The Journal of Applied Instructional Design

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About the Journal

During the past 50 years, journals in the field of instructional design have been responsive to the changing needs of both scholars and to a lesser degree, the practitioner. We have seen an evolution of AVCR to ECTJ, the emergence of JID, and finally the merging of ECTJ and JID to form ETR&D. ETR&D is a widely recognized, scholarly journal in our field that maintains rigorous standards for publications.

During the past 50 years, we have also witnessed a change in the field due in part to the success of instructional design in business and other nonschool environments. The number of instructional designers working outside the university has dramatically increased. Of particular importance is the rise in the number of instructional designers with doctorates who consider themselves practitioners, but not necessarily scholars. This growing group of designers might be best described as reflective practitioners who can make a significant contribution to the knowledge of our field.

This growth and success in the application of instructional design has also changed the field. From the early days of the field until the mid-1980's, the theory and practice of instructional design was almost exclusively influenced by the academic community. With the growth of instructional designers, the theory and practice of the field is now defined by both academics and practitioners. There is a need for greater communication between the scholars and the practitioners in a scholarly journal that will support innovation and growth of our knowledge base.

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Goals

The purpose of this journal is to bridge the gap between theory and practice by providing reflective practitioners a means for publishing articles related to the field. The journal establishes and maintains a scholarly standard with the appropriate rigor for articles based on design and development projects. Articles include evaluation reports (summative and formative), lessons learned, design and development approaches, as well as applied research. The articles are based on design and development projects as opposed to pure research projects and focus on lessons learned and how to improve the instructional design process. Rigor is established through articles grounded in research and theory.

A secondary goal of this journal is to encourage and nurture the development of the reflective practitioner in the field of instructional design. This journal encourages the practitioner as well as collaborations between academics and practitioners as a means of disseminating and developing new ideas in instructional design. The resulting articles inform both the study and practice of instructional design.

Philosophy

This journal will provide a peer-reviewed format for the publication of scholarly articles in the field of applied instructional design. The journal recognizes the role of the practitioner in the work environment and realizes that outside constraints may limit the data collection and analysis process in applied settings. The limitations of real-world instructional design of the practitioner can still provide valuable knowledge for the field.

Sponsoring Organization

JAID is a publication of the Association for Educational Communications and Technology (AECT).

JAID is an online open-access journal and is offered without cost to users.

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About AECT



The Association for Educational Communications and Technology (AECT) is a professional association of instructional designers, educators and professionals who provide leadership and advise policy makers in order to sustain a continuous effort to enrich teaching and learning. Seizing opportunities to raise awareness and leverage technology, our members may be found around the world in colleges and universities, in the Armed Forces and industry, in museums, libraries, and hospitals, and in the many places where educational change is underway. Our research and scholarly activity contribute to the knowledge base in the field of Learning. We are on the cutting edge of new developments and innovations in research and application.

AECT is the premier organization for those actively involved in the design of instruction and a systematic approach to learning. We provide an international forum for the exchange and dissemination of ideas for our members and for target audiences. We are the national and international voice for improvement of instruction and the most recognized association of information concerning a wide range of instructional and educational technology. We have 24 state and six International Affiliates all passionate about finding better ways to help people learn.

Since 1923, AECT has been the professional home for this field of interest and has continuously maintained a central position in the field, promoting high standards, in both scholarship and practice with nine Divisions and a Graduate Student Assembly that represent the breadth and depth of the field. Other journals sponsored by AECT include *Educational Technology Research and Development* and *TechTrends*.

The Journal of Applied Instructional Design (JAID) is a refereed online journal designed for the publication of scholarly articles in the field of applied Instructional Design. The purpose of JAID is to provide the reflective ID scholar-practitioners and researchers a means for publishing articles on the nature and practice of ID that will support the innovation and growth of our knowledge base. The journal is for practitioners, instructors, students, and researchers of instructional design.

Call for Submissions

JAID is for reflective scholar-practitioners, who through documentation of their practice in ID, make significant contributions to the knowledge of our field. Authors are invited to submit articles documenting new or revised approaches to ID; the processes of ID including in-depth documentation of analysis, design, and development, implementation and evaluation; design-based research; as well as applied research. Articles must be based on instructional design projects as opposed to pure research projects and focus on documented processes, lessons learned, and how to improve the overall process of ID. Articles must be grounded in research and theory connecting the intellectual foundations of the ID field and how these foundations shape its practice.

The journal will establish and maintain a scholarly standard with the appropriate rigor for articles based on design and development projects. A secondary goal of this journal is to encourage and nurture the development of the reflective practitioner in the field of ID. This journal encourages the practitioner as well as collaborations between academics and practitioners as a means of disseminating and developing new ideas in ID. The resulting articles should inform both the study and practice of ID.

Submit an Article

Article Types

JAID currently accepts submissions of three article types.

Instructional Design Practice

This is an applied journal serving a practicing community. Our focus is on what practitioners are doing in authentic contexts and their observed results. These articles cover topics of broad concern to instructional design practitioners. The articles should represent issues of practical importance to working designers.

Research Studies on Applied Instructional Design

JAID is interested in publishing empirical studies exploring the application of instructional design principles in applied settings. Quantitative and qualitative studies are welcome.

Instructional Design/Performance Design Position Papers

JAID also accepts position papers that attempt to bridge theory and practice. Examples may include conceptual frameworks and new ideas facing the instructional design community. The paper must also provide enough information to allow the replication of the innovation or continuation of the research in other settings. Position papers must be based in the context of a theoretical framework. Efficacy data is strongly preferred, but not always required, contingent upon the potential generalizability or value of the innovation.

Submission Guidelines

The journal will focus on in-depth applications of the ID process and publish a variety of articles including case studies of the ID process; application articles that go beyond a mere how-to approach that provide implementation insights, guidance and evaluation of a process; evaluation articles that focus on the viability of a product or process; applied research resulting from evaluation of materials, studies of project implementation, articles on ways to improve the ID process from the perspective of the practitioner, and short essays that provide a scholarly debate of relevant issues related to the application of ID and relevant book reviews. When applicable, articles should include supplementary materials including examples of ID products, evaluation instruments, media files, and design artifacts.

The articles in the journal will be from the perspective of the scholar-practitioner rather than from the researcher. However, the manuscripts must demonstrate scholarly rigor appropriate to applied manuscripts.

Articles, including tables or figures, must follow APA 7th edition formatting and be submitted in a word or doc format using at least 12-point New Times Roman font. Each article must have an abstract (75-100 words) and a list of keywords. While there is some flexibility in the length of an article, 4,000 to 5,000 words is a best-guess estimate. If in doubt, contact the editor prior to submitting the article. Identifying information must only be located on the cover page including contact information for the first author.

You may contact the editors via email, if you have further questions.

Contact the Editor





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Introducing Undergraduates to Instructional Design in a Graduate Studio: An Experiential, Model-Centered Approach

Rebecca Stull Zundel, William Sowards, Scott L. Howell, & Jason K. McDonald

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Instructional Design | Coaching | Design Thinking | Instructional Design Models | Experiential Learning

THE JOURNAL OF APPLIED INSTRUCTIONAL DESIGN

This case study describes a combined graduate and undergraduate instructional design studio that introduced undergraduate students to instructional design in a multifaceted, holistic, and applied way. Reviewing the experience of the undergraduates in the course, this design case describes four learning interventions used to create this applied experience: (1) instructional design team projects—one non-profit and the other in higher education, (2) weekly seminars and biweekly training sessions from field experts, (3) an experiential out-of-state trip, and (4) weekly reflection journals. These studio-based learning interventions are presented within the context of the Experiential Learning Theory and Model-Centered Instruction. Overall, the course introduced the undergraduate students to the field of instructional design in an applied and experiential format.

Introduction

This case study describes a learning experience at Brigham Young University (BYU) offered in a course, "Interdisciplinary Product Design for Education," and describes how undergraduate students were introduced to instructional design using a multifaceted, holistic, and applied approach. This course provided undergraduate students with an opportunity to work closely with graduate students in the Instructional Psychology and Technology (IP&T) program as part of an advanced instructional design studio described in an earlier issue of this journal (McDonald et al., 2022). During fall semester, the graduate students in the advanced course selected two clientele from six interested parties, conducted user analyses and background research, and formed plans to prototype real-life instructional design projects. In the following spring semester, the undergraduates joined the graduates to complete the designated projects. These authentic design team projects acted as one of four learning interventions used in the course. The other interventions included training sessions and seminars from experts in the field of instructional design, an experiential grant trip to San Francisco, and reflection journals completed throughout the semester.

While the goal of the course was to introduce undergraduates to instructional design, students enrolled in the course for a variety of reasons and personal goals. Some students hoped to expand their connections, resume, and knowledge while experiencing the actual work of instructional designers. Others wanted to learn instructional principles to apply to their professional pursuits in entrepreneurship or engineering. Some students used the course as a starting point in pursuing graduate school in instructional design. Finally, the course acted as a capstone for the undergraduate students who were completing the Design Thinking minor at BYU.

Three professors facilitated the four learning interventions for these students: One professor oversaw the graduate students in the course, while another focused on the undergraduate students and experience. The third instructor prepared and led the experiential grant trip to San Francisco. With the guidance of these three professors, this course provided a holistic, multifaceted, and applied learning experience for the undergraduate students. This design case describes the four interventions of the course within the framework of two learning models. It also reviews the undergraduates' experience with each intervention.

Pedagogical Approaches

The learning interventions used in this instructional design course were contextualized by aspects of two pedagogical frameworks: Experiential Learning Theory (ELT) and Model-Centered Instruction (MCI). The ELT was introduced in 1984 by David Kolb and is widely used by scholars and educators today (Morris, 2020). Kolb (1984) defined experiential learning as a four-part cycle, which consists of (1) concrete experience, (2) reflective observation, (3) abstract conceptualization, and (4) active experimentation (see Figure 1).

In this case study, concrete experience refers to learners' active participation in situated, novel, and real-world experiences (Morris, 2020). Reflective observation is the opportunity for learners to critically review the experience and find or create meaning from it (Burns & Danyluk, 2017; Davitadze et al., 2022; Schön, 1987). Abstract conceptualization refers to the learners' attempts at drawing conclusions from the experience; they form new or modified ideas about the information at hand (Burns & Danyluk, 2017; Davitadze et al., 2022; Kolb, 1984). Finally, active experimentation is the learners' chance to apply their new understanding to further experiences (Burns & Danyluk, 2017; Kolb, 1984). Aspects of Kolb's four-part ELT cycle were observed in each of the four interventions.

Figure 1

The four stages of the Experiential Learning Cycle as described by Kolb (1984)

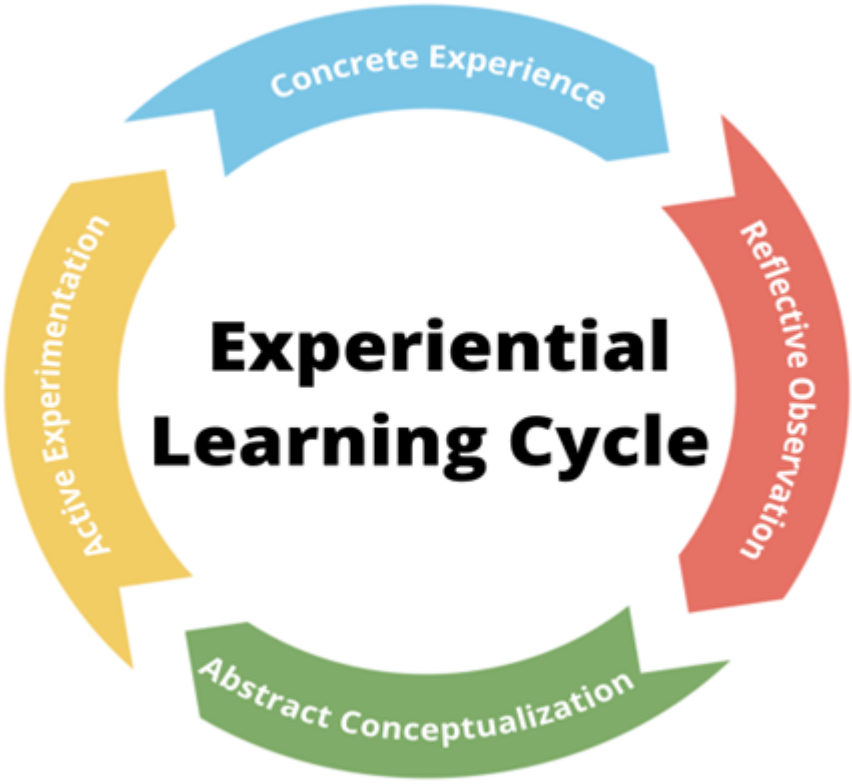


Figure 1. Experiential Learning Cycle: concrete experience, reflective observation, abstract conceptualization, active experimentation

MCI was developed by Andrew Gibbons (Gibbons, 2008) in 2001 as a way of carrying out dynamic model content. Dynamic simply refers to the constantly changing nature of the content that then necessitates adaptation (Gibbons, 2008). The purpose of MCI is to take these complex and dynamic situations and simplify them into consumable interactions that allow the learner to investigate, experiment, and practice skills (McDonald, 2018). Gibbons defined the process of MCI through seven principles (Gibbons, 2001). The seven principles of MCI are (1) experience with models, (2) problem solving, (3) denaturing, (4) sequence, (5) goal orientation, (6) resourcing, and (7) instructional augmentation (see Figure 2).

In this case study, experience with models refers to the modeling of a real-world design studio with clients, products, and feedback from instructors and graduate students (McDonald, 2018). Problem solving refers to being presented with a problem or observing a problem that requires solving. Denaturing is the modification of a model or scenario to facilitate learning. Sequence refers to the ordering of problems by task, size, or another hierarchy to facilitate learning (McDonald, 2018). Goal orientation is achieved by selecting problems that support specific learning goals or outcomes. Resourcing is providing the appropriate resources to support the achievement of the goals for instruction (McDonald, 2018). Instructional augmentation is the implementation of additional learning activities and materials that help the learner through the learning process. These are sometimes referred to as learning companions (McDonald, 2018). Portions of each of these seven principles are used throughout the interventions.

Figure 2

The seven principles of Model-Centered Instruction as described by Gibbons (2001, 2008)

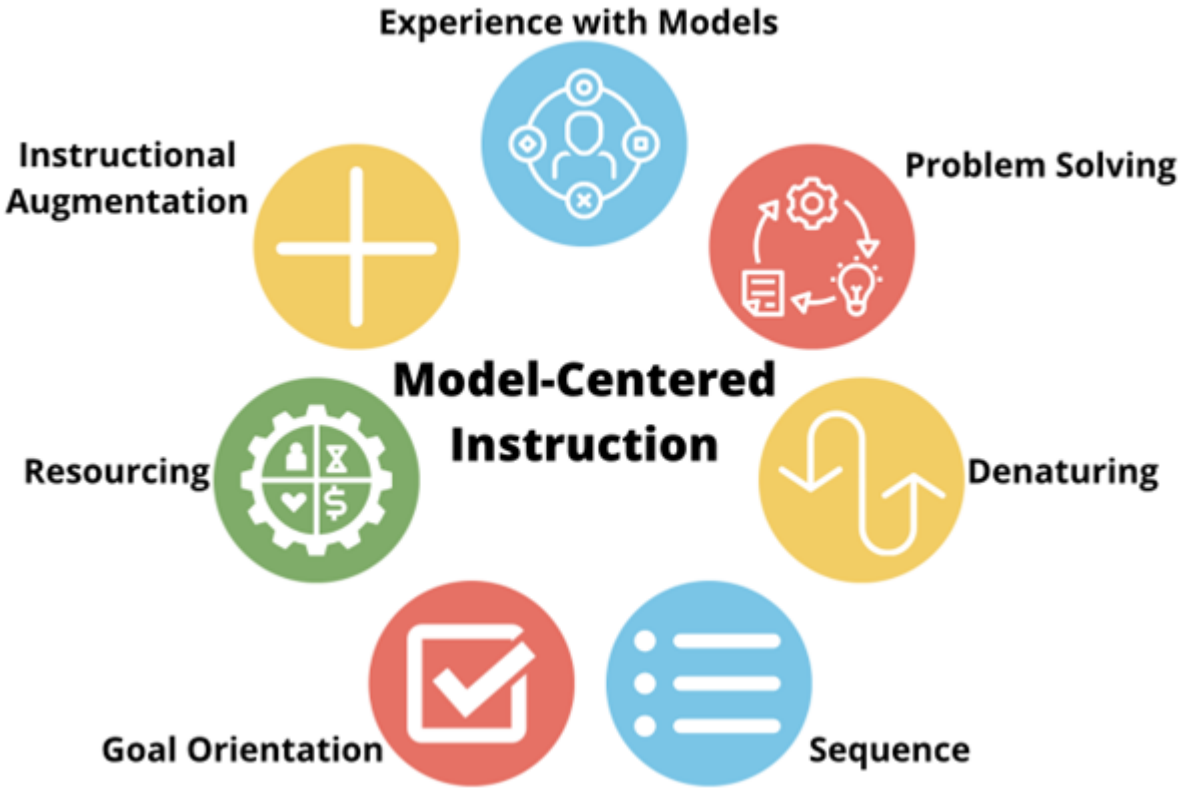


Figure 2. Model-Centered Instruction: models, problem solving, denaturing, sequence, goals, resourcing, augmentation

Interventions

The course, Interdisciplinary Product Design for Education, included four main instructional interventions, contextualized with the ELT cycle and MCI approach. These interventions include (1) the two design teams, (2) training sessions and seminars from field experts, (3) an experiential grant trip to San Francisco, and (4) the students' reflection journals. This section will detail how the four interventions fit in the ELT and MCI approaches, describe what the students did, and highlight learning outcomes for the students.

Design Teams

The No More a Stranger (NOMAS) design team and the Business design team were the primary setting for the students' learning experience (see Figure 3). In terms of the ELT cycle, the design teams acted as both concrete experiences and active experimentation. Students were actively engaged in a novel, real-world experience, and the design teams acted as an opportunity for the students to apply instructional design concepts. Similarly, the principles of problem solving, denaturing, sequencing, goal orientation, and experience with models from MCI were implemented. The teams set goals and deadlines while prioritizing tasks and deliverables. The teams also modeled real design teams working under the direction of project managers with constant communication between the clients and the teams. Denaturing was achieved through the unrealistic, semester-long length of each project (both projects would have been accomplished much faster in a real-world setting), giving students opportunities to experiment and learn new skills.

Figure 3

The two design teams, NOMAS (left) and Business Team (right), meet to work on their projects



Figure 3. Pictures of the NOMAS and Business Team, both at tables working on laptops

No More a Stranger (NOMAS)

The first team designed and prototyped a micro-learning instructional product for a non-profit foundation called No More A Stranger (NOMAS). NOMAS is an organization that assists individuals seeking entry into the United States and provides guidance through the various methods of entry that individuals can pursue. NOMAS' mission is to "advocate on behalf of and together with individuals from immigrant, migrant, and refugee backgrounds to strengthen our communities" (NOMAS, n.d.). NOMAS fulfills this mission through the work of volunteers and a team of legal representatives.

NOMAS's Challenge: ELT Concrete Experience. In realizing this mission, NOMAS faces the challenge of training new volunteers in immigration legal practices, so, in turn, they may train those interested in their services. In the past, NOMAS held an eight-week training course (both in-person and using video conferencing software) in which a member of the full-time staff trained new volunteers on skills and knowledge. With increased demands on the full-time staff, it became difficult to balance teaching with other responsibilities. Members of the NOMAS staff approached BYU's IP&T department seeking help in designing asynchronous instructional materials to facilitate the training of new volunteers while also alleviating pressure from full-time staff.

Addressing the Challenge: MCI Problem Solving, Sequencing, and Resourcing. The first design team addressed the NOMAS challenge by developing an asynchronous eight-week course. Prior to the inclusion of the undergraduate students, graduate students developed learning and performance outcomes for each lesson built on an analysis of the previous course content and in collaboration with NOMAS staff. All pre-development analysis and development work was created by the graduate students and stored in a Google Drive folder. Workflow was managed using the workflow software application Trello (Trello, n.d.) and a Gantt chart created using Trello (see Figure 4).

Figure 4

NOMAS Gantt chart for organizing lessons and workflow

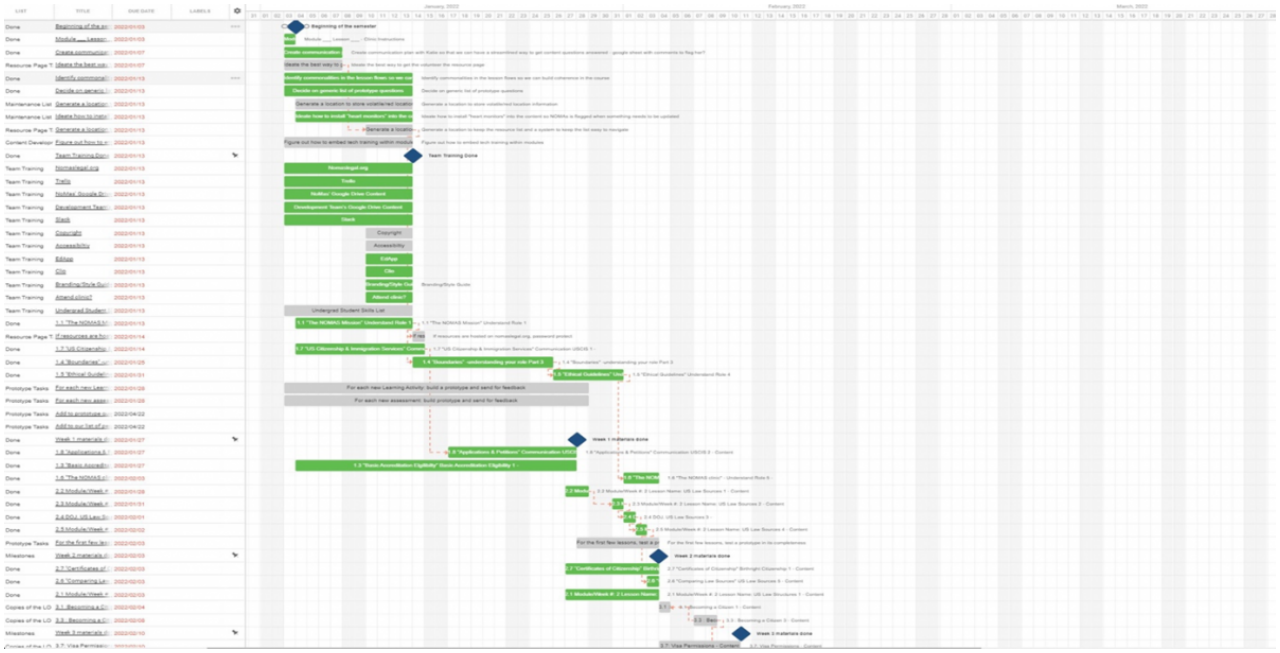


Figure 4. A Gantt chart with the organization and workflow of the NOMAS group

Through Trello, all team members (undergraduates included) were able to monitor the development of lessons and select which lessons to develop themselves (see Figure 5). Initially, undergraduates were assigned lessons based on the simplicity of the lesson's content because they did not have the background knowledge of the graduate students. All development work utilized rapid prototyping (Dong, 2021) and peer review—two team members reviewed every lesson to ensure the quality of each lesson. A content development checklist was used to standardize the approach each team member had when developing their assigned lessons. After various learning management software (LMS) was researched, EdApp (EdApp, n.d.) was selected as the ideal learning platform to deliver the instructional material.

Figure 5

NOMAS Trello sheet for organizing and assigning work between different team members

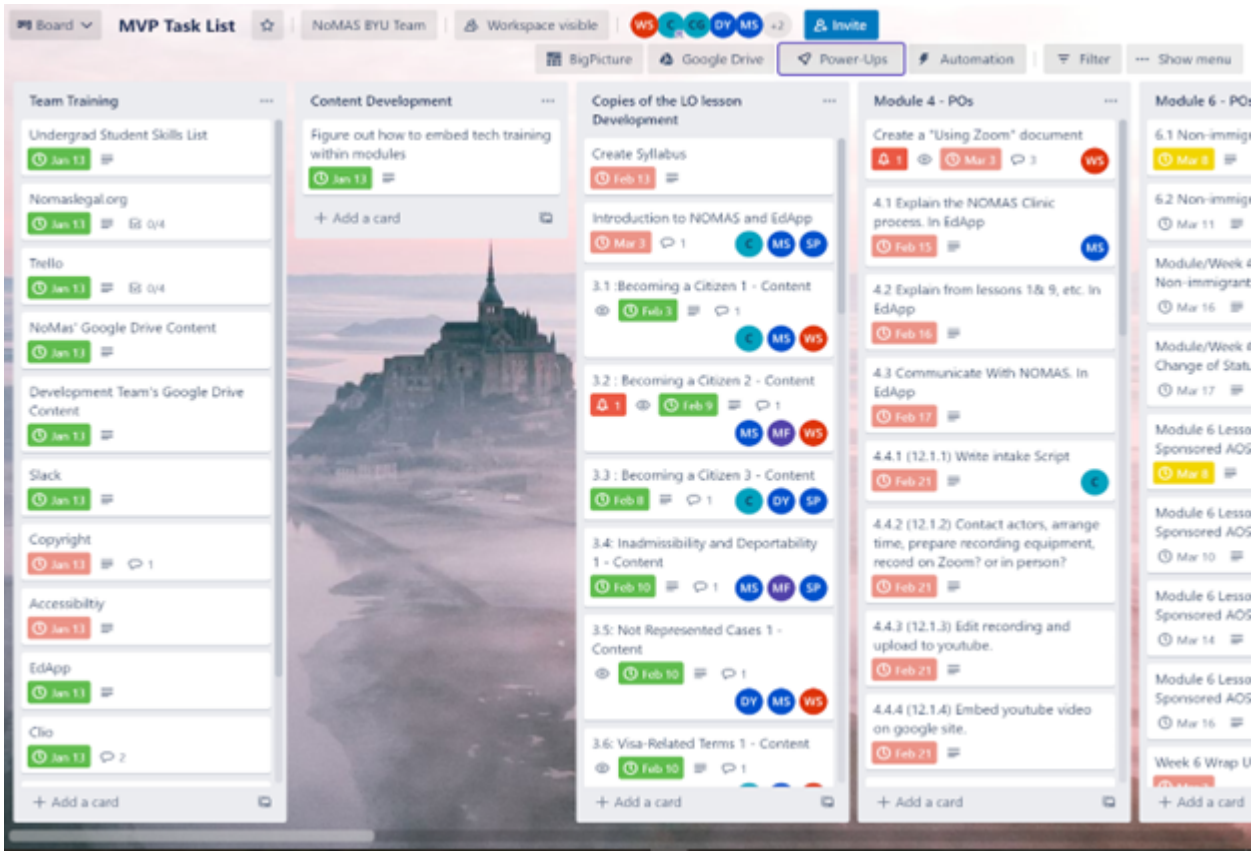


Figure 5. A Trello sheet with tasks assigned to different NOMAS group members

Undergraduate Participation: ELT Active Experimentation. As the semester progressed, the undergraduate students engaged in more skill-specific tasks. One student's background in film, as well as her access to filming equipment and locations, enabled her to work with a graduate student to film mock interviews and clinic sessions. This student was the primary editor for the final versions of the videos used in three weeks' worth of lessons. Another undergraduate with considerable experience in video conferencing developed a training sheet for volunteers using Zoom, a video conferencing software (Zoom, n.d.). This sheet used videos to teach NOMAS volunteers how to navigate Zoom in a professional setting. This was necessary as the personas developed by the aforementioned design team represented some who struggle using technology. This sheet also met accessibility standards and was included in the resources portion of the final online class. These undergraduates worked as equal partners with the graduate students and each developed multiple lessons for the eight-week course. The graduate students mentored the undergraduates to provide guidance and support while still allowing them to work independently.

