgment. Assessment is the process of gathering information, while evaluation is the process of making decisions based on the results of an assessment. An assessment becomes an evaluation when we make a determination about an individual based on assessment results.

Types of and Purpose for Assessment

Assessment serves multiple purposes in education, including:

Measuring Student Learning: *Summative assessments* measure achievement, enabling teachers to determine what students have learned (accountability) and verify they have accomplished the expected learning outcomes (certification). These types of assessments are most often evaluations.

Informing Instructional Planning: *Formative assessments* help teachers make informed decisions about the instructional needs of their students. The results of a formative assessment can help teachers plan the scope and focus of their instruction.

Assessing Readiness and Need: *Placement assessments* are a form of formative assessment that helps teachers determine a student's readiness for the planned instruction or whether a student needs to participate in the proposed instruction.

Diagnosing Learning Problems: Like formative assessment, *diagnostic assessment* can help with lesson planning, but at an individual level rather than a group level. The results of a diagnostic assessment are used to identify specific misconceptions a student may have or provide reasons why they failed to accomplish a specific task (got the question wrong). The results of a diagnostic assessment are used to provide detailed feedback to students---not just that they got a question wrong but also why they may have answered a question incorrectly or unsuccessfully completed a task.

Study Guides: Research has shown that using tests can be an effective study technique (Karpicke & Blunt, 2011). For example, taking a test-your-understanding quiz can help students improve their retention and recall of information. The results can provide valuable feedback for students, helping them identify areas where they need to improve. In addition, taking practice tests can reduce test anxiety as students become more comfortable with the testing process and the types of items used in an assessment.

Evaluating Program Effectiveness: The results of assessments can be used to evaluate the effectiveness of educational programs and initiatives, helping teachers and schools make data-driven decisions about improving the education they provide. However, when evaluating a program, assessment results are but one piece of evidence that should be considered. For a complete evaluation, one might include, among other things, an implementation fidelity study, a negative case analysis, or an analysis of unintended consequences.

Background of Assessment in Instructional Design

The field of instructional design emerged in the mid-1900s. The military was the first to design instruction systematically; they needed to train soldiers quickly and efficiently to perform specific tasks. An essential aspect of the military's training was the assessment of a soldier's aptitude and ability to correctly carry out what they had learned. Over the next few decades, an Instructional Systems Design (ISD) approach was adopted by most instructional designers. The main goal of ISD was to outline key steps that should be taken to ensure that quality instruction was created.

In the 1970s, the ADDIE model for designing and developing instruction was one of the first formal ISD models developed – reportedly by the Center for Educational Technology at Florida State University for the United States Armed Forces. ADDIE stands for Analyze, Design, Develop, Implement, and Evaluate. The analysis phase of the Addie model required a gap or needs analysis to determine the goals and objectives of the instruction to be developed. The original purpose of the evaluation phase in the ADDIE model focused on assessing student learning to determine whether the learning objective of the course had been met. The results of a summative assessment were used to certify that students had accomplished the intended learning objectives and were the main criteria used to determine the effectiveness of the instruction. However, the purpose of evaluation in the model was later expanded to include a more comprehensive view of evaluation that included formative evaluations of the instructional approach, design, usability, and maintenance of the instructional product.

The ADDIE model is arguably the most prominent instructional design model developed, but many others have since been developed and promoted. There are differences in the models, but there are three broad activities an instructional designer must accomplish:

1. Establish the learning objectives for the instruction.
2. Decide how to assess the expected learning outcomes.
3. Design and develop instructional activities to facilitate the desired learning.

Wiggins and McTighe (2005) popularized this idea by coining the term *Backward Design* or starting with the end in mind. Their book *Understanding by Design* included the following steps: Identify the desired results, determine acceptable evidence that the expected learning outcomes have been met, and then plan learning experiences and instruction to facilitate the expected learning. This approach of establishing learning objectives and assessments into the instructional plan before creating learning activities was not a new concept, but Wiggins and McTighe effectively rebranded the ideas of Tyler, Gagné, Mager, and others—concepts that were the foundation of most ISD models developed in the 1950s and 1960s. As a result of Wiggins and McTighe's work, present-day educators and instructional designers have been reintroduced to these critical concepts.

Test Plans and Learning Objectives

Many instructional designers skip this step, but creating a test plan with clear learning objectives is crucial before creating an assessment. Creating a test plan helps ensure that the test is designed to measure what learners are expected to know and be able to do after completing a training or learning program.

There are many ways to plan a test. A test plan need not be complicated, but there are a few specific details the plan should address.

1. **Purpose**. The purpose of the assessment should be established. Who will take the test, and how will the results be used?

2. **Learning Objectives**. A test plan with clear learning objectives that help focus the testing process on the specific knowledge and skills learners need to demonstrate.

3. **Content**. Describing the content to be covered can help guide the test creator and the instructional designer.

4. **Test Specifications Table**. A table of specifications helps test creators make decisions about the number of items to include. It helps them align test items with the content and the learning objectives or constructs being assessed. Using a specification test can also help validate an assessment by providing a visual representation of the content and construct coverage.

Performance assessments. Formal traditional testing processes involve what is often referred to as paper and pencil tests of cognitive learning objectives. Although, to a large extent, online assessments have replaced printed assessment formats, and informal assessments may be quite informal, involving a knowledgeable other asking questions and receiving responses verbally. Also, not all tests assess an individual's cognitive ability; many assessments are best classified as performance assessments. These tests assess the abilities and skills of an individual and are designed and administered differently. Learning objectives that address skills should be assessed by observing the performance of the skill. For example, when learning a foreign language, a cognitive assessment of vocabulary is important but not a sufficient demonstration of speaking ability. A performance test must be planned differently from cognitive assessments. These assessments will include a description of how the assessment will be administered, and because no two performances will be exactly the same, a rubric for grading the quality or adequacy of the performance will often replace the table of specifications.

Designing Valid Assessments

Instructional designers need to create assessments for several purposes. This may include creating a test-your-understanding quiz, a unit review, or a summative assessment at the end of the course to certify a student has accomplished the expected learning outcomes. Unfortunately, not all assessments are valid measures of what they intended to measure, and the results cannot be used for their intended purpose. This is why an instructional designer needs to learn how to create learning objectives and develop quality assessment instruments that align with the goals of the instruction.

Definition of Assessment Validity

The results of an assessment are valid if the assessment measures what it is supposed to measure accurately and consistently.

Creating valid assessments goes beyond ensuring test questions focus on material covered in class or in the curriculum standards. Assessment validation involves checking that your assessment instruments produce accurate results and are used appropriately.

When we say a test is valid, we really mean the results are valid. In other words, the results are credible (i.e., they measure what they were supposed to measure) and, therefore, can be and are used for a specific intended purpose. And while we might say a test is (or the results are) valid, assessment validity might better be understood as a continuum. An assessment must be sufficiently credible and trustworthy. Or the results can be used confidently to make decisions (i.e., evaluations).

The validation process involves gathering evidence that allows you to confidently conclude that the results accurately represent whatever the assessment was supposed to measure. Several types of evidence can be used to support the validation process:

- Evidence of ***Content Validity*** refers to the extent to which the assessment instrument covers the content domain it intends to measure. Evidence of content validity can be obtained by reviewing the assessment items and assessing their relevance to, and importance within, the intended domain. For example, suppose an assessment is designed to measure knowledge of world geography. In that case, the assessment items should adequately cover each geographical area of the world. The test should also focus on the most important ideas and concepts the individual should understand. Missing some content or skipping important ideas would diminish the validity of the assessment.

- Evidence of ***Construct Validity*** refers to the extent to which the assessment instrument focuses on the construct or concept it intended to measure. Evidence of construct validity can be obtained by examining the relationship between the assessment scores and other measures of the same construct. For example, if an assessment is designed to measure critical thinking skills, evidence of construct validity can be obtained by comparing assessment results with other validated measures of this construct. Additional evidence is obtained by examining the items used on a test to verify that the items elicit the targeted skill, not some unrelated or irrelevant skill or ability. For example, if the results of a math skills assessment are influenced by reading ability, the assessment results are less valid.

- Evidence of ***Assessment-Criterion Relationship Validity*** refers to the extent to which a test score (the assessment) predicts future performance or success (the criterion). Predictive validation studies focus on the relationship between the assessment and future performance. For example, if we determine that individuals will need specific math skills to do a particular task (i.e., the criterion), then an assessment of the requisite math skills should correlate well with the individual's ability to complete the task. Concurrent validation studies compare the results of an instrument designed to measure a requisite skill with validated measures of the criterion.

Creating test items

There are lots of resources available that teach item writing basics. Still, it is easy to write a lousy test. The quality of your assessment will depend on the quality of the items you use. Selecting the most appropriate type of test item to capture the expected learning is crucial, as well as testing and revising the items you create. Best practice suggests you write multiple versions of an item to weed out faulty items or to use similar items for equivalent forms of an assessment or in a test bank of questions.

There are a few item statistics that can help identify problematic items. However, these statistics only provide information that may be useful to review and improve the test items used in an assessment. Reviewing items needs to be done by subject matter experts and assessment specialists (e.g., psychometricians).

1. **Item Difficulty**. This statistic indicates the percentage of people who got an item correct. This information is not related to the quality of the item. You may wish to review the easy items as well as the difficult items. An easy item, one that almost everyone gets correct, may have an unintended clue to the correct answer or be written in a way that the correct answer is obvious. A difficult item may be unclear or contain more than one correct answer. These kinds of item writing mistakes lead to measurement error and diminish the validity of the assessment results.

2. **Discriminating Index**. This statistic, also known as *discriminating power*, is a statistical measure that indicates the relationship (i.e., correlation) between the overall score on a test and how well individuals answered a specific test item. Each item on a test will have a discriminating index. A high discriminating index indicates that the item effectively discriminates between high and low performers. Conversely, a low discriminating index suggests that the item or question is less effective in differentiating between individuals and may not contribute as much to the overall purpose of the test.

These statistics are typically used for norm-referenced tests where differentiating between students is the goal. Very easy and very hard items will have little or no discriminating power. In norm-referenced tests, items with low discriminating power are typically excluded. In a criterion-referenced test, this statistic is less important. Item selection is based on the importance of the material or skills being tested.

When reviewing items, questions with a negative discriminating index should be reviewed. A negative discriminating power indicates that students who do better on the overall test tend to get this item correct. In other words, the more a student knows, the less likely they will answer this question correctly. Likewise, items with little or no discriminating power should also be reviewed. A discriminating index around zero suggests it is equally likely that a student who did well on the overall test will get this item correct as a student who does poorly on the test.

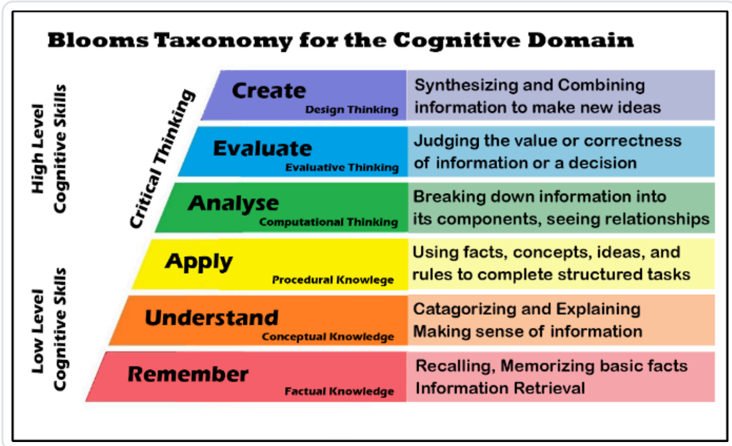
A detailed discussion of the development and testing items is beyond the scope of this chapter. However, as a general rule, items should align with the intended learning objectives; the items used should adequately cover the content, focusing on the most important information and skills. Those developing an assessment should follow best practice guidelines for each item.

Assessment Challenges and Issues

Assessment specialists face many challenges when creating valid assessments. We have outlined a few here, but there are others.

Getting beyond recall and understanding. One of the biggest mistakes test creators make is focusing too heavily on the recall of basic information. This may be acceptable when a course's learning objective intentionally focuses exclusively on the ability to remember and understand facts and definitions; however, in many courses, the instructional objectives attempt to measure student learning beyond the initial level of Bloom's Taxonomy.

Measuring affective characteristics. Most of what we measure in schools and training situations falls within the cognitive domain. However, often the instructional goals of a course may include affective objectives. Unlike knowledge, skills, and abilities, the affective domain includes personal characteristics like attitudinal dispositions, values, beliefs, and opinions (e.g., interest, caring, empathy, and appreciation) (see Davies, 2021). Simon and Binet (1916), the fathers of intelligence testing, suggested that as important as assessing cognitive ability may be, we might be well served first to teach (and assess) character. Assessing these personal characteristics required a different kind of assessment. It requires us to create a scale that measures the degree to which individuals possess a certain characteristic or quality.



High-stakes testing. One particularly contentious issue in schools is the political mandate to test students using standardized, summative assessments. A few issues arise from this policy. One issue with high-stakes testing revolves around the idea that these tests do not assess the whole person. The "whole person issue" in assessment refers to the challenge of capturing a person's entire range of abilities, characteristics, and experiences in a comprehensive and accurate manner. Using a single assessment to judge a person may be limiting. A second issue focuses on balancing the need to assess with the need to teach. This can be problematic. Some educators complain they are so focused on testing that they have little time to teach. This includes the problem of teaching to the test. One additional issue with high-stakes testing relates to the need for such testing. Many educators believe that the most important purpose for assessment in schools is formative, not summative.

Interpretation and inappropriate uses of assessment results. The inappropriate use of assessment results can also be a problem. Assessments are typically created for a specific purpose, and the results are not valid for other purposes. Assessment results are only valid if appropriately interpreted and used for the assessment's intended purpose. For example, in schools, test scores are designed to evaluate individual students' knowledge, skills, and abilities. Unfortunately, they are also inappropriately used to judge the quality of the instruction provided. While the quality of the teacher or instruction may influence the results of an assessment, many students fail to achieve despite being provided quality instruction. Often, students succeed despite their teachers' failings. A better assessment of teacher quality would require assessments explicitly designed for that purpose.

Another example of inappropriate use of assessment results happens when we don't have a good measure of the intended learning outcomes. This can happen, for example, when we want to develop a specific s affective characteristic but don't have a valid measure of the disposition—using an achievement test as an indirect substitute indicator would not be appropriate or valid practice. The challenge for assessment developers is to create direct valid measures of the expected learning outcomes.

Areas of Assessment Research

If you are interested in researching the topic of assessment, there are several promising and challenging areas you might consider.

Online test security. With increased online and distance learning acceptance, cheating on exams has become a prominent concern. Research on this topic has identified various vulnerabilities and proposed measures to address them. Online proctoring tools can help mitigate the risk of cheating. Using biometrics to verify students' identity and authorship has also been studied (for example, Young et al., 2019). Security breaches can be an issue for high-stakes testing and certification exams, where keeping test items secure is crucial. Proper training and communication with students can help promote ethical behavior during online assessments; however, ongoing research and development in this area will be important to ensure the integrity and validity of online assessments.

Learning Analytics. Recent calls for data-driven decision-making have prompted considerable interest in learning analytics. Research in this area is concerned with ways to personalize instruction. This includes the topics of stealth assessment and non-intrusive assessment data collection. With learning analytics, creating and using dashboards to communicate essential learning accomplishments and areas for improvement is particularly important. This includes identifying at-risk students and monitoring student progress with real-time student achievement results and engagement updates. Additional research is also needed to address student privacy and confidentiality concerns regarding the information we collect about students.

Automated Tutoring Systems. Providing feedback is an important function of the assessment process. Results from assessments can provide the information students need to resolve misconceptions, increase their understanding, and improve their skills. Timely feedback is essential for effective learning. Automating the feedback process can improve the speed and consistency of our assessment feedback. However, while more timely, many of these automated systems are less effective than human feedback in providing personalized, context-specific, and actionable feedback. Much of the research in this area relates to artificial intelligence and machine learning. However, critics point out that inappropriate applications and overreliance on artificial intelligence to provide feedback can lead to trained incompetence rather than increasing students' ability. Research in this area will be important to ensure that automated feedback is accurate and administered appropriately.

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IV. Educational Technology

United States National Educational Technology Plan 2024

Educational Equity · Educational Reform · Educational Systems · Educational Technology

The nation can close the digital access, design, and use divides. The NETP includes examples from every state in the country where schools, districts, and their partners are proving it's possible. For this possibility to reach all students will require an understanding that the kinds of instructional tasks students need to prepare them for the world they will inherit cannot rely on content alone. The instructional core requires attending to both content and people.

Editors' Note

The following is excerpted from the U.S. Department of Education's National Educational Technology Plan, released in 2024. It is in the public domain, but here is the appropriate citation:

U.S. Department of Education, Offices of Educational Technology (2024). National Educational Technology Plan, Washington, D.C.

Students are encouraged to review the entire plan, which includes excellent examples and case studies of best practices for addressing each of the divides mentioned below. The plan is free, and available at https://tech.ed.gov/files/2024/01/NETP24.pdf.

Introduction

Technology can be a powerful tool to help transform learning. It has the potential to empower students to expand their learning beyond the confines of the traditional classroom, support self-directed learning, help educators tailor learning experiences to individual student needs, and support students with disabilities. Technology also has the potential to allow students and educators to collaborate with peers and experts worldwide, engage with immersive learning simulations, and express their learning creatively. Furthermore, it has the potential to collect student performance and engagement data, providing insight into student progress and allowing educators to deploy targeted support.

Yet, as researcher Justin Reich (2020) noted, “Predictions of imminent transformation are among the most reliable refrains in the history of educational technology.” And, across that history (Cuban, 2001) and present-day classrooms, it has failed to realize this full potential. Where technology has realized its potential, it is often for a small minority of learners and contributes to growing inequities (Attewell, 2001; Connected Learning Alliance, 2017; Reinhart, 2011). Similarly, educational technology (edtech) tools sometimes claim (without independent, research-based evidence) that student assessment results will soar if school systems adopt a given digital resource. Such claims are not only misleading, but they can undermine the true potential of edtech. Reliance on a specific tool to accelerate learning or deliver a comprehensive and rigorous education for every student places all responsibility on the content (City et al., 2009). It ignores educators and students and the relationships between all three.

Somewhere between the promise of transformation and the barriers to realizing that promise lies the potential for states, districts, and schools to build systems that better ensure that edtech’s promise is afforded to all students, no matter their geography, background, or individual context.

This 2024 National Educational Technology Plan (NETP) examines how technologies can raise the bar (U.S. Department of Education, 2023) for all elementary and secondary students. It offers examples of schools, districts, classrooms, and states doing the complex work of establishing systemic solutions to inequities of access, design, and use of technology in support of learning. The identification of specific programs or products in these examples is designed to provide a clearer understanding of innovative ideas and is not meant as an endorsement.

Digital Divides

Building on the concept of the instructional core, this plan considers the barriers to equitable support of learning through edtech as three divides:

1. **Digital Use Divide:** Inequitable implementation of instructional tasks supported by technology. On one side of this divide are students who are asked to actively use technology in their learning to analyze, build, produce, and create using digital tools, and, on the other, students encountering instructional tasks where they are asked to use technology for passive assignment completion. While this divide maps to the student corner of the instructional core, it also includes the instructional tasks drawing on content and designed by teachers.

2**. Digital Design Divide:** Inequitable access to time and support of professional learning for all teachers, educators, and practitioners to build their professional capacity to design learning experiences for all students using edtech. This divide maps to the teacher corner of the instructional core.

3. **Digital Access Divide:** Inequitable access to connectivity, devices, and digital content. Mapping to the content corner of the instructional core, the digital access divide also includes equitable accessibility and access to instruction in digital health, safety, and citizenship skills.

As a path to closing these divides, the NETP also provides actionable recommendations to advance the effective use of technology to support teaching and learning. The recommendations in each section are also followed by tags identifying whether they are most immediately intended for states, districts, or school buildings. These recommendations are meant as components of solutions that bridge each divide but cannot comprise all of what is necessary within a given geography, culture, or context. Throughout each section, examples are offered of states, school districts, and schools engaged in the work of putting these recommendations into practice.

Many schools in the United States are equipped with greater connectivity and access to devices and digital learning resources than ever before as a result of the need for emergency remote learning brought about by the COVID-19 pandemic. However, this continued bridging of the access divide will only add to the failure of edtech to deliver on its promises if systems do not consider its use in conjunction with all components of the instructional core. This NETP attempts to chart a path for all schools, educators, and students to realize the potential of technology in supporting better “everywhere, all-the-time” learning.

The Digital Use Divide

As discussed in the 2017 National Educational Technology Plan, a divide exists between those students who regularly encounter opportunities to leverage technology in active, critical, and creative ways and those whose experiences with technology in their learning are limited to more passive expectations of use. Some students experience a school year full of critical media analysis, video and podcast creation, real-world data collection, connections with remote content area experts, and authentic opportunities to share their learning with global audiences.

Other students—often students from historically marginalized backgrounds—have very different experiences with technology (Fishman et al., 2016; Ritzhaupt et al., 2013; Valadez & Durán, 2007; Warschauer & Matuchniak, 2010). They are guided towards more limited engagements that frame them as passive technology users. They have school years of digital worksheets, point-and-click assessments, locked-down devices, and penalties for organic collaboration. In some cases, they may have access to more technology than their peers on the other side of the divide but seldom have opportunities to use that technology in formal education beyond digitized versions of practices of classrooms of a century ago.

Closing this digital use divide—ensuring all students have transformative, active, creative, critically thoughtful experiences supported by technology—is the focus of the following section. Beginning with a clear vision of what states and districts want for all graduates, it then offers guidance and recommendations for operationalizing, evaluating, and systematizing the experiences necessary for all students to fulfill that vision.

Recommendations for Closing the Use Divide

1. Develop a "Profile of a Learner/Graduate" outlining cognitive, personal, and interpersonal competencies students should have when transitioning between grade levels and graduation. (States, Districts)

2. Design and sustain systems, including needs assessments, technology plans, and evaluation processes supporting the development of competencies outlined in the "Profile of a Learner/Graduate" through the active use of technology to support learning. (States, Districts, Schools)

3. Implement feedback mechanisms that empower students to become co-designers of learning experiences. (Districts, Building-Level Administrators)

4. Develop rubrics for digital resource and technology adoptions to ensure tools are accessible and integrated into the larger educational ecosystem, support Universal Design for Learning (UDL) principles, and can be customized in response to accommodation or modification needs of learners with disabilities. (States, Districts, Building-Level Administrators)

5. Review subject area curricula or program scopes and sequences to ensure that student learning experiences build age-appropriate digital literacy skills through active technology use for learning. (States, Districts)

6. Build public-private partnerships with local businesses, higher education institutions, and nonprofit organizations to help students access edtech-enabled hands-on learning and work-based learning experiences. (States, Districts)

7. Provide professional learning and technical assistance to district leaders, building-level administrators, and educators to support the use of evidence to inform edtech use. (States, Districts)

8. Develop guidelines for emerging technologies which protect student data privacy and ensure alignment with shared educational vision and learning principles. (States, Districts)

Digital Design Divide

While the digital use and access divides are well documented by decades of scholarship, we present the digital design divide as a new consideration of the intersection of school culture, professional learning, and edtech. The design divide is between and within those systems that provide every educator the time and support they need to build their capacity with digital tools and those that do not. While socio-economic status has historically been a predictor of where schools and school systems may fall on either side of the use and access divides, the same is not true of design. Absent vision and sustained support, effective learning design using edtech can vary between neighboring classrooms within a school, schools within a district, and districts within a state (Cuban, 2018; Cline, 2018; Dexter et al., 2016; McLendon et al., 2015; Senge, et al., 2015). Considering the instructional core defined in the introduction of this report, the design divide can limit equitable, active student use, even when all students can access the necessary technologies and content. Not all teachers have the time, support, and capacities necessary to design instruction that incorporates active technology use.

Closing this divide requires a clear vision, re-imagining systems of support, and bringing teachers to the table as co-designers of their professional learning. The guidance, recommendations, and examples that follow lay out a path to supporting teachers inundated by increasing demands on their time and unclear expectations as to how they utilize technology most effectively.

In systems where the average teacher can access more than 2,000 digital tools in a given moment, training on a tool's basic functionality is insufficient. Closing the design divide moves teachers beyond the formulaic use of digital tools and allows them to actively design learning experiences for all students within a complex ecosystem of resources.

Recommendations for Closing the Design Divide

1. Develop a "Portrait of an Educator" outlining the cognitive, personal, and interpersonal competencies educators should have to design learning experiences that help students develop the skills and attributes outlined in the profile of a graduate. (States, Districts)

2. Design and sustain systems that support ongoing learning for new and veteran teachers and administrators, providing them with the time and space needed to design learning opportunities aligned with the Universal Design for Learning (UDL) Framework. (States, Districts, Building-Level Administrators)

3. Implement feedback mechanisms that empower educators to become leaders and codesigners of professional learning experiences. (Districts, Building-Level Administrators)

4. Provide educators and administrators with professional learning that supports the development of digital literacy skills so that they can model these skills for students and the broader school community. (States, Districts, Building-Level Administrators)

5. Develop processes for evaluating the potential effectiveness of digital tools before purchase, including the use of research and evidence. (State, District, Building-Level Administrators)

6. Foster an inclusive technology ecosystem that solicits input from diverse stakeholders to collaborate on decision-making for technology purchases, learning space design, and curriculum planning. (States, Districts, Building-Level Administrators)

7. Support and facilitate a systemic culture that builds trust and empowers educators to enhance and grow their professional practice to meet the needs of each student. (States, Districts, Building-Level Administrators)

8. Regularly solicit educator feedback and evaluate professional learning efforts to ensure alignment with the Portrait of an Educator. (District, Building-Level Administrators)

Digital Access Divide

For all learners to have the deep, complex, active learning experiences described above, states and districts must focus on closing one other key divide - the digital access divide. This divide has historically been defined as providing equitable access to reliable, high-speed connectivity, hardware, and digital resources. Accessibility and digital health, safety, and citizenship are also key to closing the access divide. While school systems have made great strides in closing the digital access divide since the publication of the 2017 NETP, pernicious problems such as geographic barriers and local skill capacity require swift action at all levels to realize the design and use visions laid out above. This section outlines the recommendations and examples of learning environments designed (or re-designed) to close that divide and enable “everywhere all-the-time learning.”

Recommendations for Closing the Access Divide

1. Develop a “Portrait of a Learning Environment” to set expectations around habits and abilities no matter what the space. (States, District)

2. Establish and maintain a cabinet-level edtech director to ensure the wise and effective spending of edtech funds. (States, Districts)

3. Conduct regular needs assessments to ensure technology properly supports learning. (States, Districts, Building-Level Administrators)

4. Develop model processes and guidelines for device refresh policies based on local funding structures. (States, Districts)

5. Leverage state purchasing power or regional buying consortia when purchasing edtech hardware, software, and services. (States, Districts)

6. Develop learning technology plans in consultation with a broad group of stakeholders and according to established review cycles. (States, Districts, Building-Level Administrators) The Digital Access Divide stands between those students and educators who have equitable, sustainable access to connectivity, devices, and digital content and those who do not. This also includes accessibility and digital health, safety, and citizenship.

