The Holistic 4D Model: A Holistic Approach to Designing Learning Experiences

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Formative Design
Holistic 4D Model
Holistic Design
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Instructional Design
Learner-centered Theory
Learning Experience Design

This article identifies an important situation for instructional designers, where they need to design learning experiences as multifaceted complex adaptive systems. Stakeholders, clients, and learners expect instructional designers to create learning experiences aligned with instructional theory, that guides the integration of new technologies like AI, new instructional methods for learner-centered instruction, and new media which motivate and inspire learners. It is in this context that we developed a new instructional design model – the Holistic 4D Model – which integrate such instructional theory into an updated, holistic instructional design process that offers guidelines

for four phases: Define, Design, Develop, and Deploy. The model recommends that designers construct their designs in three stages: Top Level "fuzzy vision", Mid-Level operational plans, and Lower-Level detailed blueprints. The holistic 4D Model also provides unlimited analysis-design-evaluation (ADE) cycles based on designer needs for managing complexity, and gives guidance for how and when to address task expertise and topic expertise in the learning experiences. A key benefit of the Holistic 4D Model is that it contextualizes the emerging design, so you, as a designer, can create the parts of your design in context.

Introduction

Knowledge about methods to facilitate learning – and knowledge about the process for designing such instruction more effectively and efficiently – has evolved rapidly over the past several decades. Since 2000, we have observed the birth of several influential instructional design (ID) models and instructional theories which have reshaped how designers think about instructional design. For example, Merrill's (2002) First Principles presents an instructional model which suggests the five elements of effective instruction: Problem, Activation, Demonstration, Application, and Integration. Ten years later, Allen (2012) introduced the Successive Approximation Model (SAM), an ID process model which aligns with adaptive, agile, design-thinking principles (Schmidt et al., 2023). These principles have been instrumental in providing designers alternatives to linear, waterfall-oriented instruction (Gawlik-Kobylinska, 2018) and are well-suited to designing learner-centered instruction.

Learner-centered instruction (An, 2012; An & Reigeluth, 2011; Aslan & Reigeluth, 2015; Lambert & McCombs, 1998; Reigeluth & Karnopp, 2000) is very different from teacher-centered instruction. It requires designers to focus much more attention on learning experience quality (Jahnke et al., 2022) and the instructional methods to enhance that quality (Reigeluth & Honebein, 2023). For example, learner-centered instruction favors constructivist-oriented instructional methods such as authentic problems, social dialog, group processes, and multiple viewpoints (Bonk & Cunningham, 1998). Similarly, the process for designing and developing learner-centered instruction is very different from the process for designing teacher-centered instruction. Furthermore, designing instruction for building task expertise (how to do things) is different from designing instruction for topic expertise (deep understandings) (Romiszowski, 2016).

Learner-centered instruction is challenging for designers, stakeholders, and learners because of how it radically changes teacher and student roles and expectations (An, 2012; An & Reigeluth, 2011; Aslan & Reigeluth, 2015; Reigeluth & Karnopp, 2000). Imagine what it would feel like to be an instructor or a learner who's primary learning experiences have always been passive – reading and listening. But then, in the next semester, administrators now expect instructors and learners to participate in project-based and self-directed learning. These changes in the learning experience can increase the amount of time it takes for instructors to provide feedback for learner projects. In other words, designing learner-centered instruction is a dynamic and complex process which can involve numerous formative design cycles with stakeholders as the design of the learning experience evolves. Nelson and Stolterman (2012) suggest holistic design enables emergent qualities; we associate the term "emergent" with complex systems (Cillers, 2000), for which there is a reasonable amount of evidence in the instructional design literature. Honebein and Reigeluth (2020) write:

> *Learning-experience designers conduct the work they do in a living, self-organizing, complex system (Rowland, 1993, 2007; You, 1993; Solomon, 2000, 2002; Honebein, 2009). What this means is that learning experiences will behave in ways that researchers cannot predict or expect; their nature is emergent "…in that [it is] shaped and developed over time through an evolutionary process" (Honebein, 2009, p. 29). For example, an instructor can design and teach a class one semester, and then the very next semester can teach the same class again, and the experience for the instructor, the learners, and any other stakeholders will likely be different (p. 10).*

Cillers (2000) describes systems as being simple, complicated, or complex. In this structure is a natural design relationship which links holistic, emergent, and complex systems as being entities with complex characteristics which can deliver remarkable learning experiences. McDonald (2021) suggests:

> *To create designs that are truly remarkable and uncover at least some aspects of human potential, people need to experience instruction with emergent, holistic qualities. These are generated as designers consider the connections between individual elements of their instruction, form those connections into structured relationships, and align both into a unified whole that can produce an aesthetic, transcendent effect.*

In addition to designers adopting instructional models like Merrill's First Principles and ID process models like Allen's SAM, a learner-centered instruction designer should address both task expertise and topic expertise within an ID process (Romizowski, 2016). This integration suggests learner-centered instruction should be (Spector, 2002, p. xii):

1. Holistic in nature, meaning it is not a "fragmented and isolated [solution] to particular problems".
2. A process "to make significant advances in promoting understanding in complex domains".
3. "Necessary to adopt a holistic perspective that effectively integrates the learning situation, the many dynamic and interrelated aspects of the subject matter, learners, teachers, and technology".