Business Course

The second team formed an instructional product for BYU's Marriott School of Business (MSB). The MSB sponsors a nationally ranked education to thousands of students each year (BYU Marriott School of Business, n.d.) and offers a variety of undergraduate and graduate business-related degrees in fields like accounting, information systems, human resources, and more. The MSB also offers a minor in business.

The Business School's Challenge: ELT Concrete Experience. However, the MSB lacks an integrative, introductory business course that could address two issues faced by some students at BYU. First, certain non-business major students are interested in learning business principles and skills to apply to their professional interests and widen their career options. Second, some business students begin their education in a business discipline major with little to no background experience in the field. These students may feel stuck and regret their decision. In both cases, an integrative, introductory survey course would expose these students to the disciplines of business and help them

develop business skills to use in their professional lives. The MSB approached BYU's IP&T program hoping for assistance in completing the design and construction of this introductory, survey course for non-majors.

Addressing the Challenge: MCI Problem Solving, Goal Orienting, and Resourcing. Addressing the needs of their clientele, the second design team created a semester-long, asynchronous course that will introduce business minor or non-business major students to the principles and skills of business. The course is presented using the Canvas LMS (Canvas, n.d.) and follows the basis of three learning outcomes identified by the clients' requests and a learner analysis conducted by the graduate students in the previous semester. The learning outcomes are to (1) understand key business principles in a variety of settings, (2) apply business skills to improve real organizations, products, or services, and (3) demonstrate integrative thinking of business topics to address real problem-solving experiences. Throughout the semester, this design team worked with subject-matter experts (SME) from the MSB to form content, assignments, and projects that would assist the students in meeting these learning outcomes. This process was guided by a project manager—one of the graduate students—and the assistance of Trello boards, a Gantt chart, and two team meetings each week during the semester.

Undergraduate Participation: ELT Active Experimentation. The undergraduate students on this team participated in the design process in two main ways. First, each team member designed content and created assignments for their discipline with the help of a subject-matter expert (SME), who was typically a faculty member in the MSB. As an example, one undergraduate formed the content for human resource management and organizational behavior (HR/OB). To do so, this student worked closely with an HR/OB professor, as SME, to create content and assignments that would meet the needs of the clientele and help future students meet the course learning outcomes (see Figure 6). The second way in which the undergraduates participated in the design process was by addressing different needs of the course as a whole. For example, the undergraduate students on this team worked together to create a Canvas structure that would accommodate the unique needs of the different business topics while maintaining uniformity and integration throughout the course. Overall, the undergraduates in this group were given opportunities to experience instructional design in a real-world setting.

Figure 6

One part of the business team's final product on as viewed on mobile

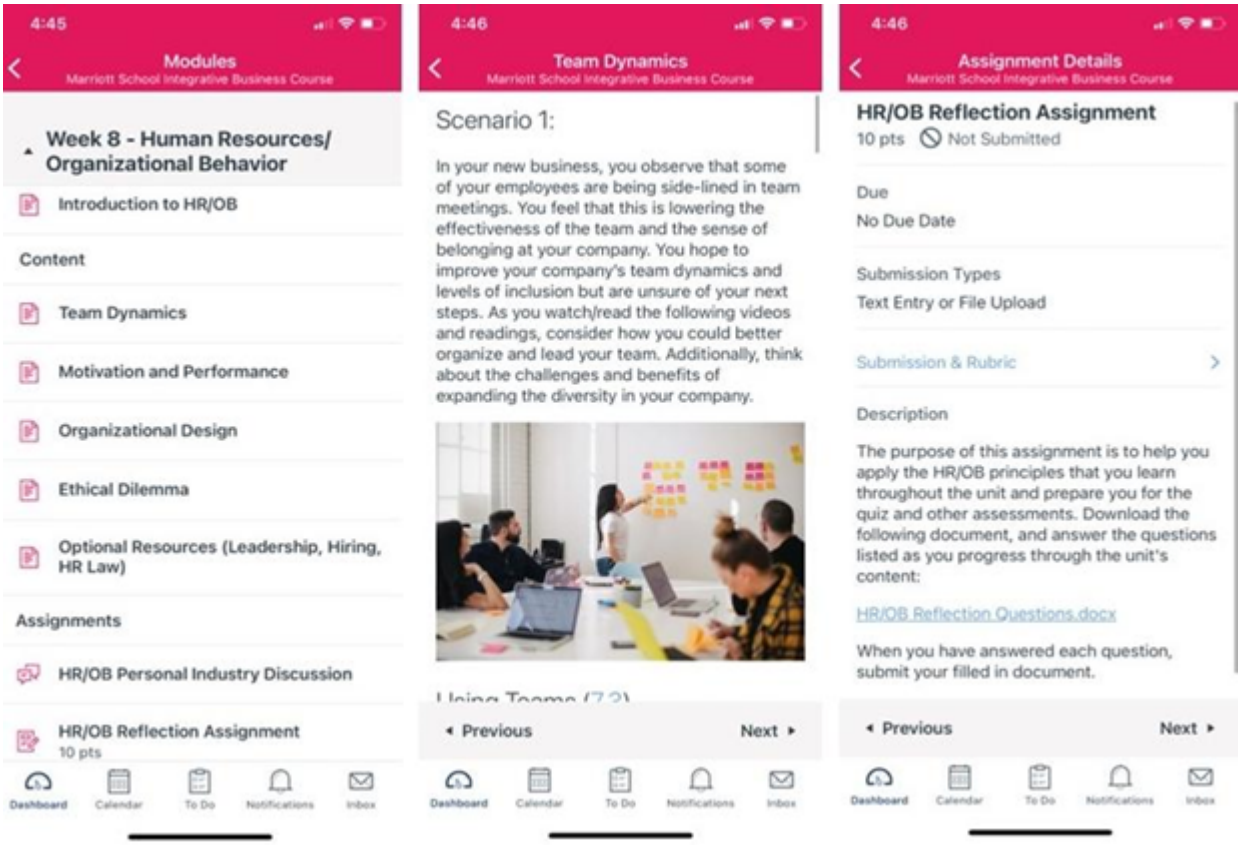


Figure 6. Mobile screenshots of a Canvas module and pages

Outcomes

As the undergraduate students participated in these instructional design projects, at least five outcomes were realized as reported in the undergraduate students' reflection journals and researchers' observation notes. First, the students experienced the kind of work that many instructional designers do in non-profit, corporate, and university settings. It helped them to see the outcomes and challenges of working in teams and with clients and SMEs. Second, designing courseware helped the undergraduates apply a variety of learning and instructional theories beyond learning these concepts abstractly. Third, the students created an actual instructional product that can be added to their design portfolios and resumes. Fourth, building the course encouraged the students to use design-thinking processes. In doing so, they came to better understand the need for continual empathy, rapid prototyping, testing for feedback, and other parts of the instructional design process (Doorley et al., 2018). Finally, working in this concrete experience introduced the students to learning management systems as well as a variety of project management techniques and tools they will use later in their careers.

The undergraduates' learning experience was positive overall, but they felt that it took some time for the graduate students to fully embrace and integrate the undergraduate students into their teams. In retrospect, this should have been better anticipated—the graduate students had already spent the previous semester working together on their respective design projects. While one group successfully integrated the undergraduate students into the team's workflow, the other group struggled to find a place for the undergraduate students, especially early on in the project. This left these undergraduates with little work and limited learning opportunities until later in the semester. In future iterations of the course, the undergraduates could be offered the opportunity to join the graduate students for their capstone experience the first semester, rather than the second, or change the capstone experience for the undergraduate students to a two-semester class, as it is for the graduate students. Conversely, faculty could help the graduate students better prepare to welcome and integrate the undergraduate students into their teams and add a measure of accountability to the expectation.

Seminars and Training Sessions

A second intervention used in the course included biweekly training sessions and weekly seminars from experts in the field. These opportunities acted as a second concrete experience in the ELT cycle; the undergraduate students were invited to participate in discussion and lecture-based experiences covering a variety of topics. This then led to reflection, contextualization, and experimentation of those topics in their design team projects. These trainings served to support instructional augmentation when analyzed using MCI principles as additional instruction was given to the students outside of the project workspace. These skills, while pertinent to instructional design, were not always directly related to the work that they were engaged in within their respective design teams but served to expose students to a broader understanding of instructional design.

The weekly seminars are part of a half-credit hour class offered by the IP&T department for faculty and graduate students, which the four undergraduate students were encouraged to attend each week. A sample of some of the presentations given by other professors and experts included the following: “Chigen-iku: A universal performance improvement method,” “Learning Engineering . . . ,” “Conversational Instruction and Message Layer Design,” “Learning Experience Design: Why Content Alone Isn't Enough,” and “Improving STEM Teaching and Learning.”

For the four undergraduate students enrolled, the professors also provided 30-minute, biweekly training sessions offered by experts in the field on topics relevant to their instructional design work for the design team projects (see Figure 7). The titles of training sessions included “User Interface Design,” “Methods of Design,” “Microlearning,” “Blended Learning,” “Graphic Design for Learning,” and “Adaptive Comparative Judgment.”

Figure 7

Undergraduate students participating in one of the bi-weekly trainings offered by a field expert

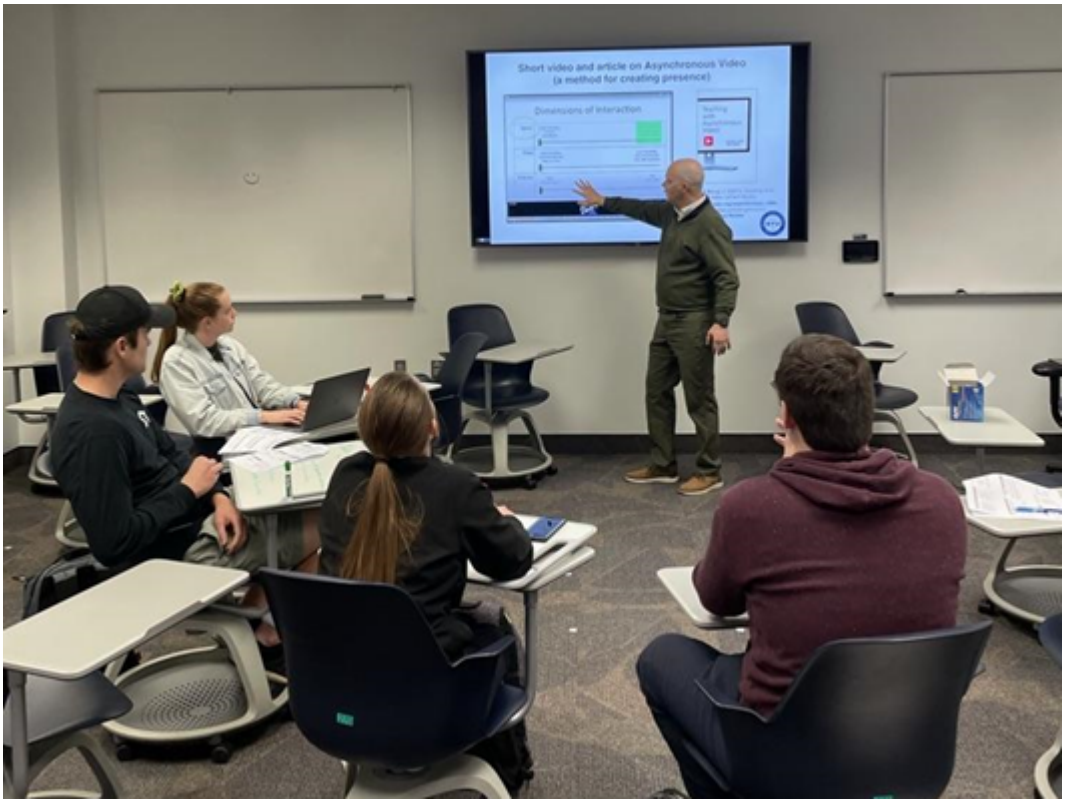


Figure 7. Guest instructor presenting to four students

Based on the undergraduate students’ reflection journals and researchers’ observation notes, the weekly seminars and biweekly training sessions led to three main outcomes for the undergraduate students in the course. First, the students

were able to interact with faculty and students currently in the IP&T graduate program. As some of the undergraduates are interested in the program, this helped form relationships and connections to assist their educational futures. A second outcome from training sessions and seminars was students were able to gain further knowledge about the processes, theories, and research surrounding instructional design. This helped students better apply instructional design topics to their own design projects. Finally, the training sessions and seminars acted as an opportunity to network with and learn from professional experts in the field of instructional design. These connections will help the students in their professional pursuits and give the students insights into the many ways that an IP&T education can be employed.

However, one challenge came with the timing of the biweekly training sessions. Each training was given during class time, which is when the design teams worked on their projects. Only the undergraduate students attended these training sessions, so the graduate students on the design teams would oftentimes continue their planning and work while the undergraduates attended the training. This sometimes left the undergraduates behind on the decisions and progress made on the team projects. This challenge might be easily resolved by including the graduate students in the training; they, too, would benefit from these training sessions, if for no other reason than to further network with other professionals in the field.

Experiential Grant Trip

The third intervention for student learning was an experiential grant trip to California. Thanks to generous donors, some students—including the four undergraduate students—were given the opportunity to participate in a field trip to San Francisco, California, where they observed design processes in action in the unique instructional design elements of Alcatraz Island (Boling, 2014) and the Exploratorium (King et al., 2018). They also participated in instructor-led, reflective discussions about their experiences. In this way, the field trip facilitated reflective observation and abstract conceptualization in Kolb's (1984) ELT cycle. Within MCI, field trips act as a way for students to experience models outside of those in the studio. Students can also see various instructional models in action and consider ways of implementing them within their own designs. This was an example of instructional augmentation as students participated in an activity outside of the original scope of their project that provided them with additional learning opportunities.

Alcatraz Tour

Alcatraz has been transformed from the United States' first high-security prison to an innovative museum experience that takes patrons through the lives of many of the prisoners that stayed behind its walls (Boling, 2014). Students were given an afternoon to explore and interact not only with the cellhouse tour, but with the many other exhibits and locations found on the island (see Figure 8). Students were then brought back together, in larger group settings, and discussed what they learned from Alcatraz; specifically, how what they learned could relate to the projects they were currently engaged in. Students found that the Alcatraz experience, while initially not having much to do with their projects (NOMAS and the business course), had more in common with them than they thought. The Alcatraz designers had the same basic goal as the two groups: to help learners relate to the information presented and understand how it could apply to them. Some pointed out that this gave them new ideas and expanded their view of what learning could look like in different settings.

Figure 8

Members of the design teams (both undergraduate and graduate) and faculty at Alcatraz Island



Figure 8. Members of the design teams (both undergraduate and graduate) and faculty at Alcatraz Island

The Exploratorium

The Exploratorium is an innovative collection of interactive science exhibits ranging from physics to life sciences to psychology (King et al., 2018). The students were given the morning to explore and interact with the exhibits in small groups of two to four (see Figure 9). Within their small groups, and later with the instructors, the students were encouraged to discuss how different design experiences in the Exploratorium could relate to their design team projects (NOMAS or the business course), work problems, or projects for other classes. For example, some students discussed how they could prototype more interactive content into their design projects. Others mentioned how they wanted to add more authenticity to their project. In short, the students' time at the Exploratorium allowed them to observe how the design process resulted in real-life products and experiences like what they were doing to create instructional products and experiences for their clients in their design studio.

Figure 9

Design team students interact with an educational exhibit in the Exploratorium



Figure 9. Students interacting with a musical exhibit at the Exploratorium

Outcomes

Research shows that field trips are uncommon in higher education, yet when they take place, they assist student learning in a variety of ways. These include a greater sense of connection between their peers and instructors, increased intrinsic motivation, and more opportunities for non-traditional learning (Fedesco et al., 2020). Students from the 2018, 2019, and 2022 experiential trips reported similar results along with a few other outcomes in a qualitative survey that they completed shortly after their trips. For example, some of the students who observed design processes firsthand mentioned how valuable it was to see their studies contextualized and applied in a real-world setting. It also helped inform the direction and plans of others concerning their future schooling, research, and career. While not surprising, one challenge was that the experiential grant trip exacted extensive planning and preparation. One of the professors did all the work—from application to arranging venues, transportation, and housing, and then leading the two-day trip. To address this challenge, future professors might employ students (even students in the course) to help with planning and logistics. This would be another concrete experience for the students.

Reflection Journals

The final intervention of the instructional design course included reflective journal entries that the four undergraduates completed each week. Journaling acted as another opportunity for reflective observation as part of the ELT cycle. Each student was encouraged to reflect on their experiences thoughtfully and critically throughout the week and construct meaning from their own experiences as part of (or participants in) the graduate-led design teams, expert training, and the experiential trip to San Francisco. While the MCI model lacks a specific principle of reflection and feedback, the case can be made that the principles of instructional augmentation and goal orientation include reflection and feedback.

In this course, the students were asked to write and submit a half- to one-page reflection each week. These reflection entries were to include a thoughtful reflection of the students' experiences and lessons learned in their team project and

related learning activities. For example, parts of one student's final reflection entry are shared below:

> *It's not often that you end a course feeling truly accomplished and proud . . . I felt like every class period was productive and useful and I learned like I would on a job. I think skills are best taught when students are trusted to figure things out while also providing them with support systems. By the end of this course, I was able to do as much as the graduate students in developing and creating content . . . We worked so well because we worked as a team rather than as a class. I think that classes work to achieve the low-hanging fruit or the bare minimum. A team has a clear understanding of what they want to do and sets standards to ensure that the final product is quality and even goes beyond what was asked . . . I feel like this class was the best way to recognize what skills I had and what skills I wanted to develop.*

This student was able to use reflective journaling to assess their progress in the course, evaluate progress, and construct meaning from their learning experience.

Such use of reflective journaling as an academic exercise to promote deeper learning and lifelong learning is an accepted teaching practice and assessment activity (Allan & Driscoll, 2014). An important outcome for the teacher is that the journaling activity provides insight on how the student is doing, how the class is going, and what things the teacher can do to improve the learning experience—if not with the current class, then in a future class. An important outcome for students who are encouraged to journal as part of the learning (and design) experience is that it helps them learn by improving their metacognitive skills and deepening their critical thinking as they write and reflect (Sternberg, 1998). Along with these outcomes, the undergraduates felt reflective journaling helped them assess their progress, fill or connect gaps in their knowledge, and set personal learning goals.

Conclusion

This design case described a graduate instructional design studio that was used to introduce undergraduate students to instructional design with a multifaceted, holistic, and applied approach. First, the course was analyzed through the lens of two pedagogical frameworks. The first was Kolb's ELT, which includes concrete experience, reflective observation, abstract conceptualization, and active experimentation (Burns & Danyluk, 2017; Cherrez & Nadolny, 2017; Davitadze et al., 2022; Kolb, 1984; Morris, 2020). The second was Gibbon's (2001, 2008) seven principles of the MCI, such as experience with models, problem solving, denaturing, sequence, goal orientation, resourcing, and instructional augmentation (McDonald, 2018).

Within the context of these theories, this article described four learning interventions used in the course to create a holistic experience: (1) authentic instructional design team projects for clients, (2) training from field experts, (3) an experiential out-of-state trip, and (4) reflection journals. These interventions, along with the opportunity for undergraduates to work with graduates, allowed this course to fulfill the expected outcome of introducing undergraduate students to instructional design in a multifaceted, holistic, and applied way.

Each of these interventions also led to their own specific outcomes. The design teams, for instance, introduced the students to the work of instructional designers, helped them apply learning theories to their own designs, and allowed them to create an authentic product for clients. The training sessions and seminars gave the students opportunities to network with and learn from experts in the field on a variety of topics. The experiential grant trip to San Francisco helped the students form relationships with their classmates and professors, find inspiration for their professional futures, and contextualize design theories. Finally, the reflective journaling helped the undergraduates assess their progress, construct meaning, and improve their writing and critical thinking skills.

Working with graduate students provided a rich learning experience for each of the undergraduate students, as well as two other opportunities—namely, the opportunity for graduate students to mentor undergraduate students and the opportunity for faculty to take feedback to improve future offerings of the course. This class, capstone experience, and learning studio experience not only introduced the undergraduate students to instructional design principles and practices, but also linked them to fellow students (undergraduate and graduate) and faculty, with whom they spent a

semester working on real-world instructional products. The student experiences described give motive to provide future students with similar applied and experiential learning opportunities that draw from multiple learning frameworks.

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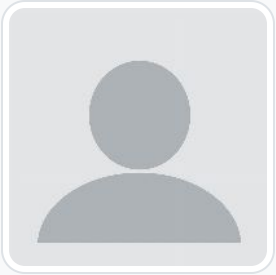
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Flexibility Within Structure: Factors contributing to Faculty Perceptions of Autonomy and Standardization in Course Design and Delivery

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Curriculum Design | Autonomy | Quality Control | Standardization

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At times, universities' structures for quality assurance can impede professors' sense of autonomy. This descriptive qualitative study examines factors that contribute to stakeholders' perceptions regarding standardization and autonomy in the realm of course design and delivery. The central understanding of this study is that stakeholders are keen to adopt standardization when they perceive those structures to be advantageous for faculty, students, and degree programs. Yet stakeholders imagine the borders of these structures to be flexible, thus creating a space for autonomy. As administrators explain quality assurance structures to professors, they should leverage the perceived advantages and demonstrate to faculty how they will retain the required flexibility.

Introduction

Accrediting bodies expect universities to guarantee faculty high levels of autonomy regarding course design and delivery, but accreditors also expect a certain degree of standardization to ensure quality (DeCesare, 2021). There is wide variation in the ways that universities balance autonomy and standardization. Some institutions are more "faculty-centered" (Abbot et al., 2018) and others engage in more "centralized design" (Felber, 2020). One main factor that seems to impact an institution's approach toward autonomy and centralized design is faculty and administrators' conceptualizations of "quality" and "quality assurance." For example, Goff (2017) discovered stakeholders who think of quality in terms of prestige tend to support institutional approaches that are very hands-off, while those who conceptualize quality as return on investment, or alignment with objectives, tend to support centralized design. Stakeholders seem to hold complex attitudes about centralized design, at times championing course templates (Burgess et al., 2008), standardization of rubrics (Reddi & Andrade, 2010), and assessment structures (Cardoso et al.,

2013). At other times, they refer to standardization as time-consuming or restrictive (Harvey & Newton, 2007; Newton, 2000).

Much research has examined quality control measures in course design and delivery (Gregory et al, 2020) — especially in the online environment (Conklin et al., 2020; Lynch & Gaston, 2020). However, little empirical research has been done to understand factors contributing to stakeholders' perceptions of autonomy and standardization of course design and delivery. This descriptive qualitative study closes this knowledge gap by providing data from stakeholders who are involved in the course design process at multiple universities, with various roles at their institutions.

Studies on Stakeholders' Attitudes Toward Quality Assurance

Many universities implement some level of centralized design to assure that the curriculum is achieving its desired outcomes. Therefore, the standardization of course design and delivery falls under the wider issue of Quality Assurance (QA). While QA is notoriously difficult to define (Welzant et al., 2015), Vroeijenstijn's (1995) definition will suffice here: QA is the "systematic, structured and continuous attention to quality in terms of quality maintenance and improvement" (p. 30).

Various bodies of literature examine how structure leads to the enhancement of quality. Some institutions have standardized and incentivized professional development to improve quality. Additionally, online programs have leaned heavily on standardizing course design and delivery. The literature review below discusses empirical studies on stakeholders' perceptions of these efforts to enhance quality.

Perceptions of Assessment as a Means for Enhancing Quality

A growing body of literature exists on the scholarship of assessment. One subset of this corpus is comprised of empirical studies on faculty perceptions of assessment as a means for quality assurance. For example, Cardoso, Rosa, and Santos (2013) surveyed 1,782 academics in Portugal to determine the aspects of QA professors are more likely to embrace. Participants were least supportive of the assessment of non-curricular student support services and most likely to support the assessment of professors' qualifications and teaching activities.

Reddy and Andrade's (2009) meta-analysis of studies on the use of rubrics for assessment indicates faculty attitudes are mixed: Faculty are not certain rubrics increase student outcomes, but they do recognize that rater calibration with the use of rubrics can lead to grading consistency.

Emil and Cress (2014) interviewed seven faculty to understand their perceptions of engagement in assessment. Their study revealed that the degree to which departmental leadership embraced assessment structures affected professors' engagement. The study also suggests professors who have a commitment to research and data-driven decision making may be more likely to embrace assessment. However, their study did not involve inferential statistics and cannot be generalized.

Perceptions of Professional Development as a Means for Enhancing Quality

Several studies have examined how professors respond to professional development as a means for quality assurance. Openo et al. (2017) suggest that the scholarship of teaching and learning (SoTL) can help professors understand the link between assessment structures and quality enhancement (QE). Specifically, SoTL encourages professors to consider alternatives to lectures as a means of increasing students' comprehension and retention (Halliday & Soden, 1998). Pleschová and McAlpine's (2015) meta-analysis of 17 studies showed that universities had utilized peer mentorship to calibrate professors' teaching methods, though there is a need for more research on how professors' attitudes change due to mentoring. Hopkins' (2020) phenomenological study of 20 faculty members at a community college described participants' beliefs about the impact of professional development on their course design. One theme that emerged from the study was the sense that while professors were confident as experts in their own disciplines,

they felt they had not previously learned how to be high-quality educators. Five professors described learning the process of “backwards design” (p. 78). The participants also widened their repertoire of learning activities (Hopkins, 2020).

Universities are implementing other structures such as first-year faculty experiences to communicate course design and delivery standards. Additionally, promotion and tenure requirements may be tied to teaching outcomes. Unfortunately, little research to date has focused on stakeholders’ perceptions of institutional efforts to improve quality through these incentives.