7. Leverage public/private partnerships and community collaboration to bring broadband internet access to previously under-connected areas and ensure student access to "everywhere, all-the-time learning." (States, Districts, Building-Level Administrators)

8. Develop processes and structures that ensure the inclusion of accessibility as a component of procurement processes. (States, Districts, Building-Level Administrators)

9. Plan for and incorporate skills and expectations across all grade levels and subject areas for Digital Health, Safety, and Citizenship, and Media Literacy. (States, Districts, BuildingLevel Administrators)

Conclusion

As has ever been true, educational technology holds vast potential to improve teaching and learning for every student and teacher in the United States. In recent years, driven by the emergency of a pandemic, schools have found themselves with more connectivity, devices, and digital resources than at any other moment in history. This current context presents a unique opportunity.

States, districts, and schools across the country can leverage this momentum of a narrowing access divide to focus key efforts in providing all teachers the time, support, and capacity they need to design authentic learning experiences for all learners supported by this proliferation of digital tools. They can set bold new visions of the skills, knowledge, and experiences all students must have as they progress through and graduate from PK-12. Furthermore, states, districts, and schools can eliminate barriers and uncover biases in practice that have historically limited innovative and promising learning experiences supported by edtech to a predictable minority.

The nation can close the digital access, design, and use divides. The NETP includes examples from every state in the country where schools, districts, and their partners are proving it's possible. For this possibility to reach all students will require an understanding that the kinds of instructional tasks students need to prepare them for the world they will inherit cannot rely on content alone. The instructional core requires attending to both content and people.

An NETP24 Guide for Educators

The National Educational Technology Plan (NETP) is the flagship edtech policy document for the United States articulating a vision of equity that calls upon all involved in American education to ensure every student has access to transformational learning experiences enabled by technology. As the individuals entrusted with educating the students in their classrooms, educators play a critical role in achieving this vision, but may not feel empowered to drive system-level change. This guide provides teachers with some practical steps they can take to support their peers and the communities and students they serve to advance the goals of the NETP.

As a starting point, every educator should use the NETP to evaluate their own practice by reflecting on critical questions relating to the three digital divides:

Digital Use (active student creation and critical analysis):

• Are all the students I serve having transformative, active, creative, critically thoughtful experiences supported by technology?

• Am I actively empowering students to become co-designers of their learning experiences?

Digital Design (universal design for learning; teacher time and capacity):

• Am I developing my digital literacy skills and am I modeling those skills for the students I serve?

• Am I taking advantage of opportunities to grow and enhance my professional practice?

• Am I designing learning opportunities and experiences that align with the Universal Design for Learning principles?

Digital Access (connectivity, devices, content, accessibility, digital health, safety, & citizenship):

• Does every student in my classroom have equitable access to the learning experiences I design?

• Have I ensured that every student in my classroom can access the edtech tools we use?

The following are some immediate, high impact steps educators can take to advance the goals of the NETP and improve the equitable and effective use of edtech in their communities.

1. Establish professional learning networks and communities with your peers on topics in the NETP.

2. Advocate directly or through your member organizations for the conditions necessary to support the effective use of technology in your classroom and community.

3. Inspire your peers and leaders with examples of incredible work taking place in other schools across the country.

4. Adopt the UDL Framework in your school. Educators are encouraged to read the full report for more recommendations and examples of states, districts and schools that are using technology effectively to drive outcomes for learners.

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Technology Integration Frameworks

Kimmons, R.

Educational Technology

Technology Integration

Technology Integration Model

Technology integration models are theoretical models that are designed to help teachers, researchers, and others in the education field to think about technology integration in meaningful ways. There are many, many technology integration models that are used by different groups. Some models are very popular, while some are used by only very small groups of people, and some are very similar to one another, while others are very unique. This chapter reviews some of the most common models and provides a comparison of their individual strengths.

Editor's Note

The following is excerpted and adapted from Dr. Royce Kimmon's open textbook, K-12 Technology Integration [https://edtechbooks.org/-UeB]. *It is licensed*

This excerpted and adapted version can be cited as follows:
Kimmons, R. (2017). K-12 technology frameworks. Adapted from R. Kimmons (2016). *K-12 technology integration [https://edtechbooks.org/-cD]*.PressBooks. In R. West (Ed.), *Foundations of Learning and Instructional Design Technology.* Retrieved from https://edtechbooks.org/-dk

The original work can be cited as follows:
Kimmons, R. (2016). *K-12 technology integration [https://edtechbooks.org/-cD]*. PressBooks. Retrieved from https://edtechbooks.org/-cD

Technology Integration Models

Technology integration models are theoretical models that are designed to help teachers, researchers, and others in the education field to think about technology integration in meaningful ways. There are many, many technology integration models that are used by different groups. Some models are very popular, while some are used by only very small groups of people, and some are very similar to one another, while others are very unique. Rather than provide an exhausting description of each technology integration model, we will provide a brief overview of a few that we believe to be most widely used or valuable to help you begin thinking about technology integration in your classroom. The models we will explore will include the following: TPACK, RAT, SAMR, and PIC-RAT.

TPACK

TPACK is the most commonly used technology integration model amongst educational researchers. The goal of TPACK is to provide educators with a framework that is useful for understanding technology's role in the educational process. At its heart, TPACK holds that educators deal with three types of core knowledge on a daily basis: content knowledge, pedagogical knowledge, and technological knowledge. Content knowledge is knowledge of one's content area, such as science, math, or social studies. Pedagogical knowledge is knowledge of how to teach. And technological knowledge is knowledge of how to use technology tools.

These core knowledge domains, however, interact with and build on each other in important and complicated ways. For instance, if you are going to teach kindergarten mathematics, you must understand both mathematics (i.e., content knowledge) and how to teach (i.e., pedagogical knowledge), but you must also understand the relationship between pedagogy and the content area. That is, you must understand how to teach mathematics, which is very different from teaching other subject areas, because the pedagogical strategies you use to teach mathematics will be specific to that content domain. When we merge content knowledge and pedagogical knowledge together, a hybrid domain emerges called pedagogical content knowledge. Pedagogical content knowledge includes knowledge about content and pedagogy, but it also includes the specific knowledge necessary to teach the specified content in a meaningful way.

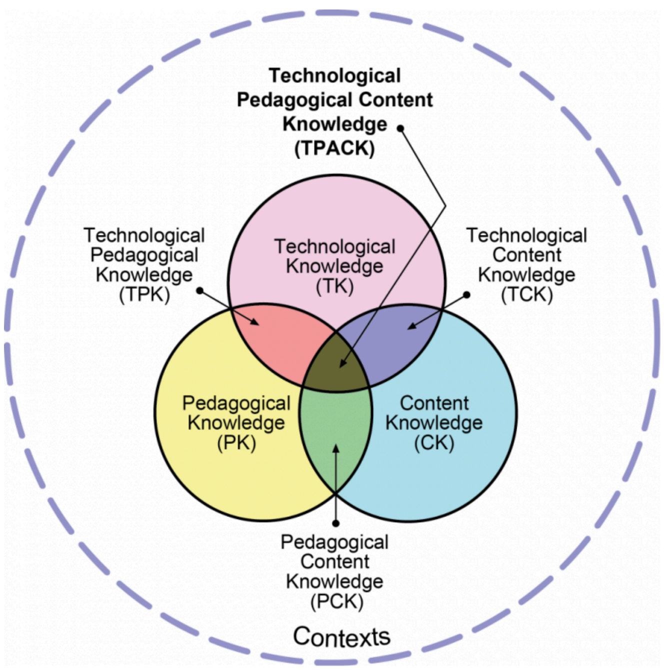

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Figure 1. *Technological Pedagogical Content Knowledge (TPACK).*

TPACK goes on to explain that when we try to integrate technology into a classroom setting, we are not merely using technological knowledge, but rather, we are merging technological knowledge with pedagogical content knowledge to produce something new. TPACK or technological pedagogical content knowledge is the domain of knowledge wherein technology, pedagogy, and content meet to create a meaningful learning experience. From this, educators need to recognize that merely using technology in a classroom is not sufficient to produce truly meaningful technology integration. Rather, teachers must understand how technology, pedagogy, and content knowledge interact with one another to produce a learning experience that is meaningful for students in specific situations.

RAT and SAMR

RAT and SAMR are very similar technology integration models, though RAT has been used more often by researchers and SAMR has been used more often by teachers. Both of these models assume that the introduction of technology into a learning experience will have some effect on what is happening, and they try to help us understand what this effect is and how we should be using technology in meaningful ways.

RAT is an acronym for replace, amplify, and transform, and the model holds that when technology is used in a teaching setting, technology is used either to replace a traditional approach to teaching (without any discernible difference on student outcomes), to amplify the learning that was occurring, or to transform learning in ways that were not possible without the technology (Hughes, Thomas, & Scharber, 2006). Similarly, SAMR is an acronym for substitution, augmentation, modification, and redefinition (Puentedura, 2003). To compare it to RAT, substitution and replacement both deal with technology use that merely substitutes or replaces previous use with no functional improvement on efficiency. Redefinition and transformation both deal with technology use that empowers teachers and students to learn in new, previously impossible ways.

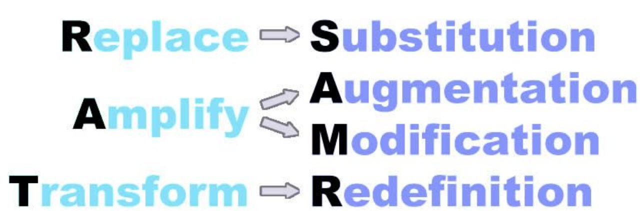

Figure 2. *RAT & SAMR*

The difference between these two models rests in the center letters, wherein RAT's amplification is separated into two levels as SAMR's augmentation and modification. All of these levels deal with technology use that functionally improves what is happening in the classroom, but in the SAMR model, augmentation represents a small improvement, and modification represents a large improvement.

Both of these models are helpful for leading educators to consider the question: What effect is using the technology having on my practice? If the technology is merely replacing or substituting previous practice, then it is a less meaningful use of technology, whereas technology use that transforms or redefines classroom practice is considered to be more valuable.

PICRAT

Building off of the ideas presented in the models above, we will now provide one final model that may serve as a helpful starting point for teachers to begin thinking about technology integration. PIC-RAT assumes that there are two foundational questions that teachers must ask about any technology use in their classrooms:

1. What is the students' relationship to the technology? (PIC: Passive, Interactive, Creative)
2. How is the teacher's use of technology influencing traditional practice? (RAT: Replace, Amplify, Transform; cf. Hughes, Thomas, & Scharber, 2006)

The provided illustration maps these two questions on a two-dimensional grid, and by answering these two questions, teachers can get a sense for where any particular practice falls.

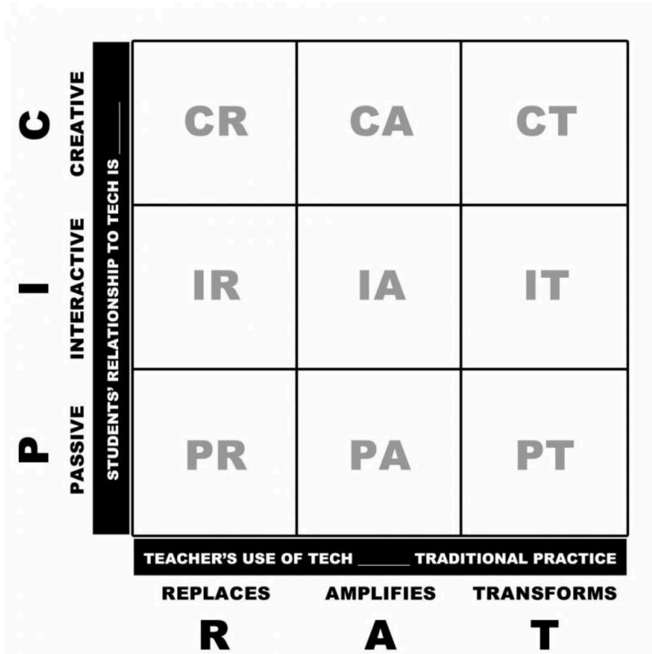

Figure 3. *PIC-RAT*

For instance, if a history teacher shifts from writing class notes on a chalkboard to providing these notes in a PowerPoint presentation, this would likely be categorized in the bottom-left (PR) section of the grid, because the teacher is using the technology to merely replace a traditional practice, and the students are passively taking notes on what they see. In contrast, if an English teacher guides students in developing a creative writing blog, which they use to elicit feedback from peers, parents, and the online community on their short stories, this would likely be categorized in the top-right (CT) section, because the teacher is using the technology to transform the practice to do something that would have been impossible without the technology, and the students are using the technology as a tool for creation.

Experience has shown that as teachers begin using technologies in their classrooms, they will typically begin doing so in a manner that falls closer to the bottom-left of the grid. However, many of the most exciting and valuable uses of technology for teaching rest firmly in the top-most and right-most sections of this grid. For this reason, teachers need to be encouraged to evolve their practice to continually move from the bottom-left (PR) to the top-right (CT) of the grid.

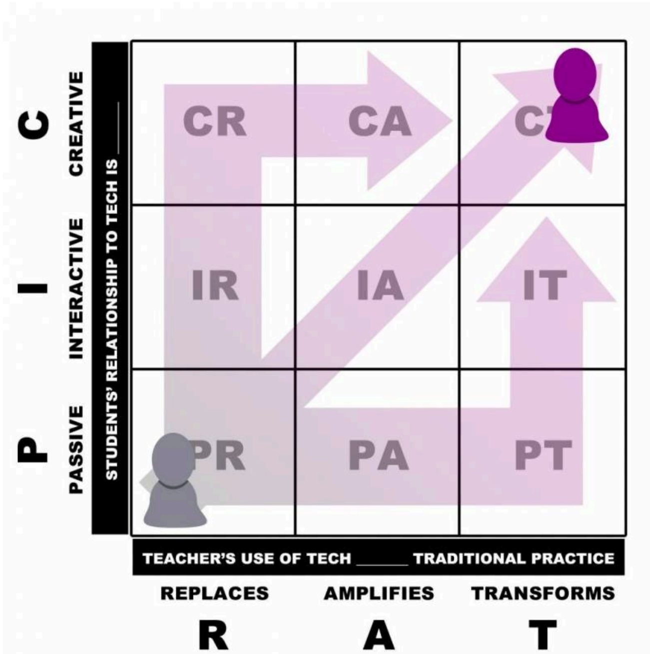

Figure 4. *The use of PIC-RAT.*

Further Resource

For more information on the PIC-RAT model, please view [this video [https://youtu.be/bfvuG620Bto]](https://youtu.be/bfvuG620Bto), scripted by Dr. Kimmons and Dr. Richard E. West of Brigham Young University.

PICRAT for Effective Technology Integration in Teaching

[Watch on YouTube]

Please complete this short survey to provide feedback on this chapter: http://bit.ly/TechnologyFrameworks

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Distance Learning

Standards, Perspectives, and Best Practices of Online Education

Martin, F. & Oyarzun, B.

Online learning has continued to increase in the last decade across higher education and K-12 education. Covid-19 forced many instructors and teachers globally to teach and learn online. Research in online learning has been conducted at micro and macro levels. This chapter explores several research trends in distance learning in order to assess the state of distance learning and provide recommendations for designers.

Online learning has continued to increase in the last decade across higher education and K-12 education (NCES, 2021). Covid-19 forced many instructors and teachers globally to teach and learn online. Research in online learning has been conducted at micro and macro levels. Micro level research has been conducted at the course or individual case study level, investigating variables such as effective instructional strategies or demographic profiles of successful learners in these environments. Macro level research has been conducted at the national or global levels, investigating access to education via free online courses such as

Massively Open Online Courses—otherwise known as MOOCs—and examining global standards for online learning.

This chapter explores several research trends in order to assess the state of online learning and identify opportunities for future research. In order to better understand the research trends, definitions are presented first, followed by quality standards for online learning courses and the summary of programs developed by professional organizations. Student, faculty, and administrator perspectives of online learning research are reviewed in addition to best practices in design and facilitation in online learning. Best practices regarding faculty and learner support, as well as inclusive and equitable online learning, are also discussed. Finally, the chapter concludes with a list of academic journals dedicated to online learning research.

Definitions of Delivery Methods

In this section, we briefly define the various terms involved with online delivery methods (Table 1).

Asynchronous online learning	A course course where most of the content is delivA courseered online and students can participate in the online course from anywhere and anytime. There are no real-time online or face-to-face meetings.
Synchronous online learning	A course where most of the content is delivered online and students can participate in courses from anywhere. There are real-time online meetings and students login from anywhere—but at the same time—to participate in the course.
Bichronous online learning	A course that blends both asynchronous and synchronous online learning; students can participate in 'anytime, anywhere' learning during the asynchronous parts of the course but then participate in real-time activities for the synchronous sessions.
MOOC	These are Massive Open Online Courses where an unlimited number of students can access the open-source content free of cost.
Blended/Hybrid	A course with a combination of face-to-face and online delivery with a substantial portion of the course delivered online.

Asynchronous online learning	A course course where most of the content is delivA courseered online and students can participate in the online course from anywhere and anytime. There are no real-time online or face-to-face meetings.
Blended Synchronous	A combination of face-to-face and synchronously online students in the course.
Hyflex	A flexible method providing students the option to attend class in person or online, asynchronously or synchronously.

Table 1. Definition of Online Delivery Methods

Distance education and online learning are terms that are often used interchangeably. However, online learning and its components is encompassed within distance education, which contains two components that are not representative of online learning: correspondence courses and satellite campuses. Figure 1 is a visual representation of the delivery methods of distance education.

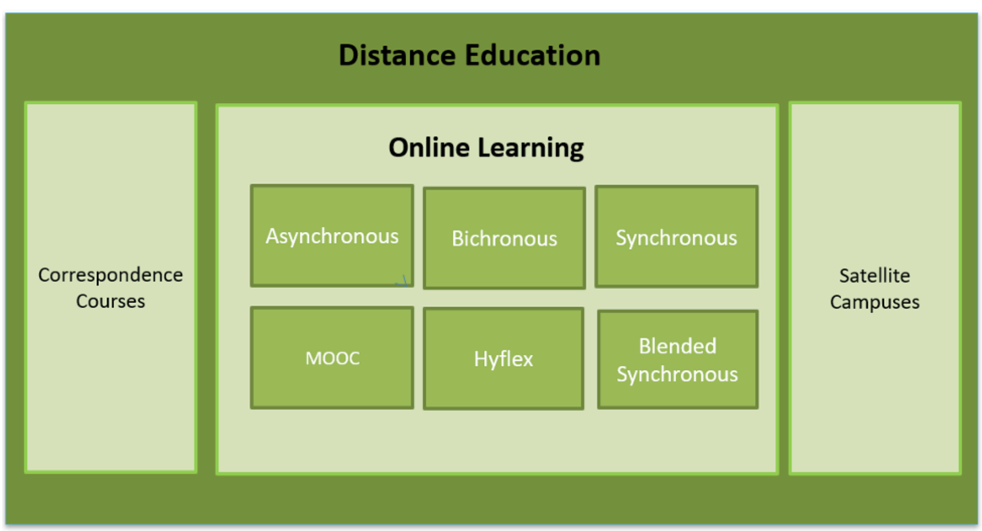


Figure 1. *Online Learning and Delivery Methods*

Standards and Frameworks for Online Learning

Various standards and frameworks have been established and made available for instructors and administrators to use when designing and implementing online learning. Shelton (2011) reviewed 13 paradigms for evaluating online learning and suggested a strong need for a common method for assessing the quality of online education programs. Shelton found that the institutional commitment, support, and leadership theme was frequently seen in these standards. At least 10 of the standards included institutional commitment, support, and leadership theme as a primary indicator of quality. Teaching and Learning was the second most-cited theme for indicating quality.

Daniel and Uvalic-Trumbic (2013), in their review of quality online learning standards, list institutional support (vision, planning, and infrastructure), course development, teaching and learning (instruction), course structure, student support, faculty support, technology, evaluation, student assessment and examination security as elements essential for quality online learning. They also add that to assure quality online learning in higher education, the most essential requirement is the institutional vision, commitment, leadership, and sound planning.

Martin, Polly et al. (2017) reviewed twelve different global standards for online learning found that the number of standards varied in these documents from 17 to 184 (Table 2). While instructional analysis, design, and development (N=164), student attributes, support, and satisfaction (N=115), and institutional Mission, structure, and support (N=102) were the top categories, course facilitation, implementation, and dissemination (N=40), policies and planning (N=33), and faculty support and satisfaction (N=27) were rated the lowest three.

Standard Name	Year	Sponsor	Number of Sections	Number of Standards
Quality on the Line: Benchmarks for Success in Internet Based Distance Education	2000	Institute for Higher Ed Policy, supported by NEA and Blackboard	7	24
Open eQuality Learning Standards (Canada), http://www.eife-l.org/publications/quality/oeqls/intro	2004	Canada	4	25
Online Learning Consortium (formerly Sloan-C) Quality Score Card	2005	OLC Consortium	8	75
Blackboard Exemplary Rubric	2000	Blackboard	4	17
Quality Matters	2015, 5th edition	Quality Matters	8	45

Standard Name	Year	Sponsor	Number of Sections	Number of Standards
CHEA Institute for Research and study of accreditation and Quality Assurance	2002 revision 1	Council for Higher Education Accreditation	7	7
NADEOSA (South Africa)	2005 revision of 1996 document		13	184
ACODE (The Australasian Council on Open, Distance and e-learning)	2014	Australasian Council on Open, Distance and e-learning	8	64
AAOU (Asian Association of Open Universities)	no date	Asian Association of Open Universities	10	54
ECBCheck	2012		13	46
UNIQUe	2011		10	71
International Organization for Standardization (ISO)	2005		7	38

Table 2. *Standard Details (Name, Year, Sponsor, Number of Sections and Number of Standards).* Used with permission from Martin et al. (2017)

These three analyses of the quality standards and frameworks over time echo similar results of study showing that institutional factors such as vision, support, and planning are important indicators of quality online learning.

Student, Instructor and Organizational Perspectives of Online Learning Research

Several researchers have examined student, faculty, and organization or administrator-focused research on online learning. In the following section, we have categorized research studies on key online learning topics based on these perspectives.

Student Perspective

In Table 3, we summarize the key aspects of student-focused topics studied on online learning including benefits and challenges.

Student Perspective	***Example Research Studies***
Readiness	Joosten & Cusatis (2020); Martin et al. (2020); Ranganathan et al. (2021); Wei & Chou (2020)
Self-Regulation and Motivation	Chiu et al. (2021); Landrum (2020); Su et al. (2018)
Flexibility and Convenience	Schwartzman (2007); Leasure, Davis, & Thievon (2000); Petrides (2002); Schrum (2002); Poole (2000), Karaman (2011)
Online discussion helps in providing thoughtful/supporting responses	Meyer (2003), Petrides (2002), Vonderwell (2003)
Belongingness in Online Learning Community	Lapointe & Reisette (2008); Peacock et al. (2020); Peterson et al. (2018)
Interaction and engagement	Martin, Parker & Deale (2012); Kaufmann et al., 2020; Martin & Bolliger, 2018
Lack of immediacy	Petrides (2002); Vonderwell (2003)
Lack of sense of community/ feeling isolated	Lack of sense of community/ feeling isolated
Equity, Inclusion and Diversity	Chandler et al. (2021); Fussell et al. (2021); Sublett (2022)

Table 3. Student Perspective

Faculty Perspective

In Table 4, we summarize faculty-focused research on online learning including benefits and challenges.

Faculty Perspective	***Example Research Studies***
Readiness	Cuitri & Mena, 2020; Dimaculangan et al. (2021); Martin et al. (2019)
Flexibility and Convenience	Hiltz et al. (2010); Luongo (2018)

Faculty Perspective	***Example Research Studies***
Accessibility	Dolamore (2021); Guilbaud et al. (2021); Nambiar (2020)
Technological difficulties	Bolliger and Wasilik (2009), Lieblein (2000), Hunt et al. (2014)
Workload issues	Bolliger and Wasilik (2009), Mandernach et al. (2013)
Institutional Support	Gaytan (2015), Martin and Parker (2014), Kumar et al. (2022)
Mentoring and Supervision	Byrnes et al. (2019); Kumar & Johnson (2019); Pollard & Kumar (2021)

Table 4. Faculty Perceptive

Organization Perspective

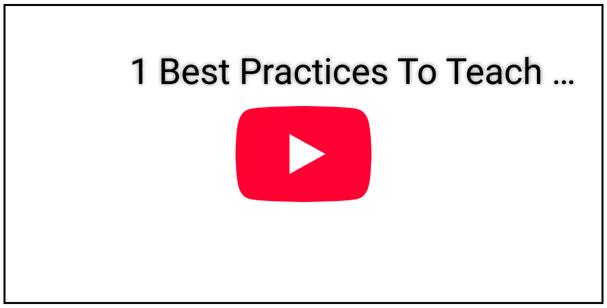
In Table 5, we summarize the key aspects of organization or administrator-focused research on online learning including benefits and challenges.

Organization Perspective	**Example Research Studies**
Advocacy for online education, staying informed and learning about online education, collaborating with faculty, procedural changes, changes in schemas and roles	Garza (2009)
Securing the necessary resources, developing the organizational structures, influencing organizational culture	Barefield & Mayer (2013)
Sufficient resources for training, technology, and course design/development	Alexander (2015)
Local, state, federal laws, digital divide, technology diffusion, student income	Palvia et al. (2018)
Evaluation of Online Teaching	Lowenthal et al. (2015); Reyes-Fournier et al. (2020); Schwanenberger et al. (2021)

Table 5. Organization Perspective

Best Practices for Online Teaching

Martin and Kumar (2021) categorized barriers into institutional, technology and technical, pedagogical, and interpersonal barriers. Research in online teaching has tried to address these issues by focusing on course design, course engagement, course facilitation, learner and instructor support, and inclusion and equity.



In this video (https://www.youtube.com/watch?v=jobEenvgqv0), Dr. Florence Martin discusses several best practices to teach online.

Course Design

Lister (2014) conducted an analysis of online learning literature to identify patterns and themes for the design of online courses. Four themes emerged: course structure, content presentation, collaboration and interaction, and timely feedback. Similarly, Mayes et al. (2011) conducted a literature review around six themes to identify specific recommendations for designing quality online courses. The themes used were learners and instructors, medium, community and discourse, pedagogy, assessment, and content. Recommendations identified included structuring courses, developing student-centered interactive learning activities, building collaboration through group projects, incorporating frequent assessments and strategies for equitable scoring such as rubrics, and providing sufficient detail and solicit student feedback.

Jaggers (2016) developed a course design rubric that assessed organization/orientation, objectives/assessments, interpersonal interaction, and the use of technology for their effects on student achievement. The results showed that well organized courses with specific objectives were more desirable but may not have an impact on student achievement. However, the quality of interpersonal interaction within the courses positively correlated with student grades. The following sections explore research in course design trends in more depth.