So, with respect to Spector and his colleagues, we call our learner-centered process model the Holistic 4D Instructional Design Model. This model specifically includes guidance regarding how a designer should address task expertise and topic expertise within a complex, learner-centered learning experience.

Model Development

According to Edmond et al. (1994) and Richey (2005), development of a new instructional design model should undergo a form of validation, at minimum internal validation, and ideally external validation. The current Holistic 4D Model has undergone internal validation but not external validation. The design setting for the model is learner-centered instruction (An, 2012; An & Reigeluth, 2011; Aslan & Reigeluth, 2015; Reigeluth & Karnopp, 2000), with target instructional designers ranging from undergraduate and graduate novice designers and pre-service teachers to intermediate designers with roughly 1 to 5 years of design experience. Senior-level designers who are not familiar with learner-centered learning experiences will also find the model useful.

Expert review was the primary validation process. The authors recruited 11 instructional design professionals with Ph.D. degrees, representing both academia and industry, to conduct formative evaluations of the Holistic 4D Model. In addition to these professionals, two clients who provided financial support to the project provided formative evaluation, and one internationally renowned instructional designer and ID book author provided additional content and ideas, as well as formative evaluations. All expert reviewers were based in the U.S. Four of those reviewers emigrated from the following countries: Turkey, India, and South Korea.

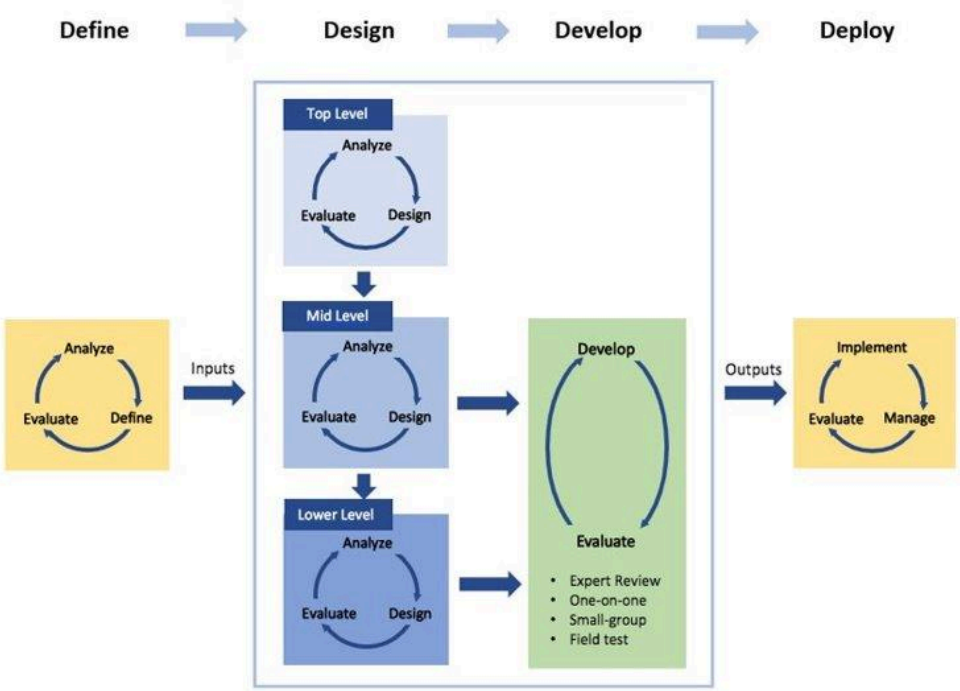
In addition, many parts of the Holistic 4D Model – both ID process parts and learner-centered instructional theory parts – have significant research support in their own right (APA Division 15 Committee on Learner-Centered Teacher Education for the 21st Century, 1995; APA Work Group of the Board of Educational Affairs, 1997; Bransford et al., 2000).

The Holistic 4D Model

Our aim for creating the Holistic 4D Model was to promote greater creativity and coherence when designing learner-centered instruction. We also wanted to provide considerable flexibility by adopting a contextual design process (Holtzblatt & Beyer, 1997). Contextual design is a systemic, user-centered design process that is grounded in the delivery of tangible representations of what a learning experience might look like and ultimately what it does look like when learners engage in the learning experience. The process is iterative in that it provides guidance for multiple cycles of analysis, design, and evaluation throughout the holistic ID process. Additionally, it offers guidance for helping learners to develop both task expertise and topic expertise. The “4D” in the model name represents the overarching process: Define, Design, Develop, and Deploy (see Figure 1).

