Statement of Research Activities

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Research Philosophy and Themes

My research philosophy stems from my aims as an educator and instructional designer to improve access to teaching and learning opportunities for all stakeholders. In preparing this Research Statement for the purposes of a fourth-year tenure-track review, I reflected upon my research path up to this point and looked ahead to where I see myself going in the future. I identified three interconnected themes centered on the seamless use of technology in education:

1. The facilitation of collaborative learning interactions.
2. Increasing teachers' perceptions of self-efficacy with the use of educational technologies.
3. Reduce barriers to learning opportunities (through the use of assistive technologies and the adoption of Digital Accessibility standards, and through the implementation of alternative pathways to teacher training and certification).

Research History

Prior to undertaking a position with Cape Breton University, my research focused primarily on the themes of facilitation of collaborative learning and increasing teacher self-efficacy. These themes are evidenced in my work with instructional design for mobile learning, and my recent research publications.

Mobile Learning, Collaborative Interactions, and Teacher Self-Efficacy

My previous research focused the use of mobile technologies in education. That served as a starting point for my interest in the connections between pedagogical approaches and teacher confidence with technology. This research led to the development of the Collaborative Situated Active Mobile (CSAM) learning design framework, and a survey instrument called the Mobile Teacher's Sense of Efficacy Scale (mTSES). I worked with Ohio State University to investigate the utility of these tools in teacher professional development (Power, 2013, 2015; Power, Cristol, & Gimbert, 2014). Our findings were presented at the 13th World Conference on Mobile and Contextual Learning (mLearn 2014) in Istanbul, Turkey (Power et al., 2014) and the 14th World Conference on Mobile and Contextual Learning (mLearn 2015) in Venice, Italy (Power et al., 2015a, 2015b), and published in the *International Review of Research on Open and Distributed Learning* (Power et al., 2016).

Recent Research Publications

Since undertaking the role of Assistant Professor with the School of Education and Health at CBU in January 2020, I have collaborated with colleagues and graduate students on several publications. Moodley, Cacellier, Power, and Côté (2020) focuses on the design and assessment of on online learning intervention for claims adjudicators in the Ontario insurance industry. Power et al. (2020), Power (2022*c*), and Power et al. (2023) were initiated as collaborative responses with CBU graduate students to support educators shifting to online teaching because of the COVID-19 pandemic. Kay, Ruttenberg-Rozen, and Power (in press) explores an evidence-based framework for classifying and using educational apps.

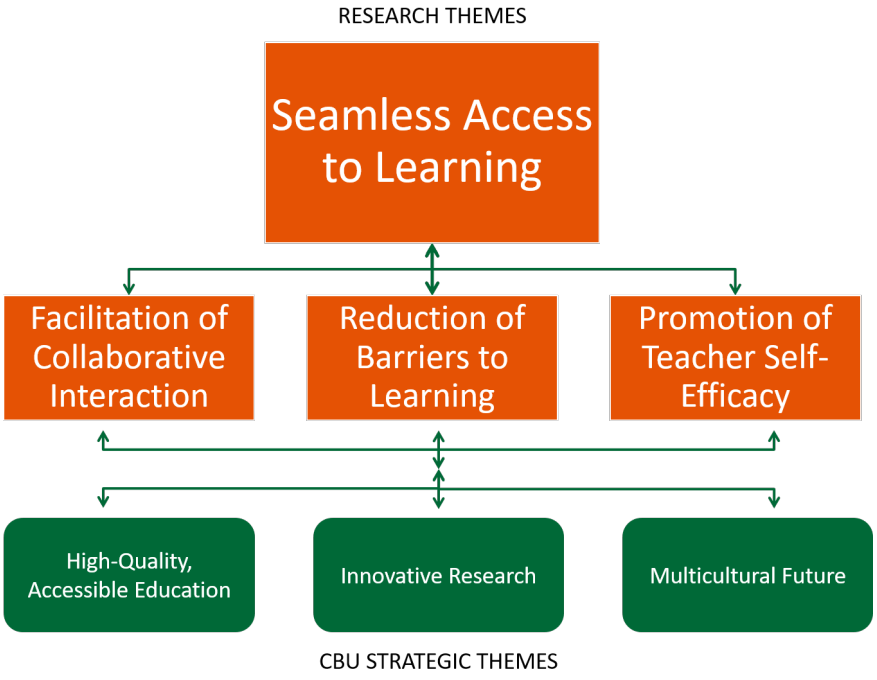
Current Research

My current work leverages new partnerships to build upon my research themes of supporting online teaching and learning, promoting seamless learning, and promoting Digital Accessibility.