Instructors may have various levels of control over the design of the course structure depending on organizational philosophies. Lee et al. (2012) defined three approaches to faculty control of course structure: fully autonomous, basic guidelines, and highly specified. When faculty have less control of their course design, the courses are designed by the institution with instructors serving more as facilitators. Regardless of the amount of faculty control, there are basic elements to course structure that research has shown to be effective, such as a having a consistent course structure throughout the course (Swan, 2001).

Gamification and the use of games, virtual worlds, and simulations have also gained traction in the online learning research. Gamification is defined as the application of game design elements, such as digital badges, in non-game contexts. Hamari et al. (2014) conducted a literature review of gamification studies and found that gamification can have positive effects, but those effects depended on the context in which the strategies were implemented and the audience. For example, in the context of applying gamification in an educational setting, learners experienced increased motivation and engagement. However, some negative outcomes were also identified such as increased levels of competition. Applying the same gamification strategies in such as health and exercise increased levels of competition may not be considered a negative outcome. Similarly, the different qualities of the users may also have effects on levels if motivation and engagements. Merchant et al. (2014) conducted a meta-analysis to examine the effects of games, virtual worlds, and simulations as instructional methods. The results showed that students had higher learning gains with games over virtual worlds and simulations. Clark et al. (2016) found similar results when investigating the literature for effects of games on learning outcomes. The effectiveness of the content delivery method depends on the effectiveness of the design of the instruction and the suitability method for the context of instruction.

Assessment affects how learners approach learning and the content as well as how learners engage with one another and the instructor (Kolomitro & MacKenzie, 2017). Students access course content based upon the belief that the course will help them learn and have better outcomes (Murray et al., 2012). Therefore, the design of online assessments should promote active learning and ensure that success depends on retaining course content. Martin and Ndoye (2016) examined learner-centered assessment in online learning and how instructors can use learning analytics to improve the design and delivery of instruction to make it more meaningful. They demonstrate several data analytic techniques that instructors can apply to provide feedback to students and to make informed data driven decisions during instruction as opposed to after the instruction. Applying such techniques can increase retention of online students.

Course Design

Martin et al. (2021) identified the Online Course Design Elements (OCDE) based on six areas that can guide design in online courses:

- overview
- content presentation
- assessment and evaluation
- interaction and communication
- assessment and evaluation

- support

Course Engagement

Transactional distance theory defined the feeling of isolation or psychological distance that online learners often experience (Moore, 1989). To lesson transactional distance, Moore defined three types of interaction: (a) learner-to-learner, (b) learner-to-instructor, and (c) learner-to-content to guide faculty to create quality distance education experiences. Bernard et al. (2009) conducted a meta-analysis on 74 distance education studies on the effects of Moore's three types of interaction and found support for their importance for achievement.

The Community of Inquiry framework built upon these types of interaction and defined a quality education experience for an online learner in terms of three overlapping presences: cognitive, social, and teaching (Garrison et al., 1999). This framework provides guidelines for faculty and designers to create meaningful interactive learning experiences that increase the level of social interaction. However, the Community of Inquiry framework's ability to create deep and meaningful learning experiences has come into question due to much of the research using self-reporting, achievement, and perception measures (Rourke and Kanuka, 2009; Annand, 2011). Community-building in online classes has received more attention in recent years. Social presence refers to "the strength of the social relationships and emotional connection among the members of a class or learning community" (Rubin, 2013, p. 119). On an individual level, social presence refers to how involved and engaged each individual student is in the community and their motivation and drive to share, interact, and learn from others. On a community level, social presence refers to the shared sense of belonging of the students in the classroom. Teachers can influence social presence by designing group assignments, creating discussion forums, rewarding community building behaviors, and modeling openness and sharing (Rubin, 2013). Teacher presence refers to designing learning experiences, guiding and leading students' work, providing feedback and facilitating interaction and community-building (Rubin, 2013).

Another research lens used to address online learner isolation is learner engagement. Engagement in any learning is important. However, in online learning, engagement is essential because online learners have fewer chances to interact with each other, the instructor, and the institution. Redmond et al. (2018) used a constant comparative method to establish a conceptual framework of online engagement. The framework identifies five key elements for online engagement to guide research in this area: social engagement, cognitive engagement, behavioral engagement, collaborative engagement, and emotional engagement.

Dixon (2010) created and validated a scale to measure online learner engagement. The instrument was used to survey 186 online learners from six different campuses. Results showed that multiple communication channels or meaningful and multiple ways of interaction may result in higher learner engagement. However, more research should be conducted to validate these results.

Research on all of these frameworks echo the importance of collaborative or cooperative learning to increase interaction. Borokhovski et al. (2012) conducted a follow-up study to the Bernard (2009) meta-analysis investigating the effects of online collaborative learning on achievement. The results indicated that collaborative learning activities had higher effects on student achievement. Conversely, Oyarzun and Morrison (2013) conducted a quasi-experimental study investigating the effects of cooperative online learning on achievement and found no significant difference in achievement between students who completed the assignment individually or cooperatively. However, more experimental research is needed to validate the effects of collaborative learning and to identify effective methods of online collaborative learning.

Course Engagement

Bolliger and Martin (2021) designed Online Engagement Strategies Questionnaire (OESQ) and validated it with students and instructors. Based on the exploratory factor analysis, four engagement constructs emerged which are critical in online courses. These include:

- peer engagement
- multimodal engagement
- instructor engagement
- self-directed engagement

Course Facilitation

Muilenburg and Berge (2007) identified several issues related to online learning implementation from the student perspective, including course materials that are not always delivered on time, instructors not knowing how to teach online, lack of timely feedback, and lack of access to the instructor. Three of these issues deal specifically with instructor immediacy or responsiveness. Bodie and Michel (2014) conducted an experimental study manipulating immediacy strategies for 576 participants in an introductory psychology course. Results revealed that learners in the high immediacy group showed greater learning gains and retention. Martin, Wang et al. (2017) investigated the effects of 12 different facilitation strategies on instructor presence, connection, learning, and engagement. They found that students perceived timely responses to questions and feedback on assignments from instructors helpful. It was also noted that instructors' use of video aided in building a connection with the instructor. Timeliness and immediacy are common themes in the research. Again, more experimental research should be conducted to identify specific strategies for faculty.

In addition, Oncu and Cankir (2011) identified four main research goals for course design and implementation to address achievement, engagement, and retention issues in online learning. The four goals are: (a) learner engagement & collaboration; (b) effective facilitation; (c) assessment techniques; and (d) designing faculty development. They further recommended experimental research be conducted to identify effective practices in these areas. Thus, there are many frameworks and principles for effective design and implementation of online learning but still a lack of research validating many of these ideas or providing effective cases.

Course Facilitation

Martin et al. (2018) identified facilitation strategies for online course categorized as *Pedagogical, Social, Managerial, Technical*. Based on this study, online students perceived the following:

- Instructors' timely response to questions/feedback on assignments were helpful.
- Video-based introduction was helpful in building instructor connection.
- Instructors' response to reflections helped establish connection with instructor.

Faculty and Learner Support

Faculty Support

Several universities that offer online courses are providing online course planning and development support and technology support to their faculty along with institutional support.

Online teaching can be very demanding on faculty. One study found that online teaching demanded 14% more time than traditional teaching and fluctuated considerably during times of advising and assessment (Tomei, 2006). With the spread on online teaching practices in higher education, many academic staff are faced with technological and pedagogical demands that require skills they don't necessarily possess (Weaver et al., 2008). The quality of online programs depends upon the pedagogical practices of online teachers; therefore, faculty support in online programs is very important (Baran & Correia, 2014).

Some believe that the success of online teaching depends upon the support of faculty on three main levels: teaching, community, and organization (Baran & Correia, 2014). The teaching level includes assistance with technology, pedagogy and content through workshops, training programs, and one-on-one assistance. The challenge here is often the fact that academic staff find it hard to adapt to changes in their teaching or allow someone else to tell them how to teach, therefore individuals who design online programs need to first establish themselves as experts and be viewed as such by faculty (Weaver et al., 2008).

The community level includes collegial learning groups, peer support programs, peer observation, peer evaluation and mentoring programs. Some have highlighted the importance of creating a supportive community for online instructors who often feel isolated (Eib & Miller, 2006). Building learning communities and communities of practice for online teachers as well as providing opportunities for students and online faculty helps combat feelings of isolation (Eib & Miller, 2006; Top, 2012).

The institutional level of support consists of rewards and recognition and the promotion of a positive organizational culture towards online education (Baran & Correia, 2014). Institutional support is seen as supremely important (Baran & Correia, 2014; Weaver et al., 2008). On one hand, if the Deans and Department Heads do not support online teaching, the faculty who do may feel marginalized, unsupported within their discipline, and isolated. On the other hand, if upper management adopts online teaching and pushes for too many changes too quickly, planned implementation and adequate training can be grossly neglected, resulting in dissatisfaction among academic staff (Weaver et al., 2008).

Learner Support

Online education is supported by technology-assisted methods of communication, instruction, and assessment. The methods of communication in online learning are very important since feedback given to students depends on them. For some students, synchronous communication helps with receiving direct feedback, whereas for others, asynchronous communication methods allow for more control on the part of the students to process feedback and respond at their own pace (Gold, 2004). Some have stressed the importance of not simply creating online interaction but rather developing high-quality, technology-assisted communication to promote student outcomes (Gold, 2004). Students report that the most common negative aspects of online classes are technology problems and feeling lost in cyberspace. On the other hand, they appreciate the flexibility of online classes and find instructor availability and a sense of community to be positive aspects of online learning (El Mansour & Mupinga, 2007).

Technology characteristics in online learning are important considerations. Some have suggested that interface design, function, and medium richness play a key role in student satisfaction. The medium should accommodate both synchronous and asynchronous communication and the interface should be appealing, well structured, easy to use, allow for different mediums such as text, graphics, audio and video messages, and have the capability of providing prompt feedback to students (Volery & Lord, 2000). Ice et al. (2010), Merry and Orsmond (2007) and Philips and Wells (2007) found that students responded positively to audio feedback.

Within the context of learner support, providing accommodations and support for students with disabilities is also an important consideration in online education. In particular, for students with cognitive impairments, navigating an online course can be particularly challenging, as existing platforms typically do not support such learners (Grabinger et al., 2008).

Instructor Support

Kumar et al. (2022) developed the Online Instructor Support Survey (OISS) consisting of five sections that are various supports that online instructors need for effective online teaching:

- Technology and technical support
- Pedagogical (Course Development and Teaching) support
- Online Education Academic Support Services
- Institutional Policies for Online Education
- Online Instructor Recognition, Rewards, and Incentives

Inclusive and Equitable Online Learning

When creating online courses, it is essential to create inclusive and equitable online content to meet the needs of diverse learners. The online course can be made more inclusive and equitable through various aspects of online teaching and learning, such as (a) online instructor self-awareness and commitment to inclusive and equitable online teaching, (b) getting to know the online learners, (c) designing the course, and (d) during course facilitation and evaluation.

Instructor self-awareness. Some of the strategies that the instructor can use includes reflecting on the students and their needs; examining your own assumptions about student behavior; including a Diversity, Equity, and Inclusion statement in the syllabus; and reviewing the syllabus to identify changes, such as course policies that need to be updated, to make it equitable.

Getting to know the online learners. Some of the strategies the instructors can use include surveying the students at the beginning of the semester to understand student needs and their readiness, ensuring all students have access to the devices they need as well as reliable internet for online learning, advocating for students who have greater needs and fewer resources, and supporting students who need specialized instruction and services (e.g., students with disabilities and English language learners).

Course Design. During course design, some of the strategies instructors can use to make the course inclusive and equitable include creating a welcoming online environment, including materials that are accessible to all learners, ensuring that instructional materials include a diverse representation of individuals, including multiple low and high stakes assessments throughout the course, and including resources necessary to support their learning.

Course Facilitation and Evaluation. During course facilitation and evaluation, some of the strategies instructors can use to make the course inclusive and equitable include ensuring equitable participation in asynchronous and synchronous discussions, recording lectures and virtual meetings so that students who are unable to attend can view it later, being available to support students through virtual office hours and providing timely response to questions, providing opportunities for students to engage in smaller group settings, grading anonymously to reduce bias, and collecting feedback anonymously from students for course improvement.

Additional Resources

Table 7 includes a list of journals that publishes research focusing on online learning and distance education.

American Journal of Distance Education	https://www.tandfonline.com/journals/hajd20
Distance Education	https://www.tandfonline.com/journals/cdie20
Distance Education: An International Journal	https://teachonline.ca/tools-trends/journals/distance-education-international-journal
Distance Learning	https://www.infoagepub.com/distance-learning.html
European Journal of Open and Distance Learning (EURDL)	http://www.eurodl.org/
International Journal of Instructional Technology & Distance Learning	http://www.itdl.org/index.htm
International Journal on E-Learning	http://www.aace.org/pubs/ijel/default.htm
International Journal of E-Learning and Distance Education	http://www.ijede.ca/index.php/jde/index
International Journal of Online Pedagogy and Course Design	http://www.igi-global.com/journal/international-journal-online-pedagogy-course/1183
International Review of Research in Open and Distance Learning (IRRODL)	http://www.irrodl.org/
Journal of Interactive	http://www.ncolr.org/jiol/

American Journal of Distance Education	https://www.tandfonline.com/journals/hajd20
Online Learning	
Journal of Online Learning Research	https://www.learntechlib.org/j/JOLR/
Online Journal of Distance Learning Administration	http://www.westga.edu/~distance/ojdla/browsearticles.php
Online Learning Journal	https://onlinelearningconsortium.org/read/online-learning-journal/
Open Learning: The Journal of Open and Distance Learning	https://www.tandfonline.com/journals/copl20
Quarterly Review of Distance Education	https://www.infoagepub.com/Quarterly-Review-of-Distance-Education.html
The Journal of Distance Education (Formerly the Journal of Distance Education)	https://www.learntechlib.org/j/JDE/
Turkish Online Journal of Distance Education	http://tojde.anadolu.edu.tr/index.htm

Table 7. Journals focusing on Online Learning and Distance Education

Learning Check

A course that blends both asynchronous and synchronous online learning, and where students can participate in anytime, anywhere learning is called: (Select one answer)

- ☐ Hyflex
- ☐ Blended
- ☐ Bichronous

- [ ] MOOC

Which of the following are important aspects of online teaching? (Check all that apply)

- [ ] Course design
- [ ] Course facilitation
- [ ] Course engagement
- [ ] Inclusion and Equity

Editor's Note

To read more on this topic, see the chapter titled "Distance Learning" published in the first edition of this textbook.

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Computer-Supported Collaborative Learning

Hmelo-Silver, C. , Jeong, H. , & McKeown, J.

Collaboration | Collaborative Learning | CSCL | Learning Sciences | Pedagogy | Technology

Computer-Supported Collaborative Learning (CSCL) research has become pervasive in STEM (science, technology, engineering, and mathematics) education over the last several decades. Guided by sociocultural and social constructivist theories of learning, CSCL focuses on shared meaning making and is influenced by the three pillars of CSCL: enabling technologies, pedagogical designs, and modes of collaboration. This chapter identifies four different approaches or clusters to CSCL that involve different combinations of these pillars. Focusing on two of these clusters, this chapter (a) identifies robust themes in this field and (b) discusses the positive outcomes associated with these aspects of CSCL.

> *Outcomes include learning gains, process improvements, and affective outcomes. Across clusters, results demonstrate that scaffolding and feedback in different combinations affect outcomes. Moreover, different combinations are used with learners at different ages and with different learning goals. Designing CSCL for different learning environments requires considering the complex system of learning environments that emerge from the interaction among contexts, learner characteristics, and learning activities.*

Many contemporary theorists characterize learning as that which is fundamentally social rather than individual (Danish & Gresalfi, 2018). Advances in computer technologies have enabled diverse modes of collaboration and set the stage for **Computer-Supported Collaborative Learning (CSCL)**. CSCL refers to collaborative learning that is mediated in some way by computer technology (Stahl, Koschmann, & Suthers, 2014). It rests on three major pillars: the technologies that support and enable CSCL, the pedagogical designs that apply CSCL to learning, and the modes in which learners collaborate. In describing the goal of research in CSCL, Miyake (2007) argued that research and design of CSCL environment must take "collaboration seriously, and implements and evaluates technological support to materialize effective learning designs" (p. 248), addressing three key foundations of CSCL. Similarly, Roschelle, Bakia, Toyama, and Patton (2011) have argued that we need to understand the compound resources at play in complex learning environments. By looking at different combinations of CSCL design elements, we move closer to being able to understand how to design for CSCL in different contexts. This chapter considers how different combinations of these pillars affect the outcomes of CSCL research with a focus on science, technology, engineering, and mathematics (STEM) education, where much CSCL research has been conducted (Jeong, Hmelo-Silver, & Jo, 2019).

CSCL: An Overview

The pillars of CSCL are the technology, the **pedagogy**, and the mode of collaboration. CSCL environments may be synchronous, that is, with learners collaborating at the same time, or asynchronous, with learners collaborating at different times (Jeong et al., 2014). Synchronous collaboration can be at a distance (e.g., web conferences), or it can be face-to-face. An example of synchronous face-to-face CSCL is secondary school students discussing simulations in their classroom together (e.g., Sinha, Rogat, Adams-Wiggins, &

Hmelo-Silver 2015), whereas an asynchronous CSCL design can involve learners distributed across time and space (e.g., Yukawa, 2006).

Within CSCL, the focus is on learning through **technology-mediated collaboration** as a coordinated effort to build shared knowledge (Stahl et al., 2014). A broad range of theoretical perspectives can apply (Hmelo-Silver & Jeong, 2021). However, because a general constructivist **sociocultural** orientation or sociocultural framework accounts for the majority of CSCL research, we ground our discussion in these latter frameworks, as they have been the dominant **paradigms**.

This chapter adopts a broad view on technology, focusing on the **affordances** and supports rather than technical features that these technologies provide for collaborative learning. Jeong and Hmelo-Silver (2016) proposed seven affordances of CSCL for learning. Affordances here refer to the ways technology mediates learning in CSCL. CSCL technologies provide learners opportunities to (a) engage in a joint task, (b) communicate, (c) share resources, (d) engage in productive collaborative learning processes, (e) engage in **co-construction**, (f) monitor and regulate collaborative learning, and (g) find and build groups and communities. Different combinations of these functions can be used in CSCL designs to support a range of instructional designs and pedagogical approaches.

Learning Check

What are the three pillars of CSCL? (select all that apply)

- ☐ Enabling technologies
- ☐ Gamification
- ☐ Pedagogical designs
- ☐ Modes of collaboration

What is an example from this chapter of synchronous collaboration that occurs at a distance?

- ☐ In-class presentations
- ☐ Self-moderated learning modules
- ☐ Web conferences
- ☐ Discussion boards

What is an example from this chapter of synchronous collaboration that occurs face-to-face?

- [ ] Elementary school students posting self-introduction videos to a class discussion board while at home
- [ ] Secondary school students discussing simulations in their classrooms together
- [ ] Researchers participating in an online Zoom meeting (online video conference software) to discuss research methods
- [ ] Teaching assistants collaborate to create a test review while they are in different offices

How is asynchronous CSCL design different from synchronous CSCL design?

- [ ] Asynchronous CSCL design involves learners interacting in the same space
- [ ] Asynchronous CSCL design can involve learners interacting with learning material face-to-face
- [ ] Asynchronous CSCL design can involve learners across time

What is the focus of CSCL?

- [ ] encoding of informational details like time, space, and meaning of words
- [ ] visual representation of the relationship between ideas
- [ ] the input of information into the memory system
- [ ] learning through technology-mediated collaboration as a coordinated effort to build shared knowledge

Jeong and Hmelo-Silver (2016) proposed that technology can mediate learning through engagement in a joint task and engagement in co-construction. What are three of the five other ways technology mediates learning in CSCL? (select all that apply)

- [ ] Communication
- [ ] Sharing of resources

- [ ] Proliferation of ineffective learning practices
- [ ] Engagement in productive collaborative learning processes
- [ ] Promotion of in-person collaboration

Effects of CSCL on Learning

Recent meta-analyses suggest that CSCL has significant effects on student learning. Chen, Wang, Kirschner, and Tsai (2018) examined the role of collaboration, computer use, and overall CSCL environments on learning. They found overall moderate effects of CSCL on learning outcomes and social interaction, with large effects on group tasks. Vogel, Wecker, Kollar, and Fischer (2017) focused on **scaffolding** with CSCL **scripts**. They found small effects on knowledge gains and a moderate effect on collaboration skills. Scripts were particularly effective for learning domain knowledge when they prompted learners to engage in activities that built on the contribution of other group members or when they provided additional content-specific support. In a meta-analysis of CSCL in STEM domains, Jeong et al. (2019) found a similar overall moderate effect size. They did find, however, that effect sizes were affected by types of technology and pedagogy, education levels of learners, and modes of collaboration. For example, **representational tools** (e.g., simulations, modeling tools) were more effective in face-to-face than in asynchronous settings, as was **inquiry learning**. The use of scripts and discussion boards were more effective in asynchronous settings.

These syntheses suggest that CSCL is effective. However, these syntheses found that different factors moderated the effectiveness of these approaches. Jeong et al. (2019) drew from a larger corpus of CSCL research that was coded for types of technologies, pedagogies, and collaboration modes (c.f.,McKeown, Hmelo-Silver, Jeong, Hartley, Faulkner, & Emmanuel, 2017). They found that there was not just one CSCL but rather four unique clusters of CSCL designs:

- **Face-to-face Inquiry with Dynamic Feedback**— face-to-face collaboration, inquiry and exploration pedagogies, and dynamic or other tools.
- **Online Generative Inquiry**— asynchronous or face-to-face collaboration, inquiry and exploration or teacher-structured pedagogies, and sharing and co-construction technology.
- **Asynchronous Teacher-Structured Discussion**— asynchronous collaboration, discussion or teacher-structured pedagogies, and asynchronous communication technologies.
- **Synchronous Collaboration**—synchronous collaboration and communication technologies.

Here we focus on the first two inquiry-oriented clusters to show how CSCL has been used in different learning designs. This focus was selected because these were among the most commonly identified clusters and they provide a useful design contrast in considering how inquiry-oriented pedagogies are used with different technologies.

Learning Check

According to Jeong et al. (2019), what are two examples of how the effectiveness of teaching tools and pedagogies differ from face-to-face synchronous to asynchronous settings? (select all that apply)

- [ ] Representational tools and inquiry learning are more effective in face-to-face settings
- [ ] Scripts and discussion boards are more effective in asynchronous settings
- [ ] Representational tools and inquiry learning are more effective in asynchronous settings
- [ ] Scripts and discussion boards are more effective in face-to-face settings

Which of the four clusters of CSCL designs are discussed in this chapter? (select all that apply)

- [ ] Asynchronous teacher-structured discussion
- [ ] Online generative inquiry (OGI)
- [ ] Problem-based learning (PBL)
- [ ] Face-to-face collaborative inquiry with dynamic feedback (F2FCI)

Face-to-Face Collaborative Inquiry with Dynamic Feedback (F2FCI)

This cluster emphasizes face-to-face collaboration with inquiry and exploration pedagogies using dynamic technological tools such as simulations, games, and immersive technology. These provide feedback based on learner actions as well as rich contexts. In addition, a substantial number of the papers in this cluster also used sharing and co-construction tools. Within the cluster, the majority of papers were in K-12.

Outcomes

Learning under this type of CSCL led to significant learning gains, promoted student engagement, and supported positive process outcomes such as critical thinking and reasoning skills. These outcomes cut across quantitative and qualitative studies, disciplinary content, and education levels. K-12 math students improved their problem-solving skills (e.g., Roschelle, Rafanan, Estrella, Nussbaum, & Claro, 2010; Sao Pedro, Baker, & Rodrigo, 2014), conceptual understanding (Lai & White, 2012; Turcotte, 2012), and group collaboration (Chen et al., 2012). In physics, positive effects on learning gains were found in primary and secondary education (Turcotte, 2012; Echeverría et al., 2012, respectively). Primary students experienced positive learning gains and improved critical thinking skills from designing digital science games (Yang & Chang, 2013). Primary students who were guided either with awareness tools or scripts learned more about photosynthesis through a drawing task than students in a **control condition** (Gijlers et al., 2013).

F2FCI research also highlighted positive effects on student engagement and affective measures at multiple education levels. Primary students using handheld devices in an authentic outdoor learning task were enthusiastic and developed great interest in the assignment (Avraamidou, 2013). Secondary biology students who participated in a CSCL review game were more engaged than students in the control group who participated in traditional paper and pencil review sessions with CSCL support (Annetta, Minogue, Holmes & Cheng, 2009). Additionally, computer science secondary and tertiary students felt empowered in their own learning (Tsai, Tsai, & Hwang, 2012).

Furthermore, lessons using dynamic technologies with inquiry and exploration pedagogies promoted meaningful interactions between elementary students, which in turn led to greater learning outcomes (Lai & White, 2012). For example, students engaged in high quality interaction patterns which entailed discussing the problem, task delegation, and helping each other in turn complete more assignments correctly than students with poor communication and collaboration (Chen, Looi, Lin, Shao, & Chan, 2012).

Factors That Support Effectiveness

Overarching themes that emerged from this cluster are that both (a) pedagogies that support collaborative inquiry and (b) rich problem contexts that establish a joint task are needed to promote positive outcomes (e.g., Chiang, Yang, & Hwang, 2014; Kong, Yeung, & Wu, 2009; Lai & White, 2012). **Authentic problem contexts** can be set in games and simulations (e.g., Nelson & Ketelhut, 2008; Sinha et al., 2015). One way facilitators provided guided instruction was by giving assistance and feedback throughout collaborative inquiry, and by providing authentic problems for problem-based learning (e.g., Avraamidou, 2013).

Instructors provided guided instruction ranging from very open-ended to more highly-structured. For example, undergraduate and graduate students were given very open-ended guidelines as they engaged in mobile learning outside of the classroom (Tsai et al., 2012), whereas secondary-level students were provided more facilitation in a student-driven augmented reality game to help them learn electrostatics (Echeverría et al., 2012). Even greater structure was provided for primary students who were given systematic processes to follow as they engaged with inquiry learning to help them with knowledge sharing (Chiang et al., 2014). In a grade 5/6 study of Knowledge Forum, teacher and researcher questions were helpful in advancing student thinking (Turcotte, 2012).

Closely tied to the theme of guided inquiry is feedback (Hmelo-Silver et al., 2007). In studies with F2FCI with dynamic feedback, participants at a variety of educational levels received immediate feedback on a task or problem from facilitators (e.g., Kong et al., 2009;), peers (e.g., Lai & White, 2012), and/or software (e.g., Chen et al., 2012; Holmes, 2007; Roschelle et al., 2010). Software feedback could include direct hints or prompts or be more indirect in providing changes in the state of a simulation or game in response to learner actions (e.g., Eberbach & Hmelo-Silver, 2010). Teachers noted elementary student success with technology required active teacher feedback (Chiang et al., 2014; Kong et al, 2009).

Factors That Inhibit Effectiveness

Factors that may inhibit student learning and engagement are related to feedback. An example of the importance of informative feedback emerged from two studies with primary students and teachers. When teachers lack content expertise, the technology itself needs to have that content feedback embedded or risk leaving student questions unanswered (Kong et al., 2009). This is also a problem when a teacher is working with several groups and cannot provide consistent active feedback for each group (Chiang et al., 2014; Kong et al., 2009).