Figure 1

The Holistic 4D Model of Instructional Design



There are five major reasons a designer should consider using the Holistic 4D Model for learner-centered instruction. It:

1. Integrates learner-centered theory with the ID process
2. Offers a holistic design process with three levels of design
3. Uses multiple analysis-design-evaluation (ADE) cycles
4. Addresses both task and topic expertise
5. Offers contextual and flexible design

We discuss each of these in more detail next.

1. Integrates Learner-centered Theory with the ID Process

ID is a process to create instructional systems which promote high-quality learning experiences. To be most useful, an ID model must offer guidance grounded in theories of learning and instruction. Learner-centered instruction aims to engage one's personal domain, which "comprises those personal qualities and skills thought to be associated with effective teaching, especially when viewed as an interpersonal activity" (Ingram, 2006). This can lead to positive impacts on motivation and learning (An & Reigeluth, 2011). Teachers and administrators often ignore the personal domain in teacher-centered schools and classrooms. Thus, in learner-centered environments, engaging one's personal domain can make learners feel supported by teachers and peers, feel ownership over their learning, and be more motivated and engaged to learn. This can lead to high levels of achievement (McCombs & Whisler, 1997).

Further, the learner-centered paradigm focuses on developing real-world skills, such as higher-order thinking, problem solving, decision making, and collaboration skills, in addition to content knowledge (An, 2012; Bransford et al., 2000; Reigeluth, 1994). Therefore, the Holistic 4D Model integrates learner-centered theory, and that integration typically improves the efficiency of the ID process, as well as the quality of the resulting instruction.

Learner-centered theory includes:

1. Learning-by-doing or project-based learning (Krajcik & Blumenfeld, 2006; Reigeluth & Keller, 2009)
2. Competency-based learning (Reigeluth & Karnopp, 2020; Torres et al., 2015; Voorhees, 2001)
3. Collaborative learning (Kirschner, 2004; Reigeluth & Keller, 2009)
4. Self-directed learning (Albanese & Mitchell, 1993; Barrows, 1986; Barrows & Tamblyn, 1980; Jonassen, 2011; Kirshner et al. 2006; Reigeluth et al., 2017; Reigeluth & Karnopp, 2020; Savery, 2009).

Learning-by-doing or project-based learning typically involves authentic, interdisciplinary, ill-defined projects of a significant length. The design of such projects focuses initially on the experiences which will best promote the desired learning outcomes. In addition, each project should have appropriate scaffolding, which often takes the form of just-in-time tutorials and/or coaching.

Competency-based learning requires the design of competency-based learning targets, competency-based learner progress, competency-based learner assessment, and competency-based learner records (Reigeluth & Karnopp, 2020). Learner assessment should typically be done through the just-in-time tutorials during a project, such that each student independently "practices until perfect" before being allowed to use in the project what was just mastered. Having to practice in diverse contexts promotes transfer of the competency to situations beyond the project and also promotes retention and even automatization, when appropriate. Practicing until mastery ensures every learner is successful before moving on to their next task. This addresses one of McClelland's (1987) three human needs or motivations, the "need for achievement."

Collaborative learning typically takes the form of team-based projects in which learners play different roles if they have different learning targets, or the same role if they have the same learning targets. When learners perform individual projects, collaboration takes the form of peer support, typically by a peer who has already performed a similar project or otherwise mastered the competency with which the learner is having difficulty. This addresses McClelland's (1987) "need for affiliation" – the social dimension of motivation to learn.

Self-directed learning entails learners making decisions about what to learn, how to learn it, and how to assess their learning of it, with coaching from their teacher or instructor. They assume progressively more responsibility for directing their learning as their self-direction skills develop, so learners gain the skills and motivation to be lifelong learners. This rounds out McClelland's (1987) three human needs by addressing "need for power." While self-directed learning is an important part of the learner-centered paradigm, empowering learners may have some unintended consequences for the learning experience, learners, teachers,

parents, and administrators (Greenbaum, 1997; Kearns, 1997; Lacks, 1997; Suhor, 1997). Designers should be aware of these potential consequences.

2. Offers a Holistic Design Process

The prevailing fragmented approach to ID begins with an exhaustive analysis process where the designer breaks down "what should be taught" into tiny pieces. The designer then proceeds to design instruction for each of those pieces.

In contrast to the fragmented approach, the Holistic 4D Model uses a holistic design process which focuses on the integration of analysis, design, and evaluation tasks (Watson & Reigeluth, 2008). Tasks begin with the designer creating a "fuzzy vision" of the instructional system (top-level design). Think of fuzzy vision as a flowchart, prototype, sketch, written narrative, or some other tangible representation of what the learning experience might be like (Honebein & Reigeluth, 2023). The designer then proceeds to work out progressively more details on the fuzzy vision in two more cycles (mid-level and lower-level design). These three large cycles of design make the instruction less fragmented, more creative, more effective, more efficient, and more appealing to clients and learners.