Perceptions of Enhancing Quality Through Course Design Training

Several empirical studies have examined how universities enhance quality by training faculty in course design, especially for online delivery. Quality Matters (QM) is an example of these efforts. The QM framework has been adopted by more than 100,000 members at over 1,500 institutions worldwide (“Quality Matters”, n.d.). In Kearns and Mancilla’s (2017) survey of over 2100 faculty members who had been trained in QM, between 55% and 71% of participants said they improved their course overviews, objectives, assessments, and instructional materials as a result of the training. In another study, a Kennesaw State University survey of 57 faculty showed that 94 to 100% who went through a course on online instructional technology believed the course helped them design higher quality courses (Terantino & Agbehonou, 2012).

Several researchers have used the QM rubric to score courses before and after faculty have been trained in course design. Conklin et al. (2020) indicated that all three courses improved in all eight criteria of QM after a course design workshop. Shields et al. (2021) reported that the mean QM scores of 29 professors’ courses went from 80 to 91 points after being trained in course quality. Mercer (2013) reported that 25 faculty who participated in a QM workshop indicated a statistically significant increase in knowledge about best practices but could not show a significant increase in willingness to use the QM rubric. Later, Budzick (2014) carried out a modified version of Mercer’s (2013) study and discovered that after the course design workshop, faculty (n=19) were more likely to use QM and were more aware of their course quality, and said they were more aware of best practices. In focus groups for Budzick’s (2014) study, faculty indicated a willingness to adopt QM because of empirical research, which indicates that alignment and clear objectives lead to student retention, engagement, and success.

Perceptions of Enhancing Quality Through Templates

Some empirical studies have also been conducted to understand stakeholders’ perceptions of quality assurance through standardized course templates. A survey of 72 professors at the University of West Florida showed that 95% of faculty would use the templates again, 85% felt the templates did not stifle their creativity, and 37% noticed an improvement in student outcomes after adjusting the course to match the templates (Burgess et al., 2008).

Despite the success of templates in these studies, standardization of courses can be a sensitive topic. To combat potentially negative concepts, administrators at the School of Nursing (SON) at Indiana State University decided to introduce humor as a strategy to get professors to accept course templates. They implemented the Robinhood-esque theme of “stealing content” throughout the training in template use, but assured professors that they would retain their autonomy. The SON professors adopted the innovation. According to Huun and Hughes (2014), “After adopting and implementing the template, encouraging results show that faculty are even more impressed with the template design and application, with 67-80% of respondents each semester being ‘very pleased’ after implementation versus 20-33% prior to application” (p. 22).

Haubrick, Levy, and Cruz’s (2021) mixed-methods study of the use of “master templates” suggested that some professors may fear that the implementation of a “master template” may cause them to be seen as replaceable (p. 322). How professors deal with this fear may be a factor impacting their attitudes about autonomy and standardization.

The review of literature shows that institutions with centralized course design have subject matter experts create the outcomes, rubrics, and assessments. While faculty in these institutions may not have total autonomy over the design of

their courses, these universities have leveraged multiple opportunities for faculty to interject their voice in creating and delivering the content. Additionally, many universities attempt to control and improve quality by training professors in course design. The quantitative studies discussed above show that course outcomes, student satisfaction, and course quality improve when faculty are trained in instructional design, and qualitative studies show faculty view training as beneficial. Yet little is known about factors contributing to stakeholders' adoption of standardization or their requirements for autonomy.

Methods

This section describes the methods for collecting and analyzing data in this study. The limitations are also described below.

Data Collection

Purposive sampling was used to identify "individuals that are especially knowledgeable about" this research topic (Creswell & Plano Clark, 2011). Twelve professors and administrators from four different universities in the United States were recruited. They represent a variety of disciplines and backgrounds in higher education. Table 1 below gives some participant descriptions.

Table 1

Participants

Susie	West Coast US	Private	Professor, administrator (traditional)
Oliver	West Coast US	Private	Professor, administrator(traditional)
Linda	West Coast US	Private	Professor, administrator(traditional)
Tyler	West Coast US	Private	Professor, administrator(traditional)
Karl	Southeastern US	Private	Adjunct (online)
Jim	Southeastern US	Private	Professor, administrator (online)
Joseph	Southern US	Private	Professor, administrator (online and traditional)
Lacey	Eastern US	R1	Professor
Lydia	Eastern US	R1	Professor
Genny	Eastern US	R1	Professor
Nora	Eastern US	R1	Professor
Elizabeth	Eastern US	R1	Professor, staff

Semi-structured, open-ended interviews were used to gather their experiences with structure and autonomy in the arena of course design and delivery.

Data Analysis

As the interviews were completed, they were transcribed and coded in Dedoose Software—first at the idea-by-idea level to generate discrete "open codes" (Strauss & Corbin, 1990); then, the researchers used the "interpretive approach" described in Miles and Huberman (1994) to "compare, aggregate, contrast, sort and order" the data (Savenye &

Robinson, 2004, p. 1059). Two main themes emerged: adopting structure and making space for autonomy. The findings section describes the parameters within these two major themes.

Limitations

The study is limited to participants' self-awareness and candor regarding their experiences with autonomy and centralized course design. Some may have felt uncomfortable and, therefore, less candid when sharing their negative experiences with university oversight in their course design. To mitigate these limitations, the participants were assured confidentiality would be maintained. Additionally, the collection and constant comparison of data (Glaser & Strauss, 1967, p. 105) to the point of "theoretical saturation" (Saunders et al., 2018) has helped the study achieve a thick, rich description of the participants' attitudes regarding standardization and autonomy.

Findings

Surprisingly, the findings did not indicate that participants can be grouped into either a "champions of structure" camp or an "advocate of autonomy" group. Instead, the findings show that participants all adopt structures, and all require flexibility, depending on the perceived advantages that flexibility and structure provide for the faculty, students, and the degree program.

Adopting Structure

Certain aspects of curriculum development in higher education call for structure. Participants noted several issues that warrant adopting structure to support the faculty, support the students, or assure the quality of the degree program.

Perceived advantage of structure for faculty

Designing new courses can cause anxiety for faculty members, especially when they are given a short time period to prepare. Yet structure can relieve some of that anxiety, as it clarifies what an instructor must do to prepare for class. Two participants felt relieved to discover the course they were assigned to teach was already well-developed and ready for delivery. "Nora" [pseudonym], who teaches traditional courses at an R1 institution, said, "I was very grateful, right, to not come up, start a new class from scratch . . . Like, the *tabula rasa*, right? Like the blank canvas, might be a little bit intimidating." Jim [pseudonym], who teaches online and on-campus courses, explained that he is given plenty of advanced notice for his on-campus courses because "they expect me to go in and do the work to design it and set it up and review the textbooks and all those sorts of things." On the other hand, his online courses are assigned with less than ten days' notice. This time crunch does not cause undue stress because, in contrast to his traditional courses, "when you have a canned [online] course like that, you don't have to do all those things."

Participants were also happy to adopt structure that supports the adjunct or guest faculty members, who may not have the time or inclination to develop a course from scratch. Joseph [pseudonym], who is the chair of an online and traditional program, said, "adjuncts are asking for more structure, not less." Due to time constraints, courses that are already developed and ready to go allow adjunct faculty to step in quickly and do well with the material even if they do not have time to spend on course design. Karl [pseudonym] explained his full-time employer gets his "best energy and time," whereas he tries to keep his adjunct responsibilities "contained to ten hours a week" by "fitting it in at the end of the day." He can take on this added responsibility because his adjunct courses are "pre-packaged, almost like a box. Just like- you just open the box, and it's ready to go." He said that if he were "overly managed" at his "real job," he would be "pretty irritated . . . But I don't want my adjunct teaching role to be something that has a lot of uncertainty." This aligns with one participant's hunch that "usually adjuncts teach the bare minimum." Therefore, it may be unreasonable or unrealistic to expect adjuncts to create courses without any structure. As Lydia [pseudonym] said, "we don't pay them enough." Participants largely agreed providing structure for courses taught by adjunct faculty was a positive act of support.

Structure may be as comprehensive as "inheriting" a course (as one participant indicated), but it may be as minimal as providing templates for syllabi. Elizabeth [pseudonym], an instructional designer at an R1 institution, believes that "when

faculty use [syllabus templates], they're always, always helpful. They're always pleased to use that for the most part." Lydia described how she shares syllabi with part-time faculty who may not have time to develop a syllabus from scratch. Genny [pseudonym] said the syllabus and learning activities are "pretty much spelled out" for professors in her program.

Participants also experience the way that structure provides clear expectations. Tyler [pseudonym] had extensive experience as an adjunct before becoming a full-time professor. He worried that he would "miss the base . . . not really giving students all they need," when the only structure he was given was the name of a textbook to use for his courses. He found it easier when he was "given a shell" that described the key learning objectives, assignments, and rubrics. "I was like, okay, whew, good, this is already there. Now I can build on it." Linda [pseudonym]said that the course templates helped her know:

> *the absolutes and then where you have some freedom . . . The freedom is mainly in the description of the assignments, how many assignments we have, what value they have, how they're linked to the objectives. But other things are already just laid out as in the template.*

Perceived advantage of structure for students

Participants also embrace structures they believe lead to student success. Specifically, professors may embrace institutional guidelines they perceive have pedagogical value. They also note consistency of the layout in the Learning Management System (LMS) can improve the student experience.

Program leads had difficulty selling structure unless they could show how the new structure would add value to the student experience or to the faculty experience teaching the course. Jim, who directs over thirty professors in a large university, had to communicate to his team about a new policy for giving feedback on assignments. The professors resisted the change because "they said, 'students don't read feedback anyway. And you're asking me to invest this time?'" He believed for professors to adopt a structure, they must see "the value-added." Tyler, who also must communicate university policies about structure to professors, said he needs to explain to professors, "this is going to help you, it's going to help the students . . . Everybody wins."

The consistency of the layout in the LMS was a repeated theme. One program director recognized structure would keep students from "having to learn Blackboard all over again" each time they encounter a new course, as they try to find the syllabus, policies, and course content. She explained, "If that were the case, there would always one place where students would go to look for materials."

Structure in the LMS may be especially important for online students. Karl mentioned above that he adds his adjunct responsibilities "at the end of the day" and recognizes that many of his online students do the same:

> *They're busy with full-time jobs . . . . They're probably doing a lot of coursework in the evenings. I think that generally [structure] translates into a pretty predictable product for them, which is going to be a highly structured experience: Very clear instructions for assignments, pretty predictable feedback timespan.*

Perceived advantage of structure for the degree program

Participants also described a need for structure to maintain the quality of their degree programs. Eight of the 12 participants referred to the need for consistency in content. One program director worried that professors "do their own thing without structure." Another said some departments at her university are like "the wild west." Susie [pseudonym] said she wants a "framework, right? Because I want to make sure we're getting the same outcomes" across the department. Tyler, who has the added responsibility of a curriculum coordinator, said the powerpoints are placed in all course sections "to ensure continuity across sections of courses."

In addition to continuity of content across sections, stakeholders want to ensure there is not unnecessary duplication of the material as students move through the courses in the degree program. Linda recalled when she was first hired, students would tell her they had used the same textbooks or had done the same activities in previous courses. She

believed someone must have compiled the scope and sequence but was unsure where to find it. She said, “What are the courses we’re offering, and the objectives? That’s someplace. I just had to get my hands on it. What are the textbooks people are using . . . what is our plan here?”

Other participants were in departments that adopted structures to show scope and sequence. For example, two department chairs described how a committee reviews the required textbooks for all sections of the courses under their purview. Oliver [pseudonym] said, “we moved away from the ‘whatever you want to do’ model twenty years ago to, ‘We're using the same textbook for this class.’ Or, ‘If you're an adjunct, you get the choice of textbooks for this class.’” Joseph explained students in all sections of a particular general education class “all read the same book and then write a reflection paper on that book. That's been done for a number of years.”

Consistency in general education, lower-division courses, or courses that are offered early in the program often leads to more complex courses later in the major programs. Participants may adopt structures that ensure the courses' curricula are sequenced. Lydia explained, “I know my colleagues that teach general biology . . . actually talk across all the [department] and share syllabi, and there are modules that are online that they also share . . . they communicate much more . . . for the courses that are part of sequences.”

In summary, participants are willing to adopt institutional structures that guard against “curricular drift” by establishing textbook committees, creating standardized syllabi, and even creating course templates. Structure for the purpose of maintaining rigor and quality within the program is seen positively by instructors.

Making Space for Autonomy

The findings above indicate stakeholders adopt structures they perceive to be advantageous for the faculty, students, or degree program. However, participants cautioned that they are leery of structure for structure-sake. One professor felt that the curricular control “clipped his wings.” A program chair was concerned the educational effectiveness arm of the university “may not know the people they’re relating to,” and another likened the university structure to the bureaucracy of the department of motor vehicles. Linda’s department viewed one university policy as “standardization to the n^{th} degree.” Oliver recalled that the “assessment culture” at his university had resulted in nine different assessment systems in 18 years. He recounted, “There was assessment fatigue . . . It was the tail wagging the dog . . . Assessment *ad nauseum* — I needed a vomit bag.”

Yet participants did not express a wanton desire for autonomy. Instead, they articulated a need for flexibility to embody their individuality as experts in their fields, to respond to individual student needs, and to meet department needs.

Perceived advantage of flexibility for faculty

Participants described times they had inherited a course or had been provided course templates, yet they were quick to note that faculty members who have taught the class in prior semesters should have the ability to “make the course their own” (as one put it) by adjusting the activities or the content. Oliver asked rhetorically, “We don’t want to tell the experts what to do all the time — to micromanage them, right?” And, as faculty teach courses, they desire the flexibility to make the course their own. Linda said she updates and changes her course as “I’m feeling more comfortable in my skin.”

Professors’ expertise on a topic can cause them to reject structure for flexibility. For example, Jim shared how a book had been chosen for the class because it was “easier” for the students to understand. Jim was concerned that the book “contained flaws.” He advocated (unsuccessfully) for a more rigorous book with accurate content. This top-down structure left him frustrated with the constraints of the system. Nora described how she operationalized flexibility:

> *I changed different pieces and moved things around and changed the assignments and things. I think I have — practically speaking - complete control . . . I've changed the course objectives. If I wanted to change the schedule, if I wanted to change the content that we're talking about. As long as there's sort of like a pedagogical, methodological reason for it. I think people would be very supportive.*

Lacey [pseudonym] believes adjunct faculty should be expected to make changes to the class as a sign of being a good instructor. If the adjunct professor is not allowed to make appropriate changes, “then this is not the right field for them.” In fact, adjunct or guest instructors may also add value because of their specific expertise. Genny explained, “we have guest speakers come in who teach things that we are not experts in.” When the expertise of the adjunct instructor is valued, the instructor is given more freedom with the course.

Lacey described launching a course that had never been taught before. The field within the discipline was just developing, so there were no “tried and true” courses or textbooks out there to use to design the course. As a result, the course description was written very broadly to allow the faculty teaching the course to try different learning activities. She appreciated the ability to dig into the field and develop the curriculum herself, which she had the freedom to modify over time Lacey explained, “I really like the . . . freedom within the course to keep the course updated . . . As new tools come out . . . I can automatically update the course. I don’t have to go through any curricula process.”

Perceived advantage of flexibility for students

Professors need the flexibility to adapt course content depending on the students’ learning styles and interests. Linda said, “we all teach differently…and we’re trying to reach different learning styles . . . There should be a lot of freedom in . . . modifying what we’re doing to teach them.” Susie described her need for freedom stating, “I was like, oh, I do not want to teach it the way it had been taught. I can meet the learning objectives, but instead of short assignments, I had longer assignments.” She had:

> *academic freedom in the sense that . . . it wasn’t totally scripted . . . Students loved it. It gave them all sorts of levels of learning. They got the auditory, they were able to see what they were doing, and then they were able to actually create it.*

Additionally, some courses lend themselves to tight structures, while other courses lend themselves to more freedom for the instructor. For example, Elizabeth described two different courses she teaches. One is a general education course that is very well-structured to provide a common experience that leads to other courses. Meanwhile, her other course is designed to develop general critical thinking skills. Instructors are expected to bring in current events, encourage students to talk about their life experiences, and engage in ongoing dialogue with students about the issues they bring up in class. In that case, Elizabeth believes it would be inappropriate to have a structured curriculum because the purpose is to build the discussion topics with the students throughout the class. Each section of the course has a different topical focus while developing the same skills.

Online programs typically have more structure than traditional face-to-face programs, and professors sometimes resist these structures. Jim’s university has structured the online courses down to the number of discussion boards, lectures, papers, and quizzes each week. Jim is philosophically committed to good discussion design and values his discussions with students throughout an activity. However, he felt there were times when a different learning activity would be a better way to engage students with the material. Twice while designing a course, he decided he was “not going to do” what the university structure required. Instead of creating a discussion board for one week in the course, he put in a different assignment. He felt that instructors should be able to make changes to the structure when there was a clear benefit to the students.

Karl, who also teaches at Jim’s university, agrees with the need for some flexibility — especially when it comes to constraints on videos. According to the course design policy, instructional videos may not be longer than six minutes. Although Karl generally agreed with the practice, he felt “handcuffed” by the “cookie cutter approach.” He wanted to use a particular video that was outside of the university’s policy regarding the length of videos. Both Jim and Karl spoke of how the policy, which was intended to support learning, became a barrier to good instruction. In this particular case, the guidelines were put in place to make it easier for students to access material, but they hampered the instructor’s ability to use quality content that supported course objectives. If the university had been more flexible, Karl and Jim believe the students would have benefited from engaging with better content.

Perceived advantage of flexibility for the degree program

Professional degree programs have the added dimension of maintaining currency with practices in the field. In some cases, participants talked about keeping up with the profession because the profession itself was changing so rapidly. A psychology professor said, “as new tools come out or as new types of visualizations are developed, I can automatically update the course” without going through the curriculum committee.

Linda and Susie shared that instructors in their fields often keep one foot in the industry to maintain relevancy and currency. These instructors often work side jobs outside the university to keep up with how the field adjusts each year. They then use those experiences to adjust the courses they teach. Susie spoke of redesigning a major assignment in one of her classes to ensure that students demonstrated certain skills prior to leaving the program.

The curriculum may also need to be flexible due to the different environments where the courses are taught. A health sciences professor emphasized the importance of freedom in course design to allow instructors in various settings to create learning activities that will benefit the local community. Programs that engage students in the community need enough flexibility to meet those needs and find appropriate placements while still meeting course requirements.

Discussion and Implications

This study touched on the themes of academic freedom and structure. Elman (1994) understood quality assurance and academic freedom as goals that regional accrediting bodies hold paradoxically. Sullivan (2018) did not see this as a paradox but as a balancing act:

> *There always has to be a balance between zones of jurisdiction and room for manoeuvre. Too much of the first is likely to crush agency, undermine initiative, damage enthusiasm, invite inauthenticity and prevent real responsibility. Too much of the second is likely to invite chaos, cause unnecessary inconsistency, damage coherence and fail to promote the mission (p. 118).*

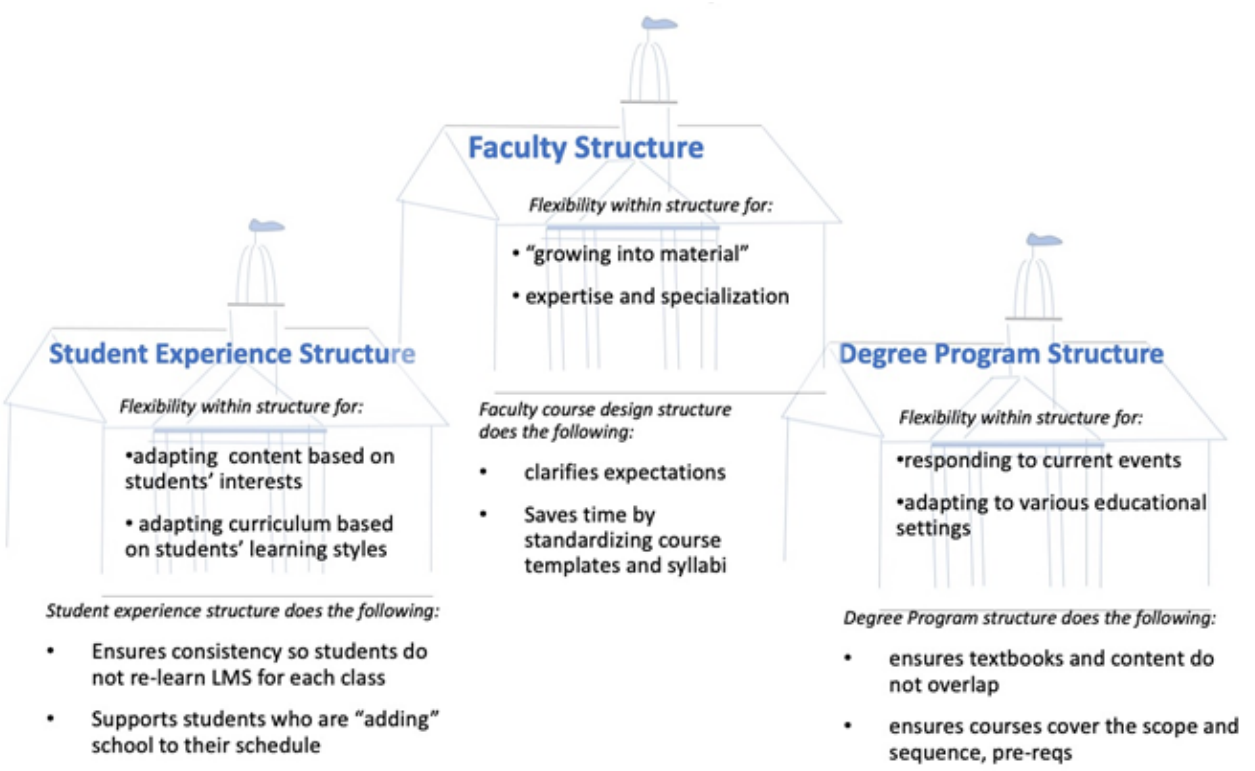
Aside from the complaints about “assessment *ad nauseum*,” participants did not describe an environment where structure “damages enthusiasm” or “crushes agency” as Sullivan (2018) put it (p. 118). Apart from one participant’s fear that it was the “wild west” in another department, participants did not perceive that autonomy in their workplace created chaos.

However, participants did not particularly conceptualize a balancing act (viz. Sullivan, 2018) nor as a paradox (viz. Elman 1994). Instead, participants accept flexibility within structure. They understand the need for consistency in policies and curriculum; they see the advantage that quality control provides for their degree programs, and they adopt structures that save them time. However, within those structures, professors want room to individuate learning activities, textbooks, and assessments based on their own expertise, the needs of their students, and the changes happening within their fields.

Stakeholders are keen to adopt structures when they perceive the advantages to faculty, students, and the degree program. Yet they imagine the borders of the structures to be flexible, making space for autonomy. Figure 1 below depicts this “flexibility-within-structure” model.

Figure 1

Factors Contributing to Stakeholders’ Perceptions of Flexibility and Structure



Accepting Structure

The theory that emerged from this study indicates that stakeholders embrace structures that ensure quality. Quality is a "contested term that takes on different meanings to different stakeholder groups" (Goff, 2017, p. 180). Goff placed 10 administrators' conceptualizations of quality into five categories: 1) exceptional (i.e., having an international reputation); 2) fitness for purpose (i.e., students learn what the university promises they will learn); 3) value for money; 4) the ability to induce change; and 5) perfect consistency. No participants referenced the reputation of their institution (though some work for prestigious universities), and none spoke in terms of value for money. The concepts of fitness for purpose and consistency were corroborated by participants in this study.

The process of gaining faculty buy-in for structures like centralized course design can be seen through the lens of scholarship on culture change. Two theorists have examined the adoption rate of QM through a culture change lens. Huun and Hughes (2014) applied Rogers' (2003) theory of diffusion to explain the acceptance of course templates at a Midwestern University, and Budzick (2014) used Davis' (1989) Technology Acceptance Model (TAM) to understand the acceptance of QM at a community college in Ohio. This study's findings corroborate the relative advantage concept in TAM. Stakeholders adopted structures that clearly provided the advantages of time management, scope and sequence, and a consistent student experience. Some faculty were hesitant to adopt structures that seemed only to benefit the educational effectiveness department but showed no clear promise for improving the student or faculty experience.

Making Space for Autonomy

This study highlighted how stakeholders perceive the need for some freedom to choose or design academic learning outcomes, assessments, rubrics, and learning activities. Very little attempt has been made to define or understand freedom in this sense, although teacher autonomy is well-studied in the K-12 context (Skaalvik & Skaalvik, 2014; Worth and Van den Brande, 2020; Wu & Wu, 2018). Worth and Van den Brande (2020) defined autonomy as "direction over one's own decisions and actions" (p. 6), specifically in terms of job tasks, work hours, and work manner. Note that the participants in this present study did not overtly assert a need to have direction over their own actions. Instead, all 12

participants desired autonomy when it proved advantageous for the faculty experience, student experience, or the degree program's quality.

Autonomy may seem to be semantically connected to the concept of academic freedom. However, in higher education, the term “academic freedom” is often conceptualized as the professor’s freedom to write and teach according to his or her conscience (Bilgrami & Cole, 2015; Williams, 2016). In this study, participants distinguished between being able to select topics and materials that were pertinent to the ideas they wanted to share (i.e., academic freedom) and the ability to make changes to how the course was taught (i.e., autonomy). Constraints on course design from university policy was discussed in terms of student accessibility and learning rather than control of the topic. For example, faculty who had trouble selecting the book they wanted to teach were constrained by the length and readability of the text, not because of the ideas expressed within the text.

Conclusion: Putting the “Flexibility-with-Structure” theory into Practice

The identification of factors that contribute to a strong need for flexibility and to fears of “the tail wagging the dog” (as one participant stated) can foster mutual understanding among the various stakeholders across the university. The findings from this study suggest that administrators who bear the responsibility of standardization will benefit from doing the following:

- Demonstrate how standardizing syllabi and course content will save the professors time (see Faculty Structure in Figure 1);
- Demonstrate how standardizing the LMS will improve the student experience, but create space for customization (see Student Experience Structure in Figure 1);
- Limit textbook oversight to guard against duplication, and to ensure the materials are leveled and sequenced, but create space for professorial choice (see Degree Program Structure in Figure 1).
- Assure professors that assessment structures will not impinge on their own areas of specialization (see Flexibility within Structure in the Faculty Structure section of Figure 1).
- Reassure faculty of ways they can individuate curriculum based on current events and the pedagogical context (see Flexibility within Structure in the Student Experience Structure section of Figure 1)
- Communicate to faculty how they can grow into their courses by adding personal touches based on their specializations (see Flexibility within Structure in the Degree Program Structure section of Figure 1).

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Considering What Faculty Value When Working with Instructional Designers and Instructional Design Teams

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The purpose of this research was to study what university faculty valued when working with instructional designers and instructional design teams to develop educational simulations. We did this through a case study of three faculty, where we analyzed what they discussed among themselves or communicated to other team members about what mattered to them about their team relationships or the design processes they employed. We structured our case report around three thematic issues that expressed how our participants depicted good relationships and processes. Our report concludes with a discussion of how instructional designers could use our findings in their practice.