The lack of consistent, active feedback are pedagogical and technological concerns applicable at all educational levels. Technologies can be used to provide content feedback in such situations, but as Turcotte (2012) noted, just because technology provides affordances for particular kinds of activity such as elaborated explanations, learners do not always take advantage of those affordances.

Summary and Implications

In this cluster, there was a trend for students to be collaboratively engaged with authentic problems and their learning nurtured by guided instruction, feedback, and discussion. Together, these combinations were associated with significant learning gains, positive student engagement, meaningful interactions between students, and improved group collaboration and communication skills.

Simulation tools and augmented reality games allow students opportunities for practice, feedback, and revision as they collaboratively engage with disciplinary content and practices without the time or expense of physical tools. In this cluster, learning with authentic problems was supported by opportunities for guided inquiry and immediate feedback from the tools and discussion. Technology played a role in helping students to work in settings that are more authentic and have opportunities to directly test their ideas and solutions, with the tools providing dynamic feedback.The main difference between the higher education and K-12 school environments was the control retained by the instructor. When this design was used in higher education, students had greater autonomy than primary and secondary education students. Questions remain about how much information needs to be embedded in the technology and how to help teachers support their students.

Learning Check

What are the overarching themes present in the F2FCI cluster? (select all that apply)

- [ ] Pedagogies that support collaborative inquiry
- [ ] Use of open educational resources
- [ ] Amount of time spent engaging in informational gathering activities
- [ ] Rich problem contexts that establish a joint task are needed to promote positive outcomes

Why is feedback an important factor in F2FCI?

- [ ] Feedback will provide more opportunities for the students to solve problems independently
- [ ] An absence of feedback will leave students' questions unanswered
- [ ] An absence of feedback is proven to cause all students to experience detrimental levels of stress

Think About It!

What type of collaboration does F2FCI emphasize and what tools does it use?

What is an example of how a need for structure may vary from one group of learners to another in an F2FCI environment?

Online Generative Inquiry (OGI)

This cluster was primarily concerned with **integrated learning environments** (e.g., learning management systems) or online sharing and co-construction technologies (e.g., wikis). Asynchronous collaboration with inquiry and exploration pedagogies was a main focus, but collaboration and pedagogy were more varied than in some of the other clusters. By nature, integrated environments offered a variety of tools that could be used to collaborate asynchronously or in face-to-face environments. Most OGI research focused on higher education, suggesting connections between learner education level and collaboration types. Communication and discussion occurred through sharing/co-construction tools and integrated environments that allowed direct communication through built-in chat tools or discussion forums.

Outcomes

Research in this cluster primarily reported process gains as well as some learning gains. The positive process gains included metacognitive skills supported by a knowledge-building environment (Pifarre & Cobos, 2010) and improved reasoning and collaboration via e-learning environments or wikis (Huang, & Nakazawa, 2010). In an undergraduate statistics course, student report writing was completed individually or collectively via a wiki (Neumann & Hood, 2009). There were no differences in terms of final report quality, but students who collaborated within wikis were more engaged and had higher attendance than those who worked alone.

Learning gains in this cluster were not uniform. On one hand, collaborative use of a multimedia-enriched **concept map** produced greater short-and long-term retention scores than a control group that received regular instruction and worked on assignments individually (Marée et al., 2013). However, another study found no differences between the final grades of a group that collaborated through wikis and a group that worked independently with a word processor, despite positive engagement (Neumann & Hood, 2009). Here, some students reported dissatisfaction with using the technology, and task completion could be negatively affected by low group member participation. Mixed learning gains were reported in Krause, Stark, and Mandl (2009) in examining the role of adaptive feedback in an asynchronous statistics class. They found that feedback was beneficial for students with low prior knowledge but had no effect on students with high prior knowledge.

Factors That Support Effectiveness

In a wiki co-construction environment, students reported more interaction with peers than with their instructor, and that the instructor moved to more of a moderator role, allowing students to initiate interactions (Huang & Nakazawa, 2010). Students also noted the importance of receiving public feedback about revisions within the wiki where these could be discussed by group members. This feedback functioned as collaborative scaffolding and an anchor for their discussions. In using representational tools, Marée, van Bruggen and Jochems (2013 when there was less teacher guidance.

This OGI research also offered some promising implications about specific technologies and pedagogical practices. For example, in asynchronous discussion threads (i.e., a technology), particularly when students act as facilitators (i.e., a pedagogical practice), they need to understand different types of thread patterns and how questioning, summarizing, pointing, and resolving may affect discussion thread development and closure (Chan, Hew, & Cheung, 2009). Feedback, whether from instructors or peers, may promote more reflection--especially when it offers explanations (Krause et al., 2009). Thus, regardless of the source, feedback should be thoughtful, thorough, and encourage students to go beyond remembering information. Pifarre and Cobos (2010) demonstrated the importance of scaffolds in improving peer questioning and co-regulation.

Much of this research investigated how students used and perceived specific technology. These suggest that the use of collaborative group activities, instructors' timely feedback, and support materials embedded within an integrated system all related to student satisfaction with a variety of STEM related vocational e-learning courses (Inayat, ul Amin, Inayat, & Salim, 2013). When guided instruction and immediate feedback are integrated within these pedagogies and technologies, it can lead to improved student learning (Krause et al., 2009; Marée et al., 2013) and task completion (Hämäläinen, & Arvaja, 2009).

Although scripts might be effective for task completion, they do not necessarily avoid variability in collaboration processes among groups. In a study of university students engaging in **case-based learning**, Hämäläinen and Arvaja (2009) still found differences in collaborative activity with unequal participation or a dominant group member. This suggests that the structure from script may not be sufficient to promote uniformly productive collaboration.

Factors That Inhibit Effectiveness

Again, feedback was mentioned in relation to factors that inhibit effectiveness. Consistent with findings in other clusters, a lack of feedback can negatively affect students' learning outcomes (Krause et al., 2009). Meanwhile, too much feedback, or using facilitation techniques that resolve conflicts or summarize key points can lead to discussions closing prematurely (Chan et al., 2009). Without enough guidance regarding the importance of positive collaboration, students may have high task activity but not necessarily high-quality collaboration (Hämäläinen, & Arvaja, 2009).

Summary and Implications

Timely guidance from teachers and peers plays an important role in increasing student outcomes as well as favorable perceptions of the environment. The results for this cluster also highlighted the importance of keeping the guidance at an optimal level.

In contrast to F2FCI, communication was heavily mediated in this cluster. It made students' thinking visible in ways that a face-to-face classroom may not allow. Teachers can thus follow persistent threads of discussion along with the artifacts being created. This gives teachers opportunities for ongoing **formative assessment** and may also provide grist for student reflection on these ongoing interactions in ways that face-to-face discussions may not. This may be particularly important in higher education contexts with their larger class sizes that might otherwise offer few opportunities for discussion and feedback.

Learning Check

What is OGI primarily concerned with?

- [ ] Providing learning tools to groups of learners
- [ ] Promoting the adoption of cognitivist learning theories in teaching practices
- [ ] Integrated learning environments or online sharing in co-construction technologies
- [ ] Adoption of practices that integrate in-person context-based learning activities

What are the two primarily reported gains in OGI? (select all that apply)

- [ ] Systematic gains
- [ ] Proscriptive gains
- [ ] Process gains
- [ ] Learning gains

What did the study conducted by Hämäläinen and Arvaja (2009) suggest regarding scripting?

- [ ] Scripts may not be enough to promote uniformly productive collaboration
- [ ] A script reader's comprehension is essential to the improvement of learning gains
- [ ] Scripts are lesson guidelines that allow for flexibility in teaching
- [ ] Scripts are only recommended for teachers who feel comfortable with the material they are covering

Think About It!

How did OGI learning gains vary across different studies?

Discussion

It is clear that the three pillars of CSCL—collaboration, technology, and pedagogy—are used in different combinations to design effective learning environments. However, we need to better understand how to design for the balance between developing appropriate structures and supporting student agency in ambitious learning practices promoted by CSCL (Glazewski & Hmelo-Silver, 2019). This is particularly important in being able to support diverse learners (Uttamchandani et al., 2020). We review this in the context of the major issues this chapter has identified.

First, feedback and support are themes that run through all the clusters, whether the feedback comes from the teacher, peers, or tools. Questions about feedback consider both timing and quality. Poorly timed feedback that does not address appropriate content, skills, or practices may impede learning. In designing effective CSCL, it is important to think about feedback and support as part of the CSCL system of technologies, pedagogies, and collaboration modes. It is important to consider which aspects of feedback and support should be fixed and part of the environment and which should be adaptive to the needs of the situation. Much dynamic feedback needs to come from teachers and peers. Not enough research has addressed ways to support high quality peer feedback (De Wever, Van Keer, Schellens, & Valcke, 2010). Research on scripts and roles may be one way to scaffold students to provide good quality feedback to their peers. To support teacher feedback, CSCL environments should provide mechanisms for teachers to monitor multiple groups, identify challenges that groups might face, and provide appropriate feedback and resources.

Second, certain technologies lend themselves better to particular **communication channels** and/or pedagogical goals. Dynamic representational tools are generally used in face-to-face environments as the F2FCI Cluster demonstrates. Rapid cycles of activity and engagement with such tools lend themselves to the immediacy of being in the same place at the same time. Additionally, the tools allow for **deictic referencing** as learners can easily point to phenomena on-screen and observe the gestures of others. Effect sizes were larger when dynamic representational tools were used in face-to-face settings (Jeong et al., 2019). Similarly, the use of sharing and co-construction tools dominated the OGI cluster. These tools may be more critical for online environments because learners' interaction channels are limited and thus need to be mediated by communication tools. When communicating and collaborating with these tools, learners need to be more explicit about their actions and contributions, which can provide opportunities for reflection, thus fostering knowledge co-construction .

Third, different learning environments are used for different learners**.** CSCL involving younger learners tends to involve face-to-face collaboration rather than online collaborations. Online collaboration requires dealing with a broader range of communication modalities and as such may be used for more mature learners. The trend seems to be for more structure and face-to-face collaboration for younger learners, perhaps due to the need for social presence in this population as they tend to be in the same physical space. In addition, technology tools can add to cognitive demands and pose increasing challenges for regulation that may be difficult for younger learners. However, these challenges are not unique to younger learners. Creating social presence and supporting self-regulated learning is challenging even for more mature learners in online environments.

Learning Check

What are the three major issues identified within this chapter? (select all that apply)

- ☐ Feedback
- ☐ Retention
- ☐ Assignment of technologies to different environments and pedagogies
- ☐ Learner and learning environment compatibility
- ☐ Language

True/False: CSCL provides a one-size-fits-all solution to collaborative learning.

- ☐ True
- ☐ False

Implications for LIDT

Considerations for Practice

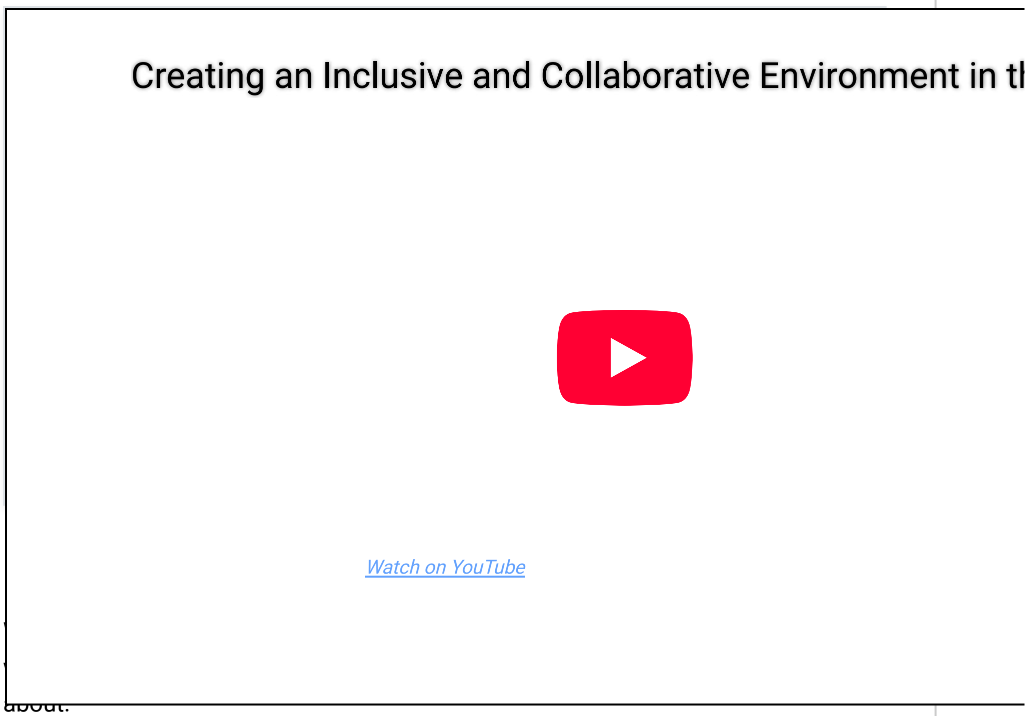
Helping **stakeholders** become aware of the usefulness of CSCL is a first step in implementing **evidence-based practices**. This includes reporting on CSCL in practitioner venues publications. In addition, professional development training is important for instructors in order to effectively implement CSCL. Facilitating CSCL requires mastering the technology, tailoring it to tasks, and providing adequate scaffolds that can be differentiated for student skills and prior knowledge.

CSCL as a Complex System

It is critical to consider CSCL as a system of compound resources (Roschelle et al., 2011). There is no one-size-fits-all solution; how CSCL is used in different learning environments needs to be tailored to the particular level of the learners and the learning goals. Designers and teachers will need to consider how the collaboration modes, technology, and pedagogical choices fit together in ways that are more than the sum of their parts. A consideration of the seven CSCL affordances can help them to directly design efforts along with considering the learning contexts and educational goals.

LIDT in the World

While you watch this video, pay attention to how the technology is being used to facilitate collaboration:



about:

- What are the benefits or drawbacks to implementing technology like this in the classroom?
- Is it sustainable? Why or why not?
- Do you think this technology would be received as well in classrooms with older learners?
- Can the assignment of this technology be flexible enough to fit in different pedagogies?

- Is the use of this technology compatible to a variety of learning environments?

Acknowledgements

This work was supported by the US National Science Foundation [Grant # 1249492]; and the National Research Foundation of Korea [Grant # NRF-2016R1D1A1B03935697]. We thank Jessica McKeown for her contributions to this synthesis. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the funding agencies.

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The 5Cs of Openness: Articulating an Open Education Infrastructure (OER)

West, R. E. & Wiley, D.

OER · Microcredentials · Badges · Open badges · Open education · Verifiablecredentials · Open recognition · Assessment

Open Access

Open Badges

Open Education

Open Education Resources

Open Educational Practices

Open Educational Resources

Open Learning

Open License

Open Science

Open Source

OpenAI

Openness

Open education needs to evolve to fully realize its potential. Emerging innovations such as generative artificial intelligence (GenAI) and open credentials provide exciting opportunities for this growth. In this chapter, we briefly define the key characteristics of open education, describing its history, current opportunities for open education through generative AI, and then articulate an

overarching 5Cs framework for open education that can guide research and practice into the future.

Editor's Note:

Some portions of this chapter were repurposed and revised from earlier openly licensed publications by the authors, including:

West, R. E. (2023). Open Recognition. EdTechnica: The Open Encyclopedia of Educational Technology. https://doi.org/10.59668/371.13762

West, R. E. (2024). Open Recognition, Badges, and Microcredentials. In R. E. West & H. Leary (Eds.), Foundations of Learning and Instructional Design Technology, 2nd Ed. Edtech Books. Available at https://edtechbooks.org/foundations_of_learn/open_recognition.

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Why We Need Open Education

The phrase open education describes efforts to improve education through openness and sharing. These improvements take on many forms. First, open education can be effective at improving intellectual outcomes. Openly available resources can be more easily updated, and students can "own" them in perpetuity, allowing learners to keep returning to class resources for review even after a semester ends. They can also be modified to apply to unique and local contexts. Open educational practices are more motivating and engaging by privileging learner agency, collaboration, and creativity. Second, because open materials can be repurposed according to copyright licenses that allow for sharing/remixing, they can more actively engage students in creating and remixing, rather than just consuming, educational materials. Third, open education can stimulate economic innovation and growth by removing restrictions on content, licenses, and credentials. Finally, open education can help improve equity in society by driving down the price of education, increasing access to high quality learning resources, and creating the opportunity for more culturally relevant customization of learning. Indeed, Stracke et al. (2023) documented many positive impacts from open education including financial, design, organizational, social, and learning benefits.

Despite these and other benefits, open education needs to evolve to fully realize its potential. Emerging innovations such as generative artificial intelligence (GenAI) and open credentials provide exciting opportunities for this growth. In this chapter, we begin by first briefly defining the key characteristics of open education, describing its history, current opportunities for open education through generative AI, and then articulate an overarching 5Cs framework for open education that can guide research and practice into the future.

A Brief History of Open Education

Open Education, which does not have a canonical definition, describes efforts to improve education through openness and sharing. We view open education as incorporating "open" versions of everything necessary for education to be successful. As Cronin (2020) described, the key features of open education are efforts to improve learners' ability to:

1. access education
2. collaborate with others as part of their learning
3. create and co-create knowledge openly,
4. and integrate formal and informal learning practices, networks, and identities.

Because open education represents any effort to improve, through openness and sharing, formal/informal learning through increased access, collaboration, and knowledge creation (Cronin, 2020), there have been efforts to “openly” educate for as long as education itself has existed. Indeed, Jesus’ efforts to freely teach thousands by the Sea of Galilee, Plato’s granting of free entry to the public to his Academy, or Confucius’ willingness to teach people of all social status could be considered early examples of open education.

In more modern times, technological developments have accelerated the open education movement. Nearly every technology can support the acceleration of open education, but the following key innovations were particularly significant in the more recent times of the last 40 years:

Open source software: While sharing of computer code was prevalent with early computer engineering, these practices were suppressed by software companies. Richard Stallman’s GNU Manifesto (1985) described a rationale and need for free and open software, which was embodied in the GNU Project to create an open operating system. Shortly afterwards, Linus Torvalds released the Linux kernel in 1992 as freely modifiable source code for a computer operating system (Stallman, 1999). Additional open software components followed, such as Apache web services, MySQL database structure, and PHP scripting language. The combination of these formed the LAMP software framework.

Open licenses: As open software was created, licenses were needed to provide legal permissions for using the software. Many consider the first open license to be the GNU General Public License in 1989, but this was followed by many “permissive” licenses (created by academia, and not requiring source code in a share alike manner) and “copyleft” licenses (created by software programmers to require sharing source code with similar openness, see Stallman, 1999). Wiley in 1998 and Wiley and Raymond in 1999 shared their own versions of open publication licenses (see Wiley, 2007), and shortly afterwards, Creative Commons licenses were launched in 2002 (Creative Commons, n.d.).

Open content: As technologies and licenses made it more possible for everyone to create and share educational materials, the open educational resources movement gained momentum. Branching out of the online learning movement, Wiley argued for an analogous content version of the open source software movement. At first, universities sought to archive recordings of in-person courses along with all class materials as open courseware, starting at MIT in 2001 (see https://en.wikipedia.org/wiki/MIT_OpenCourseWare). Eventually, universities and private companies began creating courses specifically for open sharing on the Internet, which spurred the Massive Open Online Courses (MOOCs) movement in the late 2000s, beginning at the University of Manitoba in Canada by George Siemens and Stephen Downes, and quickly spreading across the world.

Open textbooks: Accompanying the creation of open courses, open textbooks became popular, with early leadership from Connexions/OpenStax, BC Open Textbooks, Flat World Knowledge, and the Open Textbook Library, among others. In 2018, Royce Kimmons of Brigham Young University created EdTechBooks.org as both an open textbook authoring tool and marketplace.

Open credentials: Researchers/developers at the Mozilla and MacArthur Foundations created the idea of open badges as an open credential to recognize informal/formal learning utilizing open technologies that facilitated learners owning and sharing their own credentials (Mozilla Foundation, 2012). For more information on the evolution of the open recognition/credentialing movement, see West, 2024, in this book.

Open practices: The open education movement increasingly seeks to incorporate openness into all educational practices, including in the use of open pedagogy, open universities, open science, and other open educational practices (Boskurt, 2019).

Open generative AI: As generative AI burst into the public imagination in 2022 with the launch of ChatGPT, discussions and arguments immediately started over what it would mean for this latest technology to be "open" (see, for example, the Open Source Initiative's effort to define "open AI" (OSI, 2024). Answers to these important questions, and the implications of those answers for education, are still being worked through today.

5 Cs Open Education Framework

As Generative AI causes educators to rethink every aspect of their work, we need frameworks and guiding principles for understanding how various aspects of open education work together for a vision of student learning and success. The Cambridge Dictionary describes a framework as "a supporting structure around which something can be built." If our goal is to build educational systems that are open, equitable, and accessible to all, we need a framework that supports this as it will not be sufficient to have a framework representing a cobbling together of open and non-open educational practices. In the past, much of open education has focused too much on just open content/open educational resources, and this has limited our creative thinking about what open education can accomplish. While it is critical to have open resources for students to learn from, if we believe education is more than content, then open education must be more than open books, resources, or even courses. It must include everything necessary for effective education. We propose the following as an articulated vision for an open education framework:

- Open **Competencies** that articulate what learners should be achieving.
- Open **Content** that teaches about those competencies
- Open **Customs** that utilize these resources, recognition practices, etc. (e.g., open pedagogies, open scholarship, open sharing of AI integration strategies, open communities)
- Open **Credentials** that help students, teachers, and others know what has been accomplished
- Open **Co-Intelligence** that collaborates with designers, teachers, learners, and others in support of their engagement in all aspects of teaching and learning, from planning to credentialing.

Open Competencies

One of the primary reasons competency-based education (CBE) programs have been so slow to develop in the U.S.—even after the Department of Education made its federal financial aid policies friendlier to CBE programs—is the amount of work necessary to develop a solid set of competencies. Not everyone who needs to teach from competency frameworks has the time or expertise to do this work. However, because this is challenging work, many institutions with CBE programs treat their competencies like a secret family recipe, hoarding them away and keeping them fully copyrighted (apparently without experiencing any cognitive dissonance while they promote the use of OER among their students). This behavior has stymied growth and innovation in CBE.

If an institution would openly license a complete set of competencies, that would give other institutions a foundation on which to build new programs, models, and other experiments. The open competencies could be revised and remixed according to the needs of local programs, and they can be added to, or subtracted from, to meet those needs as well. This act of sharing would also give the institution of origin an opportunity to benefit from remixes, revisions, and new competencies added to their original set by others. Furthermore, openly licensing more sophisticated sets of competencies provides a public, transparent, and concrete foundation around which to marshal empirical evidence and build supported arguments about the scoping and sequencing of what students should learn.

Open competencies are the core of the open education framework because they provide the context that imbues resources, assessments, and credentials with meaning about fit and appropriateness for the learner. Likewise, a credential is essentially meaningless if a third party like an employer cannot refer to the skill or set of skills its possession supposedly certifies.

Open Content

Open content is what most people think of when they refer to open education, and it involves the open creation and sharing of instructional texts, curriculum, and materials. This includes more than the instructional materials designed for student use, like textbooks. Open content also includes assessment instruments like assignments and rubrics, discussion prompts, and quiz banks, as well as supplemental instructional materials like handouts, pacing guides, and Powerpoint slides instructors might use in support of their teaching.

Open Content and Open Educational Resources are frequently used incorrectly as synonyms of open education. In reality, these terms describe any copyrightable work (traditionally excluding software, which is described by other terms like “open source”) that is either (1) in the public domain or (2) licensed in a manner that provides everyone with free and perpetual permission to engage in the 5R activities:

1. Retain – make, own, and control a copy of the resource (e.g., download and keep your own copy)
2. Revise – edit, adapt, and modify your copy of the resource (e.g., translate into another language)
3. Remix – combine your original or revised copy of the resource with other existing material to create something new (e.g., make a mashup)

4. Reuse – use your original, revised, or remixed copy of the resource publicly (e.g., on a website, in a presentation, in a class)
5. Redistribute – share copies of your original, revised, or remixed copy of the resource with others (e.g., post a copy online or give one to a friend)

While open licenses like the Creative Commons licenses provide users with legal permission to engage in the 5R activities, many open content publishers make technical choices that interfere with users' ability to engage in those same activities. The ALMS Framework provides a way of thinking about those technical choices and understanding the degree to which they enable or impede a user's ability to engage in the 5R activities permitted by open licenses. Specifically, the ALMS Framework encourages us to ask questions in four categories:

1. **Access to Editing Tools:** Is the open content published in a format that can only be revised or remixed using tools that are extremely expensive (e.g., 3DS MAX)? Is the open content published in an exotic format that can only be revised or remixed using tools that run on an obscure or discontinued platform (e.g., OS/2)? Is the open content published in a format that can be revised or remixed using tools that are freely available and run on all major platforms (e.g., OpenOffice)?
2. **Level of Expertise Required:** Is the open content published in a format that requires a significant amount of technical expertise to revise or remix (e.g., Blender)? Is the open content published in a format that requires a minimum level of technical expertise to revise or remix (e.g., Word)?
3. **Meaningfully Editable:** Is the open content published in a manner that makes its content essentially impossible to revise or remix (e.g., a scanned image of a handwritten document)? Is the open content published in a manner making its content easy to revise or remix (e.g., a text file)?
4. **Self-Sourced:** Is the format preferred for consuming the open content the same format preferred for revising or remixing the open content (e.g., HTML)? Is the format preferred for consuming the open content different from the format preferred for revising or remixing the open content (e.g., Flash FLA vs SWF)?

Using the ALMS Framework as a guide, open content publishers can make technical choices that enable the greatest number of people possible to engage in the 5R activities. This is an invitation to instructional designers to be thoughtful in the technical choices they make—whether they are publishing text, images, audio, video, simulations, or other media.

Open Credentials

Despite always learning, our learning often must be recognized in order to be useful in our lives. Traditionally, the emphasis in learning recognition has been top-down. In this approach, an institution is trusted to appropriately recognize whether and what a student has learned, and certify this learning. This recognition of learning appears in the form of grades, progress reports, competency dashboards, certificates, and degrees. These markers are "proxies for ability and potential" (Gallagher, 2016, p. 38) that signal to other entities in society (e.g., employers) about what the student has learned. These end entities trust these proxies because of the trust they have in the institution recognizing the learning.