The CBU Strategic Plan 2019-2024 stresses that "Cape Breton University is committed to high-quality, accessible education; innovative research; and a vibrant, multicultural future for the Island" (Cape Breton University, 2019, p. 2). The connections between this, my current research agenda, and my overarching research themes are illustrated in Figure R1:

Figure R1

Relationships between research themes



Facilitation of Collaborative Interaction and Promotion of Teacher Self-Efficacy

Online Teaching and Learning

Early after the onset of the COVID-19 pandemic, I partnered with colleagues from the Mitch and Leslie Frazer Faculty of Education at Ontario Tech University to investigate the responses of higher education faculty to the rapid transition to online teaching, the support mechanisms that facilitated that transition, and the impacts of the transition on the current and future teaching practices. We concluded our data collection and analysis in late 2021. In May 2022 we presented our findings at the *Redefining Learning in a Digital Age* conference hosted by Ontario Tech University (Power & Kay, 2022), and at the 2023 Canadian Network for Innovation in Education Annual Conference (Power & Kay 2023*b*). Two papers from this research have also been published. Power and Kay (2023*a*) focuses on recommendations for supporting faculty as they integrate technology and innovative pedagogies, and Power, Kay, and Craig (2023) examines the impacts of the COVID-19 experience on faculty's teaching practices in online environments and upon the return to in-person classrooms.

In March 2022, I published a chapter (Power, 2022*b*) on instructional design process recommendations for faculty designing, developing, and testing online learning content as part of the eCampus Ontario funded T*hriving Online: A Guide for Busy Educators* Open Access eBook initiative.

Seamless Learning

I am a member of an international research collaborative called the International Research Network for Innovative Sustainable Seamless Education (IRN-ISSE) formed in 2018 which has developed a framework for the design of seamless learning experiences in higher education. In 2020, we published an Open Access book about the framework (Hambrock et al., 2020). The second stage of this research investigated the implementation of seamless learning interventions at higher education institutions from North America, Europe, Asia, Africa, and Australia. This phase of our research resulted in a second Open Access volume of the research collaborative's findings (Hambrock et al., 2022). The team also plans to disseminate further results at various milestones through conference presentations, and peer-reviewed journal articles.

Peer-Collaboration in Online Learning

Power et al. (2020), Power (2022*c*) and Power (2023) are examples of how I have incorporated peer-to-peer collaboration into my teaching practice to facilitate rich learning and the production of meaningful learning artifacts. In the Spring 2022 term, I joined a team of researchers from Ontario Tech University to begin examining the benefits of using the online platform Kritik (2022) to streamline peer-

to-peer interactions when authoring and providing peer feedback on graduate-level academic writing activities. Our aim is to analyze the peer feedback process itself, as well as students' perceptions of the benefits and drawbacks of the use of such digital platforms.

Teacher Self-Efficacy with Artificial Intelligence Tools

In the fall of 2023, I conducted a CBU and Ontario Tech University REB-approved study examining the impacts of targeted professional development and hands-on use of Artificial Intelligence tools on graduate Education students' perceptions of self-efficacy with AI agents like ChatGPT (OpenAI, n.d.). That study led to the development and pilot testing of a new research instrument called the ChatGPT Teacher's Sense of Efficacy Scale (Chat-T) (Power, 2024*b*). The findings from this study are currently in-press with the Journal of Educational Informatics (Power, in press).

Reduction of Barriers to Learning

Digital Accessibility and Assistive Technology

Over the past four years, I have collaborated with Dyslexia Canada and Drs Sandra Jack-Malik, Janet Kuhnke, and Christina Phillips from the School of Education and Health at Cape Breton University. We have facilitated a series of open access presentations on supporting children and adults who have Dyslexia. I am continuing with the development of a research agenda linked to the creation of an elective course that will initially be offered the students at CBU, and that will eventually be offered as a faculty professional development opportunity, and as an open-access public learning opportunity. Research themes under consideration center on the efficacy of technology-based interventions to support children and adults with Dyslexia for which there is anecdotal evidence of benefit.