Introduction

A key to success for instructional designers in higher education is the relationships they develop with faculty. Research has shown the positive effects working with instructional designers can have to improve faculty's ability to integrate technology into their teaching (Scoppio & Luyt, 2017), or to develop high-quality online courses (Olesova & Campbell, 2019). Research has also pointed towards several factors important for instructional designers to develop or maintain effective relationships with faculty. A common conclusion in the literature is that designer/faculty relationships should be collaborative (Chen & Carliner, 2021), presumably meaning that both designers and faculty work towards shared goals, and attempt to develop their association into a productive partnership (Ritzhaupt & Kumar, 2015). Other findings include that relationships should be flexible (Scoppio & Luyt, 2017), built on trust (Richardson et al., 2019) and empathy (Bawa & Watson, 2017), and allow designers to serve as mentors for skills in which they have expertise (Olesova & Campbell, 2019; Richardson et al., 2019).

As Chen and Carliner (2021) concluded in their systematic literature review on this topic, however, much of the research into instructional designers' relationships with faculty has been carried out from the designers' point of view. As useful as these findings have been, then, they have likely missed important insights that could be discovered if the faculty viewpoint had been studied as well. The scope of Chen and Carliner's review ended in 2017, and some further research has been published since that did provide more understanding of what faculty were looking for when working with instructional designers (e.g., Olesova & Campbell, 2019; Richardson et al., 2019). But even with these additional studies, it appears instructional design researchers have not explored the faculty worldview in the sense encouraged by Liu et al. (2007), who advised designers to seek to understand matters that faculty care about from *the faculty perspective*, and not only from how those concerns fit into the designers' communities of practice.

Our purpose in this paper was to contribute towards this end. We used a case study methodology, focused on three faculty members who were part of an instructional design team, to understand what they valued when working with other team members (instructional designers, software developers, and subject matter experts) to develop a suite of educational simulations. We focused on how the faculty depicted what mattered to them about work relationships and team processes when communicating with each other and with other team members. This case presented an opportunity to analyze faculty values from their own point-of-view, largely independent from the perspective they might have provided if they were directly asked what they thought about working with instructional designers or with their design team. This provided a way of understanding faculty concerns and interests that instructional designers can consider to help their own relationships with faculty be more effective (cf. Packer, 2018). The specific question guiding our study of this case was: how did university faculty depict what mattered to them about instructional design relationships and processes, both in conversation with each other as well as in communication with other members of an instructional design team?

The Relationship Between Instructional Designers and Faculty

Given that only a minority of faculty work with instructional designers in meaningful ways (Jaschik & Lederman, 2017), how to build relationships between designers and faculty is an important issue in instructional design research. Among other factors, this issue carried with it broad implications for how the results of their work (e.g., projects they complete) could affect the ultimate performance of the students they are both attempting to serve (Chen & Carliner, 2021). Prior studies showed two trends, both of which pointed towards the importance of improving designer/faculty relationships in higher education. The trends were summarized by Pan et al. (2003), who observed that the "relationship between the instructional designer and the faculty is intimate but vague" (p. 292). On the one hand, research indicated that faculty generally found their experiences with instructional designers to be rewarding (Olesova & Campbell, 2019; Richardson et al., 2019). Along with this, faculty reported enhanced course design (Brown et al., 2013; Drysdale, 2019) and improved student outcomes (Chittur, 2018) after collaborating with instructional designers. Further, Olesova & Campbell (2019) found that faculty skills and teaching strategies improved after being mentored by designers. Overall, faculty who worked with designers perceived it as beneficial (You, 2010) and were enthusiastic about continued collaboration (Drysdale, 2019). But at the same time, faculty have also experienced the other side of Pan et al.'s (2003) observation. Many faculty did not know what to expect from a designer, or understand the roles designers played in relation to faculty (Drysdale, 2019; Richardson et al., 2019). This hindered the relationships designers were attempting to develop with them, which sometimes led to unsatisfying collaborations (Halupa, 2019).

Several factors seemed to be important in developing or maintaining instructional designer/faculty relationships. In a systematic literature review, Chen and Carliner (2021) found seven factors recurring in the research. These were: "communication, attitude, trust, commitment, flexibility, empowerment, [and] healthy workplace culture" (p 13). These reflected a conclusion drawn in Ritzhaupt and Kumar's (2015) study of skills needed by instructional designers in higher education, who stated that a key competency designers should cultivate was the ability to interrelate with faculty in a professional manner. As valuable as these factors were, however, they were not a comprehensive list. For instance, Richardson et al. (2019) concluded that faculty appreciated a sense of assertiveness on the part of designers they work with. While faculty wanted designers to be flexible as well, they also expected designers to take stands on important

matters, in a spirit of being an effective mentor (cf. Olesova & Campbell, 2019). This suggested that instructional designers should seek to tailor their approach to what faculty expected in their working relationships (cf. Bawa & Watson, 2017).

Conversely, research indicated there were also factors that could interfere with instructional designer/faculty relationships. Chen and Carliner (2021) found five hindering factors in their literature review:

- Not understanding the role of the instructional designer, including beliefs on the part of some faculty that instructional designers are primarily "technical-support staff" (p. 15).
- Not being able to communicate clearly, especially when faculty or instructional designers used technical terminology that is unclear to the other party.
- Being overworked on the part of both faculty and instructional designers; having so many assigned tasks or expected duties that these got in the way of faculty and designers' ability to consistently work together on a project.
- Uncertainty about independence, where faculty believe that working with instructional designers will impede their ability to teach what or how they want.
- Issues of institutional authority, where it was unclear who was really in charge, the faculty member or the instructional designer.

Problems could also arise when institutions sent mixed messages, such as when research universities deemphasized teaching improvements (Richardson et al., 2019; see also Bawa & Watson, 2017). Differentials in power structures (Schwier & Wilson, 2010), lack of professionalism on the designers' part (Liu et al., 2007), or faculty being required to work with instructional designers (Albrahim, 2018) could also be concerns.

Our study explored factors that faculty valued in their relationships and processes when working with an instructional design team. Of course, prior research has also examined faculty attitudes about educational technology, online course development, and related issues (Harrison et al., 2017; Smidt et al., 2014; Tabata & Johnsrud, 2008; Wingo et al., 2017). Our study differed in that we did not focus on issues studied in prior research, like the effects of technology on students or challenges that faculty encountered when teaching online. We were interested in how they would depict valuable relationships with instructional designers or design teams, along with how they depicted the processes they thought would lead to worthwhile ends, apart from other issues that might also affect their satisfaction with matters related to educational technology. We were also interested in how faculty would depict these issues *in situ* as their work was unfolding, which also differed from prior research that often asked faculty to talk after the fact about their relationships with instructional designers (Richardson et al., 2019). This differing focus should provide new insights for instructional designers to understand how to work with faculty more effectively.

Method

We used a qualitative case study methodology, focused on three faculty leading a project to design and develop educational simulations. The case bounds were what they discussed among themselves or communicated to other team members about what mattered to them in their work with the instructional designers, software developers, and others associated with the project. Data were drawn from our ethnographic study of the team, specifically emails the faculty sent to each other about team organization, and project newsletters they used to communicate with the rest of the team. We completed a thematic analysis of this data, drawing on techniques associated with ethnography (Packer, 2018) and hermeneutics (Fleming et al., 2003), to develop an interpretive account of how the faculty depicted good working relationships and team organization, grounded in the details of their *in situ* project communications. Our report took a narrative form, common in interpretive research approaches like case studies (Newkirk, 1992). We did this to draw attention to the interrelated character of the values that mattered to the faculty, and to avoid reducing their experiences into an overly simplistic view that can occur when qualitative data is reduced into an abstract system of codes (Packer, 2018).

Case Background

The data for this case were taken from our ethnographic research project, studying an instructional design team that was developing educational simulations to teach students to collaborate in STEM careers. Our research began when the team was formed in June 2019. To date we have gathered 97 video observations of team meetings or other interactions, 30 interviews with team members, and over 800 artifacts team members produced (emails, design documents, project newsletters distributed to team members, etc.). The team itself was distributed across three universities, and was overseen by faculty members who had received an NSF grant to study the simulations. In addition to three faculty who were consistently involved as principal investigators, five other faculty worked on the project to perform certain tasks (including the lead author, who coordinated video production for the simulations). Over 30 graduate and undergraduate students have also worked on the project, some for a few weeks with others engaged for its duration (including two of the three co-authors, one of whom conducted an evaluation of the team's on-boarding processes and the other who provided research support for the principal investigators).

The specific team members we studied were the three faculty leading the team, referred to by the pseudonyms of Jack, Stacy, and Tim. Jack and Stacy worked at one university in the Eastern United States, and Tim at another university in the Western United States. All three belonged to departments of Information Technology and had extensive experience in the field of human-computer interaction (HCI). Although Jack had an advanced degree in the learning sciences, none of the three identified as instructional designers. All three faculty members played very active roles on the project, directing the day-to-day work of the other faculty and students. Other faculty and students, in turn, were the instructional designers, software developers, and subject matter experts engaged in designing and developing the simulations. They also provided subject matter expertise themselves, as well as contributed substantive ideas about the learning outcomes, pedagogical models and activities, and methods of assessment for each simulation. Finally, they coordinated the simulations' testing and evaluation, either in their own courses or those of colleagues in their departments.

Our case began five months after the project was funded. In November 2019, Jack, Stacy, and Tim flew as many team members as they could to one location, where they held a series of intensive meetings to begin designing the simulations' instructional components (basic learning outcomes, ideas for instructional events, etc.). Upon returning from these meetings, the three faculty began emailing each other about how to continue the progress they had made in-person. Over the next three months they debated how to configure the team to encourage relationships and processes they thought would help them complete the project, discussed advantages and disadvantages of different configurations, and communicated their conclusions to persuade the rest of the team to align with their ideals.

Data Sources

The data for the case were 51 emails and newsletters the faculty wrote over a three-month period, from mid-November 2019 to mid-February 2020. This was a time early in the project when the faculty were setting norms for their team relationships and design processes, and so were having frequent email discussions to persuade each other about the value of certain relational or process factors. They were also frequently communicating what they valued to other members of the team. Even though this data set included communication about, and to, team members other than instructional designers, since the background context was an instructional design project the way the faculty depicted their relationships and processes can still be a contribution to instructional design scholarship. As McDonald et al. (2021) argued, "it seems an unnecessary constraint to say that instructional designers cannot be informed by the motives of their colleagues, especially in the context of team-based design" (p. 1646).

The research value of this data derived from it being what Flyvbjerg (2001) called an "extreme" case (p. 77). Extreme case studies are not meant to test a hypothesis, but rather to yield large amounts of information about a single phenomenon. Their usefulness is at least partially found in their uniqueness. It is less important that a case can be generalized than that it provided a unique vantage point to view a phenomenon, one that could reveal fresh insights about common things (Packer, 2018). Our judgement that this case would be able to generate the type of information useful for our research questions was based on three criteria: (a) because the team was distributed they addressed

even minor issues through email, leaving a rich record for analysis; (b) during this formative phase of the project a number of issues arose that drew out details about what mattered to the faculty about their working relationships and team organization; and (c) the faculty were discussing these matters among themselves, not with instructional designers or researchers, so it is unlikely they were shaping their comments based on what they thought other audiences wanted to hear. While they all consented to be research subjects and knew the artifacts they generated could be analyzed, this specific case was not chosen until after the events had transpired, and the faculty members did not know in advance these specific emails would be selected for study, so it was unlikely that any of them were positioning their comments for public display.

Data Analysis

We conducted a thematic analysis of our data based on a procedure developed by Packer (2018), and a theoretical framing described by Yanchar and Gong (2019) that provided techniques for determining matters of significance to research participants. Beginning with the email and newsletter texts, we identified instances where the authors argued for some facet of their team relationships or processes as being better or worse than an alternative, as being good or bad, leading to better or worse simulations, etc. These claims provided material to analyze our participants' preferred ways of relating to each other (cf. Yanchar & Slife, 2017). Through close readings of these instances, we carried out a hermeneutic analysis of the effects participants' comments had on their own, and each other's, understanding of their experiences. This took place as we identified: (a) the context of each artifact – its background, purpose, and information it contained about our participants' project involvement; (b) participants' attempts to persuade each other along with other team members about the importance of certain relational or process factors; (c) breakdowns in their experience, and how participants' depicted their values or underlying assumptions while working through the difficulties; (d) any explicit values or other knowledge a participant identified as important for the team's progress; and (e) instances where a participant directly responded to another's statement of value, indicating the effect the original statement had for them.

From these details we developed a thematic structure of values depicted by our participants. This consisted of: (a) summarizing details using a word or short phrase that described the original participant's comments; (b) comparing/contrasting individual phrases, looking for relationships between phrases, merging similar phrases, etc.; (c) using whole/part analysis (Fleming et al., 2003) to refine our interpretations by considering individual phrases in light of all our data, as well as comparing the whole to the details of our growing structural system; and (d) selecting illustrative quotes from the original artifacts to build an account of our thematic structure. We reported these themes using a narrative style (Newkirk, 1992). This is common in ethnographic and case study research, because it allows for research to be presented in the context of the circumstances in which it is relevant (Stake, 2000; Van Manen, 2015), allows researchers to better explicate interconnections between findings (Flyvbjerg, 2001), and avoids the reductions of meaning that could occur when relying on methods like reporting the number of times certain codes were found in the data (Packer, 2018). Narrative reports have a tradition in educational research (Gong & Yanchar, 2019; Packer, 2011; Taeger & Yanchar, 2019), including instructional design research (McDonald & Rogers, 2021; Mertala, 2020; Nelson & Palumbo, 2014).

Limitations

This was a single case study, and so the particular issues that mattered to our participants will not necessarily be universal to faculty in all circumstances. There also might have been other issues that mattered to our participants that either they did not articulate, or that they were unaware of but were still shaping the situation in which they were working. Further, the context of our study was higher education; subject matter experts or clients that instructional designers work with in other industries may hold to different commitments than the faculty members we studied. We recommend future research investigate such issues in other industries. Finally, our qualitative method did not allow us to make causal claims about our participants' experience.

Findings

We structured our case report around three thematic statements that expressed how our participants depicted good team relationships and processes. Each theme contained a dual pair of concepts; each concept within a pair tended to arise near the other when the faculty were discussing the team qualities they sought. These were:

- Collaborative and inclusive – making decisions through discussion and consensus, while actively seeking to include team members' ideas and perspectives.
- Rational and efficient – valuing objective decisions, made in a cost or time effective manner.
- Expert and engaged – seeking to include individuals with sufficient expertise, as well as those who had demonstrated their commitment to the project.

In the first two themes the concepts seemed to reinforce each other, while in the third the faculty sometimes experienced each as being in tension with the other. Additionally, there were sometimes tensions across the themes as well. Table 1 summarized the themes along with narrative accounts from our data that illustrate each. We then elaborated on them in the sections that follow.

Table 1

Summary of Themes and Illustrating Narratives

Theme	Illustrating Narratives
Collaborative and inclusive – faculty valued making decisions through discussion and consensus, while actively seeking to include team members' ideas and perspectives.	• Jack proposed a design task force to allow many team members to be involved in design decisions. • Tim and Jack promoted the value of including student employees. • Stacy promoted the value of including people from different disciplinary backgrounds. • Jack and Tim promoted the value of including work from all team members.
Rational and efficient – faculty valued making objective decisions in a cost or time effective manner.	• Jack advocated for design processes based on rational criteria. • A project newsletter promoted the team's rational ideals. • Tim trusted that orderly and efficient processes would facilitate the team's progress. • Jack asked Stacy to generate design options that could be evaluated through rational criteria.
Expert and engaged – faculty valued the inclusion of individuals with expertise, as well as those who had demonstrated their commitment to the project.	• Jack and Stacy proposed a subject matter expert be appointed leader of the design task force. • Tim proposed that he and Stacy lead the task force because they had design expertise and had been most involved in the project. • Tim advocated for other team members to take leadership positions because of their expertise. • Jack resisted Tim's proposal because one of those individuals had not demonstrated commitment to the project. • Stacy suggested participation from someone with expertise in the team's instructional design process. • Jack changed his mind about the task force leader because his first choice had not demonstrated commitment to the project; at the same time he requested further involvement from an instructional designer who had expertise in an area of need.

Collaborative and Inclusive

The artifacts we analyzed indicated that our participants treated design relationships as good when they collaboratively made decisions through discussion and consensus, and actively sought to include team members' ideas. They sought this across institutions, across disciplines, and between levels of their social hierarchy (e.g., faculty and student

employees). This should not be taken as evidence that their work was always as collaborative and inclusive as they claimed. While we did not analyze their actual decision making in this study, we noted that in reality small groups made many of the significant decisions about the simulations (such as each one's learning outcomes, the instructional strategies underlying their design, or how outcomes would be assessed). Yet, regardless of how their practice unfolded, the faculty depicted themselves as embracing collaboration and inclusion, while claiming that deviations were necessary adjustments needed to manage the project's complexity.

Our first examples were drawn from an email conversation where Jack proposed creating "a design task force" consisting of members from all three universities, to carry forward the momentum the team had generated during their in-person design meetings. Task force members would meet regularly to "share info and gather ideas from others who are not in the group so that others are involved," as decisions were made about the learning activities students would complete during each simulation. While Jack realized that "adding [people to decision making structures] adds complexity," he wanted to include anyone who was interested, "if a person feels strongly they want to be involved I would be open."

Although both Tim and Stacy had questions about Jack's proposal, as they replied they also expressed the same commitments of collaboration and inclusion. Tim agreed that "bringing in input from those on your list seems critical." But he was "concerned" about the specific structure Jack proposed, so he suggested that he and Stacy lead the design. He also attempted to preemptively resolve concerns Jack might have about his recommendation by saying, "perhaps you are worried that we would exclude others' opinions? . . . I can assure you that would not be what happens." In a series of additional emails, while they continued to disagree about the task force itself, they both affirmed their interest in collaboration and inclusion through statements like, "I would like a process where alternatives are discussed;" "any member(s) of the team can propose how things will work;" "I really like the idea that anyone can contribute designs;" and "we can all be part of decision-making." Stacy also agreed with the values her partners expressed and specifically noted the importance of including a certain individual with instructional design experience, "I don't see why he should not be included – it's better to be inclusive at this stage."

We found similar commitments to collaboration and inclusion in other artifacts. At one point Tim promoted the value of including student employees in the process, "it's essential that we get students heavily involved in the design." Later, in an email to students, Jack assured them that they would be meaningfully involved. Even though "because of logistics we are going to be a small group making the final decisions," he wanted the students to know "we will include people and support your ideas being part of this." In another email, Stacy proposed including people from different disciplinary backgrounds, offering an example of one individual who would be "an excellent sounding board" while the team was selecting instructional material. And finally, in another email, Jack asserted, "I am determined to include the work of everyone." In his reply, Tim began by reiterating Jack's position, "I like how we're trying to incorporate work from everyone."

Rational and Efficient

The artifacts we analyzed also suggested that our participants valued rational and efficient decision making, which they seemingly defined as making decisions based on objective criteria, in a cost- and time-effective manner. This was more than discussing options in a utilitarian sense, attempting to dispassionately weigh alternatives based on rational or efficient criteria. While at times they debated the merits of specific options in terms of how to maximize their ability to make rational or efficient decisions, they also described rationality and efficiency as being goods in themselves. They treated them like fundamentally better ways to design educational products. This suggested they viewed those motives as more praiseworthy than alternatives. Their team would be a better team, and their simulations would be better learning experiences, the closer they aligned with rational and efficient ideals.

One example was an email from Jack to Tim. Jack noted that, "I am primarily interested in a process that gives us a good design and team." He highlighted that a reason for this was if they did not have such a process, "we might just move forward and lose things we could have learned," and thereby become less efficient decision makers. Jack then encouraged Tim, "you and I will need to . . . exercise some discipline to have a complete process." Jack also alluded to

how their process should be rational. He suggested that the right process would facilitate a principle-based "analysis" of instructional design "options" the team generated. He added that, "[if] we give it what it needs . . . as a group we will find the best options." He also suggested that using rational decision-making criteria would mean, "our first iteration [of the simulation] is the better in my view." We draw attention to the language in Jack's email suggesting the qualitative value he was attributing to rationality and efficiency. The team would find the "best" options if they followed a process that allowed them to rationally weigh alternatives. The first iteration of the simulation would be "better" if they did so. An efficient process was a "good" process. Even stating that they should have the "discipline" to follow such a process suggested that Jack saw these motives as being more exemplary than alternatives, as if those who did not adhere to them were lacking the virtue of self-discipline.

A similar tone was evident in other writings. In one instance, the faculty sent a newsletter to team members that included a section seemingly meant to convince them of the value of the team's rational ideals. Contrasting their instructional simulation with off-the-shelf games, the newsletter stated that entertaining games could presumably be designed through any process. But the intricate simulations the team was designing, that were meant to be more than "fun and engaging" but also would allow "student players to take away some knowledge," needed a different approach. It "requires a deliberate design [process]" that would help them "structure" the many components of a simulation, so they aligned with the objective principles of the instructional strategy and the learning outcomes on which they were relying. And at another time, Tim described his trust in an orderly and efficient process that would facilitate the team's "progress" towards decisions about "high level learning outcomes and the core [instructional] structure." A further instance was an email where Jack proposed having Stacy and another individual generate some alternatives for the simulation narrative, which would then be evaluated by team members who "would look at it in terms of pros and cons." Jack reiterated that Stacy and her colleague would generate "different possibilities," but that "we will need some way to evaluate options" to choose the best one. In context, all these statements evoked a similar sense that rationality and efficiency were virtues, as they were entwined with expressions that suggested our participants considered such forms of decision making to be praiseworthy. These included Tim's declaration that "I really like the idea" of a honed, efficient process, and Jack's statement that "I expect we would be happy" to adopt ideas generated through rational means.

Expert and Engaged

As the faculty conversed with each other they tended to describe their relationships and processes as good when they placed people with what they called "expertise" in key positions. Although they rarely, if ever, explicitly defined how they were using the term, they used it often, frequently discussing it as a quality they should seek out and promote when they found it. However, in contrast to a pure expert-centric approach, they also routinely argued that at least in some circumstances people's demonstrated commitment to, and prior engagement with, the project should be prioritized over expertise.

One example was found in Jack's proposal for the design task force. This instance not only illustrated how expertise was important to the faculty, but also how they moderated its importance by also considering how engaged people had been with the project. When Jack proposed the task force, he also suggested a certain team member, Ann, be appointed "chair of the task force" because he thought it was "a good fit for her expertise." She was the instructor of classes that taught similar subjects to those students would learn in the simulations. She also had HCI experience and so could provide input into the simulations' user interface. Later, Stacy similarly recognized the importance of including Ann because of her expertise, or, as she put it, "she brings a wealth of knowledge." But in contrast, when Tim expressed his concerns about the task force, he stated that while he agreed that "including [Ann] is wise," he thought appointing her as chair was "unwise" because she had not "been involved in everything people have been learning over the past 6 months" (expressing his concern that Ann had not been as engaged as others). Further, when Tim argued that he and Stacy should lead the design, he justified the suggestion both by his own expertise, saying he had years of experience designing educational simulations and so "I typically play a similar role" in other projects, and because of Stacy's prior engagement, since she had been "the most involved from [her university]."

The debate about Ann's proposed leadership continued a few days later in further emails. Jack continued to advocate for Ann being the task force leader, "I need to have a role for Ann, and I thought that by chairing this group we could use

her expertise as we work through alternatives." In contrast, Tim argued for including Ann somehow, but not to appoint her as leader, "don't get me wrong, I think we should use her expertise, just not put her in a leadership role over design." Tim also pointed out how promoting Ann might be problematic for those who had been committed to the project for a longer period of time. He said, "it may also seem strange" to other team members if Ann were given a leadership role, in the sense of wondering why a person who had not been involved was given a key position, and not one of them.

The faculty's commitments to promoting expertise and engagement were also evident in other emails. In a discussion about two individuals in particular, Tim advocated that either, or both, of them should be included because they "both have extensive experience with this." One was an instructional designer and the other was a creative writer, both of whom had worked with Tim on previous simulations. But Jack expressed reserve about how committed and engaged one of these individuals had been, "I would be worried with [this person] based on him not showing up to . . . meetings that were designed for him specifically." In another email, Stacy seemed to prioritize an expert-centric quality to the team's design relationships. She observed that a certain individual should be sought out and invited to participate because he was "familiar" with an instructional design process that "is aligned with our approaches." Finally, at another time Jack requested that a particular instructional designer be brought into a discussion about the process the team would use to create learning activities, since that type of work "seems in his wheelhouse" (that is, an area of expertise). Additionally, by that time Jack had also become less enthusiastic about including Ann in the design task force because she had stopped responding to his emails, which indicated to him that she was possibly not as engaged as he wanted her to be.

Tensions Across Themes

At times in our analysis, the faculty's commitment to certain themes seemed to be in tension with their commitments to others. One example was tensions between the values of rationality and efficiency, contrasted with their commitments to collaboration and inclusion. For instance, when discussing how to collaborate with various groups, the faculty would occasionally note there was a limit to how inclusive they would be—usually justified on grounds of helping the team be as efficient as possible. Some of these examples were described earlier, such as when Jack emailed student employees about their involvement. Before soliciting their participation, he was careful to state that "because of logistics" students would not be decision makers, but could offer "suggestions." Also, when proposing the design task force Jack alluded to how "adding more [people] adds complexity," and so as the principal investigators one of their roles was to "keep our meetings manageable." And in a project newsletter, the faculty wrote that "we need to be efficient in how we use [the] expertise" of the individuals involved, due to the difficulties of "getting a large number of people" together, "complicated by geography and time zones." Similarly, at times our participants seemed to recognize that their commitment towards collaboration and inclusion could be in tension with an expert-centric approach, or, alternatively, promoting team members who had been most engaged. We illustrate this by referring back to Jack's concern that a certain individual was "not showing up" to meetings. In the same message where he expressed his concern, he reiterated, "again, anyone can spend time designing and propose a design," but this did not mean those who were not committed could assume any role on the project. Those with a history of engagement were to be prioritized over others.

It was also notable that while faculty members' communication among themselves and with the rest of the team reflected the existence of competing commitments, they never explicitly or directly commented on the tensions. We can imagine that if any friction had been pointed out to the faculty, they would have been able to recognize it, and even been able to comment on why the tensions existed, or what commitments they consciously thought should be prioritized. Yet in the moment, such self-reflection seemed to be absent. There was not evidence of any conscious attempt on the faculty members' part to reconcile the tensions. Instead, if any sense of why they were acting as they did was evident in their communication, it seemed to be based on their affective responses to salient features of the individual situations. Certain situational aspects presented themselves as the decisive motive for taking an action. This was evidenced by statements from the documents that highlighted faculty members' affective motivations, such as a newsletter's claim that logistical challenges "raises the importance" of choosing a team organization that balanced collaboration and efficiency, or when Tim noted that he was "extremely anxious" that the team not let collaboration get in the way of making efficient decisions about the simulations' learning outcomes or learning events.