This formal, top-down recognition of learning is important as both "the foundation of the business model for most higher education institutions" (Gallagher, 2016, p. 3) as well as a key pillar of an industrialized society in need of specific skill sets. However, this form of learning recognition is also limited for several reasons:

1. **Lack of Equity** — A top-down system breeds inequity as the power within society, as it relates to education, is controlled by few hands—in this case, usually universities. As all institutions can exhibit bias, this has the potential to exacerbate a lack of equity within society.
2. **Lack of Access** — When recognition of learning is controlled by a small segment within society, then access to the benefits of learning recognition is limited. Even though humans are constantly learning, only those who can get their learning recognized by the correct institution will be able to benefit from their learning. As an example, it is possible to learn a skill such as computer programming outside of a university, but for a long time this knowledge was not recognized as equally valuable. Because of the power of technology companies in society, that view, in this particular domain, is changing as more technology companies recognize alternatives to higher education degrees (Caminiti, 2022).
3. **Lack of Openness** — Openness, as related to educational content, has been defined as the ability to reuse, retain, revise, remix, and redistribute (Wiley, 2015). Learning recognition can similarly be considered open only when a learner can retain their own learning data/credentials, reuse them for their own purposes, revise and remix them to better represent their own abilities, and redistribute them. This openness requires new technologies that take control of the recognition of learning away from institutions and instead share it equally with formal/informal learning institutions, as well as learners and communities.

Open credentials use open technologies and practices to recognize all learning, including learning not formally recognized by traditional degrees and certificates. It encompasses similar concepts such as microcredentials, open/digital badges, blockcerts, verifiable credentials, and comprehensive learner records.

Another aspect of open credentials is having open assessments that can be used to determine what type of credential a learner should receive. For years, creators of open educational resources have declined to share their assessments in order to "keep them secure" so that students won't cheat on exams, quizzes, and homework. This security mindset has prevented sharing of assessments.

In our effort to try and break free from this security mindset, I (Richard) has launched an open assessment/instrument "book" to serve as a database bank of instruments that could be reused/remixed/repurposed for free. This book, Open AIMs (assessments, instruments, and measurements), allows creators to get permanent URLs for their instruments that can accrue citations, independent of any research articles that may use those instruments. Thus, when an instrument is published first in Open Aims with an open license, it will forever remain open, even if later republished in a traditional journal. If interested, view Open Aims at https://edtechbooks.org/aims and submit through the submission template (https://edtechbooks.org/aims/template).

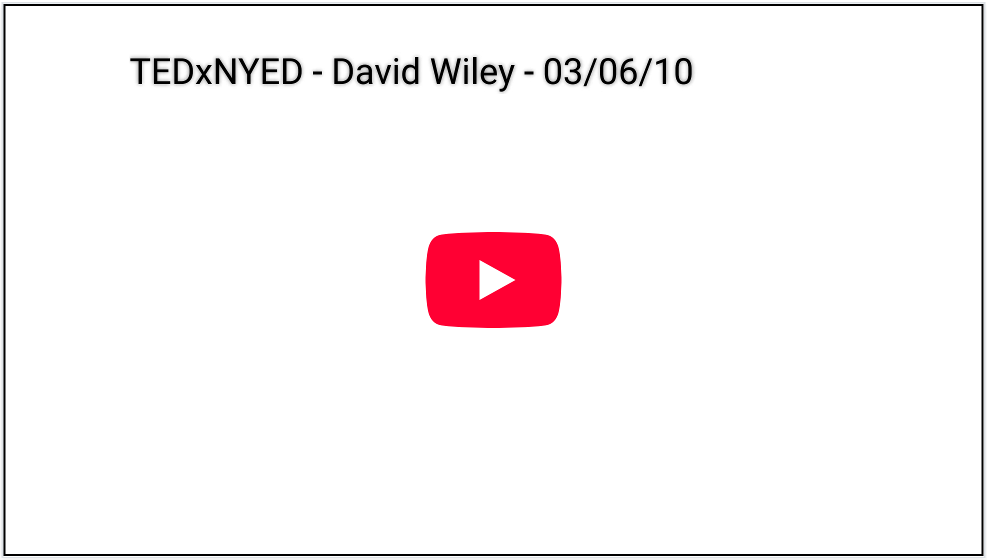
In competency-based education programs, students often demonstrate their mastery of competencies through "performance assessments." Unlike some traditional multiple-choice assessments, performance assessments require students to demonstrate mastery by performing a skill or producing something. Consequently, performance assessments are very difficult to cheat on. For example, even if you find out a week ahead of time that the end of the unit exam will require you to make 8 out of 10 free throws, there's really no way to cheat on the assessment. Either you will master the skill and be able to demonstrate that mastery or you won't.

Because performance assessments are so difficult to cheat on, keeping them secure can be less of a concern, making it possible for performance assessments to be openly licensed and publicly shared. Once they are openly licensed, these assessments can be retained, revised, remixed, reused, and redistributed.

Another way of alleviating concerns around the security of assessment items is to create openly licensed assessment banks that contain hundreds or thousands of assessments—so many assessments that cheating becomes more difficult and time consuming than simply learning.

Open Customs

In the past, the primary emphasis has been placed on open "stuff" (e.g., content, courses, credentials, etc.) rather than on open practices and strategies. In addition to being about products and technologies, openness is also a mental framing around how instructional designers and education professionals do their work. For example, do they view education as an expression of their individual creativity? Something that must be protected and reserved as unique to their person? Or do they view education as freely sharing, in much the same way that you can share a thought or express a feeling with someone else, and still retain it for yourself? We agree with Wiley (2010), "Education is sharing" (see video). This, however, conflicts with an industrial mindset of education that views learning as competitive in the crush to gain more of the resource to prove one's worth. In short, is education inherently competitive or collaborative? Open customs support a view that education should be collaborative, and mutually beneficial.



David, in this TEDx talk shares how a mindset of education as sharing can lead to more open customs.

If one accepts openness is about empowering all learners through permissions (both legal and pedagogical) that increase their agency, collaboration, and trust, then open customs are any practices that increase that empowerment. Still, open customs is a concept difficult to define (see this interesting collection of differing opinions around the term "open pedagogy": https://www.yearofopen.org/april-open-perspective-what-is-open-pedagogy/). However, we argue that for a starting place, we can consider open customs as those that increase learner collaboration, creativity, and agency by:

1. **Removing barriers to individual learning, creativity, and growth.** For example, using open licenses removes restrictions on what people can do with an idea. In addition, removing limitations on when, how, or what "counts" as learning can empower learners. This can lead to what Adam Thierer referred to as "permissionless innovation" (Thierer, 2016). Permissionless innovation is the ability to create and invent without seeking and obtaining prior approval, allowing "the creativity of the human mind to run wild in its inherent curiosity and inventiveness" (Thierer, 2014, para. 4).
2. **Increasing learner involvement in learning.** Open educational customs typically empower the learner to be a co-creator, rather than simply consumer, of knowledge (Cronin, 2017).
3. **Empowering all learners to achieve.** Open customs can improve equity in learning by being especially aware of learner inequities in educational and societal systems and using practices to improve equal access and participation by all in learning.

Open customs, then, are those "that empower educators (and we would add learners) to benefit from the best ideas of their colleagues" (para. 4) as mentioned in the Cape Town Open Education Declaration. Following these principles, many scholars have posited different practices that could be considered open customs. For example, open scholarship (Veletsianos & Kimmons, 2012b; Weller, 2011), open teaching (Couros & Hildebrandt, 2016), open pedagogy (DeRosa & Robison, 2015; Hegarty, 2015; Rosen & Smale, 2015; Weller, 2014), participating in open and online peer communities, open planning of an educational lesson or experience (Grush, 2014), and using “renewable assignments” that extend beyond single use in a classroom (Wiley, 2017, para. 18).

However, while open customs are growing in popularity in the research literature and among practitioners, we offer a caution—you cannot actually build practices, pedagogies, or customs on a foundation of openness. In other words, the foundational commitments in terms of pedagogy and practices should be based on a sound understanding of how learning happens. Once we have a fundamental understanding and commitment to what effective learning is, then we can use open customs to gain better leverage. In short, good teaching and learning is the first goal, with openness as a means to achieving this goal—not an end to itself.

Open Co-intelligences

In the two years since it entered the public view, generative AI has quickly become one of the most powerful tools available to instructional designers, instructors, and learners. Instructional designers working with generative AI can dramatically reduce the cost and time of completing each step in the ADDIE process (analysis, design, development, implementation, and evaluation). Instructors working with generative AI can dramatically reduce the cost and time of completing many administrative and instructional tasks (e.g., lesson planning or grading). Also, students working with generative AI can dramatically reduce the cost and time of completing many study and learning tasks (e.g., creating flash cards or engaging in open-ended retrieval practice with immediate feedback). Each aspect of the teaching and learning process is impacted by generative AI, just as every aspect was impacted by the advent of public access to the internet decades ago.

Similar to the other framework components described above, the first powerful generative AI models available for public use were proprietary. The release of powerful, openly licensed generative AI models came later. For example, large educational materials publishers like Pearson, McGraw-Hill, and Cengage spend a significant amount of time and money creating proprietary course materials. Because these products are expensive and time-intensive to create (sometimes millions of dollars per product), most instructors end up adopting one of these pre-existing resources rather than creating their own. About 25 years ago, individuals, and then organizations, began creating openly licensed alternatives to these proprietary products. Large OER publishers like OpenStax, Lumen, and CMU OLI spend a significant amount of time and money creating open content. These OER are significantly more affordable than the proprietary alternatives and, because of their open licensing, can serve as the foundation for a wide range of innovations in teaching and learning.

In the generative AI space, companies like OpenAI, Anthropic, and Google spend a significant amount of time and money creating proprietary LLMs. Because these LLMs are so expensive and time-intensive to create (possibly more than a hundred million dollars per model), most people end up using one of these models rather than creating their own. But organizations have now begun creating openly licensed alternatives to these proprietary LLMs. Organizations like Meta, Mistral, and IBM are creating openly licensed LLMs that everyone can retain, reuse, revise, remix, and redistribute. These "foundation" models provide the foundation upon which we can build a wide range of innovations in teaching and learning.

Ensuring that every person has access to co-intelligence will be one of the great equity challenges of the 21st century. Ensuring that every person also has permission to adapt, edit, and contribute directly to the localization and improvement of these tools for their own purposes will be one of the great challenges to open in the 21st century.

Strengthening the Open Education Framework

In conclusion, we argue that an open education framework, which can support extremely rapid, low cost experimentation and innovation, must be comprised of at least these five parts:

- **Open Competencies** that articulate what learners should be achieving.
- **Open Content** that teaches about and assesses those competencies
- **Open Customs** that utilize these resources, recognition practices, etc.
- **Open Credentials** that helps students, teachers, and others know what has been accomplished
- **Open Co-intelligence** that supports efforts across all aspects of education

This interconnected set of components provides a foundation that will greatly decrease the time, cost, and complexity of the search for more effective models of education. (It will provide related benefits for informal learning, as well.) From the bottom up, open competencies provide the overall blueprint and foundation; open educational resources provide a pathway to mastering the competencies; open customs seek to increase learner participation, agency, and learning in innovative ways; open credentials communicate when learners have mastery of the competencies; and open co-intelligence that makes engaging in all the work across the stack more efficient, more effective, more creative, and more affordable

When open licenses are applied up and down the entire stack—creating truly open credentials, open assessments, open educational resources, open competencies, and open generative AI models, resulting in an open education infrastructure—each part of the stack can be altered, adapted, improved, customized, and otherwise made to fit local needs without the need to ask for permission or pay licensing fees. Local actors with local expertise are empowered to build on top of the infrastructure to solve local problems. Freely.

Creating an open education infrastructure unleashes the talent and passion of people who want to solve education problems but do not have time to reinvent the wheel and rediscover fire in the process.

How can you, as students, support and promote open education? Stracke et al. (2023)

offered suggestions for the future of open education research. As part of that, they argued that we need to take "local actions so that we can collectively make a global impact" (p. 23). If each of you, and us, work to increase openness in our local sphere of openness, the impact globally will be massive.

We believe that "openness facilitates the unexpected" (Wiley, 2013). We can't possibly imagine all the incredible ways people and institutions will use the open education infrastructure to make incremental improvements or deploy novel innovations from out of left field. That's exactly why we need to build it, and that's why we need to commit to a strong conceptualization of open, grounded firmly in the 5R framework and open licenses.

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Open Recognition, Badges, and Microcredentials

West, R. E.

Microcredentials

OER · Microcredentials · Badges · Open badges · Open education · Verifiablecredentials · Open recognition · Assessment

Open Badges
Open Education
Open Education Resources
Open Educational Practices
Open Recognition

This chapter explores the concept of open recognition, badges, and microcredentials in education. I argue that traditional credentialing systems fail to recognize learners' skills and abilities, leading to wasted learning opportunities. The emergence of open digital credentials that are data-rich, open-standard-based, micro-focused, and flexible can better represent learning from both formal and informal situations. The chapter reviews the role of credentials in society, discusses technological innovations, and examines research findings on when and how these technologies are helpful. It also relies on a 3M model to understand how educational credential systems interface at micro, meso, and macro levels.

Editor's Note:

This chapter is adapted from the following previous articles written by the author and published with a creative commons license:

West, R. E. (2024). Open recognition. In Edtechnica. EdTech Books. https://edtechbooks.org/ensyclopedia/open_recognition.

West, R. E. & Cheng, Z. (2023). Digital credential evolution. In O. Zawacki-Richter & I. Jung. (Eds.), Handbook of Open Distance and Digital Education. Springer. https://doi.org/10.1007/978-981-19-0351-9_71-1. https://link.springer.com/referenceworkentry/10.1007/978-981-19-0351-9_71-1

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Introduction: Why Learning Recognition Matters

Humans are continually learning. Every second, our senses take in 11 million bits of information (NPR, 2020). We naturally, and often unconsciously, use that information to reshape mental schemas, emotional frames, and behavioral patterns. We are constantly learning and growing, irrespective of and largely uncontrolled by any external system or instructional design.

Despite always learning, our learning often must be recognized in order to be useful in our lives. It is recognized by an employer when they believe us to be qualified for a particular job or promotion, or by a school admissions board when they judge that we have learned enough to qualify for higher education. There are also important informal recognitions of learning, such as when a peer recognizes our ability in a particular area and asks for our assistance, or when we recognize our own abilities and shortfalls and make decisions about what to focus on learning next. These informal recognitions motivate and inspire learners in interesting ways. Much of the field of instructional design relies on recognition of learning as part of analyzing learner needs, gaps in knowledge, objectives that should be learned, and the sequencing of learning that might be most helpful.

While most efforts to reform or improve education focus on improving educational content or the important relational communities that support learning (see West, 2023), it is equally important to consider the recognition that is part of any educational system. Similarly, in attempting to make education more open, we need to consider open recognition equally to open content and open pedagogies.

Learning has typically been recognized only in formal ways with grades, degrees, and certificates, and this often presents challenges in fully recognizing students' learning. Consider the following hypothetical examples:

- Victoria, a brilliant student, completes 80% of her degree, but because of family health challenges requiring her assistance, she drops out of college. After many years and despite all that she has learned and the skills she has gained, she has no degree and no effective way to communicate to others what skills she has. Her years of learning are largely wasted, and she resigns herself to not being able to work in her chosen career.
- Maria, like 65,000 other computer science majors graduating each year in the United States, understands programming languages. However, she also has highly effective relational and communication skills. Her degree in computer science does not describe these important skills and her potential abilities as a bridge builder between programmers and other people within an organization.
- Robert had a personal interest in technical communication while earning his English-literature degree and sought out courses and internships in this area, developing skills in technical writing, graphic design, and media technologies. However, he did not formally earn a minor in technical writing, and thus his English degree does not communicate how Robert's skillset is different from that of a typical English major.
- Vikram speaks a second language and lived abroad for several years. He continues to study this language through MOOCs (Massive Open Online Courses), language apps, and community meetups. He has received some digital certificates from these various

places, but they do not transfer to his university. Consequently, they do not show up on his official learning record, and he is not allowed into advanced language courses. In addition, employers do not understand how he can actually use his language skills in a job.

- Ashanti learned several new technologies at the university, so she volunteered to lead a technology initiative at her school, where she teaches chemistry. However, her degree in secondary education does not explain what her technology skills are, and her principal would like some proof of her ability. She contacts her former professors, but they cannot remember what level of skill she had. She remembers that her professors complimented her on her work, but that positive feedback was never captured in a credential that she could keep and share with others. She can ask one of her professors to write a letter of recommendation, but it will be vague because he cannot remember her performance from several years ago.

These examples showcase several of many possible ways that the current educational credentialing system fails to communicate what students actually know and how they are each a unique person with distinctive abilities. Recently, though, technological innovations such as Open Badges, Verifiable Credentials, and Comprehensive Learner Records (West and Cheng, 2022) have opened the door to intriguing possibilities in this area. These digital credentials are similar technologies striving to accomplish the goal of greater transparency and better recognition of all learning a student achieves.

These alternative, digital credentials are novel in that they embed evidence of the actual learning in the credential itself. They can also represent learning of different types and scope. Some of these alternative credential options include microcredentials, Open Badges, nanocredentials, and nanodegrees. What these credentials have in common, though, is that they are different from traditional credentials because they are:

- data rich, embedding actual evidence of the learning permanently into the credential;
- based on open technology standards, allowing the credentials to be shared and exported/imported into different systems;
- micro, representing learning that is smaller than a degree or certificate program;
- flexible, representing learning from both formal (e.g., classes) and informal (e.g., self-learning, workshops) situations.

Despite these innovative new technologies, much of the discourse around these credentials has been uninspiring, as it has focused on how to use new tools to reinvent old systems. For example, it is popular to issue microcredentials for completed courses—which continues to only recognize learning as "valid" if completed at a university. New thinking is needed to consider how to use these internet technologies to more fully democratize education in society, recognizing learning from inside and outside formal schools and painting more complete and equitable pictures of everything a student has learned.

In this chapter, I first review the important role that credentials play in society, and I review some of these technological innovations that have emerged in this space in the past decade. I then discuss what research has found about when and how these technologies are helpful. In discussing all of this, I rely on a 3M (West and Cheng, 2022; adapted from Zawacki-Richter, 2009) model of how educational credential systems interface at micro (learner/personal), meso (institutional), and macro (societal) levels.

The Important Role of Credentials in Society

Educational institutions exist in society to meet various important needs, including preparing capable workers for society, resolving inequities, unifying a diverse population, preparing educated citizens who can more fully engage in our democracy, and helping individuals achieve their potential for self-actualization and fulfillment (see Feinberg and Soltis, 2004; Kober, 2007). In addition, schools exist for the blunt reason of producing degrees and other certifications—what Gallagher (2016) called "the foundation of the business model for most higher education institutions" (p. 3). In creating these credentials, schools meet a critical communication need by signaling to society about a particular student and their potential for various roles in society.

Besides signaling to employers about learners, there are two additional groups that educational credentials communicate to. First, they communicate to educators what kinds of teaching they should do. For example, if the credential represents an accumulation of knowledge, then instructors will likely teach through lecture as an efficient method of delivering information (Taglieri et al., 2017). If the credential represents the acquisition of skill, then using experiential learning strategies will more effectively develop these skills (Franco Valdez and Valdez Cervantes, 2018). Meanwhile, if the credential represents social skills, team-based learning and collaborative learning approaches will be used (Haberyan, 2007).

In addition, if the credential is designed based on an industrial model of sorting students into those who have "it" and those who do not, then this design communicates to teachers that their teaching should be a form of sorting. This leads teaching to become less focused on growth and equity and more focused on comparisons. It also discourages mastery grading or a "growth mindset" (Dweck, 2016) and relies instead on one-snapshot-in-time assessment. Finally, it creates artificial deadlines for learning, requiring students to learn within a set schedule, regardless of their personal situations or motivations. This disadvantages not only students who need more time to learn but also those who need less. Either way, students fall out of the "flow" of learning (Csikszentmihalyi, 1990) where learning is enjoyable and see learning instead as a chore.

In addition to communicating to employers and teachers, credentials also communicate to students about what they know, what matters, and who they are. In the previous example, traditional approaches to grading communicate to students whether they are "gifted," "average," or "struggling." These perceptions powerfully affect them.

For these reasons, credentials are core to educational reform and even societal reform; as Gallagher (2016) explained, "Evolving the credential ecosystem is key to optimizing higher education" (p. 20).

Traditional Recognition of Learning

Traditionally, the emphasis in learning recognition has been top-down. In this approach, an institution is trusted to appropriately recognize whether and what a student has learned, and certify this learning. This recognition of learning appears in the form of grades, progress reports, competency dashboards, certificates, and degrees. However, this form of learning recognition is flawed for several reasons:

1. **Lack of Equity** — A top-down system breeds inequity as the power within society, as it relates to education, is controlled by few hands—in this case, usually universities. As all institutions can exhibit bias, this has the potential to exacerbate a lack of equity within society.
2. **Lack of Access** — When recognition of learning is controlled by a small segment within society, access to the benefits of learning recognition is then limited. Even though humans are constantly learning, only those who can get their learning recognized by the correct institution will be able to benefit from their learning.
3. **Lack of Openness** — Openness, as related to educational content, has been defined as the ability to reuse, retain, revise, remix, and redistribute (Wiley, 2015). Learning recognition can similarly be considered open only when a learner can retain their own learning data/credentials, reuse them for their own purposes, revise and remix them to better represent their own abilities, and redistribute them. This openness requires new technologies that take control of the recognition of learning away from institutions and instead share it equally with formal/informal learning institutions, as well as learners and communities.

Open Recognition: A New Standard

In 2012, the Mozilla Foundation released the Open Badges standard as a new potential technology to recognize learning wherever it happens. Since then, other technologies have also been created to similarly afford open recognition, including Blockcerts, Verifiable Credentials, and Comprehensive Learner Records. These technologies provide a similar potential, and are in many ways interoperable as they use open technical standards to make share data easy (for example, standards for Open Badges [https://openbadges.org/], Verifiable Credentials [https://www.w3.org/TR/vc-data-model/], and Comprehensive Learner Records [http://www.imsglobal.org/about/clr]). All of these technologies make it possible for anyone to recognize the learning of another, or even for a learner to recognize their own learning and codify it in a marker or credential that describes their ability.

While these technologies share many similarities in how they handle learner data, the practices surrounding how these technologies are used are very different and can vary widely from informal and even self-issued badges to formal microcredentials based on competency frameworks. Because of this, nomenclature becomes important: communities using these technologies for official, top-down credentials awarded by large institutions (e.g. universities, employers, and national organizations) typically refer to these as open microcredentials or certificates. Meanwhile, communities using these technologies for informal/non-formal learning, community-based recognition, or self-claiming recognition call these awards open badges or open recognition. The term open recognition appears to have emerged in the Bologna Open Recognition Declaration (2016) and later referenced in a document produced by the Joined Research Centre of the European Commission.

Later, Open Recognition was described as “a movement born from the practice of Open Badges, exploring and promoting practices, tools and policies enhancing and broadening the opportunities for everybody, individuals and communities to be recognised and contribute to the recognition of others.” (Mirva, 2020, see also http://www.openrecognition.org/bord/). While a fairly recent movement, it hearkens back to how learning was recognized within non-formalized learning communities. As Belshaw and Hilliger (2023) explained, “Open Recognition is similar to “peer-to-peer validation and communal acknowledgement of skills and achievements, similar to how guilds or apprenticeships operated in the past” (para. 14).

To learn more about these different practices for alternative and open recognition, check out the following:

- The Open Recognition Alliance, dedicated to open recognition of all learning, including an annual conference in Europe: https://www.openrecognition.org/.
- Badge Wiki, providing guidance on how to get started with open badges: https://badge.wiki/wiki/Main_Page.
- 1EdTech, the curator of the Open Badges technical standard: https://www.1edtech.org/standards/open-badges.
- 1EdTech hosts a popular annual Digital Credentials Summit, which focuses more on formal microcredentialing practices.
- Badge Summit, an annual conference focused on design practices surrounding open badges: https://www.thebadgesummit.com/.

A Unifying Open Recognition Standard

Proponents of open recognition see the movement as inclusive of open microcredentialing, certificates, and other top-down practices (see Figure 1). Simply, Open Recognition is the recognition of all learning, by any learner, acquired anywhere, at any time. This includes formal learning in school or through an employer-based system, non-formal (but intentional) learning such as MOOCs and other internet courses or community classes/lessons, or informal learning that arises unintentionally through daily activities (Council of Europe, 2023).

Figure 1.

Open recognition includes, but also extends, concepts like open badges and open credentials.

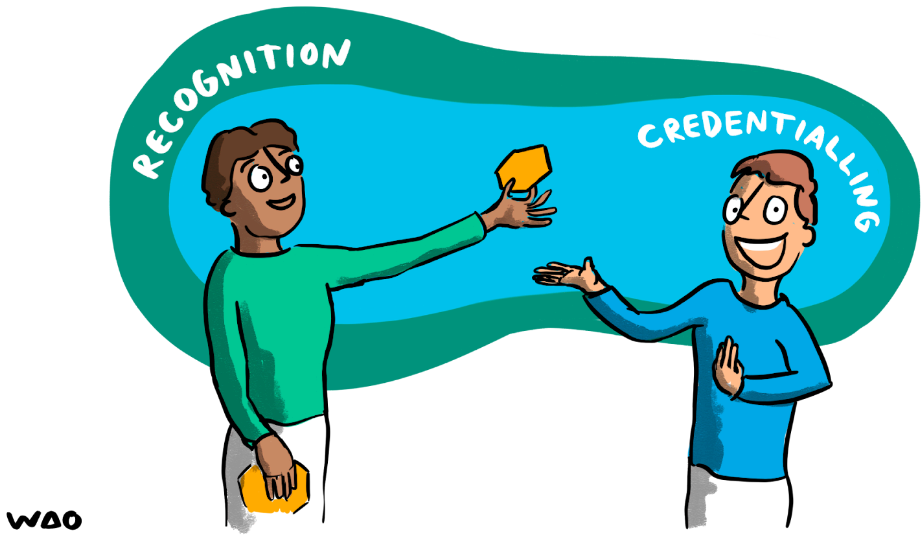
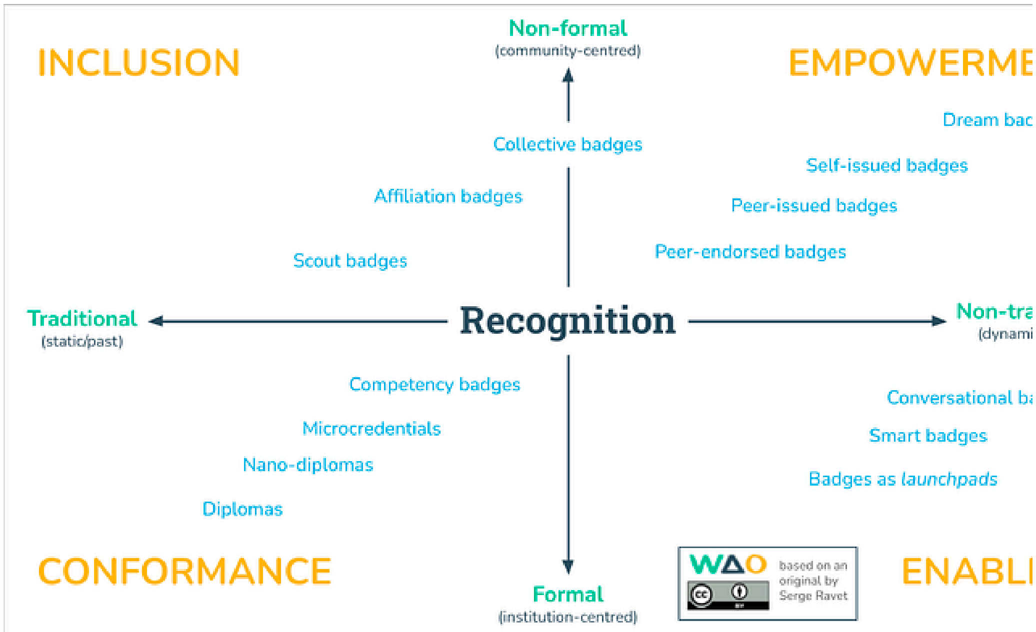


Image CC BY-ND Bryan Mathers

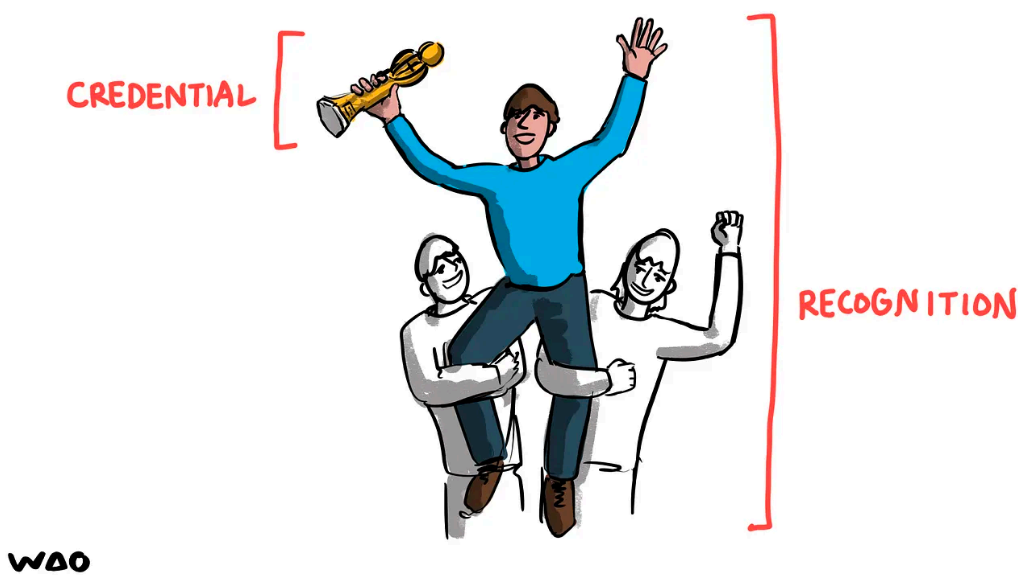
Thus, while there is overlap between the practice of microcredentials and open badges, they are also often used to mean different kinds of educational practices. However, they are all part of an Open Recognition framework that provides a method and technology for recognizing all types of learning. Figure 2 by the We Are Open Co-op visually depicts how these various types of learning recognition are related to each other on a spectrum from formal learning to informal learning, and from traditional/institutional-based recognition to non-traditional/community-based recognition.