In March 2022, I published a chapter (Power, 2022*a*) on Digital Accessibility considerations and best-practices for designing online learning modules as part of the eCampus Ontario funded T*hriving Online: A Guide for Busy Educators* Open Access eBook initiative.

In March 2024, I published the open-access digital textbook *The ALT Text: Accessible Learning with Technology* (Power, 2024*a*). This resource will serve as the primary course textbook for a newly developed course on digital accessibility and technology in teaching and learning at CBU. The "living textbook" design will allow for new sections of "critical analyses" chapters to be contributed by course participants each time the course is offered. This, in turn, may generate new research opportunities connected to the them of peer-collaboration in online learning.

Future Research Directions

My current research agenda clearly touches on all three of my major research themes. While other opportunities will arise to advance all of these themes, I have identified two initiatives that are closely linked to the reduction of barriers to learning, and the promotion of collaborative learner interactions. These research directions are closely linked to recent program initiatives and the expressed aims of Cape Breton University.

Reduction of Barriers to Learner and Facilitation of Collaboration

Alternative Pathways to Teacher Training and Certification

As a result of the restrictions imposed in Nova Scotia in response to the COVID-19 pandemic, the 2020-2021 CBU Bachelor of Education program cohort has the distinction of being the first in Canada to complete the coursework components of a B.Ed. program entirely online. In another first, in response to calls from the Province of Nova Scotia for help in addressing critical K12 teacher shortages, CBU introduced an accelerated 8-month fully-online Bachelor of Education pilot program. A new 12-month format for the on-campus B.Ed. program began with the May 2024 cohort intake. I am currently undertaking a REB-approved research project to examine the efficacy of such alternative B.Ed. program delivery formats. This will examine the within-program academic achievement of participants from the new program formats, alongside that of recent on-campus cohorts of the traditional 15-month B.Ed. program and graduates of the 15-month cohort that completed their coursework entirely online during the COVID-19 pandemic. It will also explore the impacts of the different delivery models on participants' perceptions of self-efficacy as teaching professionals, and their ability to access a career in the teaching profession. It is anticipated that findings from this research will be of benefit to policy makers and to future program development efforts.

Teacher Self-Efficacy with Artificial Intelligence Tools

Due to the limitations of the sample size in the AI-related study completed in Fall 2023, and currently in-press with the Journal of Educational Informatics (Power, in press), it was not possible to verify the construct reliability and validity of the Chat-T research instrument. It is my intention in the immediate future to submit further REB applications to conduct additional studies with larger sample sizes for the validation of this new research instrument.

Universal Design for Learning

Over the past year, I have begun collaborating with colleagues from the Education Department, including Dr. Lynn Lavette and Melissa Bishop. We aim to investigate the roles of Universal Design for

Learning principles (CAST, 2018) in teacher preparation programs, and the readiness of teacher candidates to employ UDL principles in the design and delivery of effective instruction. Our goal is to develop a survey instrument that could be used to gauge teacher and teacher candidates' perceptions of self-confidence with the integration of UDL, their overall level of familiarity with the principles, and the level of exposure to UDL principles that they gain throughout their teacher training programs.

Micro-Credentials and the Future of Online Learning at CBU

Cape Breton University has expressed a keen interest in exploring models for delivering online learning opportunities to wider audiences, including the use of micro-credentials. Alongside the existing newly-launched microcredential program offerings at CBU, our emerging training and research partnership with Dyslexia Canada offers an ideal opportunity to explore the effectiveness of different instructional design, technology integration, and learner enrolment and participation models for a higher education course. Results from this would be of interest to policy makers and program design teams at CBU, as well at other higher education institutions.