Discussion and Implications for Practice

The themes our participants expressed throughout our study suggested several possibilities for action that instructional designers could consider to help their own relationships with faculty be more effective. First, the consistency between our findings and prior research could increase instructional designers' confidence in what scholars have previously reported about important elements in designer/faculty relationships. Second, a more unique contribution of our findings was the further detail they provided about concepts found in prior literature, that address gaps in the field's understanding about what might matter to faculty in instructional design relationships and processes. Third, our study illustrates our participants' commitments to multiple values about design relationships and processes. This highlights the importance of instructional designers being sensitive to the same possibility in their own relationships with the faculty they work with. Further discussion of each of these points is provided below.

We first note the consistency of our findings with previous instructional design research. For instance, collaboration was a recurring theme among our participants, aligning with one of the more common findings about instructional designer/faculty relationships in the existing literature (Chen & Carliner, 2021). Similarly, our participants also valued efficiency as found by Olesova and Campell (2019), engagement as found by Bawa and Watson (2017), and expertise as found by Chittur (2018). Although case studies can be valuable even if they differ from prior literature, the alignment of our findings with other research suggested a useful implication. At least in part, it means this study is a form of source triangulation with what other scholars have reported (Lincoln & Guba, 1985), and helps contribute to the soundness of what scholars have investigated in instructional designers' relationships with faculty. For instance, because our findings were generated from analysis of faculty communications when they did not know researchers would be listening in, this supports the trustworthiness of similar factors that faculty have reported to researchers through interviews (the method used for many prior studies). Consistency between studies is evidence that the results of prior research have not been a result of faculty giving researchers what they perceived to be socially acceptable answers. This should increase instructional designers' confidence in regard to aligning their relationships and processes with what the literature has previously reported. A further practical implication of this consistency is the likely overlap it indicates about what matters to instructional designers and faculty about their working relationships. This suggests that instructional designers could explicitly talk to faculty about their similar values, which might help lay a foundation for developing a successful relationship themselves (cf. Rogers & Ballard, 1995).

Second, our findings offer a more unique contribution through the further detail they provided about some of the concepts reported in prior literature. This can address gaps in researchers' or practitioners' understanding of what might matter to other faculty about instructional design relationships or processes. Using collaboration as an example, Chen and Carliner (2021) noted that while many researchers have discussed its importance, they have not defined the construct itself; "despite a strong pattern . . . of studies that characterize the working relationship between faculty and instructional designers as 'collaborative' . . . few studies actually provide definitions of a 'collaborative' relationship" (p. 20). While our study did not provide a formal definition of the term either, the detail our participants provided about it could help instructional designers develop robust notions of what faculty might mean when they talk about collaboration, without reducing what is likely a multi-dimensional construct into a simple definition that could eliminate the nuance or distinctions that mattered most (this was a particular strength of our narrative case method; it allowed for rich exploration of topics that could be easy to oversimplify). For instance, when our participants talked about collaboration they included sharing ideas, actively seeking out others' opinions, allowing any team member to propose ideas, discussing alternatives people might raise, and joint forms of decision making. If instructional designers understood collaboration in the rich way our participants discussed they could be better prepared to have meaningful discussions about the type of collaborative relationship they might develop with the faculty with whom they are working.

The same is true for other themes from our findings. The detail our participants discussed about rationality in instructional design (e.g., deliberate action; finding the right process) could inform designers' conversations with other faculty about what types of processes will be most advantageous to them. Or, our participants' understanding of engagement (e.g., commitment to the project's cause; being present and involved with other team members) could

contribute towards designers' understanding of why faculty they work with may or may not welcome the help of certain individuals in an instructional design project.

Third, there were times in our analysis when it appeared that issues that mattered to our participants were experiencing tension with each other. For instance, even though our participants valued expertise and often attempted to align their team structure with this ideal, expertise was not the only value they held to about the team, and so at times we found them prioritizing engagement or collaboration over expertise. Similarly, while there were instances where they prioritized collaboration over efficiency, there were also cases of them doing the reverse. Overall, the faculty in our study were navigating a rich landscape of values that mattered to them, while at the same time trying to cope with the practicalities of their situation as they encountered it. This meant that at certain times one value could speak to them more loudly than others, and their different values were either more or less relevant based on the most salient characteristics of the moment. So, it appears overly simplistic to promote a set of values as being what matters to faculty about team relationships or processes, without also recognizing how those values could be stronger or weaker in certain contexts, or how certain values might be what faculty prioritized in one setting, while in a different setting they prioritize others that might even appear to be in competition with what they had valued only a short time before.

This observation could help contextualize factors regarding instructional designer/faculty relationships reported in prior research. For instance, Chen and Carliner (2021) described good designer/faculty relationships as being based on "clear [agreement] upon the ownerships and leaderships involved in the design process beforehand" (pp. 14-15). They also described good relationships as being flexible, "adjusting instructional-design processes and types of support" as different needs arose (p. 14). While much of the time these values could complement each other, it could also be possible for them to be at least somewhat incompatible as well. For example, there may be circumstances where a more flexible approach could overcome a roadblock in a project, yet such flexibility might conflict with agreed upon responsibilities that faculty and instructional designers had previously determined. Instructional designers should be sensitive to these possibilities, and consider the particular needs of the faculty they are working with at a particular time, which could alter how the faculty might value one course of action over another. Explicit conversations with faculty about potential value conflicts could also help instructional designers navigate these kinds of circumstances.

Conclusion

In this study we investigated what university faculty valued when working with an instructional design team to develop educational simulations. This provided insights into matters the faculty found to be significant about their relationships and processes with the team. Specifically, they valued: (a) collaboration and inclusion; (b) rationality and efficiency; and (c) expertise and engagement. In the first two themes the dual concepts seemed to reinforce each other, while in the third the faculty sometimes experienced each as being in tension with the other. Additionally, there were sometimes tensions across the themes as well. These issues were consistent with prior research, suggesting that instructional designers can have confidence in the growing body of scholarship pointing towards what kinds of factors matter in designer/faculty relationships. Unique contributions of our study were the further detail it provided about constructs our participants found to be important in their relationships and processes, as well as how it illustrated that their commitment to multiple values about design relationships and processes can be in tension with each other. While further research will be useful in understanding how these factors could affect instructional designers/faculty interactions in other settings, even with the limitations we noted our study pointed to some of the ways that instructional designers can build a foundation for successful relationships when engaged with faculty in instructional design work.

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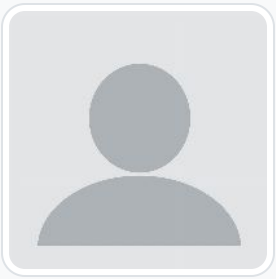
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Evaluation and Reflective Implementation of an Online Open Educational Resource (OER)

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Social Media | Open | OER | OER Development | Educational Design Research | Search Engine Optimization

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This paper presents the evaluation and reflective implementation of iteratively designed and developed online open educational resources (OER) for geoscience undergraduate classes in the context of a long-term educational design research project. The results indicated that the use of free and open software and social media allowed low cost in video content hosting and broadened cross-disciplinary review and evaluation. These methods provide insights for scientists, teachers, instructional designers, educational researchers, and librarians in the use of social media and Search Engine Optimization (SEO) for OER implementation and reuse. Pros and cons of using these evaluative and reflective methods, especially during the Covid-19 pandemic, and the sustainability of maintaining OER are discussed.

Introduction

The design, development, and use of open educational resources (OER) are increasingly broadening learning access (Cooney, 2017; Luo et al., 2020). OER enables the possibilities of integrating the collective wisdom of subject experts through intentional curation of existing and ever-growing digital resources. OER also creates engaging learning experiences using interactive digital technologies and reusable learning objects grounded in learning science (Wiley, 2000). In addition, OER has real potential to lower the costs of textbooks and related educational materials. In the disciplines of science, technology, engineering, and mathematics (STEM), these digital and/or online OER can enable low-cost access to active learning experiences in both virtual and face-to-face learning spaces. For example, OER can be used to simulate live experiences in laboratory settings with interactive content engagement when access to real world scientific equipment is limited (Ackovska & Ristov, 2014; Gaba & Prakash, 2017; Liu & Johnson, 2020). The design and development of STEM OER are ideally based upon learning science, media production principles, and technology affordances (Liu & Johnson, 2020). To successfully adopt sound design and development of OER and evaluate its effectiveness and impact, it is necessary to test and document both local viability and wider adoption practices (Larson & Lockee, 2019; McKenney & Reeves, 2019). Rigorous review and evaluation methods in an open education environment

are needed to ensure learning strategies integration, continued improvement of OER quality, and sustainability of OER adoption and growth (Atenas & Havemann, 2013; Clements & Pawlowski, 2012; Kimmons, 2015; Mishra & Singh, 2017).

In this multi-year and multi-phase OER educational design research project, the researchers conducted iterative cycles of OER creation, evaluation, and class-based adoptions for geoscience education with funding from both federal and state grants. As the design, development, and preliminary implementation were refined through formative evaluation, simultaneously OER products were promoted to broader audiences and used in target contexts to investigate their impact (Liu, Johnson, & Haroldson, 2021; Rolfe, 2016). Iteratively geoscience OER content was gradually set in place to meet instructional and funding goals. Unfortunately, revision of content format and structure, evaluation, reflective implementation, promotion, and continued refinement for broad adoption appear to have been of lower priority in the development of and documentation of most geoscience OER development projects. References to existing theoretical and practical frameworks are scarce, creating a lack of strategies and techniques to broaden the reach of OER (Rolfe, 2016).

The needs of problem-solving in OER design research kept emerging, which required “the iterative development of solutions to practical and complex problems” and provided “context for empirical investigation” (McKenney & Reeves, 2019). To optimally reach a broad audience with minimal cost (especially with limited funding cycles), the investigators of this research hosted OER videos on YouTube and performed project management with Open Science Framework (OSF), a cost-efficient content management repository. Review feedback was invited with the free version of hypothes.is, class surveys, and the comments feature in PressbooksEDU. Google and YouTube analytics were also used to adjust Search Engine Optimization (SEO) (Rolfe, 2016). The challenge of OER development evaluation was found to minimize the “tension between collecting meaningful impact data and ensuring the materials remain open and accessible through the process” (Pitt et al., 2013, p. 2).

Within the context of this educational design research project, this paper focuses on the evaluation and reflective implementation stages of the design research and provides an exploratory answer to the question, how can a series of laboratory-based STEM (geoscience) OER be reviewed and evaluated to optimize their reach of use and reuse? The literature review explores the various aspects of this research, followed by research methods and data collection for the OER developed in this study. The results are analyzed along with reference to the relevant literature as well as to the researchers’ reflections.

Literature Review

Because of the rising attention to the costs of textbooks and instructional resources as well as the availability of increasingly ubiquitous digital technologies, OER have emerged in STEM education (Allen, et al., 2015; Alves & Granjeiro, 2018; Harris & Schneegurt, 2016). The essential goal for the design, development, and implementation of OER is to enable open and inclusive learning access for all students.

The STEM OER projects in this paper were funded with the purposes of lowering textbook costs for students, maximizing availability and accessibility of laboratory equipment to students in classroom-based and online settings, and flexibly integrating active learning strategies. To replace dated and costly textbooks for the geoscience undergraduate microscopy classes, OER were created from actual teaching practices in laboratory settings. Educational design research and iterative evaluation were adopted for the OER development and implementation (Brown, 1992; Collins, 1992; McKenney & Reeves, 2019; Plomp & Nieveen, 2007; van den Akker et al., 2006). Educational design research (EDR) probes, develops, adopts, enacts, tests, and “sustainably maintains” solutions to problems in learning settings within the real context for empirical investigation (McKenney & Reeves, 2019). EDR is usually collaborative, responsively grounded, and iterative. The interventions that emerge from EDR are oriented to practically solving real-world problems in authentic settings, rather than intended to test hypotheses (McKenney & Reeves, 2019).

Literature in related disciplines and categories has provided a sound foundation for the formative evaluation, identification of methods, and reflective implementation of these newly developed OER. These include learning

strategies in OER, review and evaluation of OER and related follow-up issues, and optimizing the implementation and spread of OER (McGill et al. 2013; Rolfe, 2016).

Engaging Student Learning with OER

Shaped by learners' needs, technologies, and systemic changes, learning environments have been extended beyond physical classrooms and can provide resources and expertise online to support the search of evidence and connection of ideas, as well as enable broader problem-based learning (Jonassen & Rohrer-Murphy, 1999; Liaw, Huang, & Chen, 2007). Students' abilities and skills to connect learned concepts and theories with the search for evidence and pursuit of connection between various concepts, skills, and subject areas need proper scaffolding (Lawson, 1989). Based on social constructivism and learning cycles in science education, the scaffolding can only take place effectively with intentionally designed learning activities that introduce the to-be-learned concepts and enable student exploration and application through cooperative and collaborative learning with consistent self-assessment (Blank, 2000).

Engaging student learning in STEM education has unique challenges because of the need to blend learning of scientific theories and principles with practical applications of laboratory and field procedures as well as data evaluation and synthesis and creation and testing of new hypotheses. Traditional textbooks have played critical roles in information dissemination, acting as reference materials, and providing directions for learning assessment. With the fast-evolving innovative technologies and the progression of active learning strategies in STEM education, student perception and interaction with the content in an OER environment can be captured and measured (Dennen & Bagdy, 2019; Liu, Johnson, & Haroldson, 2021; Luo et al., 2020).

POGIL (process-oriented guided inquiry learning) is an active learning strategy that provides instructional content presentation with guiding objectives, core questions, and procedural assessment so that students can focus on deep learning (Brown, 2018; Purkayastha et al., 2019). POGIL was initially developed to engage student learning in chemistry courses (Farrell, Moog, & Spencer, 1999) and later adopted widely in teaching and learning of other sciences. It has the roots in a Piagetian model of learning and has integrated the principles and concepts of inquiry-based learning and experiential learning cycles in science and laboratory education (Abdulwahed & Nagy, 2009; Kolb, 2014; Piaget, 1964). There is strong evidence of the effectiveness of POGIL in science learning (Freeman et al., 2014).

Along with POGIL, deep learning is reflected with learning behaviors such as seeking meanings, relating ideas, use of evidence and interest in ideas (Entwistle, Tait, & McCune, 2000). These have been found to be related to student perception of teaching quality and learning experiences for students (Entwistle & Tait, 1990; Liu, St. John, & Courtier, 2017; Richardson, 2005). Educators have been probing what can potentially lead to student deep learning in ever evolving learning environments (Entwistle, etc. 1979; Jonassen & Land, 2012; Meyer & Parsons, 1989). Studies have been conducted in various contexts and disciplines to investigate contextual factors associated with student deep approaches to learning. Student perception of learning with geoscience OER, especially their self-perceived confidence in geology instrumentation and research, remains an underexplored area.

Review and Evaluation of OER for Verification of Design Ideas

OER design and development require problem-solving in an evolving and real learning environment with multiple and multi-level stakeholders. This can be optimally strategized and operationalized with educational design research which is defined as "the iterative development of solutions to practical and complex educational problems" (McKenney & Reeves, 2019, p. 6). These include iterative review and evaluation with local viability implementation to verify their fulfillment of instructional design and development concepts and procedures (Larson & Lockee, 2019; McKenney & Reeves, 2019). In this way, the designers and subject matter experts (SME) become researchers, with the mindset of being good teachers, and are thus afforded a rich and "humbling opportunity" for discovering the perception of usability and the effect on student learning (McKenney & Reeves, 2019).

In their OER integration study, Dennen and Bagdy (2019) investigated the perception of learning with OER by undergraduate students in an educational technology class. Students were given surveys with closed and open-ended items regarding their perception of using customized OER at the local institution. Students felt favorably towards the

benefits of free and customized text and readings for their classes. Formative evaluation was also conducted with mixed methods of surveys and observations, based on literature from instructional design and OER discipline-specific learning studies (Liu, Johnson, & Haroldson, 2021; Liu, Johnson, & Mao, 2021). OER usability questionnaires were based on the pre-existing criteria of assessing multimedia learning objects (Benson et al., 2002; Kay & Knaack, 2008). These evaluative studies focused on learner experiences of content presentation, interactivity, navigation, and accessibility within a specific context and as case studies.

Evaluation of newly designed OER, seen as a new educational design research product within an evolving learning environment, can consist of various stages of testing, collecting perception and reflection data of soundness and feasibility from teachers, students, and designers (Liu, Johnson, & Haroldson, 2021; Liu, Johnson, & Mao, 2021). For the study presented in this paper, after an initial pilot, student feedback and instructor reflection have been primarily used as formative evaluation to guide the design and development of courses using the customized OER.

Evaluation and Reflective Implementation for OER Spread and Sustainability

Evaluative procedures can ensure the quality of OER and their sustained impact on learning, enhancing the realization of iterative and sustainable changes (de Carvalho et al., 2016; Kimmons, 2015; Tlili et al., 2020). The breadth of implementation is viewed as the foundation of promoting OER to wider adoption and retesting with evidence of learning effectiveness (Bodily et al., 2017). The reuse, replication, and modified reproduction can also be a method to generalize the EDR output (McKenney & Reeves, 2019). Therefore, both lines of validating OER quality through reviews and evaluation and identifying mechanisms of elevated discovery are needed.

A decade of OER development is found to be “characterized largely by a proliferation of content only” (DeVries, 2013, p.57). To move forward to an OER culture for diverse curriculum-level adoption, existing OER content needs to look for further development of learning activities, assessment items, continually enhanced navigational options and discoverability, and course integration strategies (Luo et al., 2020; Wiley et al., 2017). Multiple methods of data collection and sources on OER use and evaluation, beyond host institutions and disciplines, are recommended for OER research (Pitt et al., 2013). The evaluation of OER impact, however, has its unique opportunities and challenges. After a systematic review of 37 papers in peer-reviewed academic journals on OER studies, Luo, Hostetler, Freeman, and Stefaniak (2020) discovered a split perception of OER quality between faculty and students. Their review indicated that students perceived OER with favor mainly because of their openness and cost-saving, and that faculty had split views because of awareness or concerns of quality and lack of support for contextualized instructional strategy integration. They recommend incorporation of instructional strategies in close alignment with learning outcomes and newer models of supporting OER adoption, with enabling technologies for OER implementation.

Questions were also raised regarding the formalized review of OER versus traditional publishing procedure, breadth of reach, approaches of access, and regions and disciplines of reach for broader and sustainable OER adoption. Algers and Ljung (2014) used the fourth generation of Activity Theory and conducted a study on peer review of an animal welfare education OER. Data were collected from students, teachers, and scientists. The results indicated that “OER is a new kind of learning approach which can be based on participatory enquiry; and since openness is both the objectives and the instruments, a peer review assessment of the artifact cannot be comprehensive.” In contrast to the original intent of OER, “striving to share the same object between multiple activity systems complicates the issue of power and passion.” (Algers & Ljung, 2014, p. 371).

Review and evaluation to ensure the quality was just half of the journey to sustain OER. Building discoverable OER with search engine optimization (SEO) was recommended with the UKOER project report and contributing scholars (McGill et al., 2013; Rolfe, 2016; Rolfe & Griffin, 2012). Search engine optimization (SEO) is a suite of keyword design and related implementation mechanisms to enhance searchability of web-based content, which can be used for web-based marketing and research, content reach, and customer services (Chen-Yuan et al., 2011; Malaga, 2010). In the UKOER project, maximizing the reach of OER to broader audiences had to rely on Wordpress.org platform because of easy integration of SEO. This highlighted the value of using and enhancing SEO to enable the discoverability of OER, which

related to metadata-like refined keywords so that OER could be easily discovered by end users. This also raised the OER relation to integration with content management systems or learning management systems for learner access, increasing attention to institutional support to an OER adoption culture of reuse, revision, remixing, and redistribution (Rolfe, 2016; Wiley et al., 2017). Ranking of OER, support and incentives, and possible adoption models were also studied or proposed in the global setting for OER sustainability (Koohang & Harman, 2007; Mishra & Singh, 2017; Tlili et al., 2020; Zaid & Alabi, 2020).

Truly open OER resources are suggested to be developed with existing technology and low-cost (and sustainable) media platforms in mind (McGill et al., 2013; Rolfe, 2016; Rolfe & Griffin, 2012). The development and implementation of OER can build in social media and free software components in its iterative refinement process, ideally with consistency for its sustainability. OER researchers also need to intentionally incorporate these strategies and tools in projects that have limited funding cycles. Therefore, a suite of tools with carefully designed research protocols for the OER evaluative implementation are presented in this paper. Understanding the feedback between learner experiences and valid and transparent reviews and how it impacts revisions is the core concern of this current study.

Research Context

Identification of minerals and rock textures using a commonly available piece of equipment called a petrographic microscope is a standard skill set for most geoscience curricula. Increasingly common is the use of more sophisticated equipment to measure physical and chemical properties of geologic materials, and the theory and practice of using these analytical methods are usually taught in middle- to upper-level required and elective courses in the geosciences. Learning in these classes must rely on lab equipment such as petrographic microscopes which cost thousands of dollars apiece, as well as specialized equipment which can cost hundreds of thousands of dollars or more. The classes also need to use one or more expensive and very specialized textbooks, and usually require small-group or individualized laboratory instruction. All these factors motivate the need for more open, accessible, interactive, and customized instructional content and learning activities. Therefore, OER are much sought after to meet student learning needs in laboratories, field trips, and undergraduate research, because of their low cost, potential for engaging learning activities with intentional design, and digitally more portable access.

The purpose of this project was to design, develop, and pilot OER on the parts, theory, and applications of the petrographic microscope to identify and analyze minerals, which could be used at the host university as well as in a variety of Earth Materials courses at other institutions. The OER is entitled Introduction to Petrology (Using the Petrographic Microscope). Proposed as a multi-stage project, this phase was funded by a 2019 spring Virtual Library of Virginia (VIVA) redesign grant and based on the design, development, and pilot implementation of a National Science Foundation (NSF) funded Analytical Methods in Geoscience OER for a blended learning course between 2016 and 2020. For the Introduction to Petrology OER, the project investigators completed 2 chapters, 13 units and a preface, with related self-assessment interactive exercises written by the geoscientist researcher in this project and parallel-using OER and a learning management system, videos, and 79 interactive H5P objects, published at https://viva.pressbooks.pub/petrology/.

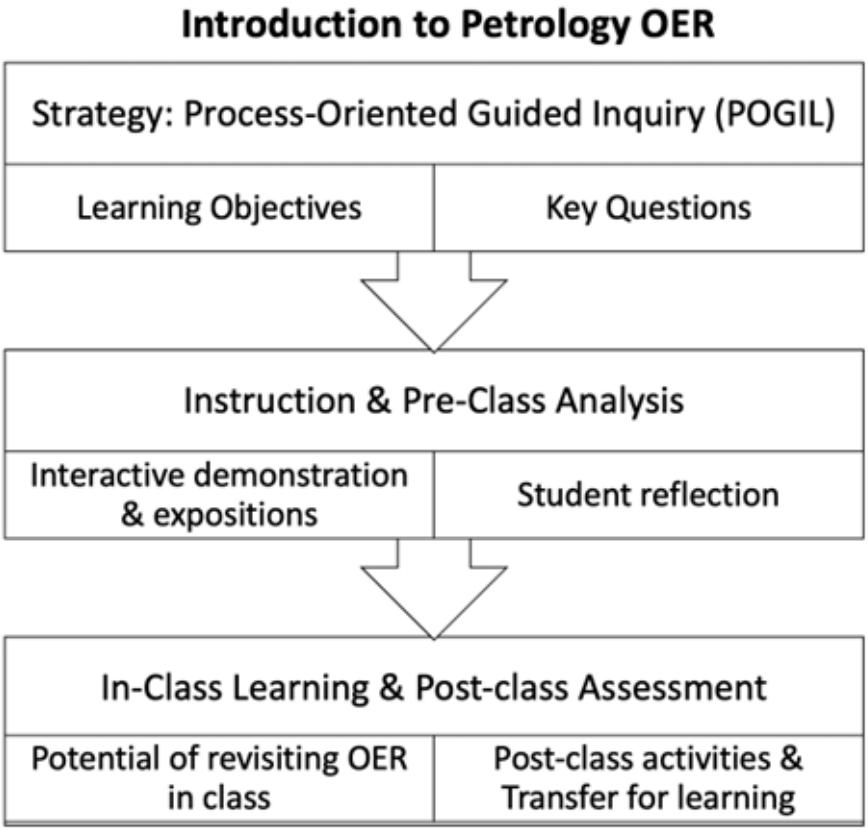
The local use of the OER has been in a required 4-credit mid-level course for the Bachelor of Science (B.S.) in Geology, specifically the Introduction to Petrology class. The course includes lecture, lab, and field components. It is offered at least once a year, and in recent years has been offered in the spring semester only. There is an approximate 20-person cap in each section of the course because of the limited number of microscopes and seats available to use in the classroom, and to accommodate the need for individualized attention from the instructor and laboratory assistant. The course is intended to be taken by sophomores and juniors, although some senior-level students (usually transfer students) also enroll for credits. The skills and competencies learned in this class are necessary for upper-level electives and the required a capstone 6-week summer field course. Each course contains more than 10 lab assignments utilizing petrographic microscopes and other lab equipment like a scanning electronic microscope (SEM).

In this OER research, each module unit was created using a customized Process-Oriented Guided Inquiry Learning (POGIL) process, presenting learning objectives followed by comprehension questions and higher-order reflective prompts with visual and interactive expositions or demonstrations (as Figure 1) (Liu, Johnson, & Haroldson, 2021; Liu & Johnson, 2020; Moog et al., 2006). With the focus on online and digital content access and learning interactivity, the original grouping strategies in POGIL were not adopted in this customization. H5P learning objects as interactive learning objects based on HTML5 were developed for learner self-paced interactivity and self-assessment. Metadata were intentionally developed with these H5P objects to enhance their searchability.

For the purposes of easy access, open adoption, and sustainability after the funding cycles, the researchers published the video content on the Analytical Methods in Geoscience (AMiGEO) YouTube Channel, with edited YouTube auto-captioning, to enhance the accuracy and accessibility of scientific terminologies. Because of limited funding cycles and multiple collaborative partnerships, the core researchers were only able to edit the scientific accuracy for some of these videos auto-captioning. Project management, including tracking versions and archiving raw images and video footage, utilized a combination between physical portable hard drives and an institutionally subscribed Open Science Framework (OSF). Using OSF enabled the flexibility of flipping the content between private and public mode. Each publicly shared object from OSF could carry a unique Digital Object Identifier (DOI) (Foster & Deardorff, 2017). These features were included in the OER design project management for future reuse.