Figure 2.

A depiction of how various types of credentials and badges are related to each other and represent options for formal, informal, and non-formal learning recognition, as well as recognition in traditional and non-traditional ways.



Or perhaps more simply put, open credentials may represent the award given at the end of an educational journey that is valued by outside entities, but open recognition also represents the very real recognition of performance that arises within communities and relationships (see Figure 3).



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Open recognition provides an exciting pairing of technologies and practices "that could potentially disrupt the educational status quo" (Belshaw & Hilliger, 2023, para. 8) in a future where "universities and other institutions still play a role, but they are no longer the sole arbiters of who is 'skilled' and who is not. They are nodes in a broad ecosystem of learning and recognition that includes employers, co-ops, communities, and self-directed learners" (Belshaw & Hilliger, 2023, para. 2).

For instructional designers, policymakers, and instructors, it is important to acknowledge the nuanced differences in how we can recognize learning in order to make wise decisions about what type of recognition or credential we believe to be most important in a given setting. Whether awarding microcredentials in a formal educational setting, or open badges in an informal, community-based experience, all learning deserves to be recognized for the value it brings to individuals, families, and communities.

How Effective Are These Alternative, Open Credentials?

Our understanding remains limited as to how effective these various credentials are for supporting student learning, communicating learner ability, and supporting the vital roles of education within society. This limitation is largely because these credentials are still a recent innovation and also because full integration into educational systems is difficult, as it requires changing teaching strategies, data-management systems, and learner expectations.

Still, research has identified a few key findings (see West and Cheng, 2022 for a full review). For example, it appears that open micro/nanocredentials are helpful for motivating students, but often more for extrinsically motivated students than intrinsically motivated ones. They also can support improved learning when paired with appropriate pedagogies (such as personalized learning) or as part of encouraging student self-regulation of learning. For example, learners in a college chemical-laboratory course (N=559) mentioned that digital badges allowed them to receive personalized feedback. In this case, via the Passport badging platform developed by Purdue University, graders and teaching assistants wrote personalized feedback to students after the latter had submitted their work, and students could resubmit their work multiple times after incorporating feedback (Santos-Díaz et al., 2019).

However, despite these benefits, many challenges remain in integrating micro/nanocredentials into education, including how institutions should incorporate these alternative and open credentials into their digital/data systems, what the credentials should represent to groups within society, and how to develop rigor and trust in the credentials.

Despite these challenges, we do know that the usage of these credentials is growing rapidly. For example, it was estimated that from 2011 to 2018, between 15 and 24 million Open Badges had been issued (IMS Global, 2022; Mozilla, 2018), a number that grew to 43 million by 2020 (Abel and Surman, 2021).

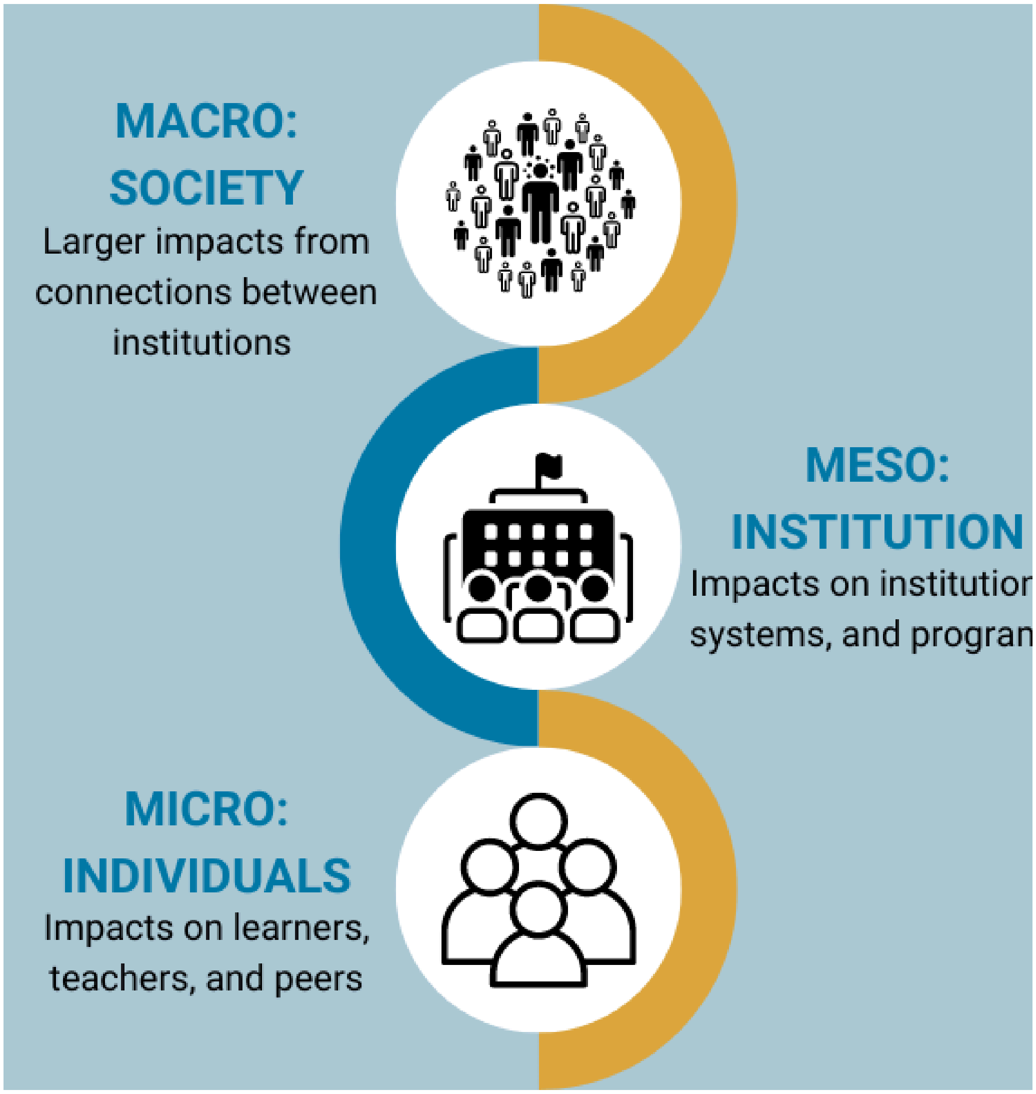
This growth has led some organizations to believe that education and learning have been irrevocably disrupted. For example, the Education Design Lab, an early innovator in this space, reported that "within the decade, all but the most exclusive learning providers, old and new, will compete for students at the competency and experience level rather than at the degree level. That is the principal paradigm shift of the Learner Revolution" (deLaski and Lifland, 2020).

Others see this change as more complementary than revolutionary. As Gallagher (2019) argued, "Rather than sweeping away degrees, new types of online credentials—various certificates, MicroMasters, badges, and the like—are instead playing a complementary role, creating the building blocks for newer, more affordable degree programs" (para. 9). Regardless, this predicts a new role for credentials in 21st-century society, as we will transition to requiring greater transparency, better data on actual learning, and stronger communication of who learners and employees are and what they are capable of doing.

Integrating Micro/Nanocredentials at the Micro, Meso, and Macro Levels of Society

In order for these new, alternative credentials to achieve their potential, we need to rethink educational policy, systems, and strategies to better incorporate micro/nanocredentials. A useful framework for considering these systemic changes is the 3M model (West and Cheng, 2022, modified from Zawacki-Richter, 2009). In this model, shown in Figure 1, the authors propose considering educational innovations and their interface with society at the micro level, or at the level of individual students and faculty; at the meso level, where institutions such as universities and colleges reside; and at the macro level, which is the societal level.

Figure 1. 3M Model for Considering the Impacts of Open Credentials within Three Levels of Society



Improving Implementation at Micro Levels

At the most micro level of learning is the dyad of instructor and student. To improve implementation at this level, we need continued development of usable technologies to issue and receive micro/nanocredentials, greater training about what they are and what they represent, and scaffolding for users. First, while open data standards provide the promise of easily transferring credentials from one system to another, the process is still not as simple as it needs to be for mass adoption. Learners need simple systems that track their performance across systems and automatically collect their credentials.

Finally, we need to also support teachers and credential issuers in knowing how to teach with micro/nanocredentials. This may require universities to relinquish some control over the teaching at their institution to allow for the flexible nature of microcredentials. We will not see the benefit, however, until teachers have developed skills in teaching strategies to match these credentials, including how to maintain the experiential and social nature of learning in this process.

In summary, recommendations for improving microcredential implementation at the micro level could include the following:

- Create simple systems for collecting learners' data across their varied learning experiences.
- Establish laws and safety systems for ensuring learners control their own data and when the data can be used as part of their learner profile.
- Teach learners how to use their data to craft their own professional profile and learning story.
- Support teachers in redesigning education to utilize these microcredentials.

Improving Implementation at Meso Levels

Gamrat and Bixler (2019) articulated four internal challenges that meso systems often face in developing open-badging systems: (a) the wide variety in how badges are designed; (b) the need for good assessment for open badges, and the reality that open badges are often trying to assess things that traditionally are difficult to evaluate (e.g., soft/career skills); (c) the complexity in designing badging systems visually and internally; and (d) the challenge of communicating the value proposition of the badges to others.

Addressing the first challenge is tricky, as school systems are typically designed to be very standardized. This has led to criticisms that campus micro/nanocredentials are overly standardized and represent a misunderstanding of micro/nanocredentials as tools for capturing a wide variety of experiences and learning. In addition, often the most meaningful learning experiences were not predicted ahead of time and could not have been predesigned. However, they are still meaningful and should be represented in a learner's profile and verified by those who witnessed them (e.g., an instructor, supervisor, or peer).

If we are not careful, the effort to formalize all micro/nanocredentials could lead to a reification and replication of current educational processes—for example, replicating course grades as microcredentials, and minors as certificates—instead of allowing for true innovation where micro/nanocredentials could capture unexpected, but still meaningful, learning.

One potential solution may be for educational institutions to create systems for validated/predesigned credentials as well as systems for unplanned/unvalidated/informal credentials. For example, a university may decide to create university credentials that match their university's mission, perhaps in areas such as service learning, multicultural awareness, citizenship, leadership, and collaboration. Simultaneously they could enable teachers, supervisors, and perhaps even peers to create university-branded (similar to official letterhead) community badges that act as signed, data-rich testimonials of what a person has been able to do. These could be created immediately, as needed, and issued on a case-by-case basis or even "claimed" by the learner themself before being validated by someone else. This kind of model would enable instructors to creatively develop new strategies for implementing micro/nanocredentials into their teaching.

Luckily, some instructional-design researchers have articulated processes to guide organizations in creating micro/nanocredentials. Stefaniak and Carey (2019) studied digital-badge programs at three different higher education institutions, and in addition to exploring their adoption patterns and successes, they developed a framework for successful badge-program implementation that provided insights into how to design the badges, how to choose/implement the platform, and how to implement the program once designed.

Also, Clements et al. (2020) wrote a referendum on how to "get started with open badges and open microcredentials" where they provide examples of various types of badges and badging systems, defined the sometimes-tricky and sometimes-technical vocabulary of open-badging systems, and articulated a process that new designers can use where you first design the system, then design the badges, then publish and implement the system, and finally work on marketing and communicating value.

Finally, the open recognition community has created an Open Recognition Toolkit that easily (and visually) guides learners, teachers, and designers through the process of creating open recognition systems. For more information, go to https://badge.wiki/wiki/Open_Recognition_Toolkit.

In summary, recommendations for improving microcredential implementation at the micro level could include the following:

- Create systems for validated/predesigned credentials as well as systems for unplanned/unvalidated/informal credentials, allowing for both types and communicating clearly to others which credentials were authorized by the university.
- Create institution-branded community badges that act as signed, data-rich testimonials by someone of what a person has been able to do, but without the need to be fully validated by the university.
- Develop assessments, rubrics, and guides within a university to help instructors and other credential issuers.
- Create design guides for practitioners that address why, who, and how to implement microcredentials effectively.

Improving Implementation at Macro Levels

Despite examples of many effective micro/nanocredential programs, projects, and courses, it remains a challenge to adopt this technology on a large-enough scale to transform educational systems within society. According to a review of 30 badge ecosystems, three competency-based digital-badge systems that received large funds from the Gates Foundation's Project Mastery initiative all encountered technology, validity, and personnel challenges, resulting in two systems being suspended after pilot implementations and one being never implemented. None of the other competency-based systems thrived in the long-term (Hickey and Chartrand, 2020). Restricted financial support remains another challenge. Scholarships and financial aid are mostly only available for formal education programs. Learners have limited opportunities to apply for financial support to earn nontraditional credits in informal learning contexts.

To overcome these challenges, future endeavors need to

- expand the value and meaning of badges outside their original context (Pitt et al., 2019);
- align micro/nanocredentials with competency-based assessment (Haughton and Sign, 2019);
- provide guidelines for what types of experiences should be credited with credentials and how to design different credentials (Tzou and Horstman, 2015);
- establish frameworks for at least developing a shared understanding of micro/nanocredentials and open recognition (Stefaniak and Carey, 2019);
- develop standards to account for privacy concerns that remain a challenge when developing an open credential ecosystem (Reynolds, 2021); and
- mediate discussions on where and how metadata associated with these credentials should be created, stored, and shared.

Proposed Research Agenda for Open Recognition

It is clear that open micro/nanocredentials and other forms of open recognition have been effective in accomplishing some outcomes at the micro and meso levels, with other instances of challenges, unresolved issues, and mixed results. In addition, it is still uncertain how to integrate the concept of open recognition within macro systems. This presents many opportunities for researchers to further study the potential of these technologies and their effects on learners, teachers, institutions, and systems.

In reviewing the research, as an example, there are several gaps. First, there is a need for more research at each of the 3M levels: micro, meso, and macro. In their review of the current literature, West and Cheng (2022) reviewed the research published in the past decade at each of the 3M levels. They concluded that we still know little about the potential and pitfalls of open credentials. Instead, most of the literature reports personal reflections on use cases instead of actual research into effectiveness. Much of the research that does exist is on professional development, particularly for primary and secondary teachers.

In addition, a great deal of research focuses on applying microcredentials as part of a transition to a skills-economy mindset, with credentials recognizing discrete skills that are often technical in nature. In addition, open credentials can support research into Prior Learning Assessment and Recognition, which also focuses on a transition to a skills-economy. However, fewer research studies have investigated the applicability of open micro/nanocredentials in other domains. As an example, open credentials have the potential to recognize personal factors beyond just acquired skills—including interests, behaviors, self-directed learning, and the cascading of learning experiences that emerge from explorative learning. In addition, open recognition may have the potential to grow and build trust, identity, and connection within learning communities However, few studies exist on the challenges and benefits, or even the implementation, of this potential.

Check out this video from Dr. West:

In this presentation, Dr. West shares a brief vision for how open recognition can support and build communities of learning. https://www.youtube.com/watch?v=KGBfQhsb7EU&ab_channel=RickWest

Conclusion

Open recognition practices have the potential to be a major disruptive innovation in education, particularly because public confidence in traditional educational credentials is waning. Levine and Van Pelt (2021) reported that only half of Americans now consider a college degree to be important and 60% believe graduates lack specific job skills. Meanwhile micro/nanocredentials are growing in popularity. For example, over 30 million people are now registered on edX for microdegree programs (Marcus, 2020), 43 million Open Badges were issued as of 2020 (see https://openbadges.org/), and an increasing number of universities are developing their own microcredentials (including 88% of universities in an Australian sample, according to McGreal and Olcott Jr., 2022).

These are challenges that open recognition is well positioned to address. First, open credentials can be earned inside colleges/universities but also in other organizations, allowing for more people to learn, grow, and earn credentials whether they choose to attend a university or not. Second, open credentials are uniquely positioned to report on specific skill/abilities precisely because they can be issued at the competency level rather than the course level. Finally, open credentials can recognize a variety of skills often forgotten in traditional education, such as social/soft/career skills. As Oblinger (2016) noted, "As the world has changed around us, our notions of what it means to be educated have evolved as well. Intellectual skills are a must in today's world, but so too are interpersonal skills" (p. viii).

However, potential does not equal outcomes, especially in education. The history of education is fraught with failed innovations that never disrupted learning institutions as promised. One reason why this happens is that new ideas, strategies, and technologies are not considered at all three of the 3M levels of implementation. Without designing effective strategies for individual teachers and learners, it is unlikely that an innovation will be successful. But similarly, failure to reform the educational institutions and the interfaces with society at large will similarly cause an innovation to fail.

For more information on open recognition, see this list of articles:

https://badge.wiki/wiki/Open_recognition

And consider joining the Open Recognition is for Everyone community at Participate.com

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How Learning Analytics Can Inform Learning and Instructional Design

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Learning and instructional designers are increasingly required to make use of various forms of data and analytics in order to design, implement and evaluate interventions. This is largely due to the increase in data available to learning designers and learning analysts due the update of digital technologies as part of learning and training. This chapter examines the historical development of what has become known as learning analytics, defining the field and considering various models of learning analytics, including the process model with its focus on student learning. The chapter then explores the ways that learning analytics might be effectively connected to the field of learning design, and provides a number of examples of applications of this, including learning analytics dashboards, tailored messaging and feedback systems and writing analytics. Examples of these different applications are also presented and

discussed. Finally, the chapter concludes with a consideration for he challenges and future directions for learning analytics.

Introduction

P. W. Anderson (1972) famously wrote that more is not just more—more is sometimes both quantitatively and qualitatively different. This is especially true in the case of data, and what is often known as "**big data**," which is central to the study of **learning analytics**. This chapter discusses the relationship between big data and learning analytics and, more importantly, what that means for learning designers and other educators. It will examine what learning analytics is, some of the advantages it offers and the challenges it faces, and what learning designers need to know to make use of it in their design work.

Making Sense of Data

One consequence of the increased use of digital technologies in education is that users now generate significantly more data than in the past. Often, this data is a kind of "digital exhaust"—something that learners do not even realize they are creating. Nevertheless, that data is generated, and researchers, academics, and businesses gather it and attempt to make sense of it. However, understanding how to use the data to improve **learning outcomes** is not easily done; This led to the development of the field of learning analytics (LA).

A Short History of Learning Analytics

Many of the tools, techniques, and data sources used in learning analytics are new, but the field itself has a long history. Since the early days of behaviorism, psychologists and educational researchers have discussed Computer-Aided Instruction (CAI), Computer-Assisted Teaching (CAT) and Intelligent Tutoring Systems (ITS)—all movements where Artificial Intelligence (AI) has been central. The key point, however, is that technology is beginning to make possible what was, before, only an idea. Some of the key tools involved in this change are **machine learning**, learning analytics, and big data. Figure 1 showcases some important events from this history.

To print this page properly, go to the "Share" panel and select "Print" under

Figure 1. A brief history of learning analytics

Defining Learning Analytics

The following definition was proposed at the first International Learning Analytics and Knowledge Conference (Siemens & Long, 2011):

> *"Learning analytics is the measurement, collection, analysis, and reporting of data about learners and their contexts, for the purposes of understanding and optimising learning and the environments in which it occurs."*

This definition is one that has been taken from the broader data analytics field and has become known as Business Intelligence (BI). The purpose of data analytics is the development of what is called "actionable intelligence." This means the data analysis is not undertaken solely for the sake of research, but rather to be able to make better decisions about what to do to reach specific outcomes. That idea is present in the definition of learning analytics as presented above, with its emphasis on "optimising learning and the environments in which it occurs." A more comprehensive definition is presented in the Consolidated Model of Learning Analytics (Gašević et al., 2016). This model (Figure 2) combines design, theory, and data science, and argues that learning analytics rests in the nexus of all of these.

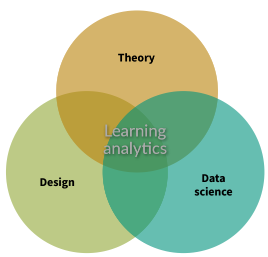


Figure 2. The consolidated model of learning analytics

How Does Learning Analytics Work?

Learning analytics is best understood as a cyclical, iterative process. This section will examine the learning analytics cycle in detail, including a discussion about the kinds of data, **algorithms**, and modelling employed in learning analytics.

Process Models of Learning Analytics: It is All About the Learning

In the formative years of learning analytics as a discipline, researchers proposed models and frameworks to facilitate a better understanding of the processes involved in data-informed educational decision-making. One example of an earlier documented process for LA is provided by Campbell and Oblinger (2007, in Clow, 2012). To gain actionable intelligence into institutional data regarding retention and success, they defined a five-step process: capture, report, predict, act, and refine. Because academic analytics involves decision-making based on institutional data (Campbell et al., 2007), Campbell and Oblinger's (2007, in Clow, 2012) model focused on statistics and modelling of big data.

As learning analytics began to draw greater attention, new frameworks and models were defined. Chatti et al. (2012) proposed a 3-stage reference model focusing on how data are involved in the process, namely: (a) data are collected and pre-processed; (b) the results of pre-processing are transformed via analytics and actions such as prediction or data-mining; and (c) improvement of the analysis process through post-processing, for example, by gathering new data or refining existing data, or adapting the analysis. Their model addressed four key questions: what (data), who (target of analysis), why (purpose of analysis), and how (how analysis is performed). The three-stage model provided a useful framework to understand the emerging trends in the early years of the discipline. Chatti et al. (2012) mapped the literature available at the time against this framework. They identified that most of the work around learning analytics at that time was purposed for intelligent tutoring systems or researchers and system designers, focusing on classification and prediction techniques. In contrast to Chatti et al.'s (2012) data-centric model, Clow (2012) aligned his model (see Figure 4) to that of Campbell and Oblinger's (2007, in Clow, 2012). Through this choice of alignment, Clow proposed a four-stage LA cycle emphasising learners and learning in the process. This cycle includes the following four aspects that explain how (a) Learners in any learning setting (b) generate data either by virtue of their demographics or through their learning activities and academic performance; (c) these data are transformed into metrics(e.g., indicators of progress, comparisons against benchmarks or peers) via analytics; (d) metrics inform interventions such as learning dashboards, recommendation systems, or emails from educators or phone calls to learners. When (or if) learners act on the intervention, they generate new data, thereby creating another iteration of learning analytics.

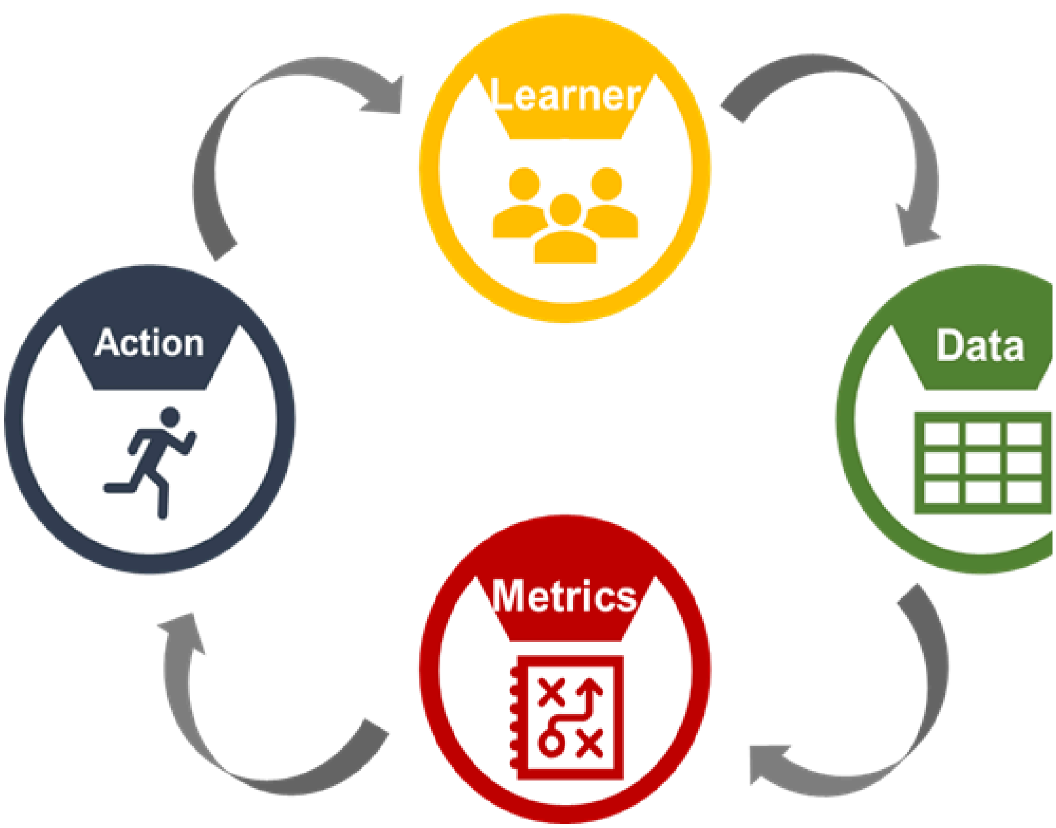


Figure 3. *The Learning Analytics Cycle (based on Clow, 2012)*

Other models have emerged in the literature to improve upon predecessors and focus more on making sense of learner data. For example, Verbert et al. (2013) proposed a learning analytics process model that focuses on processes around the sensemaking of learning analytics. However, in our view, Clow's (2012) model is useful for educators and learning designers who have control over the teaching context, as the process cycle highlights the need for LA interventions "to close the feedback loop" (p. 134) for students through actionable insights. This theme of closing the feedback loop continues to be significant when considering the effectiveness of LA interventions today. Throughout the rest of this chapter, you will see concrete examples of how this framework can be implemented in teaching and learning design.