Additional Research Partnerships

IRN-ISSE and PETL

In addition to potential research partnerships that I have forged with colleagues at CBU, I continue to develop partnerships nationally and internationally. The International Research Network for Innovative Sustainable Seamless Education continues its multinational exploration of the Seamless Learning Education Design (SLED) framework, and its impacts of the learning experiences of higher education students in different contexts. IRN-ISSE is also now discussion the integration of Artificial Intelligence applications into its research agenda, to explore how AI can enhance seamless learning experiences. The Pedagogy and Educational Technology Lab (PETL) is a partnership between myself and colleagues from Ontario Tech University. We have already completed research exploring the impacts on teaching practices of the transition to online teaching during the COVID-19 pandemic. We are now planning further potential research projects focused on collaborative peer review and open access publishing in higher education instructional design.

Funding Opportunities

In addition to the use of Start-Up Research Grant funds to support current and future research initiatives, several potential funding sources have been identified, including:

- Monetary and/or in-kind support from Dyslexia Canada.

- SSHRC Partnership Development Grant program.
- SSHRC Connect Program.
- SSHRC Insight Program.
- CBU Research Innovation Scholarship Exploration (RISE) grant program

SSHRC programs such as the Partnership Grant, the Connect Grant, and the Insight Grant, along with direct support from Dyslexia Canada, could be leveraged to advance research related to the efficacy of digital tools to support learners with Dyslexia. The CBU RISE program may be a good starting point for funding to support research into the efficacy of online program delivery for Bachelor of Education candidates, as well as research into the instructional design and efficacy of the use of micro-credentials to promote innovative online programs at CBU. The future research initiatives outlined here could also be supported through SSHRC's Partnership Development, Connect and Insight Grant programs.

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APPENDIX R: RESEARCH RELATED DOCUMENTATION

Appendix R1: Evaluating Graduate Students' Self-Efficacy with the Use of Artificial Intelligence Agents: A Case Study (Power, in press)

Word Count: 7149

Evaluating Graduate Education Students' Self-Efficacy with the Use of Artificial Intelligence Agents: A Case Study

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Abstract

Rapid expansion in the availability of artificial intelligence agents such as ChatGPT (ChatGPT, 2024; Shankland, 2024) and their growing use by students (DeLaire, 2023) create imperatives to develop institutional policies on their ethical use and to prepare educators to integrate them into teaching practice. However, educators largely remain under-prepared for this task (D'Andrea, 2023). Recommendations for increasing educator integration of AI tools include hands-on use, critical evaluation of the strengths and limitations of specific tools, collaboration on the design and delivery of AI-related curricula, and training on pedagogical approaches (Bond et al, 2024; Celik et al., 2022; Langreo, 2023*a*, *b*; MobileMind, 2024; Wilichowski & Cobo, 2023). This case study explored the use of ChatGPT by a group of graduate-level Education students to generate samples of academic writing, which they systematically critiqued for elements such as challenges in crafting effective prompts, factual accuracy or omissions, and writing and formatting conventions. The ChatGPT Teacher's Sense of Efficacy Scale (Chat-T) (Power, 2024) was developed to provide insights into the impacts of AI-focused professional development such as the student activities in this case study. Such insights can help identify potential targets for future training initiatives. Participants gained an understanding of how ChatGPT works, identified its pitfalls as an academic writing aid, and developed understandings of effective complementary roles that can exist between AI tools and teachers. They expressed an increased eagerness to leverage such tools, but also a desire for further training and support with an explicit focus on effective pedagogical approaches for integrating AI agents in teaching and learning. While further research is needed to verify the construct validity of the Chat-T instrument and utility to wider audiences, the tool instrument was able to provide insights into the strengths of the case study activity and point to areas potential future course improvements.

Keywords: academic writing, AI, artificial intelligence, ChatGPT, educational leadership, teacher self-efficacy, Technology Acceptance Model,

Evaluating Graduate Education Students' Self-Efficacy with the Use of Artificial Intelligence Agents: A Case Study