3. Uses Analysis-Design-Evaluation (ADE) Cycles

Here the designer embarks on multiple cycles of analysis, design, and evaluation (ADE), avoiding generating all of the analysis at the beginning of the process and all the evaluation at the end. Just-in-time analysis in each cycle makes the designer's process more efficient because the analyzed information is fresh in the designer's mind just when the designer needs it to make design decisions. Immediate evaluation represents a formative design approach (Bridges et al., 2018; Schmidt et al., 2019) in the ID process which avoids duplication of design problems in subsequent design activities in a project.

A challenge for designers is deciding how large a chunk of instruction to design in each ADE cycle. If it is too large, a designer does not discover design problems until they have been repeated in much of the design. This increases the amount of revision. If it is too small, the design activities are interrupted too often for an efficient ID process. This is one of many areas where contextual design (see #5) is important.

4. Addresses Both Task and Topic Expertise

The Holistic 4D Model addresses task expertise as well as topic expertise (Romizowski, 2016). Task expertise entails knowing how to accomplish a goal. Topic expertise, on the other hand, entails having deep understandings, operationalized by choice, creativity, and challenge. Topic expertise requires learners to build powerful conceptual and causal models, and there are many ways designers can develop and assess such understandings.

Designers often overlook topic expertise because most ID models look at everything to be learned as tasks, based on the behavioral roots of the field. Of course, some instruction

addresses a fairly equal balance of task and topic expertise. The Holistic 4D model provides guidance for helping learners develop both task and topic expertise.

The levels of design are a bit different for instruction focused mainly on task expertise than for instruction focused mainly on topic expertise. These differences are described under “Design” later in this article.

5. Offers Contextual and Flexible Design

The holistic design process is not a linear, lockstep process. Holistic design embraces emergent qualities (Honebein & Reigeluth, 2020; McDonald, 2021; Nelson & Stolterman, 2012). It is iterative and recursive (Holtzblatt & Beyer, 1997). Since ID projects can vary tremendously from each other, the 4D Model encourages designers to use the model flexibly, adapting it to their design context and needs. For example, designers can skip top-level analysis if the designer has already identified the major content and methods. Also, the number of analysis, design, and evaluation (ADE) cycles can vary depending on the quantity and complexity of the content.

The model also provides guidance for when a designer should conduct periodic formative evaluation of the designer’s adaptation of the Holistic 4D Model itself. This helps the designer continually improve the ID process for each of the diverse situations in which they use it.

The Four Phases

The four phases of the Holistic 4D Model are Define, Design, Develop, and Deploy.

1. Define

The first phase of the Holistic 4D Model entails defining the project. Project definition typically includes performance analysis (Rothwell et al., 2018), instructional needs assessment (Dick, et al., 2014; Kaufman, et al., 1993), and ID project planning (Project Management Institute, 2009). Based on these analyses, a designer can determine if there is a need for instruction.

A designer performs each of these analyses using the Analyze, Define, and Evaluate cycle (Figure 2). For example, the designer, based upon input from stakeholders, determines a performance analysis is necessary. The designer is now in the Analyze phase, where the designer conducts a performance analysis. After completing the analysis, the designer proceeds to the Define phase, where the designer specifies the need(s) and possible solutions to resolve those needs. From there, with data in hand, the designer moves to the Evaluate phase, where stakeholders, such as clients, evaluate the designers’ suggestions. If accepted, the cycle ends, and the designer moves into Design. If not accepted, the designer repeats the process, likely gathering more data and insights to persuade or dissuade the stakeholders.

Figure 2

The analyze-define-evaluate cycle for defining the problems and needs to be addressed