Figure 1

Unit Design of Introduction to Petrology OER



Unit design of Introduction to Petrology OER uses the strategy of Process-oriented guided inquiry (POGIL) directs formation of learning objectives and key questions, followed by instruction and pre-class analysis, with interactive demonstration and exposition, student reflection. Then in-class learning and post-class assessment, with potential revisiting OER in class and post-class activities and transfer of learning.

Research Methods and Data Collection

Because of the novelty of OER design in geosciences with adapted POGIL strategies and the emerging evaluative angle in an authentic setting, the researchers have adopted an educational design research approach (McKenney & Reeves, 2019). This paper focuses on the stages of evaluation and reflection, and implementation and spread of this research study. Reflective and empirical data have contributed to the review and evaluation which "concerns early assessment of design ideas," verified local viability for OER integration in the geoscience classes and produced feedback and reflection about wider implementation and spread (Larson & Lockee, 2019; McKenney & Reeves, 2019).

The researchers conducted iterative educational research cycles, encompassing pursuing solutions through needs analysis, experiments of aligning content development with active learning strategy integration, dissemination of preliminary OER at geoscience and education research conferences and workshops, inviting review feedback, and attempting to build a community of geoscientists, librarians, and instructional designers and evaluators to sustain the reuse, refinement, and informed continuity of these OER. A mixed-methods design was adopted to conduct this educational design research through its analysis and exploration, design and construction, evaluation and reflection, and implementation and spread stages (McKenney & Reeves, 2019). After the Institutional Review Board approval of the research protocol, the researchers collected quantitative and qualitative data from undergraduate students, faculty members, participants at geoscience conferences, and reviewers, with their informed consent. The preliminary implementation of OER was ushered with formative evaluation (Liu, Johnson, & Haroldson, 2021; Liu, Johnson, & Mao, 2021). Several approaches for data collection in this current study are presented below.

Student Perception and Performance

Students enrolled in two geoscience undergraduate classes in a public university on the east coast of the United States were invited to complete pre- and post-class surveys on their perception of using OER and knowledge gain in spring 2020 and spring 2021. The OER were piloted with a Learning Management System (LMS)-Canvas customized integration in the host institution's Introduction to Petrology class, according to the proposed timeline of the project and approved by VIVA. Because of the immediate needs of open access to instructional resources in the pandemic transition in Spring 2020, the chapters on creating thin sections (polished slices of rock on glass slides which are used in the petrographic microscope) were also integrated into an upper-level elective course called Laboratory Techniques in Geology which taught theory and methods of a variety of laboratory equipment used in geoscience research. The data collection in spring 2020 for the pre-assessment was interrupted by a system transition of the university survey platform at the beginning of spring 2020, after informed consent was collected from the classes. Later into the semester, the COVID-19 pandemic pivot to emergency remote learning then affected the post-assessment survey deployment along with the trying disruption to teaching and learning norms (Hodges et al., 2020). There was simply no room for the instructor, the researcher, and students to spare time and attention on the research side of this project. In addition, because of the COVID-19 lockdown, the equipment needed for the lab-based course was not available to the instructor nor students. Therefore, the originally proposed and IRB approved class observations were not possible.

However, even in the pivot to emergency remote learning, the instructor persisted teaching and used the OER in the Introduction to Petrology course. Student learning with the piloted content was assessed in a variety of ways, including pre- and post-class informal knowledge checks, informal Zoom poll "quizzes," homework or lab assignments based upon questions in the OER, and summative assessments in the form of quiz or test questions. These were all in alignment of the class curriculum plan and objectives, as part of the class learning activities. In the Laboratory Techniques in Geology class, student learning was assessed with written report assignments in part based upon questions in the OER and evaluated with a standard rubric developed for an earlier project ((Liu, Johnson, & Haroldson, 2021; Liu, Johnson, & Mao, 2021). In spring 2021, students in Introduction to Petrology were asked about their confidence in understanding materials in the Zoom polls and were also asked to provide feedback on each chapter in the OER as part of their homework assignments. The 19 students enrolled in this class all gave consent to participate in pre-assessment and 16 consent to post-assessment questionnaires administered with a web-based survey platform, QuestionPro. All data was collected in aggregate and anonymous form and with informed consent.

Reviewer Feedback

The OER were shared and reviewed at a workshop at the 2018 AGU (American Geophysical Union) Fall Meeting for user experience review (with the content developed through the NSF funding cycle) and as part of the Earth Educators' Rendezvous (EER) conference in summer 2019. Written notes from 2018 AGU meeting group review discussions were collected and the audio conversation of the EER workshop, in a large room with nearly 30 participants, was recorded and transcribed after the conference. Between fall 2019 and spring 2020, a science librarian and a geoscientist from a similar public university in a different state were invited to review the published OER. The reviewers were invited to mark up and comment the OER on the content rigor, navigation, and accessibility, using the free web-based annotation software hypothes.is. One reviewer chose to use hypothes.is. The other wrote a review report and sent to the project investigators via emails. Comment function within PressbooksEDU was also enabled for feedback for those who would have access through class integration or URL search.

Reflective Implementation

The researchers also attempted a pilot call for implementation with social media, Twitter and Facebook. Data was collected on SEO through Google Analytics enabled by VIVA. YouTube Analytics were collected from the Analytical Methods of Geoscience (AMiGEO) channel.

According to the originally planned research, the data collection was proposed for observations, usability test, design documentations and logs, pre- and post-test after pilot use of developed OER content, conference workshop feedback from faculty and geoscience graduate students, librarian and geoscience faculty content review feedback, and students using OER for class assignments. The STEM classroom observation checklist (Stearns et al., 2012), Koretsky, Petcovic, and Rowbotham's (2012) Geoscience Authentic Learning Experience Questionnaire, Benson et al (2002) Usability Test for e-Learning Evaluation, and Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich & de Groot,1990) were planned for evaluation and reflection for this study.

Unanticipated issues, challenges, and opportunities arose in the 2020-21 parts of this pilot study due to the COVID-19 pandemic and a change in the institutional survey platform. The second half of the spring 2020 semester was conducted solely online from home, with limited conferencing and internet resources for students and instructors and pandemically mandated asynchronous teaching. This severely limited the Introduction to Petrology and Laboratory Techniques courses taught that semester and prevented meaningful evaluation of student experiences with OER. The Introduction to Petrology course was taught in spring 2021 but was completely rearranged due to a required two-week online only period at the start of the semester, and a prerequisite course being taught solely online with no hands-on work. One benefit to this re-arranged schedule was that the entire online OER microscopy module was used to teach the students this topic, first online and then as a support for laboratory exercises later in the semester. Improved technologies allowed student feedback through Zoom polls as well. The persistence of online content presence, learning access, and SEO with Google and YouTube analytics did provide valuable data for the results.

Results

This section presents the results of this study from 1) analysis of student performance and perception with OER adoption, 2) reviewers' comments and corresponding modification process; 3) SEO analytics from Google and YouTube.

Student Learning Performance

These results consisted of the key data of viability that provided evidence of the design intervention of OER and effectiveness of its adoption in classes. This was measured with the combination of pre-class warm-up just-in-time reflections based on the key questions built in the interactive textbook, laboratory note-taking, post-class short quizzes, and assignments graded with a rubric that was generated in the NSF-funded project (DUE #1611798 and DUE #1611917).

The students in the spring 2020 Introduction to Petrology class did very well on the homework questions about the OER reading and improved their average score from the quiz (beginning of the semester) to the two exam questions based upon knowledge of mineral identification, according to the class instructor notes. For the spring 2021 Introduction to Petrology class, informal Zoom poll “quizzes” were launched at the beginning of online class lectures in January and February 2021, to engage students in completing online assignments and attending online lectures during the first half of the semester when the course transitioned from online-only to a hybrid format. These “quizzes” were NOT graded. These were given at the beginning of class to remind students of content covered previously. Several multiple-choice or multiple-answer questions were posted using Zoom polling, and students had 2-4 minutes to respond to these polling questions. Students were able to use notes or online materials if they wished, but the polls were meant as a quick review so that there was no time to search for responses at length.

Polls were conducted during five classes at the beginning of the semester. The poll on the first day of class asked students to recall information about minerals covered in the pre-requisite course taken in the previous semester. On a scale from 1=very unsure to 5=very confident, the average student confidence in their responses on this first pre-module quiz was 2.4/5. Students were more confident about their responses to similar Zoom polls after covering use of the microscope in the OER, even with the class still meeting completely virtually. Students ranked their confidence in understanding the parts and how to use the microscope as 4.1/5 after completing the OER and ranked their understanding of intermediate and advanced analytical procedures using the petrographic microscope as 3.2/5 even though they had not yet touched a microscope for any class.

There were one graded quiz and 3 questions in an exam in spring 2020 that were associated with student use of the OER content. The quiz contained 9 points of questions about mineral formulas and 21 points of questions about minerals in the thin section. The average quiz grade remained the same (within error) as the previous 2 semesters, even with the pandemic interruption in Spring 2020. The average score of quiz grades was 77.8, in comparison with the average of spring 2019, 81.4, and spring 2018, 76. The exam covered the first half of the semester, which included many other topics and labs which apply the knowledge from the microscopy unit in the Intro to Petrology OER. Only three questions from the exam directly related to identifying minerals from formulas or in thin sections (with no other additional skills required). Students did better on these 3 questions than they did on the exam as a whole. The average % correct for these 3 questions was 90%, with 14 students having answered 100% correctly among 21. The average for the individual part of the exam (53 questions) was 64%.

In the pre- and post-assessment questionnaires with QuestionPro (a total of 31 Likert-scale items: 1=strongly disagree to 5=strongly agree), there were 5 questions focusing on student learning expectations, experiences, and confidence in laboratory-based classes. The Pre-assessment questionnaire collected demographic information and previous geoscience learning experience for the spring 2020 petrology class. Among the 19 pre-assessment participants with research participation consent, there were 47% with female identity and 53% as male; 82% White, 12% Hispanic and Latinx, and 6% Asian and Asian American; 35% senior, 35% junior, 18% sophomore, and 12% other. The completion of previous relevant courses was widely diverse from physical geology, mineralogy, historical geology, introduction to environmental studies to calculus or statistics (Appendix A).

There were student perceived gains regarding the following laboratory-based learning experiences, with an average gain of .21 (Appendix B):

- To reflect on what I was learning (+.49)
- To discuss elements of my investigation with classmates or instructor (+.35)
- To be confident when using equipment (+.29)
- To share the problems that I encountered during my investigation and seek input (+.28)

More importantly, students gained confidence through the use of OER with an average gain of .52, based on the comparison of pre- and post-assessment survey results (Figure 2). The instructor reflected, “this is not significantly different from previous semesters. So, we aren't hurting student progress by using the online [OER] materials! I sort-of had the materials together in 2018 and 2019, but not in the nice interactive current form.” The results coincided with

those from previous studies, “While remaining silent on the issue of whether OER use is associated with better learning outcomes, Hilton concludes that OER use is not associated with decreases in student learning” (Wiley et al., 2017, p. 64).

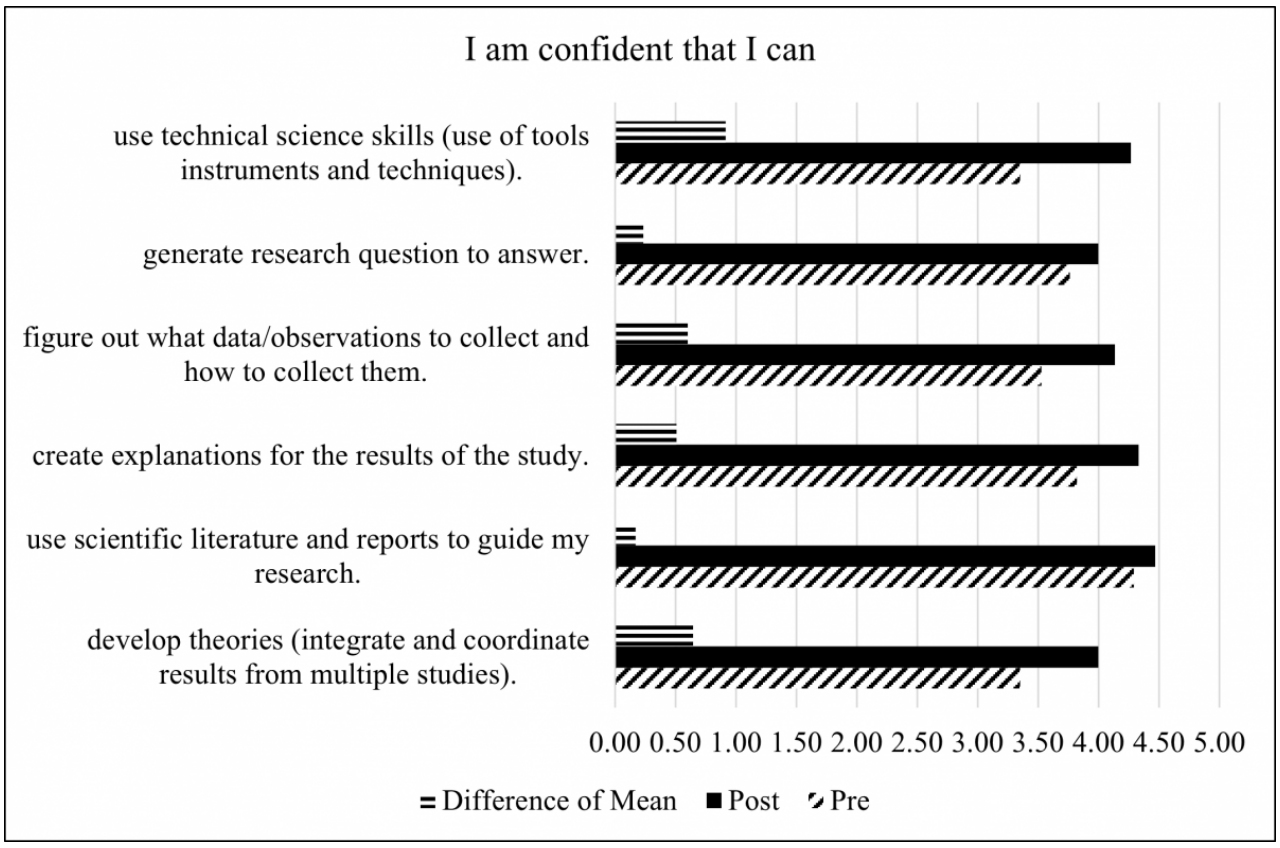
Student Perception of Learning with OER

Students also provided qualitative feedback through an open-ended question at the post-assessment, as the following:

- This course was very helpful in learning and understanding thin sections which was something I struggled with before this class.
- I was able to get hands-on lab time which I think is necessary for the identification of rocks. My confidence was not where I hoped it was at the begging of the semester, but now as we have completed the course I feel far more confident in my abilities.
- This course did a great job of showing how to use petrographic microscopes and collect data using observations and overall theories.

Figure 2

Pre- and Post- Assessment of Student Confidence



This is a bar chart showing student confidence gains in the following:
I can generate research question to answer.

For most of the graded homework assignments on the microscopy modules in spring 2021, students were asked to respond to this question at the end of the assignment:

How could this page be improved? Did you find any errors, or can you think of a better way to present the materials on the textbook site?

Although some students simply responded that it was “good” or that they couldn’t think of much for improvement, many did provide comments. These comments included technical and content suggestions or were a mixture of both. For example, one student wished that an image could be enlarged, and another would like an interactive diagram to work in a different way. Content comments tended to focus on applications, such as how to use a diagram to complete a task or question.

In terms of perception of using OER, students were motivated to provide comments when the activity became part of an assignment for credit. Each time students were assigned an OER module to complete reading and answering the online questions, there was a corresponding graded assignment in the course in Canvas. In the same graded assignments, students were also invited to contribute open comments for improving OER. The last question in each graded homework assignment asked students to provide feedback about how to improve the OER - what content to include, or how to present the material better. Students usually provided varied responses. As long as they wrote a response, the instructor gave them credit for that question.

In addition to positive feedback on the OER, students also suggested improvement of design layout, interactivity, and content enrichment with excerpts like the following:

- “It would be nice if on the question about the microscope parts they put a model of like a side view of a microscope so that I can reference to where each part is.”
- “I like the quizzes at the end of each section. For this section, I think the mini-quiz helped me understand what causes the issues and how they can be resolved.”
- “I did not find any errors, and it really cleared up some misconceptions I had on pleochroism. It would be nice to see more pictures.”

Students were also asked to complete pre- and post-surveys (Koretsky et al., 2012) prior to the use of this interactive OER textbook and at the end of its use of a semester, to measure the perceived changes in knowledge and attitude. The questionnaires included student perception of learning problem solving skills, being confident when using equipment, being intrigued by the instruments, using observations to understand the physical or chemical properties of the sample, interpreting the data beyond only doing calculations, feeling the procedures to be simple to do, developing confidence in the laboratory, thinking about what is happening at the atomic or molecular level, and being excited to do laboratory analyses. Because of the survey platform transition resulting in the failure to capture the pre-assessment at the beginning of the semester, and the pandemic hiatus toward the end of the spring 2020, the data from these surveys were not valid for analysis.

The reflection from the course instructor indicated that proactive (and well-formulated) questions were asked by students after viewing the OER online. The instructor’s reflection also revealed that students tended to ask more questions that were relevant to the operation of the instruments. Students’ questions contained information basis from the online OER which they were required to review before their lab sessions.

Review Feedback

The researchers adopted several approaches to collecting review feedback in this educational design research project. The research team conducted workshops at AGU and Earth Educator’s Rendezvous conference, focusing on a preliminary user experience and navigation of the content before the OER was formally published. The geoscience expert on the research team presented the techniques of OER content presentation with the PressbooksEDU platform and development of interactive H5P learning objects. Participants provided suggestions on the navigation friendliness of the OER and learning management system integration. These were incorporated in the later development and pilot implementation of OER, for example, with more subheadings and hyperlinks to primary sources.

The hypothes.is annotation review from the science librarian focused on the navigation of the published content, consistency of references and acknowledgement, and accessibility of images within interactive H5P learning objects. These were modified accordingly, as time allowed and before the traumatic pandemic transitions, for instance, including

modifying font size with Adobe Illustrator images, reference formatting, and alt text in Pressbooks media. The content suggestions from a geoscientist in another university enriched the resources linked to the OER later of the Spring 2020.

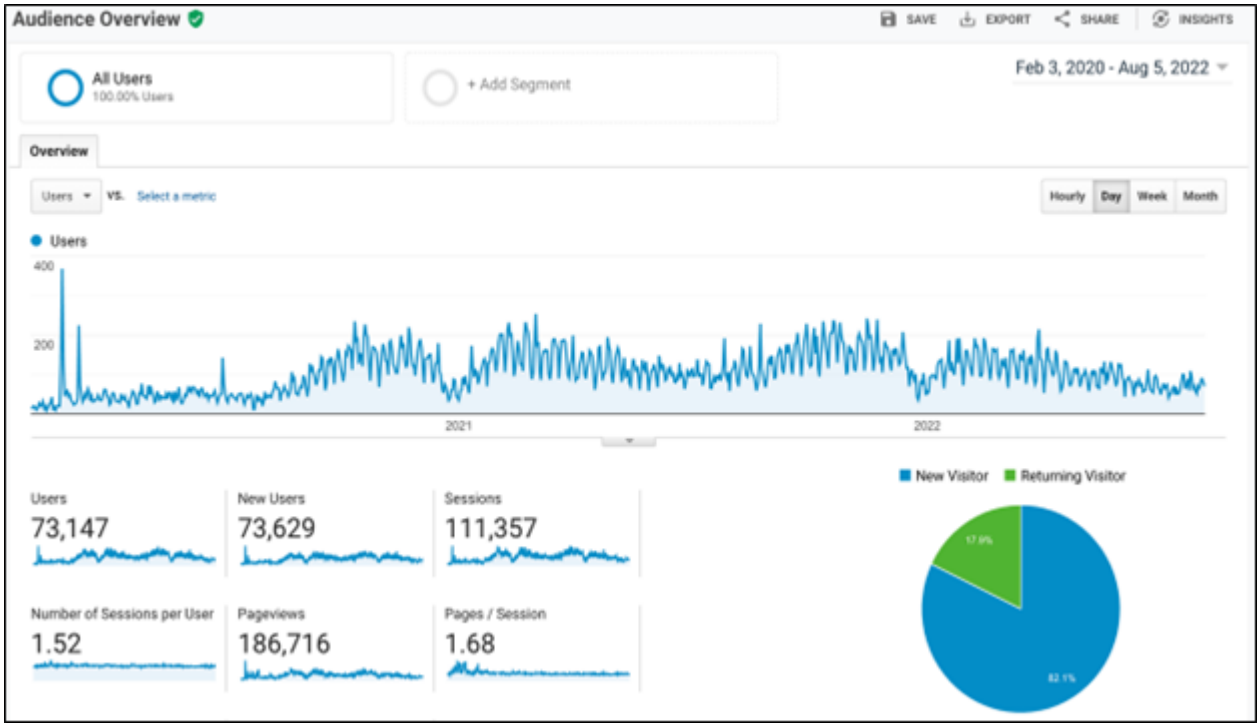
Another result was related to the commenting features in PressbooksEDU. These comments could be from anyone who had access to the OER through search engines or third-party links. There was some very positive feedback, like “I really like how you have structured everything about your questions and answers I’ll like to need more to answer”. There were also “junkish” comments, given the openness. The incorporation of review feedback was very time consuming, especially during the COVID-19 pandemic and along with envisioning the close-out of the funding cycle. However, these formal and informal review feedback provided directions and implications for some future directions of the project development, such as attention to accessibility when selecting technologies and managing workflow and balancing automated feedback to informal learning assessment interactive objects with human touch.

Wider Reach and Reflective Implementation

The researchers planned a launching campaign in spring 2020 as the grant proposal designed funding cycle. Starting from February of 2020, Twitter and Facebook (now Meta) were used to disseminate the published OER. Because of the professional networks already set up for the researchers, the retweets mostly occurred among professionals and educators in STEM, learning science, and instructional design. Nearly 720 retweets provided valuable information, including adding more meaningful feedback to users upon completion of interactive H5P questions.

Figure 3

Total Usage and Page Views between February 2020 and August 2022 of Introduction to Petrology on Google Analytics



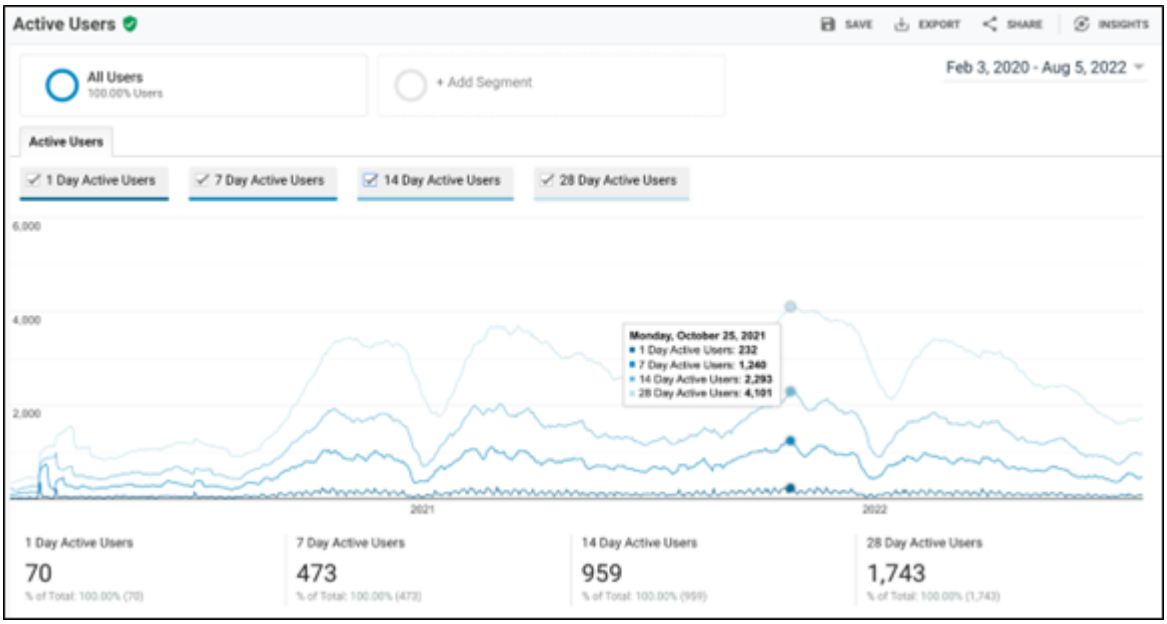
Google Analytics - Total usage and page views between Feb 2020 and Aug 2022. The graph of users through time shows a weekly cycle of higher and lower use, and an overall increase of use in the fall of 2020 continuing through 2022. There were 73,000 unique users during this time, and 73,147 active users at the time of the screen capture.

The VIVA system has enabled Google Analytics for Introduction to Petrology OER, which serves the reflective implementation of the OER with SEO strategies. “The four principal sources of traffic to a site include direct views where the visitor has knowledge of the URL, organic traffic from search engine retrieval, referrals where the URL has been placed as a ‘back-link’ in another location, and via social media. Typical SEO activity includes the researching of appropriate keywords that are then strategically placed ‘on-site’ within the written content, alongside ‘off-site’ marketing

activity." (Rolfe, 2016, p. 298). Figures 3, 4, 5, and 6 are the Google Analytics of Introduction to Petrology, with the researchers' Twitter promotion and retweets between February 2020 and August 2022. The Google Analytics of the OER Introduction to Petrology documented that there were 186,716 page views on different continents globally, 73,147 users, 17.9% returning users, and a highest point of 4,101 active users on a 28-day interval in October 2021 (Figures 3 and 4).

Figure 4

Active Users Between February 2020 and August 2022 of Introduction to Petrology on Google Analytics



Google Analytics screenshot showing active users for the Petrology OER between February 2020 and August 2022.This graph shows the highest monthly activity was in October 2021 with 4,101 users.

Rolfe recommended that "an additional digital marketing technique is the creation of content in multiple formats for easy dispersal across the web, and this was embedded within our projects and also served to promote interoperability and OER accessibility" (2016, p. 298). This was also preliminarily verified in the Sait Kyzy and Ismailova (2022) study of SEO used to promote Moodle-based digital instructional materials. In the OER project of this paper, the Google analytics demonstrated that there was 53.29% standard computer access and 45.29% of mobile access, meaning that the mobile access to these OER would be of equally important development and promotion strategies (Figure 5).