At the onset of the 2023-24 academic year, K12 and higher education institutions were endeavouring to develop policies around the ethical use of Artificial Intelligence (AI) agents such as ChatGPT by students (Cowan, 2023; D'Andrea, 2023; HESA, 2023). Educators are showing increasing interest in integrating AI technologies in their courses (Majkowska, 2023). However, there remains a lack of understanding of effective pedagogical practices when using AI agents. This can lead to anxiety, which is often seen when introducing new tools and instructional strategies. Power (2015) demonstrated that educators' confidence with the use of new tools and strategies can be addressed through the use of targeted supports including professional development with hands-on use of the tools, training on appropriate instructional design and pedagogical strategies, and access to peer-support networks. Developing targeted supports requires an understanding of gaps in educators' sense of self-efficacy with the use of a given tool or strategy. The Ohio State Teacher's Sense of Efficacy Scale (TSES) (Tschannen-Moran & Woolfolk Hoy, 2001*a*, *b*) is a well-established tool for gauging educators' confidences along the domains of student engagement, instructional strategies, and classroom management. Benton-Borghi (2006) adapted the TSES for the measurement of self-efficacy with the use of inclusive instructional practices. The mTSES instrument (Power, 2015; Power et al., 2014; Power et al., 2016) was developed for the measurement of self-efficacy with the use of mobile technologies and mobile learning strategies in the classroom. For this research, an adapted version of the TSES instrument called the ChatGPT Teacher's Sense of Efficacy Scale (Chat-T) (Power, 2024) was developed to evaluate educators' perceived strengths and weaknesses in the context of using AI agents. For the purposes of this research, AI agents refers to large language model AI chatbot tools, such as ChatGPT. A group of graduate students were provided with an introduction to how AI agents work and a tutorial on the use of ChatGPT. They then used ChatGPT to produce academic papers and to critique the output. The activity targeted perceptions of the usefulness and ease-of-use of the tool, which according to the Technology Acceptance Model (TAM) (Davis, 1989) impact intentionality and subsequent actual use of new educational technology. This research then examined whether this exposure impacted participants' sense of confidence in the domains of student engagement, instructional strategies, and classroom management measured by the TSES instrument and its variations.

Literature Review

The Emergence of ChatGPT

ChatGPT (OpenAI, n.d.) is an interactive chatbot that is "[b]ased on a large language model" that "enables users to refine and steer a conversation towards a desired length, format, style, level of detail, and language" (ChatGPT, 2024). First launched in November 2022, by January 2023 ChatGPT "had become what was then the fastest-growing consumer software application in history" (ChatGPT, 2024). ChatGPT is an open-access tool which can be customized for specific purposes such as crafting jokes, finding recipes, or finding and applying to jobs in specific markets on a user's behalf (Heydari, 2024). In January 2024, OpenAI launched the GPT Store (OpenAI, 2024), which at that time hosted over three million customized AI agents (Shankland, 2024). The number and variety of agents based on ChatGPT is expected to continue growing at a rapid pace, with University of Toronto Creative Destruction Lab executive director Sonia Sennik (in Heydari, 2024) noting "I think we're going to see ... ever more innovative tools that are built by folks like you and me, who can now speak to and engage with these models." While it has not yet had a significant impact on the search engine's user base, Microsoft has now incorporated AI tools based on the OpenAI ChatGPT platform into the Bing AI service (Cunningham, 2024). However, Onslow (2023) notes that "the field of conversation artificial intelligence has explored

in recent years with the development of tools like [ChatGPT], LLaMA and LaMDA," and that "[t]ech giants are racing to create the best chatbot and virtual assistant powered by these LLMs." These tools are being integrated into a range of products targeting everyday users, including Bard, Claude, and Bing AI. Similarly, a variety of AI image-generation tools are also gaining in popular use, including DALL-E, Microsoft Image Creator, ImageFX, and Midjourney (Ortiz, 2024).