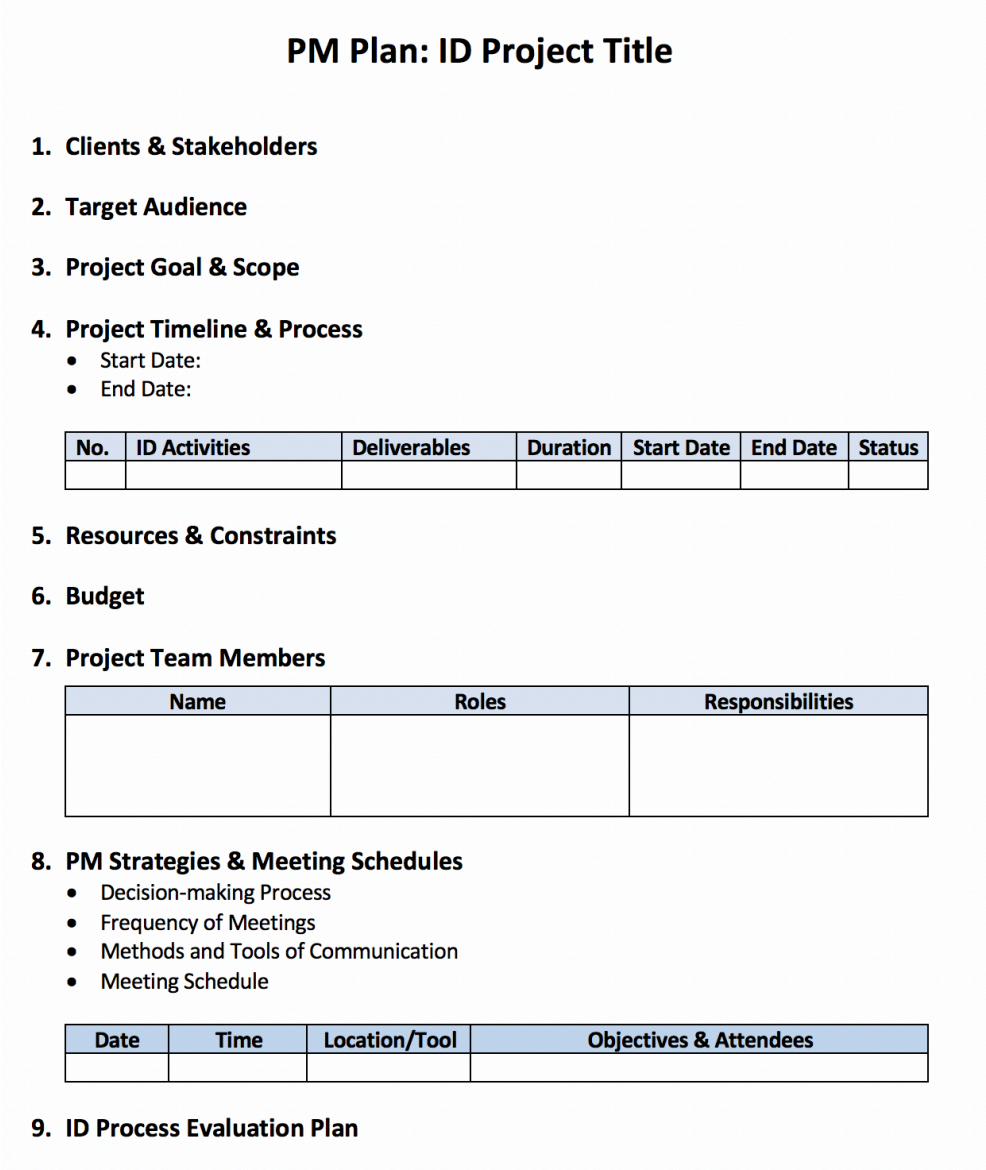
Many ID projects begin with a performance analysis, sometimes called performance assessment (Piskurich, 2015) or front-end analysis (Dick et al., 2014). Designers conduct performance analysis to identify organizational performance problems and to determine which interventions can best address the performance problems. Performance analysis may include a performance gap analysis, a performance opportunity analysis, and identification of instructional and non-instructional interventions. A performance gap analysis aims to identify the performance gap, which is the difference between the target learners' desired performance and their current performance. A designer may also conduct a performance opportunity analysis to identify areas for growth to further improve what is already good performance (Piskurich, 2015).

When the designer attributes the performance gap to organizational, environmental, or motivational problems, designers should use non-instructional interventions. Non-instructional interventions may include culture change, job redesign, incentive systems, job aids, and facilities and tool design, to name a few. In most cases, non-instructional interventions are beneficial in combination with instructional interventions (Chyung, 2008; Kaufman et al., 1993; Rossett, 2009). When a designer identifies a performance gap caused by a knowledge-and-skills deficit, the designer then conducts an instructional needs assessment to identify the major instructional goals, which is, from an ID perspective, the primary purpose of this Define phase.

Once the designer identifies the instructional goals, the designer can plan the ID project. ID projects vary in size and complexity. Whether small or large, managing an ID project can be a major undertaking. Instructional designers, ID project managers, or learning experience designers can apply project management (PM) processes and tools to successfully manage an ID project (Project Management Institute, 2009). The Holistic 4D Model suggests producing an ID PM plan in this Define phase. The purpose of the ID PM plan is to focus the design team on systematically identifying, tracking, and documenting all the project requirements, including team formation, stakeholders, target audience, project goal and scope, timeline, resources, constraints, budget, and a plan for formatively evaluating the ID process (see Figure 3).