Think About It!

As an educator:

- What information do you usually rely on to know whether your students are learning?
- How do you use this information to help your students?
- How might you use data from your students' interactions with the course's learning tasks and resources to inform your learning design?

Regardless of which LA process or model is subscribed to, a central concern of LA is data. So, what kinds of data can be collected about learners? The reality is that there are almost limitless amounts of data available. The challenge lies in putting that data in a usable format, then analysing it to find actionable insights. Many learning analysts find this kind of data analysis interesting (Mougiakou et al., 2023, p. 3):

> *A wide range of data is generated by the learners and stored in online and blended teaching and learning environments. Data is collected from explicit learners' activities, such as completing assignments and taking exams, and from tacit actions, including online social interactions, extracurricular activities, posts on discussion forums, and other activities that are not directly assessed as part of the learner's educational progress.*

Some examples are included below (Figure 4).

Where can we find the data?

Student Information System	Learning Environment	Research Instruments	Multimodal	Social Media	Other Data
• demographics • timetables • enrolment • attendance • previous assessment results	• trace data • simulation data • assessment data • social interaction • content interaction • intelligent tutoring systems • educational context data	• surveys • questionnaires • interviews • focus groups • observations	• video • audio • gesture • gaze • psychophysiological data • EEGs • fMRI	• Twitter • Instagram • Facebook • blogs	• library attendance • library helpdesk request • loan reports

Figure 4. *Sources of data*

This learner-generated data is used to assess learning progress, predict learning performance, detect and identify potentially harmful behaviors, and act upon the findings. In addition to measuring student performance, it can also be used to help us understand the effectiveness of our learning design, as will be described in the next section.

Connecting Learning Analytics with Learning Design

This section will explore various learning analytics that can be employed in order to assist students in reaching intended learning outcomes. It will take the form of practical case studies and discussions about the benefits of the different learning analytics approaches and will then explain the current areas and focus of learning analytics research. Learning analytics interventions can take any forms, including feedback or personalized study support. To do this, the interventions draw on information about the learner's activity or performance that is available from university systems or that the learner provides through self-reporting mechanisms.

Learning analytics dashboards: Visualising learning

Dashboards are perhaps the most frequently mentioned intervention associated with learning analytics and are garnering strong interest from developmental researchers Learning analytics dashboards (LADs) are visual displays of learners' information and/or progress with digital learning technologies. The dashboard's aim is to present the most important information to a range of educational stakeholders in a single display (Schwendimann et al., 2017). These systems are fully automated, in that data are transformed into meaningful metrics by preset algorithms and deployed at scale. LADs differ from *institutional dashboards*, which are designed from the perspective of academic analytics, and draw on a wide range of data captured across university systems, providing information on key performance indicators such as student enrollment patterns, retention rates, and faculty and staff employment information.

Institutional dashboards as described above draw on big data and can present useful information for the university to make decisions at an administrative level. However, when it comes to closing the feedback loop for learning (cf. Figure 4), LADs that are designed for educators and students as key stakeholders of learning analytics are important. *Student-*

and educator-facing LADs (henceforth, LADs) have been increasingly represented in the literature.

One of the earliest and most famous LADs in the field—also referred to as the "poster-child of LA" – was Purdue University's Course Signals (Arnold & Pistilli, 2012), an early-alert system that employed predictive algorithms on data from students' academic background, current performance, and ongoing progress to identify students who are at risk of dropping out or failing a subject. The results of the algorithms were presented visually, in the form of "traffic lights" to signal the likelihood of success, with green indicating a high likelihood that the learner will succeed in the course; orange indicating the presence of issues impeding success; and red flagging students who are at high risk of failing in a course. The signals are presented to students as feedback on their progress, as well as to course instructors, who can then intervene in a timely way through emails or face-to-face consultation.

Other notable LAD research has been documented by researchers around the globe. Notably, a group from *Katholieke Universiteit* (KU) Leuven in Belgium, led by Katrien Verbert (e.g., Verbert et al., 2013; Broos et al., 2018), have been actively involved in developing LADs. However, comparatively few of these developments have made their way into actual teaching and learning settings. In a recent example, Li et al. (2021) described how instructors used an instructor-facing LAD at one institution in the United States (see case-in-point below).

Figure 5. *An example of an instructor-facing LAD (Source: Li et al., 2021, p.346. Image used with permission)*

LADs have tended to draw on LMS activity data, which is not surprising as these data are readily available and automatically cached in learning platforms. However, advances in **information and communication technologies (ICTs)** as well as in **data mining** have resulted in a greater range of data reporting and **visualizations** afforded by LADs. For example, some recently developed LADs use **multimodal data** to provide feedback to educators and learners about learners' emotions during learning (e.g., Ez-Zaouia, Tabard, & Lavoué, 2020) and collaborative activity (e.g., Martinez-Maldonado et al., 2021).

With learning increasingly shifting to online or blended modes, the LMS has become a feature of most learning environments. Major LMS vendors such as Canvas and Blackboard now include dashboard features for students and instructors (See Figure 6). Accordingly, Williamson and Kizilcec (2022) noted that "the dashboard feature in LMS likely exposed millions of students and instructors to LADs" (p. 260).

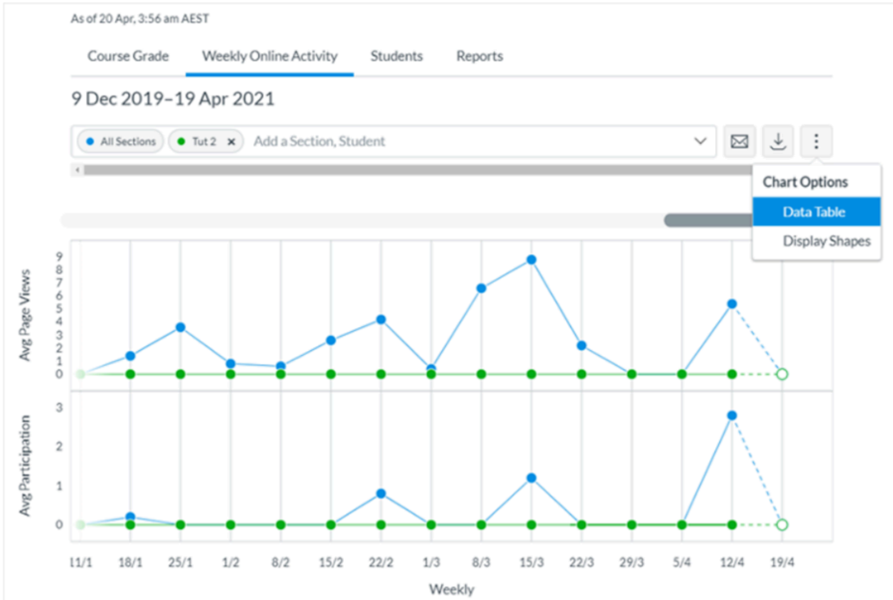


Figure 6. *An example of an instructor-facing LAD generated by the Canvas Learning Management System used at the University of Technology Sydney (Source: https://lx.uts.edu.au/collections/building-your-canvas-course/resources/canvas-new-analytics/. Image used with permission)*

LIDT in the World: How Do Instructors Use LADs in Real Teaching Contexts?

Recall the Think About It! exercise posed earlier. Consider how you might use data from your students' interactions, with learning tasks and resources in your course, to inform your learning design. LADs offer such information at a glance. So, how do instructors use this information in their own contexts? Gleaning actionable intelligence from student activity and performance information in LADs involves a sense-making process. Li et al. (2021) studied how instructors from different disciplines at a large private University in the United States made sense of a teacher-facing LAD at the institution. The LAD (see Figure 5) had been part of the institution's **learning management system** for a few years, and offered the following views for instructors:

- Timestamped data showing the extent to which students had accessed course materials
- Frequency with which students employed key words in discussion forum posts or assignments
- Interactions with video resources
- Assessment performance

From their analysis of interview data with instructors who used the LAD, the researchers identified three categories of questions to which instructors sought answers when interrogating the visualizations. Most typically, instructors approached the LAD with *goal-oriented questions*—seeking information regarding how students were interacting with course resources, and therefore, the extent to which course objectives were being met. Importantly, some instructors also applied their knowledge about their student cohort (e.g., if they were mature students) as an additional layer of insight to inform how they talked to students about course objectives. Secondly, instructors approached the LAD with *problem-oriented questions*—seeking explanations for notable issues such as students' poor performance, for instance, by examining their learning behaviours. Thirdly, instructors approached the LAD with *instructional modification questions*—making informed decisions about teaching, for example, to maximize limited class time by focusing instruction if data showed poor grasp of certain topics.

Despite their pervasiveness, LADs have come under heavy criticism as automated feedback systems. A key criticism is that, because these visualization tools are designed to scale across students and contexts, they tend to be a one-size-fits-all solution (Teasley, 2017). As noted above, LADs tend to draw on data collected from students' activity in the LMS. The way students engage with different activities—discussion forums, readings, practice exercises and other resources—is a function of learning design. Given the contextual nature of these interactions, information presented in LADs, especially those that run on **predictive analytics**, face the issue of trustworthiness.

A second criticism has to do with the communication of information: While the visualisations may be very advanced and aesthetically pleasing, most are still passive displays of feedback reporting (Jivet et al., 2021). Feedback is a **dialogic process**, requiring learners to make sense of the information presented, manage unproductive emotions, and then take action in order to improve learning or performance (Carless & Boud, 2018). As such, LADs need to be carefully designed to foster dialogic feedback processes.

Related to this, a third criticism is that many LADs are limited in their ability to offer actionable advice to learners, which is another important principle of effective feedback communication., Because of the highly visual nature of the reports, learners may need help interpreting the information. Inaccurate or unhelpful interpretation of the information could negatively impact a learner's motivation to learn (e.g., Lim et al., 2019). In fact, research examining the impact of LADs indicates that the way information is presented on LADs can have detrimental effects on students who are at risk of failing (Aguilar, 2018; Lonn, Aguilar, & Teasley, 2015).

A final criticism of LADs has to do with the increasing concern regarding equity in learning analytics. With most LADs relying on single algorithms to report on students' progress or to predict performance, there is a danger of "algorithmic bias," disadvantaging underrepresented groups (Williamson & Kizilcec, 2023). As contemporary higher education is characterised by large and diverse cohorts, there is a danger that underrepresented groups may not be able to attain the same levels of progress or performance at the same speed as those who possess more experience with academic environments.

In summary, LADs are a ubiquitous intervention in digital learning environments, due in large part to the abundance of data readily cached in LMS platforms.

However, while these fully automated feedback interventions can be aesthetically pleasing and easy to scale, most fall short of delivering on some of the principles of effective feedback and are limited in their ability to address issues of equity.

Think About It!

Have you come across LADs in your own teaching? To what extent do you make use of these visualisations to understand your students? Do you find these tools helpful or unhelpful?

Tailored Messaging and Feedback Systems: “Systems That Care”

As noted above, LADs are fully automated learning analytics feedback systems that deliver personalized feedback to learners with the aim of supporting monitoring and self-regulated learning. We also took note of some of the criticisms associated with such systems, which are designed to be administered at scale. We now turn to another class of feedback interventions that are not fully automated but are instead designed with a “human in the loop” in the learning analytics process. This means that humans intervene in the application of the system. The following interventions may be considered as “systems that care,” in du Boulay’s (2010) terms. This is because they are directed at learners’ motivation, metacognition, and affect.

These human-involved systems are currently adopted “in the wild”—in higher education settings by educators around the world. These systems allow educators to control certain features—also known as *parameters*—in accordance with their context and learning design. Depending on the tool, these parameters may include one or more of the following:

- the kind(s) of data which is the basis for feedback at specific points in time
- the rules and conditions for defining subgroups for personalization
- the content of the message that educators want to convey to students
- the scheduling of personalized feedback or other tailored support messages

This contextualization is important, as learning design significantly influences students’ engagement and success (Gašević et al., 2016). What follows are three examples of these semi-automated learning analytics feedback systems that have been featured in the literature: the Student Relationship Engagement System (SRES), OnTask, and ECoach. These systems are discussed as they are known for their implementation in higher education courses.

The Student Relationship Engagement System (SRES) and OnTask

SRES (Liu et al., 2017) and OnTask (Pardo et al., 2018) are described together here, as they share a few similarities in the way they allow for educators to make decisions regarding personalized, data-informed feedback and support, using "teacher intelligence and small (but meaningful) data" (Arthars et al., 2020, p. 229). A noteworthy point about both systems is that they were developed by educators who understood the challenges that fellow-educators face in wanting to personalize support and feedback to large cohorts of students. These tools were designed to facilitate educators' personalized support of students in a timely manner in their courses.

Both tools involve educators as part of the learning analytics process (see Figure 7). In basic terms, educators can select from the universe of data that is automatically collected from the LMS if the system is integrated with institutional systems. In addition, educators can upload additional data from other sources. This might include: attendance data from synchronous or face-to-face classes; performance on formative quizzes; or surveys that capture student academic variables such as program of study, current motivation, or learning challenges. Self-report surveys may be especially important for further personalization of support or communication. At the simplest level, at the start of the semester, instructors may ask students if they have a preferred name that differs from their official record that the instructor can use that for all subsequent communications.

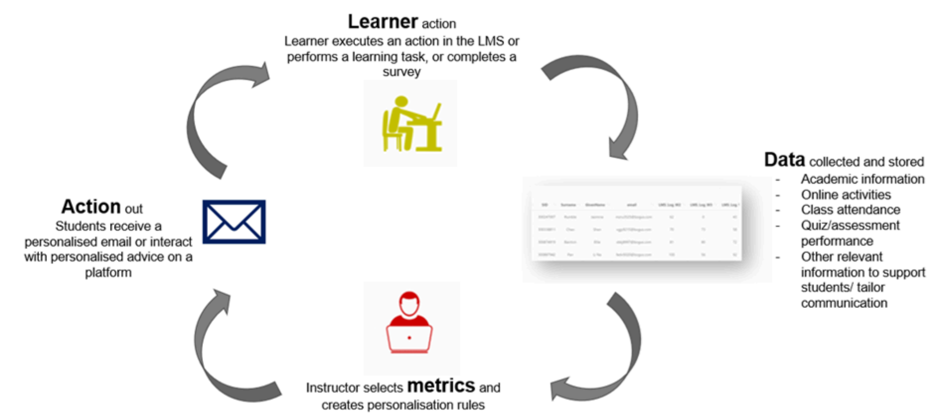


Figure 7. *The learning analytics cycle with a human in the loop*

Interviews with instructors using the SRES to communicate with their students on a first-name basis reported that the emphasis on using a preferred name helped the instructors engage personally with their students and to show their care. As students progress through the semester, instructors can deploy timely surveys to tap into how students are feeling about their current learning—for example, by asking them about "muddiest points" of the week. The instructors then possess the resources to personalize communication based on students' responses. Following this, the instructor can then segment students based on the data, and design supportive messages for personalized feedback, nudges, or advice to each student based on their progress or attitudes over the course of their study.

While these systems are still fairly new, empirical evidence that documents their impact has recently emerged. For example, results from studies with OnTask have been promising, showing positive impact on students' motivation (Lim et al., 2021), self-regulated learning (Matcha et al., 2019), and academic performance (Pardo et al., 2019; Lim et al., 2021). In these studies, performance and learning management system activity data were collected from courses where instructors employed OnTask for personalized feedback; the data were compared between cohorts who experienced personalized feedback and those who had not.

Additionally, studies exploring data on course satisfaction indicate that personalizing feedback in this way enhanced the course experience for students (Pardo et al., 2019). Through interview studies, it was also found that students experienced greater feelings of support and belonging in their courses (e.g., Lim et al., 2021). Importantly, students noted that the fact that personalized feedback was communicated from the instructor played an important motivational role in their continued efforts to learn in the course.

Research on educators' perspectives with SRES also serves as a rich source of information to understand how these key stakeholders engage with learning analytics feedback tools in actual teaching settings (as opposed to laboratory settings, which tends to be the case for new technologies), the challenges they face, and how to facilitate wider adoption of such tools (Arthars & Liu, 2020; Blumenstein et al., 2019). For example, Arthars and Liu (2020) described how instructors moved from the collection of student attendance data using paper rolls, to a digitized approach leveraging the affordance of the SRES. Later on, as the tool became integrated with the institution's LMS, further automation of the data collection process became possible. This automation then allowed instructors to generate metrics for personalized feedback on engagement data such as quizzes; it also allowed them to communicate this feedback through emails.

While sharing some similarities with OnTask, the SRES—being an earlier development—has advanced to a more mature, "multifunctional system" (Arthars et al., 2020). This new system offers additional features for interactions with feedback, such as the affordances of students' self-reflection on instructor, dialogic, and peer feedback (see Figure 8 for an illustration). As students write their self-reflections, their inputs can be the next cycle of personalized feedback (see Figure 8). It is also possible for instructors to upload data in real time; these data include tutorial attendance data, students' lab results, or marks based on rubrics in oral examinations. This has allowed instructors to greatly reduce the time it takes to provide feedback on **assessment**. To date, the SRES has been widely adopted at the University of Sydney by instructors who want to engage personally with their students (see Arthars et al., 2020 for an in-depth perspective of how and why instructors adopted SRES at the institution).

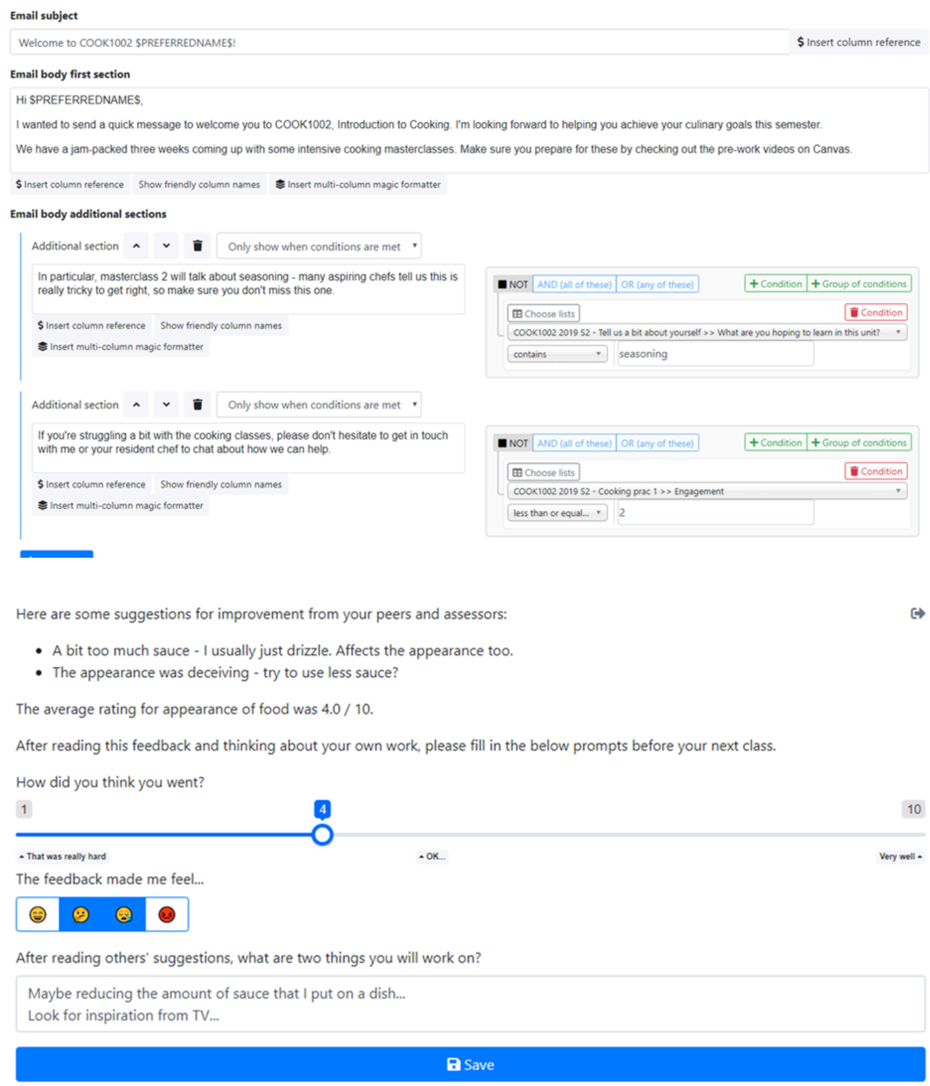


__Figure 8.__ The SRES interface. (Top) Email editor with elements for personalization. (Bottom) Feedback message showing instructor and peer feedback, and dialogue for feedback response. (Source: Arthars et al., 2020. Images used with permission)

Both OnTask (https://www.ontasklearning.org/) and SRES (https://sres.io/) are open source tools, meaning that they are available for anyone to use—what may be needed is to ensure the tool meets institutional requirements with regards to data **privacy** and security (if you are interested, read the paper by Buckingham Shum (2023) when seeking to embed learning analytics technologies within the institution).

ECoach

ECoach is a platform that leverages data to offer personalized learning support to students, offering them a personal "coach" through the students' own personalized portal. The platform was designed as a motivational coaching system for students in large, introductory STEM courses to enhance motivation and ultimately foster academic success. Managed at the University of Michigan since 2014 (Huberth et al., 2015; Wright et al., 2014), this platform is relatively mature, having undergone several iterations of design based upon ongoing research.

The platform hosts a range of features to prompt students' metacognition and reflection, and employs messages personalized to students' activity data in the course LMS, as well as to information gathered from self-report surveys. The features in the platform were gradually added over time as part of the platform's development and include tailored messages, exam playbooks, exam reflections, a grade calculator, and an interactive to-do list (see Matz et al., 2021 for details). Some of these surveys are preset, and based on existing instruments on study habits such as the Motivated Strategies for Learning Questionnaire, MSLQ (Pintrich & de Groot, 1990). The pre-set surveys ask students about their goals for the course or their study habits; other surveys can be designed by instructors and deployed to students through the system so that advice or feedback can be tailored to students based on their response data.

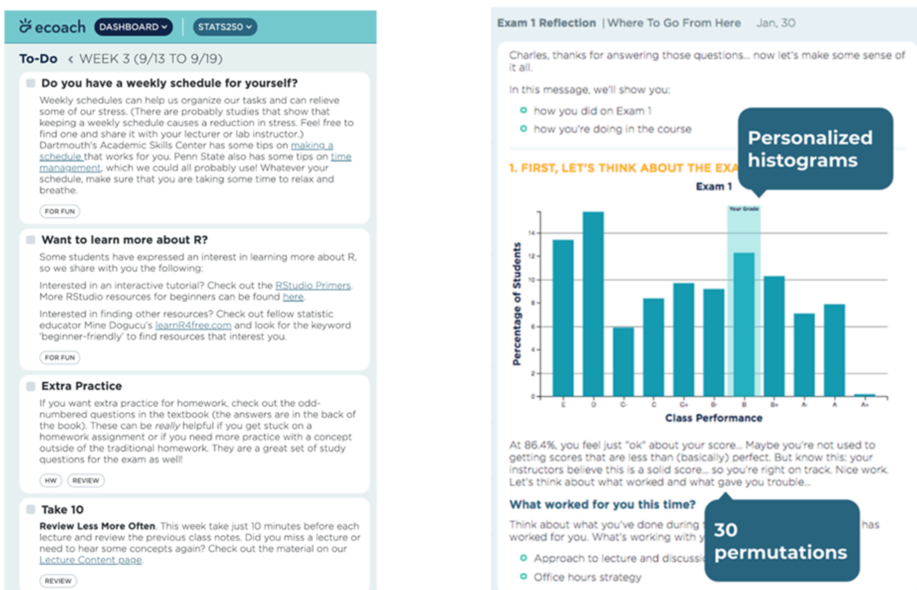


Figure 9. The ECoach platform from the students' perspective. (Left) A To-Do list tuned to the curriculum, prompting student reflection and action. (Right) a tailored post-exam reflection message integrating student self-report data about how they regarded their grade, and eliciting reflection on study habits. For details see https://ai.umich.edu/software-applications/ecoach Images used with permission.

A notable difference between ECoach and the OnTask and SRES systems, as described above, is how instructors work with the system. Instructors work directly with the OnTask and SRES platforms to select data and create rules for—as well as write—personalized messages to motivate students and nudge productive study behaviours. In the case of ECoach, a team of behavioral scientists consults with instructors to customize the platform for their course—this becomes the "coach" for students.

LIDT in the World: Aligning Learning Analytics with Learning Design—A Case

Study on Personalized Feedback

Educators can align learning analytics with learning design through personalized feedback. Here is one example: The setting was a course in the Engineering and IT discipline that employed a flipped learning design. This was a large course enrolled by close to 600 students. As is typical of flipped learning designs, students were required to complete preparatory tasks prior to the weekly lecture. The preparatory work consisted of watching a topic video and answering related questions, as well as completing a short series of practice exercises. The preparatory work was designed to support students' mastery of the weekly topics.

Because the educator wanted to increase students' engagement with the preparatory work and provide personalized feedback on the mastery of the weekly topic, they utilized the OnTask system to generate formative feedback after the preparatory work was due. This meant that students received feedback on their progress with the tasks as well as on their performance. Evaluations of this personalized feedback design found that, overall, students acquired a regular pattern of study that involved preparation and review. They also performed better when the educator included actionable study advice along with performance feedback. Importantly, the way that the personalized, data-informed feedback was designed reinforced the rationale of the flipped learning design. This is a powerful example of the impact on students' learning when learning analytics is aligned with learning design. For more details about this case study, refer to Pardo et al. (2019) and Lim et al. (2021).

Think About It!

How much do you know about your students? If you were to give them a survey to find out more about them, what would you ask? How would you use this information to offer personalized advice or feedback?