Figure 5

Distribution of Access Technologies

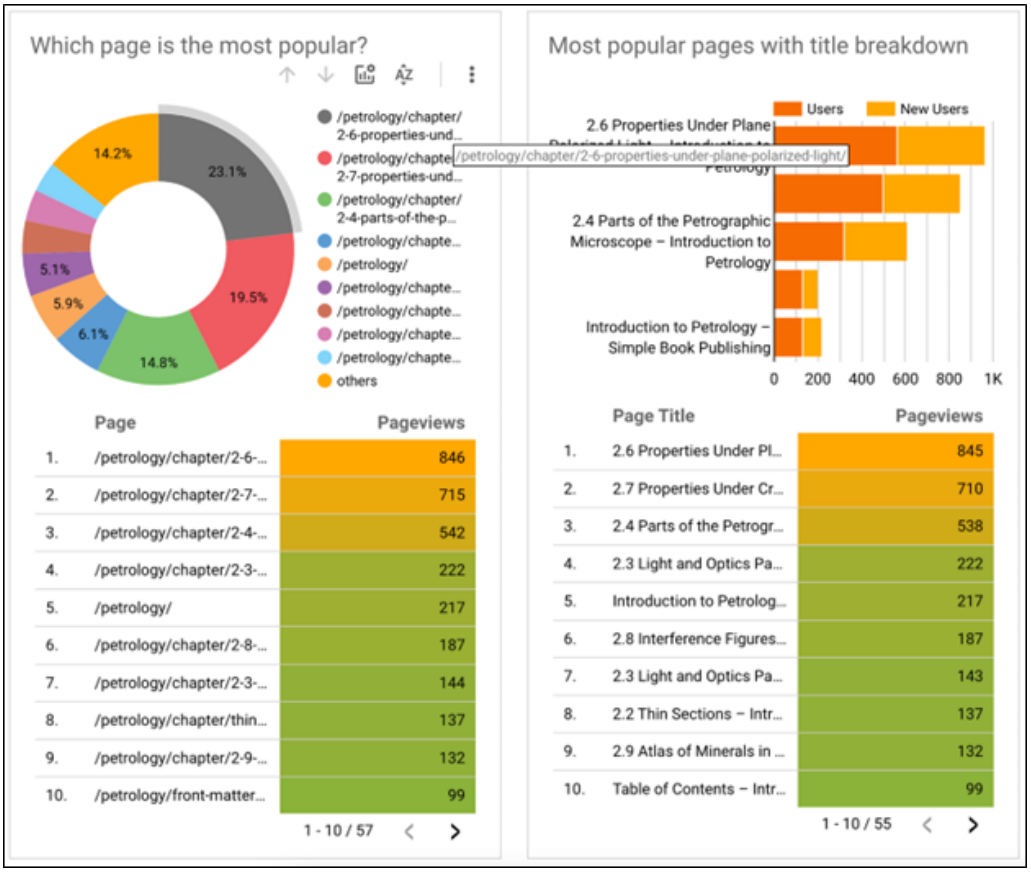


This graph shows the distribution of technologies used to access the VIVA petrology OER. 3% of students used a desktop, 45% used a mobile device and 1.4% used a tablet.

The usage information provided by Google Analytics identified what content was the most sought after by the audience. As indicated with Figure 6, the most popular content pages for Introduction to Petrology were 2.6 and 2.7, the simple and intermediate applications of the petrographic microscope to identify minerals, followed by 2.4 describing the parts of the petrographic microscope (Figure 6). Given limited resources and time, these analytics informed the further refinement of the most frequently visited chapters.

Figure 6

The Most Popularly Visited Pages between February 2020 and August 2022



The most popularly visited content for the Petrology OER between February 2020 and August 2022- A pie chart shows that the most popular pages were section 2.6 and 2.7 covering basic to intermediate concepts of how to use the microscope, followed by section 2.4 on parts of the microscope.

These OER texts are usually connected with video expositions or demonstrations on the AMiGEO YouTube Channel [https://www.youtube.com/@amigeo]. Therefore, the YouTube Studio analytics have been part of the SEO data collection.

These YouTube analytics revealed that most popularly viewed videos were demonstrations of how petrographic thin sections were created with Hand Grinding & Microscopy as well as a Thin Section creation process at Spectrum Petrographics (Figure 7). The AMiGEO Channel analytics also confirmed previous research on SEO that the metadata driven backlinked strategies would optimize the OER visit (Rolfe, 2016). In a more recent study using SEO, page content and site organization structure, together with marketing strategies have been found related to the online instructional content visibility in Central Asia universities (Sait Kyzy & Ismailova, 2022).

In this Introduction to Petrology OER, the VIVA- sponsored and maintained Pressbook.pub attracted nearly half of the traffic (48%) external to direct YouTube visitors (Figure 8). The YouTube Analytics also provided information about user accessibility needs. Of the 100,138 views between February 2020 and August 2022, 21% used English subtitles/CC,

which counted toward 33.8% of a total 2,920 hours of watch time (Figure 9). The closed caption usage analytics confirmed the value of researchers' edits of the YouTube auto captioning English version before publication to ensure scientific accuracy when supporting accessibility.

Figure 7

Engagement with Video Content on AMiGEO YouTube Channel

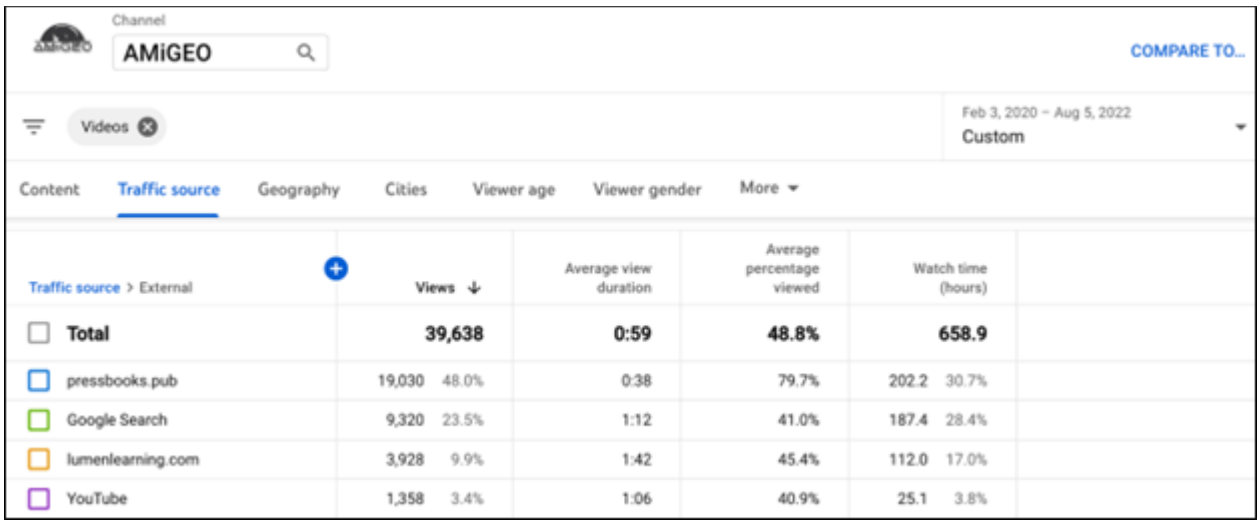


Most visited AMIGEO Youtube video content from February 2020 to August 2022-

The most commonly visited videos included content about how to prepare samples for microscope analysis in the form of thin sections of rock adhered to glass slides.

Figure 8

How the Audience Reaches the AMiGEO YouTube Channel



This table shows how the audience reaches the AMIGEO YouTube videos. Most find the videos through the OER (VIVA Virtual Virginia Library Pressbooks), followed by Google Searches.

Figure 9

Engagement with Video Subtitles/CC on the AMiGEO YouTube Channel



This graph shows viewer engagement with subtitles / closed captions on AMIGEO YouTube videos. 21% of users used the provided English subtitles.

Conclusion and Discussion

This paper reports part of a multi-phase OER design, development, and the potential of broad implementation, using an evaluative lens to answer the question of how can a series of geoscience OER be reviewed and evaluated to optimize their reach of use and reuse? The OER is published through an academic library consortium sponsored open publishing platform and enables student access to interactive content with no cost. The interactive content, aligned with the modified POGIL questions, and self-assessment, provide opportunities for students to engage close observations of instrumentation, and gain analytical skills with self-reflection. Each unit with accompanying customized POGIL components provides a base for instructional strategy recommendation for reuse and adoption.

This strategy was very welcome during the COVID-19 pandemic in spring 2020 and spring 2021 when the actual instrumentation became inaccessible or was only accessible some of the time, which indicated the need for more laboratory-based OER like the one in this study. The results of this education design research, along with many OER studies, confirmed that OER have the potential to increase student savings by integrating free materials for any courses that teach students about rocks and minerals with instrumentation for physical and chemical analysis. With proper instructional design, assessment methods, and integration of active learning strategies, these OER were perceived favorably by students and elevated student confidence in geoscience scientific instrumentation and laboratory-based learning (Liu, Johnson, & Haroldson, 2021; Liu, Johnson, & Mao, 2021).

This current study provides valuable insight and unique research procedures and results for reviewing and evaluating OER adoption and implementation in STEM education, with cost-efficient and free software. In addition to adapting online POGIL strategies to scaffold students' inquiry in geosciences, using social media and open-source software has substantially reduced the cost of publication, supported management of OER files and projects, ensured accessibility with closed captioning, and enabled transparent review. These also provide purposeful and interactive guidance for edits, adoption, and broadening the impact.

Along with engaging students' learning through interactive content and activities, OER textbooks will help develop sustained self-regulated learning for students with diverse abilities and with no textbook expense. Since educational design research is associated with analysis strategies in policy analysis, field portrait, and perception polls (McKenney

& Reeves, 2019), this study can also provide practical techniques and strategies to promote OER visits by coordinated use of multiple methods, embedding learning-centered high-traffic metadata in the online content, using the low or no-cost SEO to reach audience cross disciplines, in different geographical locations, and beyond an individual institution.

When reviewing and analyzing these results in reference to OER literature, the researchers of this project also fully recognize limitations and challenges of sustaining the continued development and effective adoption of these OER. Faculty awareness of OER and their reuse remains limited (Baas, Admiraal, & Berg, 2019). There are still tensions in applying robust research methodology in open access of OER by diverse populations (Pitt et al., 2013). For instance, the results of learning engagement with OER in this study are constrained by the small sample size in real-world teaching practice (vs. an experimental environment) and interruption of data collection in the trying COVID-19 pandemic pivot to emergency remote learning. In the meantime, the costly design and development of quality OER count on financial support from funding agencies, institutional resource and technology infrastructure support, and dedication of individuals. The results of this study reveal that there are still barriers between being truly open and the ability and resources to evaluate and edit the OER content to sustain their quality and reuse.

"Studies repeatedly alluded to systemic burdens embedded within higher education institutions that make it difficult not only to start an OER initiative, but to continue it after initial funding runs out. . . . Such a format of implementation narrows the work burden to individuals rather than sharing the load and does not address cultural and structural barriers across an institution" (Luo et al., 2020, p. 146). With the funding cycle and phased interest and balance between career and research for OER developers including subject matter experts (SMEs, in this project the geoscientist), instructional designers, and media developers, further philanthropic and systematic investment in OER may need to look at alternative models to increase quality and retain openness (Downes, 2007; Wiley et al., 2017).

Further, after the OER creation and repository compilation, the discoverability of discipline specific OER needs combined expertise of library science and instructional design as well as sustained support from institutions and professional communities (Luo et al., 2020; Tlili et al., 2020). Sustainably adopting and reusing OER, to keep the longevity of OER, rely on cohesive coordination of OER adoption, institutional steering, and academic and scholarly culture. For example, rpk Group and State University of New York (SUNY) (2019) have proposed a framework of OER adoption which points out the supportive roles of academic libraries in OER source curation and discipline-specific support with professional development. Studies have also proven that libraries can play connective roles at subject and institution levels, to reduce barriers to OER adoption with institutional strategic resource and infrastructure support (Baas, Admiraal, & Berg, 2019; Thompson & Muir, 2020).

As DeVries (2013) suggests, the acknowledgement of challenges encourages pursuing solutions to effectively reusing OER and catalyzing institution-based or community-based culture to fully repurpose these open resources. Building communities of users is recommended by OER researchers and projects like UKOER, after a multi-year creation and adoption of OER in multiple UK higher educational institutions (McGill et al, 2013; Rolfe & Griffin, 2012). The OER development community can possibly involve student creation and reuse "renewable assignments" (Wiley et al., 2017). Wiley and other researchers (2017) have summarized several well-known reusable assignment OER projects with students as creators and documented the success of the integration in student learning. There have also been attempts to experiment with a diverse variety of business, community, or academic-based OER building and adoption models (de Carvalho et al., 2016; Downes, 2007; Koohang & Harman, 2007). Baas, Admiraal, and Berg (2019) have also verified the needs of OER user community with their study in a large university in the Netherlands.

These will continue to evolve as OER development, discovery, and adoption are facilitated and optimized through SEO tools and strategies along with the maturity in conceptualizing and operationalizing OER use and reuse. The procedures and techniques of research projects like the educational design research project reported in this paper are valuable and significant for instructors, instructional designers, media producers, OER platform providers, librarians, and stakeholders in open education and OER decision- and policy making.

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Appendix A

Pre-assessment: Courses Completed prior to Taking OER-integrated Introduction to Petrology

Check the college courses that you have completed (either at JMU or elsewhere). (Please select All That Apply.)

Courses taken prior to Intro to Petrology	Percentage (%)	Count(N)
Physical Geology	13%	17
Stratigraphy	6%	8
Earth Studies	4%	5
Structural Geology	6%	7
Mineralogy	13%	17
Minerals and Rocks	2%	3
Historical Geology	9%	11
Petrology	1%	1
Geochemistry	2%	2
Hydrology	3%	4
Ocean Systems	2%	2
Environmental Systems/Cycles	1%	1
Introduction to Environmental Studies	2%	2
Earth System Studies	2%	2
Ecology	2%	2
General Chemistry with a lab	13%	16

Check the college courses that you have completed (either at JMU or elsewhere). (Please select All That Apply.)		
General Biology with a lab	3%	4
General Physics with a lab	6%	8
Calculus or Statistics	12%	15
Total	100%	127

Appendix B

Difference of Mean of Student Perceived Laboratory-based Learning Experiences in Pre- and Post-assessment Survey Results

	pre	post	gained difference
to learn laboratory skills that will be useful in my life.	4.35	4.53	0.18
to develop confidence in the laboratory.	4.59	4.73	0.14
to be certain about the purpose and the procedures.	4.35	4.43	0.08
to interpret my data beyond only doing calculations.	4.25	4.33	0.08
to make mistakes and try again.	4.50	4.73	0.23
to focus on procedures, not concepts.	3.44	3.73	0.29
to use my observations to understand the physical or chemical properties of my sample.	4.44	4.67	0.23
to use my observations to understand the broader geological or chemical questions addressed by the data.	4.56	4.67	0.11
to be confident when using equipment.	4.38	4.67	0.29
to learn problem solving skills.	4.56	4.60	0.04
discuss elements of my investigation with classmates or instructors.	3.25	3.60	0.35
reflect on what I was learning.	3.38	3.87	0.49
help other students collect or analyze data.	2.75	2.87	0.12
share the problems I encountered during my investigation and seek input on how to address them.	3.25	3.53	0.28



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Microcore: Using Online Playable Cases to Increase Student Engagement in Online Writing Environments

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Authentic Learning | Student Engagement | Educational Simulations | Online Writing Instruction | Playable Case Study

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This case study explores a type of educational simulation, an alternative reality game we call a playable case study (PCS), and how its use influenced student engagement in an online writing classroom. The goal of the simulation was to help students create professional communication artifacts and experience real-world professional communication situations. This article reports the effectiveness of the playable case study as a tool specifically for online writing instruction (OWI). The context of our research was a PCS called Microcore. Acting as interns for a company, students are asked to investigate a serious problem that occurs and present a solution to ensure similar problems do not occur again. Forty-seven students in two sections of an online professional writing classroom responded to pre- and post-survey questions and prompts that gathered their perceptions about writing, understanding of workplace communication, and levels of engagement. Responses were coded and analyzed for thematic trends. Results suggest that playable case studies like the one reported here may be effective in countering primary OWI difficulties, including disengagement; lack of social presence; faltering self-efficacy; and unclear, unproductive perceptions about writing assignments. Students responded positively to the simulation and appeared to develop more realistic views about workplace communication.

Introduction

Educational studies have long stated that student interest, engagement, and motivation are necessary for active, lasting learning. As Sullivan (2011) argued, “students who are engaged and motivated learn almost effortlessly. Those who are not almost always struggle, resist, and often fail” (p. 120). These ideas are echoed by Meyer (2014), who said that authentic learning in online classrooms requires engagement in the situation at hand—solving realistic problems and encouraging deeper engagement in assignments. However, engagement is particularly difficult to maintain in online writing classrooms because of the unique challenges that both students and teachers face. These include uncertainty related to assignments and tasks, feelings of detachment and isolation, and unclear expectations (Cunningham, 2015; Kebritchi et al., 2017). Additional studies express concern that a lack of social presence, engagement, humanity, and

training affect the learning value of online writing courses (Gouge, 2009; Hewett & Bourelle, 2017; Hewett & DePew, 2015). Further, students in online writing environments "often perceive the content knowledge they learn as independent bits of information rather than as parts of larger related constructs," leading to a failure to integrate and transfer writing skills (Boiarsky, 2004, pp. 252–53).

How to remedy this issue of engagement, along with other difficulties associated with digital learning, is still deeply debated by online writing instruction (OWI) researchers. Hewett and DePew (2015) argue that there is very little in terms of OWI practices "that might possibly be called 'effective,' let alone 'best'" (p. 34), with ideas and local developments that don't transfer broadly to other institutions. They further argue for innovations in online writing instruction that work to address issues of transfer. Other scholars have similarly insisted on the necessity of improving the quality of online writing instruction in overall design structure and focus, and offer largely broad suggestions for how to do so (Greer & Harris, 2018; Kebritchi et al., 2017). For example, Cunningham (2015) advocated helping students feel like they are communicating with actual others, addressing an often-missing sense of community in writing. Stella and Corry (2016) recommend a greater emphasis, structurally, on engagement, while Greer and Harris (2018) desired structure to be less reliant on systems and more focused on individual users. Hewett et al. (2011) asked OWI faculty what the most important principles, theoretical or pedagogical, are for OWI. Responses included "audience and purpose," "writing as a (social) process" (pp. 49-50), and more face-to-face interaction with students. These findings reflect Hewett and DePew's argument that OWI scholarship could use innovative practices that address the needs of online writing (OW) students.

In this paper we report our study of how online writing instructors can address these and similar issues through the use of serious games. Girard et al. (2013) defined serious games as "digital games, simulations, virtual environments, and mixed reality" that are concerned with education over entertainment through responsive narrative and story (pp. 208–210). Often, such games take the form of some type of simulation, which Gredler (2004) defined as, "open-ended evolving situations with many interacting variables. The goal for all participants is to each take a particular role, address the issues, threats, and problems that arise in the situation, and experience the effects of their decisions" (p. 571). The use of simulations as instruction has been a staple of both business and medical education since the 1950s (Gredler, 2004), and in the Internet-age their use has spread widely to other domains in higher education (Chernikova et al., 2020). Recently, a form of mixed-reality simulation known as an alternative reality game (ARG) has emerged as a new educational platform that focuses on student engagement in the classroom. ARGs are, "a genre of transmedia storytelling, comprised of interactive elements . . .To engage with an ARG, players . . . solve puzzles and [find] clues to reassemble the fragments of a story" (Bonsignore et al., 2014, p. 1). Over the past six years, we have developed and researched the effects of a form of alternative reality game we call a playable case study (PCS). The PCS is a unique contribution to the area of educational simulations through its combination of authentic tasks, fictional (yet realistic) storylines, transmedia forms of interaction (both computer-assisted and non-digital activities), that can be integrated into classroom instruction with minimal technical know-how or preparation on the part of the teachers involved (citation masked for review). In this paper we describe the PCS, called *Microcore*, and report our investigation into the following research questions:

1. In what ways does a professional context simulated through a playable case study impact students' writing and engagement in an online course?
2. What are the effects of the playable case study on student learning and how students approach professional writing and communication?

Literature Review

The Growth of Serious Games in Education

In the last two decades, since the development and gradual proliferation of serious games for education (Whitton, 2008), researchers and subject experts have considered the utilization of computer-based interactive games for writing instruction. Findings in education and technology studies have suggested that serious games can promote engagement

and responsibility for one's own learning (Anastasiadis et al., 2018; Bagley & Shaffer, 2011; Finseth, 2015). Some even claim that these types of games may even teach more effectively than traditional methods in classroom instruction (Girard et al., 2013; Kebritchi et al., 2017; Silvia, 2008; Sitzmann, 2011). Alexander (2009) recommended that instructors "consider using complex computer games as primary 'texts' in composition courses as a way to engage with students" (p. 37). In a similar manner, Moseley (2012) argued that the field has reached a point where games can reach new audiences of learners because of the different types of educational engagement and effectiveness they can provide.

However, a restrictive belief has persisted in the academic field that the "social motive of schooling . . . is fundamentally different than that of work. And schooling cannot represent the activity of workplaces, even in simulations" (Russell & Fisher, 2010, p. 164). Some researchers have even claimed that only professional contexts can help students learn the professional communication genres they will need in the workplace, even if school contexts are simulating the professional context (Freedman et al., 1994). Although not new, this belief became more widespread with the advent of the Internet and alternative teaching methods. But as more time and research has been applied to the topic, the conversation has shifted more toward advocating for the affordances that simulations, serious games, and similar strategies provide, along with their intrinsically motivating aspects in classrooms (Chaudhuri, 2020). However, certain divergent views have stated that simulations are not more motivating under all circumstances, contradicting the findings of Chaudhuri and others (Sailer & Homner, 2020). Thus, the research surrounding serious games is still in development, though many researchers lean toward the positive benefits that the technology can have in classrooms.

Serious Games as Tools of Engagement

One aspect of serious games that has not been sufficiently investigated is how they can function in and potentially counter the challenges of online writing instruction (OWI). The inherent problems with OWI—namely, expectations on feedback and structure, disconnection and lack of identity, and passive or nonexistent engagement (Kebritchi et al., 2017)—need to be addressed in this digital age. Simulation-based serious games, in which students are placed in new environments outside of school, could be a new solution to this problem of online engagement. Games such as SimCity have been used in traditional, in-person classrooms (Bagley & Shaffer, 2011), as have more directly educational simulations like the VirtualPREX Classroom Simulation (Dalgarno et al., 2016), and MyCase (Russell & Fisher, 2010). Russell and Fisher (2010) noted that such experiences create conditions in which students can experience in a vicarious way what it is like to participate as a member of a given community. These sorts of serious games are designed to transport participants into a fictitious story environment, where they are expected to learn to succeed in specific circumstances, interact with strangers, and deliver products in a way that mimics the real world.

hen students take online courses, there is an even greater need for engagement, since students have a far greater degree of control over their choices and amount of conscious participation (Stella & Corry, 2016). Serious games like ARGs, simulations, and playable case studies have been reported to increase overall engagement through a greater sense of interaction and control over learning, immersion, and complex, compelling narrative and real-world situations (Bonsignore et al., 2014; Gredler, 2004; Hansen et al., 2017; Russell & Fisher, 2010). Therefore, for serious games to be effective online teaching tools, they must sufficiently engage students.

The Workplace Communication Simulation Microcore

Against this backdrop of research, we have developed a new form of educational game called a playable case study (PCS). The goal of the PCS is to allow students to participate in realistic and engaging environments that simulate some aspect of the professional practices for which they are being prepared. Given the need in many workplace settings for professional writing (Williams & Beam, 2019), the PCS environment meaningfully integrates writing into other professional assignments that students will perceive as applicable outside of school. This allows students to demonstrate skills associated with critical thinking and argumentative writing in simulated environments that have real-world affordances (Hansen et al., 2017). The PCS genre is modeled on a type of serious game called an alternative reality game (ARG), that is characterized by gameplay taking place in both computer-simulated environments as well as players' everyday lives (Hansen et al., 2013; Kim et al., 2008). This blend of environments encourages a gaming ethos known as This is Not a Game, "meaning the simulation strives against interface forms that participants perceive to have

been fabricated. Interactions take place in the context of authentic digital or face-to-face modes of communication as much as possible" (Winters et al, 2020, p. 128). These immersive stories as the core of the simulation require the participants—here, students—to be a part of something that feels authentic, active, and personalized. This design creates ownership of learning, interest, and engagement through narrative, which stimulates knowledge acquisition and comprehension (Abrahamson, 1998; Hidi, 2006; McDaniel et al., 2000; Meyer, 2014). The most effective learning requires a developed sense of challenge and individual involvement in order to remain situationally interested in computer-based assignments (Finseth, 2015; Tulis & Fulmer, 2013). The open-ended approach of the PCS is designed to achieve effective learning and imitate the business world through rigorous challenge and intellectual demand. This article focuses on a PCS—known as *Microcore*—developed for advanced writing courses.

Method

Game Description

Microcore is a fictitious startup tech company, specializing in revolutionary medical nanotechnology that is on the verge of breaking into the market. Acting as new interns for the company, students are asked to investigate a serious problem that occurs—a test pig explodes due to malfunctioning nanomachines—and present a solution to ensure similar problems do not occur again. Using style guides, pre-recorded but interactive video interviews, clickable images, and other tools shown in Figures 1 and 2, participants investigate the incident and draw conclusions to present to company management in the form of a business proposal.

Figure 1

Microcore features. These include information about the (fictional) team, the library of materials—style guides and templates—an email system, and a virtual crime scene photo with clickable items.