Figure 3

Template for an ID PM Plan



PM Plan: ID Project Title

1. **Clients & Stakeholders**
2. **Target Audience**
3. **Project Goal & Scope**
4. **Project Timeline & Process**
   - Start Date:
   - End Date:

No.	ID Activities	Deliverables	Duration	Start Date	End Date	Status

5. **Resources & Constraints**
6. **Budget**
7. **Project Team Members**

Name	Roles	Responsibilities

8. **PM Strategies & Meeting Schedules**
   - Decision-making Process
   - Frequency of Meetings
   - Methods and Tools of Communication
   - Meeting Schedule

Date	Time	Location/Tool	Objectives & Attendees

9. **ID Process Evaluation Plan**

ID process evaluation is one of the key elements of the ID PM Plan. An instructional designer or project manager should develop a plan for process evaluation to ensure their adaptation of the Holistic 4D process is of high quality. A process evaluation plan may include such information as:

- How ID activities are evaluated
- Who conducts the evaluations
- When to conduct the evaluations
- What constraints impact the evaluation schedule

Designers should update the evaluation plan periodically to include new or revised information.

2. Design

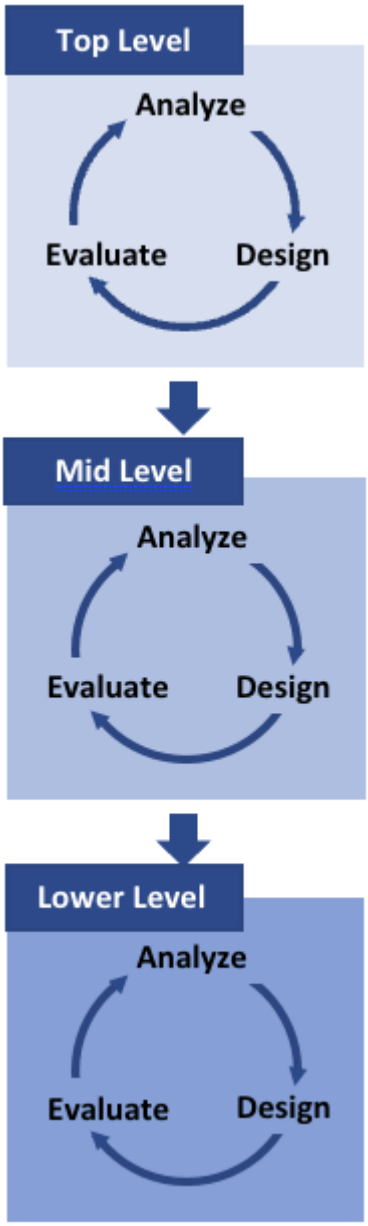
The second D in the 4D Model is for design. The whole ID process is a very complex cognitive task, so a designer cannot reduce it to just a procedure – a set of steps. It is a highly heuristic task which requires many complex understandings – the development of the designer's conceptual and causal models. We call these "considerations" for design activities. They include:

- Theories of learning and instruction
- The nature of task expertise and topic expertise
- What is important to analyze
- The concept of just-in-time analysis
- The role of subject-matter experts (SMEs)
- The nature and value of rapid prototyping
- The nature of a design documents
- The major approaches to instruction that one can use
- The importance and variety of motivational strategies, and
- Important considerations for media selection.

The Holistic 4D Model provides a combination of procedural guidance and heuristic guidance for designers to create a design document or blueprint for the learning experiences. This takes place within the three levels of design. Each level has its own ADE cycles, which the designer completes in sequence (see Figure 4). Design is done differently for task and topic expertise on the top and mid levels. However, for the lower level, the method for task and topic expertise is the same.

Figure 4

The analyze-design-evaluate cycles for the three levels of design



Top-level design.

A designer who is producing a design for top-level/task expertise uses this procedure:

1. Analyze each job (e.g., teach high school math) to identify its duties (e.g., form teams and initiate projects).
2. Analyze each duty to identify its tasks (e.g., choose members of each team).
3. Design a sequence of duties and tasks.

Designers do not analyze or design the tasks themselves at this level. However, designers do produce a fuzzy vision of the methods, which includes decisions about broad ideas such as:

- Mastery learning
- Learner-centered instruction
- Pacing
- Templates or course management systems, and
- Ideas about delivery methods and media selection.

Formative evaluation in each ADE cycle at this level is typically expert review and/or client review.

A designer who is producing a design for top-level/topic expertise uses this procedure:

1. Analyze each domain (e.g., learning theory) to identify its subjects (e.g., behaviorism).
2. Analyze each subject to identify its topics (e.g., reinforcement theory).
3. Design a sequence of subjects and topics.

As with tasks, designers do not analyze or design topics at this level. Fuzzy vision methods are generally the same as for task expertise, as are ADE expert review and/or client review.

Mid-level design

The mid level of design "aims to provide the next level of clarity about the vision for each task or topic, including not only a more detailed selection of content and its sequence, but also objectives, assessments, and instructional methods" (Reigeluth & An, 2021, p. 88). Through the mid-level ADE cycles, the designer revises and elaborates the top-level instructional methods and creates designs for learning-by-doing (for example, projects and applications) which make up the learner experience.