Concerns for the Education Sector

The rapid growth in the number ChatGPT-based tools has caused concern amongst experts and officials in various sectors. In the business sector, Heydari (2024) notes that “laws and regulations are unclear on who is to blame when things go wrong.” Heydari explains that this is a concern because of the high potential for AI applications like ChatGPT to produce plausible-sounding results that are, in fact, erroneous. Rozear (2023) points to significant concerns with the tendency of ChatGPT to "fabricate or “hallucinate” (in machine learning terms) citations [which]... may sound legitimate and scholarly, but they are not real." Walters and Wilder (2023) examined the prevalence of questionable citations in literature reviews produced using different versions of ChatGPT, and found that "55% of the GPT-3.5 citations but just 18% of the GPT-4 citations are fabricated... [and that] 43% of the real (non-fabricated) GPT-3.5 citations but just 24% of the real GPT-4 citations include substantive citation errors." This is a concern in the education sector, where DeLaire (2023) notes that a recent survey has shown that over half of post-secondary students have used AI agents to complete assignments or tests. When using AI agents ethically (for instance, to aid with idea-generation, the search for background resources, or proofreading a document), insufficient awareness and training on their limitations can lead students to produce “biased, inaccurate, or incorrect content that users should be aware of" (Foltynek, et al., 2023, p. 3). There are also legitimate concerns about the unethical use of AI agents such as submitting AI-generated products as one’s own original work “which may constitute academic misconduct" (Foltynek, et al., 2023, p. 3). By late 2023, many academic institutions had begun the task of developing formal policies around the ethical use of AI agents by faculty and students (Cowan, 2023; D’Andrea, 2023; HESA, 2023). However, D’Andrea (2023) quotes University of Saskatchewan educational ethics researcher Sarah Eaton who notes that while “[t]here are strong indications from Microsoft and Google that by the end of 2025, AI technologies will be fully integrated into Microsoft Office and the Google Suite of products,” educators remain unprepared for the deep integration of such tools into their own or student activity. As MobileMind (2024) notes, "beyond a foundational understanding of AI and how to use it on a basic level, teachers need to understand what this means for their own instruction, student learning, and education as a whole." However, Wilichowski and Cobo (2023) stress that "[m]ore work is needed to clarify exactly how to train teachers so that they cultivate the digital competencies required to use AI effectively." Likewise, Jeon and Lee (2023) stress that "despite some assumptions regarding its influence on education, how teachers may actually use the technology and the nature of its relationship with teachers remain under-investigated" (p. 15873). Bond et al. (2024) state that a meta-analysis of research on the use of AI in higher education between 2018-2023 points to “a need for greater ethical, methodological, and contextual considerations within future research, alongside interdisciplinary approaches to… application” (p. 1) as well as increased collaboration on “the development of AI applications, designing and teaching AI curriculum, and researching [AI use in Higher Education]" (p. 33). Langreo (2023*a*) emphasizes that “professional development on artificial intelligence should get teachers up to speed on what AI is and how to use it and teach about it” and that educators will need to trained on “pedagogical content knowledge specific to AI.” In a case study involving 11 language teachers who were asked to use ChatGPT in their instructional activities for a two-week period, Jeon and Lee (2003) explored what the understanding of appropriate technical and pedagogical uses of AI tools in education entailed. They identified the complimentary roles between teachers and AI tools that could emerge with thoughtful technical and pedagogical training. These included the use of ChatGPT as an

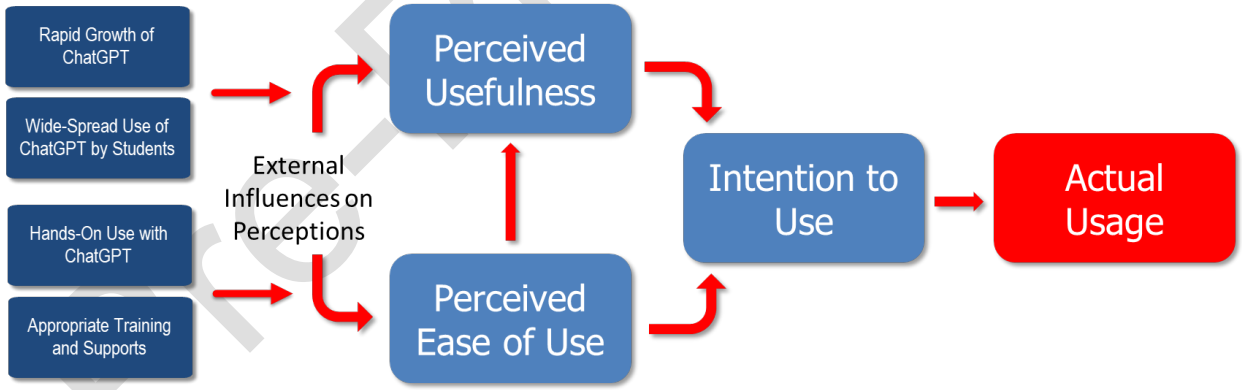
"interlocutor, content provider, teaching assistant, and evaluator," while teachers undertook three key roles to "orchestrat[e] different resources with quality pedagogical decisions, mak[e] students active investigators, and rais[e] AI ethical awareness" (p. 15873). In addition to a need for further professional development efforts and study of appropriate pedagogical approaches, Wilichowski and Cobo (2023) stress the importance of addressing "significant differences… in teachers' perception of technology" that they note may "affect how open they are to learning and adopting new digital competencies."