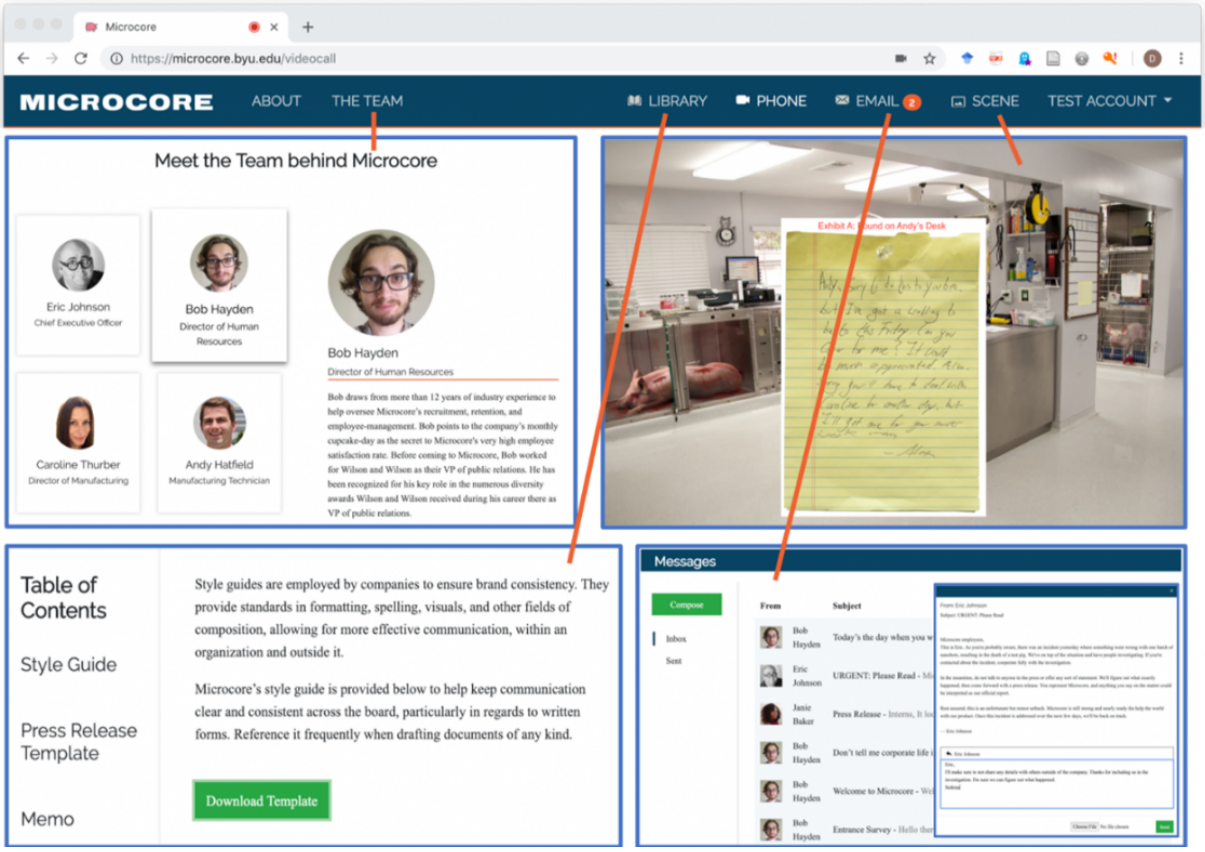
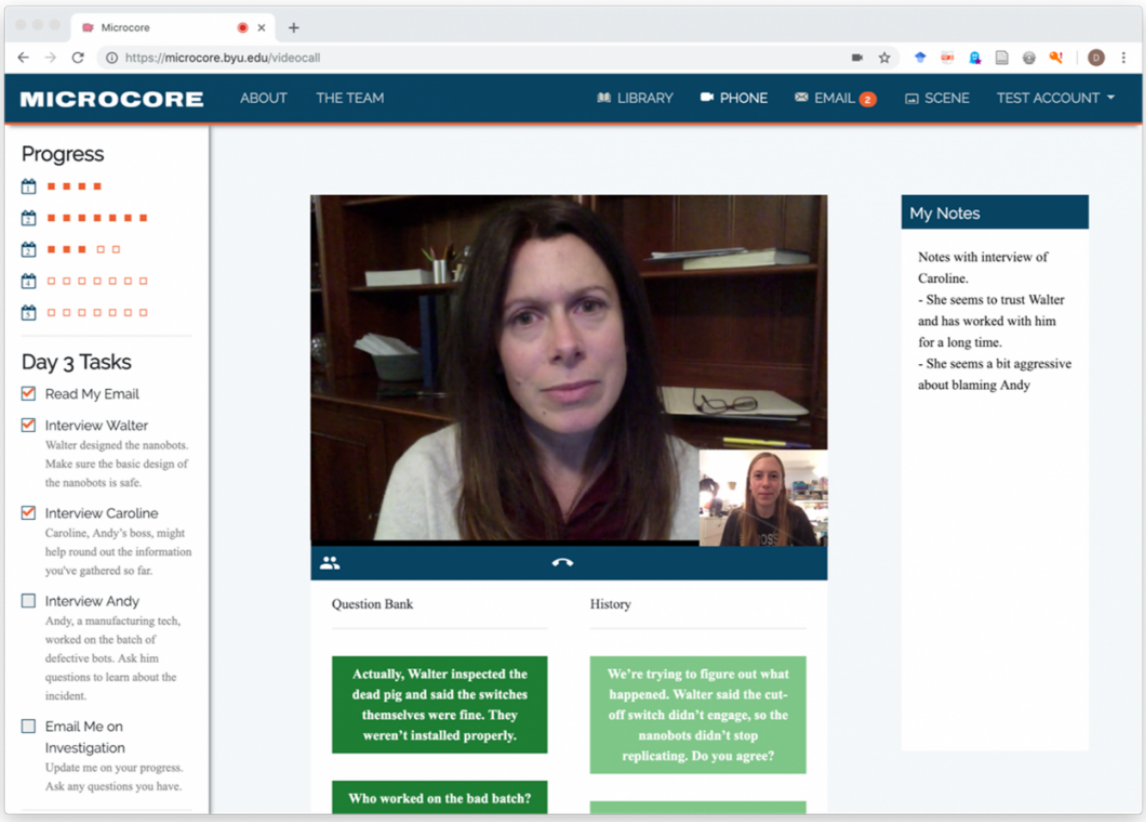


Figure 2

Microcore corporate Intranet. Progress through the five virtual days and daily tasks are shown on the left. Student (bottom-right of central image) is interviewing fictional character, Caroline, by selecting options from the Question Bank. Notes can be taken on the right



As shown in Figure 2, there are five total "days" in the PCS, each giving participants a series of tasks to complete before moving on to the next day, as well as providing new information to assist them in their cumulative goal of determining the cause of the problem and recommending a solution in the form of a written proposal. It is not mandated what solution should be presented. The open-ended setup is meant to encourage greater creativity and engagement. As Sitzmann (2011) noted, "high interactivity and the opportunity to make choices while participating in simulation games may result in trainees [participants] feeling empowered, ultimately enhancing [their] self-efficacy" (p. 495) and personal investment in their own learning and end product. Participants in *Microcore* have a company contact named Bob, who provides instruction on how to navigate the website and assigned daily tasks. In the course of their investigation, participants interact with several other employees at the company who present differing viewpoints, priorities, and interpretations of events, which students evaluate and consider to come up with their final solution and recommendation. This interactive element utilizes principles of ARG combined with the open-ended, ever-evolving component of simulations to create the playable case.

According to the College Composition and Communication Committee (CCCC) for Effective Practices for Online Writing Instruction, "an online writing course should focus on writing and not on technology orientation" and "appropriate composition teaching/learning strategies should be developed for the unique features of the online instructional environment" (CCCC Executive Committee, 2013). This principle was echoed by Greer and Harris (2018), who stated

that instructors should ensure they are prioritizing student needs above the technology to be truly effective. Serious games should first and foremost be about education. *Microcore* was created to function similarly, and thus meets the CCCC requirements and expectations. If students connect with the PCS and it counteracts online writing instruction issues, *Microcore* could serve as a reliable technology and method of teaching in digital classrooms. OWI needs effective best practices—ones that aim at engaging and at creating authentic skills, self-efficacy, and investment in personal learning.

Participants

During the Fall 2018, we used the *Microcore* playable case in two advanced online technical writing courses at a major western university. Populating these sections of advanced technical writing were students of both sexes, between twenty and twenty-five years of age, in their junior or senior years of college, and in pursuit primarily of technical degrees. These academic pursuits varied from neuroscience and civil engineering to public health and communication disciplines, allowing for a wide spectrum of intellectual diversity. Of the 50 students enrolled in both sections, 47 students agreed to complete both questionnaires about their experience using the simulation tool and allow researchers access to those responses. All students in the two classes participated in the simulation, so we could not include a control group. All policies of the university's institutional review board (IRB) were followed for the administration and analysis of the survey described in the next sections.

Data Collection and Coding

The aim of the technical writing course is to instruct students on how to produce clear, effective communication commonly used in professional environments, with the students learning genre conventions and creating a variety of technical documents, including literature reviews, presentations, and business proposals. *Microcore* aids in this teaching as it asks students to create a business proposal, as well as other smaller documents such as press releases and memos. The students in both sections of technical writing were required to take part in the playable case for the class, which was conducted and played in November 2018 over a two-week period. This was the penultimate unit, after the unit on writing instructions and before the final one focusing on literature reviews, so by this point students had over half a semester of exposure to the course and online environment. The instructor who ran *Microcore* for both sections has previous experience with the technical communication course and OWI. However, this was the instructor's first opportunity to teach this specific course online.

Our research team collected two sources of data on the students' experience with the online PCS: (1) pre and post surveys and (2) student written work in the form of online chats, emails, and class writing assignments.

To introduce students to the *Microcore* PCS, they filled out an electronic pre-survey, which asked a series of questions regarding views on communication, the writing process, and self-efficacy. Then, after the PCS was completed two weeks later, students were asked to complete a post-survey, which asked similar questions to the pre-survey. Both surveys were written in-character from the perspective of a company contact in the HR department to allow for authenticity and a more pronounced sense of verisimilitude.

The questions in the surveys can be divided into two parts, based on type. In one part, students were asked open-ended questions about applicable prior experiences (for verisimilitude), perceptions about communication and how to solve problems therein, and writing processes. In the second part, students were given prompts and asked to select their level of agreement (Not Sure, Strongly Disagreed, Somewhat Disagreed, Neutral, Agree, Strongly Agree). This scale was developed from Donald O. Prickel's research in 1994 on adult basic writing and its use in correlational analysis. Higher scores indicate higher self-efficacy. These modified Likert scale prompts dealt with self-efficacy in workplace writing, confidence in personal capacity to function well in a more professional setting, and feelings of engagement.

While care was taken to ensure consistency across the pre- and post-survey questions, some questions were adjusted in the post-survey after we could ensure that students had experience with workplace communication. For example, general questions about communication problems and the writing process were asked in the pre-survey because

previous exposure to workplace communication and the proposal genre could not be guaranteed for all participants. The questions were then specifically applied to workplace communication and proposals in the post-survey.

The student responses were collected and organized onto a multi-tab spreadsheet, with IDs being provided to students in order to deidentify the data. Two researchers followed the coding process described by Blakeslee and Fleischer (2010), including identifying themes, identifying categories within the themes, and coding for the themes. Specifically, with the pre-survey responses next to the post-survey ones, two researchers developed coding schemes for the data, searching for relevant changes in wording and ideas between the two sets of responses. These researchers had no predetermined changes for which they were specifically looking. Rather, as they went through each question and compared pre- and post-survey responses, themes became distinct between the responses before and after the PCS. They tested a code on one set of questions, found the code to be effective as an overall trend in the responses, and then repeated the process for the remaining open-ended questions and prompts. For the Likert-scale prompts discussing self-efficacy and engagement, the researchers calculated the numerical difference in responses between pre- and post-survey responses.

Comparing responses between the surveys for our open-ended questions suggested trends in expanded understanding of the social demands and humanity of workplace communication, in developed nuance in the scope of resolution required for solutions to miscommunication, and in greater sense of purpose and meaning with the *Microcore* proposal project. For the Likert-scale prompts, we found an overall positive increase in online student engagement and confidence with writing assignments and business communication.

Findings

Understanding of the Social Dimension

Student definitions of what it means to communicate professionally saw a pronounced change between the pre- and post-surveys, with students identifying a social dimension to communication. Many of the responses to the question before the PCS were impersonal in tone and generic in content. After the PCS, students appeared to see a human- and audience-focused element in workplace situations, coloring their responses and offering more professional answers. Table 1 reports student responses to the open-ended question, “What is the goal of professional communication” that illustrates this finding.

Table 1

A Subset of Student Responses About Professional Communication

Pre- and Post-Survey: What is the goal of professional communication?

Student ID	Pre-Survey Response	Post-Survey Response
344	“To allow people to communicate in a structured way that can be standard across many companies and industries.”	“To express your feelings, thoughts, and concerns to others in a professional manner. This often entails following a pattern or style that has been developed within [a] company.”
529	“The goal of professional communication is to discuss matters of importance and work through the everyday challenges of a work environment.”	“The goal of professional communication is to be clear, approachable, and open in your interactions with others via email, phone, and face-to-face conversation.”
636	“The goal of professional communication is to ensure cooperation and efficiency in professional environments.”	“To ensure that all levels of an organization interact in a professional manner and without misunderstandings.”
152	“Communicate clearly any and all details pertinent to business.”	“To clearly communicate information so that recipients of the information can completely understand what is going on.”

Students at first appeared to see professional communication as something technical, objective, and aloof. After the PCS, original definitions and conceptions about communication seemed to expand, with students adding elements of

socialization and humanity being prominent. They latched onto the social dimension, with their answers reflecting real-world interaction and complication possibly better than could be achieved in a traditional, lecture-based classroom environment. There was greater awareness of audience and its social necessities in professional communication. Post-survey responses included expanded ideas and terms such as collaboration ("team," "coworkers," "leadership," "all levels of an organization," "interact," and "help each other"), clarity ("flow of information," "no ambiguities or misunderstandings" and "limit miscommunication"), and personality ("open," "approachable," "timely," and "professional"). This theme was almost entirely consistent, with only two of the post-survey responses not mentioning the involvement of others or demonstrating any substantial changes between pre- and post-survey responses.

Varied Solutions

Microcore was built to present its users with workplace communication problems, which we specifically asked students about to determine if their methods of addressing such problems would change. A theme emerged between the two surveys of greater nuance in their scope of what it means to resolve communication problems, with larger-scale fixes—beyond just themselves—being necessary for successful solutions to these kinds of issues, as reported in Table 2.

Table 2

A Subset of Student Responses About Communication Problems

Pre-Survey: How do you solve communication problems you encounter? Post-Survey: How do you solve communication problems in the workplace?

Student ID	Pre-Survey Response	Post-Survey Response
152	"By trying to understand the disconnect and fixing it."	"By communicating. Try different methods of communication, go to other employees, managers, etc."
344	"I prefer to speak with people and figure out what went wrong and discuss how to fix it moving forward."	"You have to determine what is causing the problem, and then develop a method that will allow all people within the organization to communicate effectively and then implement it."
404	"I consider who I am communicating with, what we are discussing and how to best deliver the information I need to share. If there is a problem, I first look to see what I can change on my end to ensure that proper communication is re-established."	"Accountability. Documentation. If I need to speak with someone I reach out in more than one way. If something needs to be clarified I seek out the necessary authority and ask for help. I do not simply 'wing it' to prevent uncomfortable conversations."
560	"When communicating through writing, I revise to make sure I am clear and concise. For large projects, I have others review my writing. I ask for clarification if I do not understand the others' communication."	"Communication requires a shift in company culture. Individuals should understand the importance of working on a team and that each member has a valuable role which can't be completed unless everyone cooperates. Rules will be set in place until communication is more fluid in the work environment."

Students seemed to develop a more nuanced perspective about miscommunication and what it takes to fix communication problems, along with varied solutions to address such issues. The responses in the pre-survey offered simple, general solutions that often simply involved discussing the miscommunication with someone via an unspecified dialogue method. However, after the PCS was completed, students offered more precise and varied solutions to communication problems and took personal responsibility for the issues they encountered. We found a pronounced trend of needing to implement solutions to prevent future problems ("setting specific regulations," "approachable leaders," "rules set in place," and "build trust and foster communication between team members"). Previously, responses largely suggested that a communication problem, once addressed just by the students, would not thereafter be a recurring issue. This viewpoint appeared to evolve. Even responses that did not seem to change as much had some greater degree of nuance expressed through wording, including the importance of speaking "directly," replying in a "timely manner," and trying "different methods of communication" if one method does not work to ensure that the needed information is conveyed.

Greater Sense of Purpose

Having addressed workplace communication, we wanted to determine the effect of the PCS on students' writing process. Post-survey responses indicated that students experienced a level of enjoyment and a sense of realism and purpose with the writing process. One student wrote, "The nature of these documents [proposals] being centered around events and actions to be taken in response was something new and something I very much enjoyed." Another stated, "It was more enjoyable [than other writing assignments]. I was actually engaged in the process and was curious about what was going on." Proposals were unfamiliar to students, but students were engaged in the process of writing them.

Despite the "playable" nature of this case, students appeared to take it seriously. As one student wrote, "I felt that the writing assignments during the *Microcore* internship were actually meaningful and are . . . like what I could potentially be writing down the line of my future career." Another wrote about how the nature of the information they presented was important: "My proposal could get someone fired. That is life changing. It also could be a mistake for the company, should any of the proposal [sic] turn out to be incorrect information or a bad process." It seemed to feel real, with some even comprehending that their proposals—their suggestions of company action—could have drastic, real-world consequences, from company expenses to the firing of employees. This developed sense of purpose was reflected across most of the responses, with only three expressing superficial differences such as mentioning the templates and style guides that were provided with the PCS.

The students' expanded definitions and conceptions about professional communication and writing indicate an overall positive, rounded change in perspective that reflects a developed sensitivity to a professional context. The students appeared to identify social themes, explore larger intricacies, and develop real-world investment from the *Microcore* PCS.

Self-Efficacy and Engagement

Students responded to Likert-scale prompts before and after the case that assessed their self-efficacy and confidence in solving workplace problems with writing and professional communication skills, asserting the place writing has in their future careers, communicating in a workplace environment, understanding how writing functions in the workplace, and navigating people and tasks in the business world. They responded as shown in Table 3.

Table 3

Student's Self-Ratings Regarding Their Writing Self-Efficacy

Average Pre- and Post-Survey Responses Regarding Self-Efficacy.

Prompt	Pre- survey average	Post-survey average
I am confident in my ability to solve workplace problems with writing.	5.25	5.8
Writing is critical to my future career.	5.55	5.8
I am confident in my communication skills in a workplace environment.	6.05	5.8
I understand how professional writing functions in a workplace environment.	5.75	5.9
I am confident in my ability to navigate people, tasks, and difficulties related to communication in a business environment.	5.55	6

In four of the five responses, students reported increased self-efficacy after participating in the PCS. In particular, students reported greater confidence and self-efficacy in solving workplace problems with writing and professional communication skills, asserting the place writing has in their future careers, understanding how writing functions in the workplace, and navigating people and tasks in the business world.

This generally positive response count continued with the final section of Likert-scale prompts, in which we assessed student engagement and recommendation for this method of instruction. This was especially important to determine if

this method of OWI would be able to counteract one of the inherent problems—lack of engagement—associated with online learning. These results are shown in Table 4.

Table 4

Mean Student Responses to Questions of Engagement

Post-Survey: Select the appropriate level of agreement with each of the following statements.	
Prompt	Mean Post-Survey Responses
I found this digital internship to be interesting.	6.05
I was engaged with the assignments I was given.	5.75
The resources provided to me were helpful in understanding my assignments.	5.7
I would recommend the Microcore internship to others.	5.55

In response to all questions, students on average agreed that the PCS was interesting and engaging. Further, students on average agreed that they would recommend the case to others. Despite these positive responses, many of these students had feedback to offer in the post-survey on how to better improve the internship experience in the simulation, which suggests some opportunities for improving the simulation. However, based on the large-scale trend toward positive change in student responses, it would seem that *Microcore* is able to generate sufficient engagement with online students.

Discussion

Our intent with this survey study was to test the PCS to see what kind of impact it would have in online writing instruction. In response to research question one, results from the study indicate that the simulated environment of the *Microcore* PCS positively impacted students' writing and engagement with course topics related to business communication. The majority of students who participated in this study reported increases in self-efficacy, reported feeling engaged and invested in the material, and reported enhanced understanding of the social elements of professional communication. In response to research question two, students reported more nuanced and varied solutions to communication problems. Their responses indicated expanded understanding of the social demands and humanity of workplace communication, a stronger sense of nuance in how to resolve miscommunications, and a greater sense of purpose related to the importance of professional communications. In the discussion that follows we offer some commentary on these findings.

In pre-survey responses, students' definitions of professional communication were general and detached. However, with the completion of the PCS, students seemed to describe a greater level of humanity and social interaction necessary for effective technical communication. As Finseth (2015) stated, "technical writing does not happen in a bubble" (p. 258), and she advocates for technical communication instructors creating game-based classrooms to "keep a keen focus on the importance of audience" (p. 247). She observes that interactive games could theoretically enable students to gain this sense of audience because such games allow for audiences other than the instructor. This study applies Finseth's (2015) theoretical claim and provides some empirical evidence that suggests that a playable case study enhances students' attentiveness to audience, as supported by the students' responses to the pre- and post-survey questions. Specifically, the themes and changes in audience-focused word choices—repeated across the responses we received—suggest that students came to better consider their audiences, which we presume occurred through their interactions with the PCS's characters and personalities.

Pre-survey resolutions to communication problems were often simple and limited to students' reliance on their own selves and on one-and-done solutions, but these views changed in the post-survey, where they provided greater depth and variety of answers, with the need for systemic alterations and follow-ups. Students appeared to grasp that writing and interaction within a workplace is not isolated—even a simulated work environment—and responded accordingly. Students commented on the complexity of workplace communication, as shown in Table 3, and reported a decrease in

their perceived preparation for workplace communication. This decrease may signal students' willingness to better prepare for a more complex communication environment. Freedman et al. (1994) argue that students must be embedded within workplace contexts and not educational contexts to understand communication genres and their complexities. They argue that students must learn genres by gaining "sense from the inside" (p. 221) or organizations. However, more recent research provides some qualitative evidence that online simulations encourage students to transfer genre knowledge from the classroom to the workplace (Meyer, 2014; Russell & Fisher, 2010). Furthermore, Farashahi and Tajeddin (2018) argued that simulations were the most effective method of teaching problem solving skills in business settings when compared to case studies and lectures. The present study provides additional support that online simulations, PCSs in particular, help students gain some sense of the complexities of the workplace environment and the communication that occurs therein. These findings suggest a potential value of the playable case format we did not anticipate at the beginning of our research. It seems the simulation helped attune students to some of the detail and nuance that accompanies expert performance in professional fields.

With the final open-ended questions, we aimed to see if student approaches and feelings about *Microcore* writing projects were distinct from those of other school assignments. The findings in this study provide empirical support for the connection between objectives and engagement as the students participating in *Microcore* reported a greater sense of enjoyment with the final proposal product and work they did, compared to other school assignments, along with a developed sense of personal responsibility. The *Microcore* case clearly defined the students' roles and responsibilities, which seemed to contribute to a greater investment in their own learning and proposal they were creating. This aligns with other research on the use of educational simulations in a variety of settings to improve student engagement (Bigdeli & Kaufman, 2017; Shin et al., 2019; Veermans & Jaakkola, 2019). The majority of students also reported increases in self-efficacy and pronounced engagement with the PCS. Only one statement saw a dip in self-efficacy: "I am confident in my communication skills in a workplace environment." This change may be due to having perspectives changed on what exactly business communication entails after being exposed to the complexity and intricacy of the workplace. Thus, this decline could reflect students' more realistic understanding of the complexities of real-world workplace communication.

Our findings offer intriguing insights into student perceptions about communication and writing within the confines of online classes. Whitton (2008) suggested that there are three integral components with ARGs in order for them to be effective: exposition, interaction, and challenge. Sitzmann (2011) agreed with Whitton, stating that these narrative and design elements create a digital space for "engaging and engrossing" (p. 493) content. The *Microcore* PCS meets these criteria with a clear fictitious setting that places students in an important and interactive role, which expects them to produce a final product: a proposal—a genre with which few students had any prior experience. This sense of challenge is important for immersion, engagement, and active learning and retention (Dorn, 1999; Meyer, 2014; Tulis & Fulmer, 2013). Students on average seemed to find *Microcore* to be engaging and worthy of recommendation for similar classes, suggesting promise for the use of PCSs in OWI.

Based on these findings from our surveys, it seems that the PCS positively impacted online student writing, self-efficacy, and engagement, with visible upward trends from the responses we received. Vogel et al. (2006) similarly found that "those using interactive simulations or games report higher cognitive gains and better attitudes toward learning compared to those using traditional teaching methods." They do mention that, at the time, this claim was considered to have an insufficient research base to be entirely stated with confidence. However, this conclusion was independently reached by a number of other researchers (Meyer, 2014; Russell & Fisher, 2010; Sitzmann, 2011). Our results seem to align, with students reporting cognitive gains in demonstrating clearer and more nuanced approaches to communication and reporting better attitudes through their increases in self-efficacy.

Implications

This study has implications both for online writing instructors and for OWI researchers. Self-efficacy and the development of writing skills both happen slowly (Bruning et al., 2013), so serious games are not one-and-done solutions. But based on research from a number of scholars investigating other serious games and the preliminary results found in this study, the possibility exists for playable case studies to help online writing instructors develop

greater engagement with students and help them authentically learn and practice their writing skills. Sitzmann (2011), Girard et al. (2013), and others seem to reflect this claim with traditional classrooms and ARGs and educational simulations. As we found with this study, *Microcore* also appears to alleviate struggles typically found in *online* courses: lacking identity, disassociation and disengagement, and lacking control and interactive elements. A "social presence" (Cunningham, 2015, p. 35) is needed in every classroom to create sufficient interest, personal and situational. This effort to engage learners through narrative, to build connections through stories—as Abrahamson (1998) advocated—can create a sense of community and allow for increased retention and confidence within a program (see also Meyer, 2014). Trends in student responses suggest that playable case studies like *Microcore* could be useful to online writing instructors in rounding out student perceptions on writing assignments, increasing engagement and self-efficacy overall (though this will vary from student to student), and having a positive impact on the mentality of their students in regard to writing. Finally, it seems that the simulated environment of the PCS may be useful in attuning students to the importance of situational discriminations, as well as give them some initial practice with doing so.

Future Research

Future research could compare responses to the PCS between traditional and online classrooms to determine if the method is better suited to one or the other. Also, it could be beneficial to compare this PCS to others in the field to see how students of various locations and levels of ability respond to each in order to best engage writing students. Wouters et al. (2013) suggested that serious games (like the PCS) are not inherently more motivating than traditional methods of instruction, concluding that "serious games are more effective when they are supplemented with other instructional methods than they are when used as [the] sole instruction method" (p. 260). Future research can investigate this across an entire semester of an online class to determine if these researchers are correct in their claim.

Conclusion

This study examined student perceptions of a playable case study delivered through an online technical writing course. Students who participated in this study reported increases in self-efficacy, reported feeling engaged and invested in the material, and reported enhanced understanding of the social elements of professional communication. Their responses to survey questions also indicated expanded understanding of the social demands and humanity of workplace communication, a stronger sense of nuance in how to resolve miscommunications, and a greater sense of purpose related to the importance of professional communications. We believe, based on our results from this study, that the possibilities with the PCS are vast for online writing courses, serving as effective and authentic workplace-communication practice for students.

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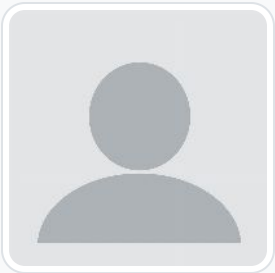
Jon Balzotti's research explores emerging technologies and design-based research for on-the-horizon tools, applications, media, and environments, attempting to discern which are of value for learning and can be implemented large-scale. He is an associate professor of English at Brigham Young University.



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