For task expertise, the designer:

1. Identifies and sequences versions of each task.
2. Identifies variations within each version and categorizes their difficulty.
3. Creates designer objectives (that is, objectives in a form most useful for designers) for each version.
4. Develops details of each project.

For topic expertise, the designer:

1. Identifies and sequences applications of each topic.
2. Identifies variations within each application.
3. Creates designer objectives for each application.
4. Develops details of each application.

Table 6.6 in Reigeluth & An (2021) provide an example of applications for a topic:

> *The topic "reinforcement theory" could be used to make predictions, give explanations, or solve problems related to human motivation and behavior, or animal behavior and training. It could be used to make decisions about either increasing or decreasing given behaviors. And it could be used in work settings, home settings, and other personal interactions. (p. 92)*

For both task and topic expertise, the model provides guidance for:

1. Formatively evaluating these mid-level design decisions in each ADE cycle.
2. Designing a learner objective (the most useful form for the learners) and learner assessment for each version or application.
3. Designing the ways learning-by-doing will be accomplished.
4. Selecting media in general.
5. Conducting additional formative evaluation of all these design decisions.

Given the design decisions made on this mid level, the designer may need to modify earlier selections of media. The designer should get a general sense of the media to be used. It is also helpful to revise and elaborate one's project management plan at this point, given the clearer view of the desired instructional system which has emerged.

Lower-level design

For the lower level of design, the mid-level design decisions give the designer a clearer vision within which to make the most detailed design decisions needed about what to teach and how to teach it for each project or application. First, the designer works out the details for each project (its procedural and/or heuristic content, which represents the "organizing content" for the task), or details for each application (its concepts and/or principles, which represent the organizing content for the topic). The designer sequences the organizing content according to the order of its use in performing the project or application so learners are able to learn just-in-time during the project. The designer then selects and sequences the "supporting content," which is added to the sequence of organizing content where most appropriate – typically just-in-time for learning the organizing content or otherwise facilitating learner performance of the project or application.

Next, the designer identifies the kind of learning, such as remember information, understand causal or conceptual relationships, and apply skills (Merrill et al., 1979; Myers & Reigeluth, 2017; Reigeluth & An, 2021), and identifies criteria for mastery for all organizing and supporting content. This is done to prepare for selecting instructional methods (such as examples and practice), which is based largely on the kind of learning. The designer can then identify resource requirements and their availability, which can include sourcing existing instruction to save time and money. The designer then collects instructional formats and methods, motivational supports, media selections, and lower-level assessments, which the designer has vetted and formatively evaluated in consideration of resource availability. This completes the most detailed design (or blueprint) for the instructional system. The designer can then develop the implementation plan and update the project management plan.

An additional Lower-Level design chapter provides guidance for designing instructional methods for each kind of learning: remember information, understand concepts and principles, apply skills, and act on values. Our book and its website provide modifiable templates for the designer's design documents on each level of design.

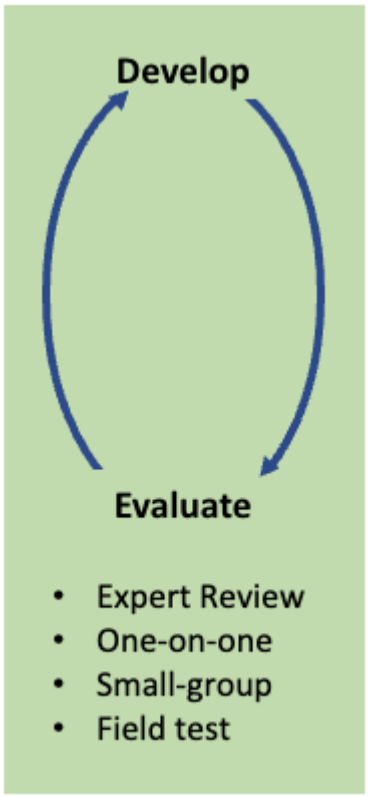
3. Develop

The third D in the 4D Model is Develop. When a designer has created a blueprint of their learning experience, the designer is ready to realize their design in the development phase. A designer can do some development during the mid-level or lower-level design process if that is convenient for the designer.

The cycles in the development phase just have two parts: develop and evaluate (see Figure 5). It is important to understand that the development process varies depending on many factors, including the type of instruction, the type of learning experience, and the available development professionals and resources.

Figure 5

Two functions for development of an instructional system



The type of learning experience greatly influences the work involved in the development phase. First, developing learner-centered instruction is different from developing teacher-centered instruction, the latter of which we don't address in the Holistic 4D Model. For typical teacher-centered instruction, a designer might develop lecture slides or videos, reading materials, and assessment materials. The Holistic 4D Model does not address this. For learner-centered instruction, on the other hand, a designer might develop project instructions, media for presenting problem scenarios, scaffolding resources, and a learner guide and instructor guide.