Writing Analytics: Supporting Students' Academic Writing with Natural Language Processing

So far, we have discussed learning analytics interventions that draw on LMS activity data and, to some extent, student self-report data to personalize feedback and support. As mentioned earlier, quantitative data have tended to be the main type of data used in the field due to the affordances LMSs offer to automatically capture and harvest learners' activity data. However, textual data is also just as ubiquitous—readily available in forms such as written assessments, qualitative survey responses, and discussion forum comments. Furthermore, writing—in particular, academic writing—is a "key disciplinary skill" (Knight et al., 2020) that is a requisite for professions such as law and business, and certainly in most areas of research. However, teaching academic writing in higher education where enrollment is in the hundreds, is undoubtedly a challenge. This is because students need personalized feedback and guidance on their writing. Even so, with educators juggling teaching loads and administrative tasks, helping every student individually with their writing is nearly impossible. With this in mind, we now turn to another category of learning analytics interventions: writing analytics feedback.

Automated text analysis tools have been around for more than a decade now. These tools can be classified into one of three categories: automated essay scoring (AES), automated writing evaluation (AWE), and intelligent tutoring systems (ITS) (Conijn et al., 2022). In this chapter, only a very brief comparison among the three classes of tools is provided; for more details, you are invited to read Conijn et al. (2022), who offers a good overview of these with examples of the tools in each category.

ITSs have been in existence for years now. These are closed systems, meaning that they are fully automated with pre-set algorithms. They are standalone platforms, able to perform a range of functions with built-in affordances for interactivity. AES tools are intended to assist educators with summative assessment of students' writing; in other words, they focus on the written piece as an end product and evaluate this product according to pre-defined rules. Finally, AWEs are the newest systems, designed to provide personalized support and formative feedback on students' writing processes, rather than the final product, to help students improve in their writing.

Automated writing evaluation tools have emerged due to advancements in automated text analysis—particularly natural language processing techniques. One example of an AWE that has been featured in the literature is a tool called AcaWriter (see Knight et al., 2020). This tool sits on an online platform and provides automated feedback to students by highlighting the presence of "rhetorical moves" (Swales, 2004) that are critical in academic writing. AcaWriter is tuned through **machine learning** to detect "phrases and sentences that indicate . . . the writer's attitude or position in relation to . . . the text" (Knight et al., 2020, p.143). For example, rhetorical moves in analytical writing include: question move (i.e., raising a question or highlighting missing knowledge), background move (i.e., describing background knowledge or consensus about a topic), and emphasis move (i.e., emphasising significant, important ideas) (Swales, 2004). When students input their written drafts into the platform, they can obtain immediate feedback on their writing regarding the presence or absence of these moves; they can also receive actionable advice on how to improve the draft to make these moves more visible.

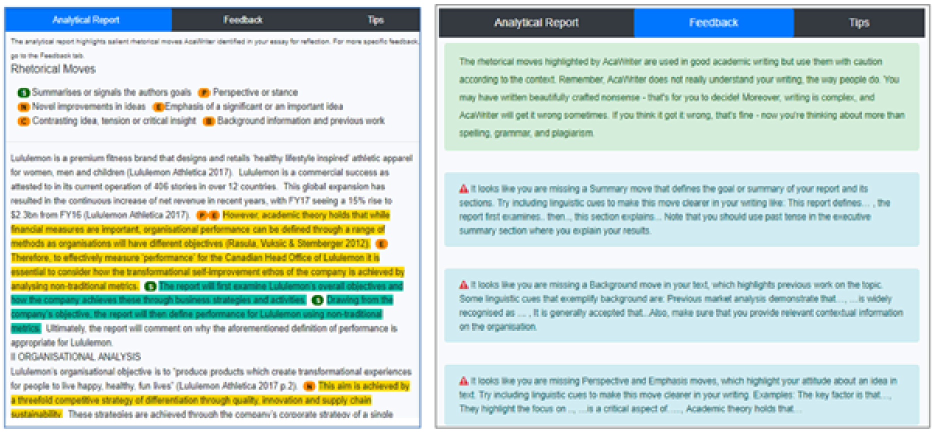
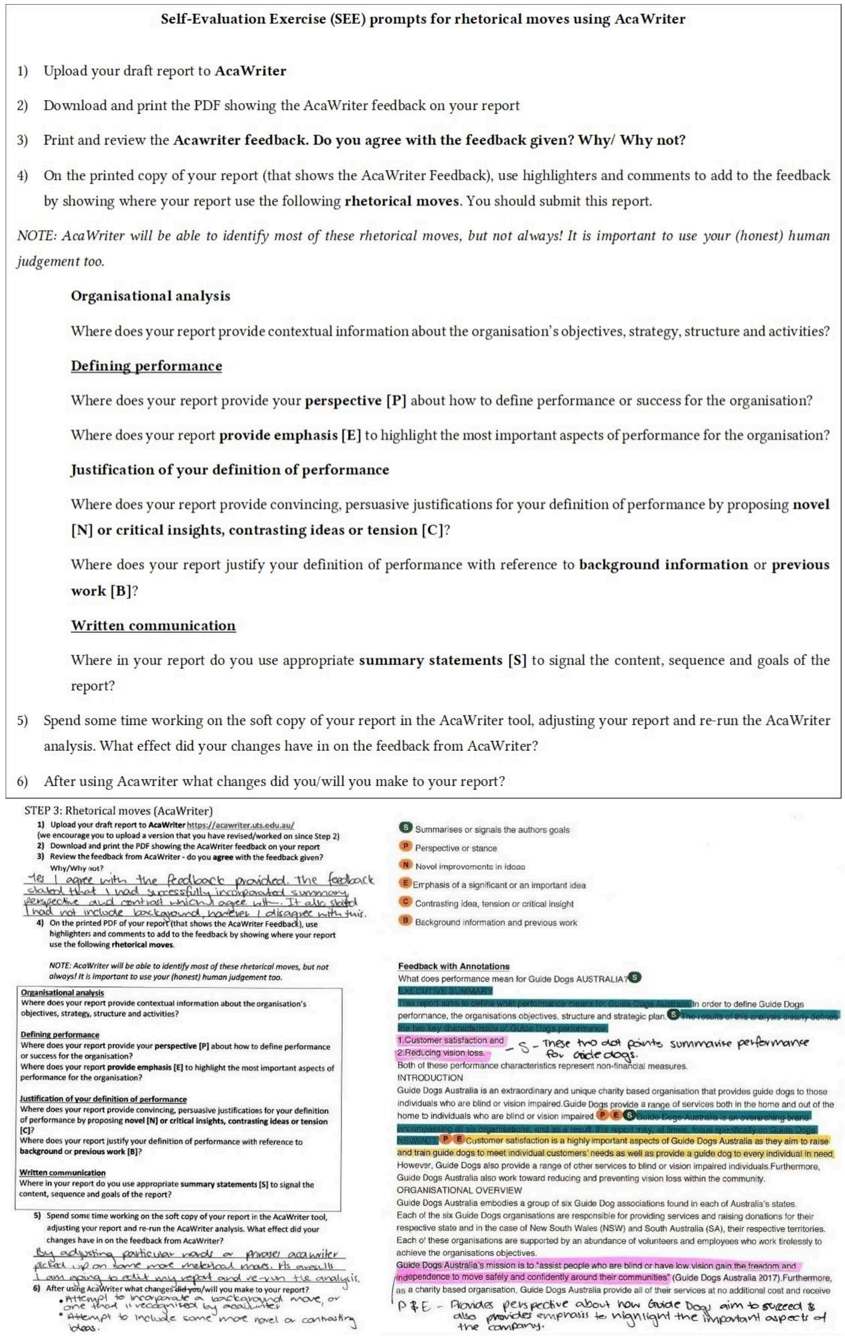


Figure 10. *The AcaWriter web interface. (Left) Highlighting of sentences in which it detects academic 'rhetorical moves' (see legend). (Right) Feedback information for the author.*

LIDT in the World: Enhancing Students' Critical Engagement with Writing Analytics Tools—Where Learning Analytics Informs Learning Design

So far, we have described how learning design informs learning analytics interventions in context, but the reverse can also be true as learning analytics can inform learning design. We see this in the case study of the AWE tool, AcaWriter. In this case, researchers worked closely with the educator in a business course to ensure the learning design of the course and the feedback intervention were closely aligned. In this co-design, both parties worked together to tune AcaWriter feedback to the assessment rubric in order to facilitate students' sense-making of the tool's feedback and actionability. Even so, it was observed that not all students engaged deeply with the feedback from the AWE tool. Some/many made only surface changes in response to the feedback they received.

To encourage students' critical engagement with the feedback from AcaWriter, the researchers worked again with the educator to create "self-evaluation exercises" or SEE sheets that students were encouraged to complete as they used AcaWriter (see Figure 11). The SEE sheets comprised prompts for students to reflect on the feedback they obtained from AcaWriter. The purpose of the SEE sheets was not to enforce compliance with the feedback, but to encourage students to consider whether they agreed with their feedback or not. Students were also invited to annotate the feedback they downloaded from AcaWriter, as a way to develop their understanding of the feedback. The use of the SEE sheets resulted in an adaptation to learning design stimulated by the learning analytics intervention. Importantly, this was done in order to foster critical **student engagement** through personalized, writing feedback. You can read the full case study in Shibani et al. (2022).



Self-Evaluation Exercise (SEE) prompts for rhetorical moves using AcaWriter

1) Upload your draft report to **AcaWriter**

2) Download and print the PDF showing the AcaWriter feedback on your report

3) Print and review the **Acawriter feedback. Do you agree with the feedback given? Why/ Why not?**

4) On the printed copy of your report (that shows the AcaWriter Feedback), use highlighters and comments to add to the feedback by showing where your report use the following **rhetorical moves**. You should submit this report.

NOTE: AcaWriter will be able to identify most of these rhetorical moves, but not always! It is important to use your (honest) human judgement too.

Organisational analysis

Where does your report provide contextual information about the organisation's objectives, strategy, structure and activities?

Defining performance

Where does your report provide your **perspective [P]** about how to define performance or success for the organisation?

Where does your report **provide emphasis [E]** to highlight the most important aspects of performance for the organisation?

Justification of your definition of performance

Where does your report provide convincing, persuasive justifications for your definition of performance by proposing **novel [N] or critical insights, contrasting ideas or tension [C]**?

Where does your report justify your definition of performance with reference to **background information** or **previous work [B]**?

Written communication

Where in your report do you use appropriate **summary statements [S]** to signal the content, sequence and goals of the report?

5) Spend some time working on the soft copy of your report in the AcaWriter tool, adjusting your report and re-run the AcaWriter analysis. What effect did your changes have in on the feedback from AcaWriter?

6) After using Acawriter what changes did you/will you make to your report?

Figure 11. The AcaWriter self-evaluation exercise (SEE). (Top) SEE prompts for reflecting on AcaWriter feedback. (Bottom) Sample student response to SEE prompts on AcaWriter feedback. (Source: Shibani et al., 2022. Images used with permission)

Challenges and Future Directions for Learning Analytics

Over a little more than a decade, learning analytics as a field has grown with rising interest; technology development; and the creation of subfields such as multimodal analytics (Blikstein & Worsley, 2016), assessment analytics, and collaborative analytics. These subfields explore wider sources of data to inform interventions in support of student learning beyond the LMS.

A key challenge for the field is that of adoption. While there are a plethora of tools and systems, few have been actually adopted "in the wild,"—that is, by educators and institutions. In this chapter, we have presented three examples of systems that have seen adoption in actual teaching environments. Each of these systems harnesses either activity, performance, or textual data, to personalize feedback and support to students.

The reason for a lack of adoption is due to the challenges involved in deciding to procure and embed such tools within existing infrastructure (see Buckingham Shum, 2023, for an overview of the levels of conversations to be had in trying to embed learning analytics tools at a university). Furthermore, educators themselves are faced with challenges when considering to adopt data-informed tools. These challenges include the time investment required to learn how to work with the technology (Arthars & Liu, 2020), as well as the kinds of literacy that are required for effectively working with data (Buckingham Shum et al., 2023). This presents specific challenges for learning designers who are trying to incorporate learning analytics in their practice.

The low adoption of learning analytics within education makes measuring the impact of these data-driven interventions difficult —according to Viberg and Grönlund (2021), the field is in "desperate" need of showing impact at scale. To show this impact, educators and learning designers may need to return to fundamental skills around teacher feedback literacy and develop additional automated feedback competencies in order to effectively design data-informed, personalized feedback and support. Stakeholders need to develop an understanding of data that can inform about students' learning within learning design. They also need to enhance their ability to work with data to personalize feedback in a meaningful way. Combining this data literacy with knowledge of effective feedback will foster greater adoption of data-informed feedback systems in the wild.

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The Future of the Field is Not Design

McDonald, J. K.

The field of learning and instructional design and technology (LIDT) has an important contribution to offer towards what Beckwith (1988) called "the transformation of learners and . . . learning" (p. 18). However, in pursuit of this mission, we have become too fixated on being designers and applying the methods of design thinking. As valuable as design is, it's ultimately too narrow an approach to help us have the impact we desire because it overemphasizes the importance of the products and services we create. To be more influential, we need other approaches that focus our efforts on nurturing people's "intrinsic talents and capacities" that are ultimately outside of our ability to manage and control (Thomson, 2005, p. 158; see also Biesta, 2013). In this chapter I first describe how design's focus on creating and making misleads our understanding and application of important dimensions of our field. I

then describe how we can cultivate an LIDT identity that is better suited for the aims we are pursuing. An LIDT-specific identity may include some methods from design thinking, but it will also encompass additional ways of improving the human condition. I end by calling on readers to consider what this important evolution for our field means for their personal practice.

We currently face a problem in the field of learning and instructional design and technology (LIDT). We have an important contribution to offer towards what Beckwith (1988) called "the transformation of learners and . . . learning" (p. 18). However, in pursuit of this mission, we have become too fixated on being designers and applying the methods of design thinking. As valuable as design has been for our field, it's ultimately too narrow an approach to help us have the impact we desire because it overemphasizes the importance of the products and services we create. To be more influential, we need approaches that focus our efforts on nurturing people's "intrinsic talents and capacities" that are ultimately outside of our ability to manage and control (Thomson, 2005, p. 158; see also Biesta, 2013). Tying ourselves to design will not accomplish this, so we need to cultivate an identity of our own—an identity centered on what Dunne (1997) called the character and dispositions of "practical judgment" (p. 160).

In this chapter I hope to make these issues clear. I start by describing how design's focus on creating and making misleads our understanding and application of important dimensions of our field, and so limits our impact. I then describe how we can cultivate an LIDT identity that is better suited for the aims we are pursuing. An LIDT-specific identity may include some methods from design thinking, but it will also encompass additional ways of improving the human condition, all centered in the character of practical judgment. I end by calling on readers to consider what this important evolution for our field means for their personal practice.

What is Misunderstood When LIDT is Defined as Design

The field of LIDT was drawn towards design thinking because it promised to help us create better learning products, strategies, services, and environments. Historically, the field relied on detailed processes for creating instruction that provided predictable, dependable results (e.g, Merrill et al., 1996). However, towards the close of the 20th century, it became clear that these processes were too rigid to be useful in many real-world settings (Rowland, 1992; Wedman & Tessmer, 1993). There were also questions about whether traditional instructional design processes, like Instructional Systems Design (ISD), even worked at all (Gordon & Zemke, 2000; Zemke & Rossett, 2002). Thus, a number of calls appeared to abandon the field's formulaic processes, and adopt more flexible approaches such as those found in design fields like architecture or industrial design (e.g., Boling & Gray, 2014; Hokanson & Gibbons, 2014; Lachheb & Abramenka-Lachheb, 2022; McDonald, 2011; Tracey, 2016). The claim was that embracing the way designers worked would "produce improvements in learning and performance far beyond those we are able to achieve today" (Boling & Smith, 2012, p. 363).

Design thinking did provide LIDT more flexibility, along with associated benefits such as a renewed emphasis on addressing the complexities found in every learning environment (Becker, 2007). But what did not change was the field's near-complete focus on creating learning products or services. This was because design is fundamentally about creating and making. Indeed, Nelson and Stolterman (2012) defined design as "the ability to imagine that-which-does-not-yet-exist [and] to make it appear in concrete form as a new, purposeful addition to the real world" (p. 12). And Archer et al. defined it as, "the conception and realization of new things . . . [through] planning, inventing, making, and doing" (as quoted in Cross, 2007, p. 16). This is the case even if LIDT professionals claim they have "moved beyond making artifacts," such as designing learning strategies, cultures, or relationships (cf. Lee, 2021, p. 497). To do this, they still tend to create some kind of object or operation (product or process) that is meant to have a discernible, concrete effect on the people using them (McDonald, 2021).

Design's emphasis on creation, however, threatens to distort our view of LIDT and its potential impact. To illustrate, consider what the effects have been of defining the field of teaching as also being a type of design (Henriksen & Richardson, 2017; Norton & Hathaway, 2015; Paniagua & Istance, 2018). Henriksen (2020) went so far as to claim that "teaching is *always* an act of design towards a learning purpose," because teachers create "engaging learning activities, effective assessment practices, and students' experience" (p. 294; emphasis added). On the surface, this seems to make sense. Teaching undeniably includes the activities Henriksen identified. And design methods often can help teachers do this kind of work well. However, as Biesta (2013, 2021) persuasively argued, there are many other dimensions of teaching that go beyond what teachers create. Teachers are role models. They manage the everyday, spontaneous events that just happen in a classroom. They counsel both students and parents. And they "call" students to live up to their full potential—not just through what they do but also through their relationships with those students (Biesta, 2021, p. 47).

These non-design dimensions of teaching are at least as definitive of teaching as creating materials or setting up conditions for students to learn. But they are not really *made* in the same way an object is made. Consider the important role teachers play in helping students believe in their own potential, especially when facing moments of self-doubt. Countless students have experienced the motivational effects of such encouragement. And it can sometimes be even more powerful than how caregivers (like parents) show confidence—given the unique fusing of care, expertise, and authority inherent in good teaching relationships. This is real teaching, as much as designing a lesson plan, and it can be life changing (Noddings, 2012). But it seems manipulative for a teacher to design situations where students experience doubt just so the teacher can show how much they care. Both common sense and research show that such Machiavellian tactics are damaging (Krause, 2012).

Biesta (2017, 2021) further argued that if teaching is primarily defined in terms of what teachers make, we can easily lose sight of its other dimensions. Thus, reducing teaching to design, because teachers sometimes make things, can ignore or dismiss as inconsequential other important teaching practices. At the extreme, this has led to both historical and contemporary attempts to replace teachers with designed learning products (Casas, 1997; Ovetz, 2021). Why hire a teacher who is likely a second-rate designer, when you can hire a trained learning designer instead? Or why not buy a curriculum that just “works” without a teacher at all? (cf. Heinich, 1995) Even without going to those lengths, when teaching is defined as something that can be made, there is a tendency to only recognize, evaluate, and reward what teachers make. And ultimately, this limits the scope of what is considered legitimate for teachers to do (Biesta, 2010). If the scholars cited earlier were asked, surely they would agree that the other dimensions of teaching identified above are important. But when they claim that teaching is defined by its activities of planning, making, and designing, the ultimate end is to eventually erase the possibility of doing anything other than plan, make, and design (Dreyfus, 2002; Thomson, 2005; Wrathall, 2019).

Like teaching, LIDT is usually defined by the products and services it creates (McDonald, 2021). Of course, LIDT professionals do create things meant to be a factor in learning situations. My claim is not that this is inappropriate, but, rather, that design is only one part of what it takes to accomplish our purpose of transforming learners and learning. They are an important part, to be sure. But, also like teaching, if what we design is viewed as our sole contribution, there will be dimensions of the field that we misunderstand. As one example, when LIDT is considered to be only a type of design, there is a tendency to consider learning to be the product we create, and students as the output of our design efforts (Gur & Wiley, 2007; Lee, 2021; McDonald, 2021). This, however, is an overly simplistic view of learning (Yanchar & Francis, 2022). Additionally, there are important dimensions of learning that are distorted if we attempt to design them, as much as if a teacher designs situations to manipulate how students feel about them. If we consider LIDT’s purpose to be the design of learning, our tendency will be to “view learners in a similar manner as other makers view the material with which they work. Learners become matter to be mastered and shaped, and instructional strategies and techniques are the tools designers have to produce . . . learning” (McDonald, 2021, p. 47).

Further, just like important teaching practices are ignored when we overemphasize the materials or activities that teachers create, the scope and types of educational help LIDT can offer is limited when we define the field as a type of design. But given our historical emphasis on creation and design, we have spent very little effort considering what other contributions we could make. To understand the possibilities, we need to broaden our views of LIDT to encompass more than the creation of products and services.

LIDT’s Future: Moving Beyond Design

What alternatives are available to us beyond creating, making, and designing? Designers suggest that whenever people seek to improve the human condition, by definition, they are designing (Nelson & Stolterman, 2012; Simon, 1996). However, a little reflection shows that this is not true. For example, doctors and nurses do not design a patient's health. They support the body as its own natural functions return itself to health. Similarly, a host of practices exist to improve ourselves and our world apart from design, including policy making, therapy, law, and—as discussed earlier—teaching. Proponents for design argue that, at least at times, such professionals are really designers even if they do not know it (Aakhus et al., 2018; Henriksen et al., 2020; Lachheb & Abramenka-Lachheb, 2022). But, as already discussed, when designers do this, it is an indication that they do not understand, or are simply dismissing, dimensions of these professions that do not involve making and creating. Of course, doctors, lawyers, and teachers sometimes make things. But what they make does not define them. They do many other things as well—things at least as definitive of their professions, if not more, than what they create. If we pay attention to those dimensions, we might learn new approaches for how LIDT can offer more, and better, contributions towards the transformation of learners and learning (see Beckwith, 1988).

In particular, we can pay attention to how these fields cultivate improvements to the human condition without managing, controlling, creating, or making. For instance, as discussed above, doctors and nurses do not actually make or create health. Instead, theirs is a *caring* profession. They rely on other forms of influence than designers rely upon with their making-oriented aims (Dunne, 1997). Sometimes this is no more than explaining the consequences of someone's current lifestyle to persuade him to live more healthily. Or, like teachers, sometimes it is by simply offering "a thoughtful glance, a soothing word, and other manifestations of caring and concern" (Arndt, 1992, p. 291). Since helping people learn also includes these kind of persuasive and caring dimensions, it seems that fields like medicine and nursing could provide insights for LIDT practice that design cannot. What might LIDT look like if we emphasized its caring dimensions as much as did doctors and nurses?

But simply importing practices from other fields (like nursing) is not enough (McDonald & Yanchar, 2020). There is something more fundamental that all these fields—including design—share that is important to help LIDT accomplish its purpose. At their core, all these fields share an assumption that instead of relying on methods and processes that attempt to define their response to every situation, the proper way to engage with the world's unpredictable and ever-changing circumstances are what Dunne (1997) called the dispositions of "practical judgment" (p. 160). Although practical judgment is difficult to define, Dunne summarized it as being when people are perceptive enough to recognize the most important characteristics of individual situations, wise enough to know what options they have available to act, and experienced enough to customize their actions to the particular environments in which they find themselves. It is doing the right thing "to the right person, to the right extent, at the right time, with the right aim, and in the right way" (p. 368). Since one of the original reasons for importing design thinking into LIDT was to correct our overemphasis on following rigid processes, it seems that we can better accomplish this goal by focusing on practical judgment directly, instead of tying ourselves to one field, design thinking, that attempts to create methods for enacting it.

In fact, as Dunne (1997) further emphasized, practical judgment is not merely an alternative, more flexible kind of process at all. Instead, it is a kind of character that people develop as they learn to respond to certain types of issues to which they were previously insensitive. Thus, it is the character of LIDT professionals that should enable them to respond to opportunities they discern for transforming learners and learning. No set of methods or processes themselves can accomplish this on their own. What a teacher does to show students they care is less important than that their actions arise out of their authentically caring disposition. This is not to argue that practices do not matter; certainly, students will view some actions as more caring than others. But practices must be situated in their proper place, as an outgrowth of a person's existing, or at least developing, dispositions and character.

Expanding our view of LIDT should therefore begin by considering what dispositions and character are associated with practical judgment in the specific context of transforming learners and learning. Issues like this have received little attention in our field's literature, although we can find a few examples (Belland, 1991; Parrish, 2012). As one example, if it is true that practical judgment "is mediated through feelings" (Dunne, 1997, p. 358), what emotional sensitivities are important for LIDT professionals to cultivate? One emotional sensitivity is certainly empathy (Matthews et al., 2017)—a disposition shared, of course, with other fields; this includes design. But how would our empathy change if we understood it in the same way the caring professions did—as the foundation of real relationships—instead of as a technique for making better products, as sometimes seems to be the case in design fields (Heylighen & Dong, 2019)?

Beyond this, are there other emotional dimensions of practical judgment, especially ones more distinct to the transformation of learners and learning? And how do we help LIDT professionals cultivate them? As we come to answer questions such as these, we can use what we learn as the basis for remixing useful practices into forms that reflect what we are trying to accomplish, while jettisoning those that are found to be counterproductive. Some of those practices could be derived from design. But others might also originate in science, nursing, teaching, law, or any other field where we find people exhibiting practical judgment in attempts to improve the human condition.

LIDT in the World

If this vision of LIDT's future appeals to you, the most important thing you can do is become the kind of professional that embodies the character and dispositions of practical judgment. We need a groundswell of professionals who are not satisfied to only create products, processes, or other services, but are also willing to explore other ways of transforming learners and learning. We also need people who are explorers—who are curious about what other forms of practice are missing from our repertoire that will help us pursue our mission. What else should be part of an LIDT identity that we haven't yet imagined? What do those dimensions contribute towards the transformation of learners and learning? And how can you become the kind of person who exemplifies these attributes?

Reflect upon these questions. Consider formalizing your reflection in a journal entry or personal statement of values:

- Based on *your* own background, talents, beliefs, and values, what do you find missing in our field's approach to learners and learning?
- Based either on precedent (examples you learn from elsewhere), or brainstorming (your own creativity), what new ideas could we incorporate into LIDT that address your concerns?
- What kind of character (practical judgment) could you exemplify to become the type of person who authentically pursues the transformation of learners and learning?
- How can you begin to develop your practical judgment through your education or practical experiences?

Conclusion

In this chapter, I have argued that design is not the pinnacle of LIDT as a field of practice. This does not mean that LIDT professionals should never design. Rather, it means that design alone is too narrow to help us accomplish our mission of transforming learners and learning. Instead, we should be a field organized around the dispositions and character associated with practical judgment. It is understandable why LIDT professionals would want to define themselves as designers. Design is fashionable. It provides the esteem that our field so often seems to desire. But the label *design* does not need to be attached to every method of attempting to improve the human condition. Design is also not the only way to enact the dispositions and character of practical judgment, which is the real core on which our field should focus. We should be in conversation with every field that exhibits such virtues, and not only design. It is true that an expanded vision for LIDT's purpose and practice will include some design activities. But if we only design, we will be limited in the types of influence we have. So, our practices should also include influences from other fields as well, remixed into a unique identity that reflects our primary focus on practical judgment and in service of our distinctive purpose. Thus, in conclusion, instead of asking how we design the future of LIDT, we should be asking instead: what future is possible for us that design does not provide?

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