Increasing Teacher Self-Efficacy with AI Agents for Academic Writing

Celik et al. (2022) emphasize that "[t]o achieve successful AI implementation in education, various stakeholders, specifically, teachers, should participate in AI creation, development, and integration" (p. 617). This participation could include the development and integration of AI-based teaching and learning resources and activities, as well as use of tools like Chatbase (2024) to create new AI agents for use in different educational contexts. This is consistent with research on faculty integration of novel technologies and pedagogies during the COVID-19 pandemic (Power & Kay, 2023; Power et al., 2023), which showed that hands-on tool use supported by just-in-time technical resources, peer support networks, and formal pedagogical training, led to technological and pedagogical innovation. For that research, Davis' (1989) Technology Acceptance Model (TAM) was used to explain how the inevitability of shifting to online instruction during the pandemic contributed to perceptions of usefulness of novel technologies (i.e., why educators should use a particular tool). Likewise, hands-on use paired with appropriate supports contributed to the perceptions of ease-of-use necessary for technology adoption. In the context of AI agent use and the recommendations for teacher preparation (Celik et al., 2022; Langreo, 2023*a*, *b*; MobileMind, 2024; Wilichowski & Cobo, 2023), Figure 1 (below) shows how TAM could be used to map out a pathway to educator readiness and willingness to leverage tools such as ChatGPT.

Figure 1

Using TAM (Davis, 1989) to Support Educator Adoption of ChatGPT



External factors such as ChatGPT's rapid market growth (ChatGPT, 2024; Shankland, 2024), combined with survey results indicating widespread use of AI agents by students (DeLair, 2023) create an imperative for educators to become competent with them (i.e., perceived usefulness of the tool). As stated by Stanford University doctoral student Daniela Ganelin (in Langreo, 2023*a*), "if students are going to be learning about it, then teachers need to be learning about it." Meanwhile, Celik et al.'s (2022) suggestion that educators more fully participate in the "creation, development, and integration" of AI agents, combined with appropriate training and supports, can impact TAM's perceived ease-of-use. According to Davis (1989), perceptions of usefulness and ease-of-use are both preconditions to the actual adoption of new tools such as ChatGPT. Both also contribute to educators' perceptions of self-

efficacy, or confidence in their ability to leverage AI agents as part of effective instructional strategies, to engage with their students, and to manage their classrooms while using such tools.

Measuring the Impacts of Using AI Agents on Teacher Self-Efficacy

The Ohio State Teacher's Sense of Efficacy Scale (TSES) (Tschannen-Moran & Woolfolk Hoy, 2001*a*, *b*) was first developed to gauge perceptions of confidence as teaching professionals along the domains of student engagement, instructional strategies, and classroom management. Subsequent iterations have been developed to place those perceptions of efficacy in specific contexts, such as the use of inclusive educational practices (Benton-Borghi, 2006) and the integration of mobile learning strategies (Power, 2015; Power et al., 2014; Power et al., 2016). In the studies by Benton-Borghi (2006) and Power (2015), the revised questionnaires were analyzed for the impacts of targeted training interventions on teacher confidence with tools or approaches, which were compared to changes in participants' broader perceptions of self-efficacy as teachers during the same timeframe. For instance, Power (2015) calculated changes in participant efficacy scores along each of the three TSES domains, and compared these to changes in their efficacy scores for the same domains for only those survey questions that specifically focused on the use of mobile technologies. This showed that participants in a targeted professional development experience did become more confident in their ability to leverage mobile technologies for instructional strategies and student engagement (Power, 2015). Following the procedures established by Benton-Borghi (2006) and Power (2015), a new iteration of the TSES instrument called the ChatGPT Teacher's Sense of Efficacy Scale (Chat-T) (Power, 2024) has been developed for measuring the impacts of ChatGPT-focused teacher professional development on confidence and intention to leverage AI agents in teaching and learning.