Second, developing online or blended instruction is different from developing face-to-face instruction. For online learning, one needs to think about such aspects as a learning

management system (LMS), online accessibility, navigation, online communication (e.g., synchronous vs. asynchronous), and online interactions. In contrast, face-to-face instruction involves developing teaching and learning resources in either teacher-centered or learner-centered classroom environments.

Third, developing self-instruction (e.g., where there is no instructor) is very different from developing instructor-led instruction. Developing self-instruction requires developing embedded scaffolds, learner guides, and self-reflection and self-evaluation tools.

Finally, developing innovative learning environments, such as digital game-based learning and virtual reality (VR) learning, often requires collaboration among diverse specialists.

The Holistic 4D Model provides guidance for developing a formative evaluation plan, which includes how frequently the designer performs formative evaluation during the development process. Designers typically determine this by how large an amount of the instruction one wants to design in each ADE cycle. Think of the ADE cycle as a washing machine: you can have a small load, a medium load, a large load, or anything in-between. And it's not just the instruction that the designer or other stakeholders evaluate. It also includes the tailored ID process that one uses based on the Holistic 4D model. The designer is constantly improving their ID process as well as the instruction they develop.

4. Deploy

The fourth D in the 4D Model is Deploy. It has four major functions:

1. Delivering or implementing the instructional system.
2. Instituting supports for the system.
3. Instituting management for the system.
4. Instituting continuous evaluation and improvement for the system (see Figure 5).

A designer or an instructor accomplishes each of these four functions in cycles: implement, revise, manage, and improve (formative evaluation). In many cases, some of the four functions may already be in place and working well. The designer or the owner of ID project itself may not be responsible for deployment, but the success of the system will depend greatly on the success of the deployment. We recommend that a designer at least offers specifications for each of these four functions, to increase the chances that the deployment will succeed.

Figure 6

Four functions for deployment of an instructional system

Delivery (often called implementation) may include hiring and training of instructors, installation or modification of facilities, procurement, equipment installation, arranging for remote access to technology, and providing adequate amounts of learning materials.

Support may include resupplying equipment, parts, and materials; maintaining equipment and facilities; reproducing instructional materials; constructing new instructional aids and facilities; providing academic and technology support to learners and staff; and providing funding.

Evaluation entails continuously finding ways to improve the instructional system, including the other three deployment functions (formative evaluation), and periodically assessing whether or not the system should continue to operate (summative evaluation).

Management might include planning and managing the other three deployment functions; firing, hiring, and managing personnel; maintaining learner records; scheduling and monitoring resources; marketing the instructional system; and much more.

In order to determine whether to continue, replace, or terminate the instructional system, summative evaluation is conducted. Summative evaluation aims to verify the effectiveness of instruction and has two parts: initial summative evaluation and continuing or confirmative evaluation. The evaluation methods are the same for both initial and continuing summative evaluation, but the timing differs. While initial summative evaluation takes place after implementation, continuing or confirmative summative evaluation takes place periodically throughout the remaining life of the instructional system. Reigeluth and An (2021) describes how a designer could conduct summative evaluation at the four levels of the Kirkpatrick model (Kirkpatrick Partners, 2018).

Conclusion

This article began by identifying an important opportunity – a design model that focuses on learner-centered instruction. To help instructional designers design better learner-centered instruction, the new Holistic 4D Model provides designers guidance for:

1. Integrating learner-centered theory with the ID process
2. Using a holistic design process with three levels of design
3. Using many cycles of analysis-design-evaluation (ADE) during the design process
4. Addressing both topic expertise and task expertise

5. Contextualizing the design process

The 4D model has four phases that align with learner-centered design: Define, Design, Develop, and Deploy. The Define phase is done in cycles of analyze, define, and evaluate (ADE), and includes performance analysis of various kinds and identification of instructional needs and non-instructional interventions. Once the instructional goals are identified, a designer plans the ID project and initiates it. To implement a holistic ID process, the Design phase offers guidance for top-level, mid-level, and lower-level ADE. We described how the development process varies depending on many factors: learner-centered instruction versus teacher-centered instruction, online versus blended versus face-to-face, instructor-free versus instructor-present, and different types of high-tech environments. Finally, the Deploy phase has four major functions: instituting the instructional system, instituting supports for the system, instituting management for the system, and instituting continuous evaluation and improvement for the system.

Given the emergent and complex nature of learner-centered instruction, the Holistic 4D Model provides designers a useful design process that navigates design risks that are inherent in learner-centered instruction. This approach will prove more useful to instructional designers than previous models. We also advise that this model is a work in progress, and that all ID models should evolve as more knowledge and experience are accumulated. We encourage all who use this model to inform us of any deficiencies and any ways they find to improve it, including adaptations for particular situations. We will make their ID cases and advice available on the model's website and in subsequent editions of the book.

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