Statement of the Problem

The number of AI agents such as ChatGPT is rapidly expanding (ChatGPT, 2024; Shankland, 2024), and over half of Canadian post-secondary students have indicated that they have used them to complete assignments or tests (DeLaire, 2023). However, educators are unprepared for the use of such tools by their students. Preparing educators to effectively leverage AI agents, and to discourage their misuse, requires targeted supports. This research used an adapted version of the TSES, called the ChatGPT Teacher's Sense of Efficacy Scale (Chat-T), to identify changes in graduate Education students' perceptions of efficacy with the use of AI agents following participation in targeted training and the critical analyses of academic writing pieces generated by ChatGPT.

Research Questions

1. How does targeted training and practice impact educators' perceptions of self-efficacy with the use of AI agents in teaching and learning practice?
2. How does targeted training and practice impact educators' intention to integrate AI agents in their teaching and learning practice?
3. What additional targeted supports do educators need to increase their confidence with the use of AI agents in teaching and learning practice?

Significance of the Research

This research investigated the impacts of a targeted training and hands-on experience with the use of AI agents on perceptions of self-efficacy with their use in teaching and learning practice amongst graduate Education students. This research also aimed to establish utility of the Chat-T research instrument, adapted from the TSES instrument, as a tool for gauging the effectiveness of professional development activities and the identification of gaps in confidence requiring further targeted supports. The results of

this research provide information and a new tool that will be useful to educators, administrators, policymakers, and others involved with planning for and supporting the integration, and effective and ethical use of AI agents in teaching and learning practice.

Methodology

During the Fall 2023 term, two anonymous surveys were distributed to students enrolled in a graduate-level Critical Issues in Education Leadership course at Ontario Tech University. The first survey included demographic questions about participants' level of experience as an educator, as well as the questions from the Chat-T instrument (Power, 2024). This was used as a pre-test of participants' perceptions of self-efficacy with the use of AI agents, as well as their perceptions of self-efficacy with teaching and learning practice in general (as per the original TSES instrument). After engaging in training sessions exploring the technical use of AI agents such as Chat GPT, and the current education leadership issues related to the use of such AI agents, students worked in pairs to complete a four-stage hands-on activity using Chat GPT to generate an essay on an educational leadership issue of their choice. Those stages included:

1. Developing prompts and using Chat GPT to generate an academic essay.
2. Systematically reviewing the Chat GPT-generated essay for topic relevance, factual errors and/or omissions, and writing style and formatting conventions.
3. Presenting a critique of the use of Chat GPT to generate academic essays based on their findings, including presenting recommendations for education leaders.
4. Revising the Chat GPT-generated essay based on their findings.

The second survey was administered at the end of the course and included the same questions as the first survey. This survey served as a post-test of participants' perceptions of self-efficacy with the use of AI agents in teaching and learning practice. The second survey also included open-response questions to collect qualitative data on participants' perceptions of efficacy, intentions to use AI agents in their own practice, and perceived needs for further training and support. The procedures used by Power (2015), Power et al. (2014), and Power et al. (2016) were used to measure changes in participants' perceptions of self-efficacy along the domains of student engagement, instructional strategies, and classroom management, between the pre-test and post-test administrations of the Chat-T instrument.

Benton-Borghi (2006) and Power (2015) established procedures for analyzing data from pre- and post-administrations of their variations of the TSES instrument to determine construct validity compared to the original TSES. However, Cohen et al. (2011) note that a minimum sample size of n=30 would be required when using Likert-style questions, such as those in the TSES and its variations, to conduct statistical analyses such as internal reliability and validity. Due to the maximum sample size of n=20 participants (the total enrolment in the target course for this study), and the actual response rates to the pre- and post-administrations of the Chat-T instrument, calculations of construct validity were not conducted.

Participant Selection

The target participant group for this research was determined through convenience sampling. Participants were all graduate-level Education students enrolled in a Critical Issues in Education Leadership course during the Fall 2023 term at Ontario Tech University. There were a total of 20 students enrolled in the course. Participants were selected by way of responding to a link to an anonymous online survey made available to all students in the target course. Target participants were provided with a letter of informed consent, and an opportunity to decline participation, before proceeding to the survey questions. There was no way for the researcher identify students from

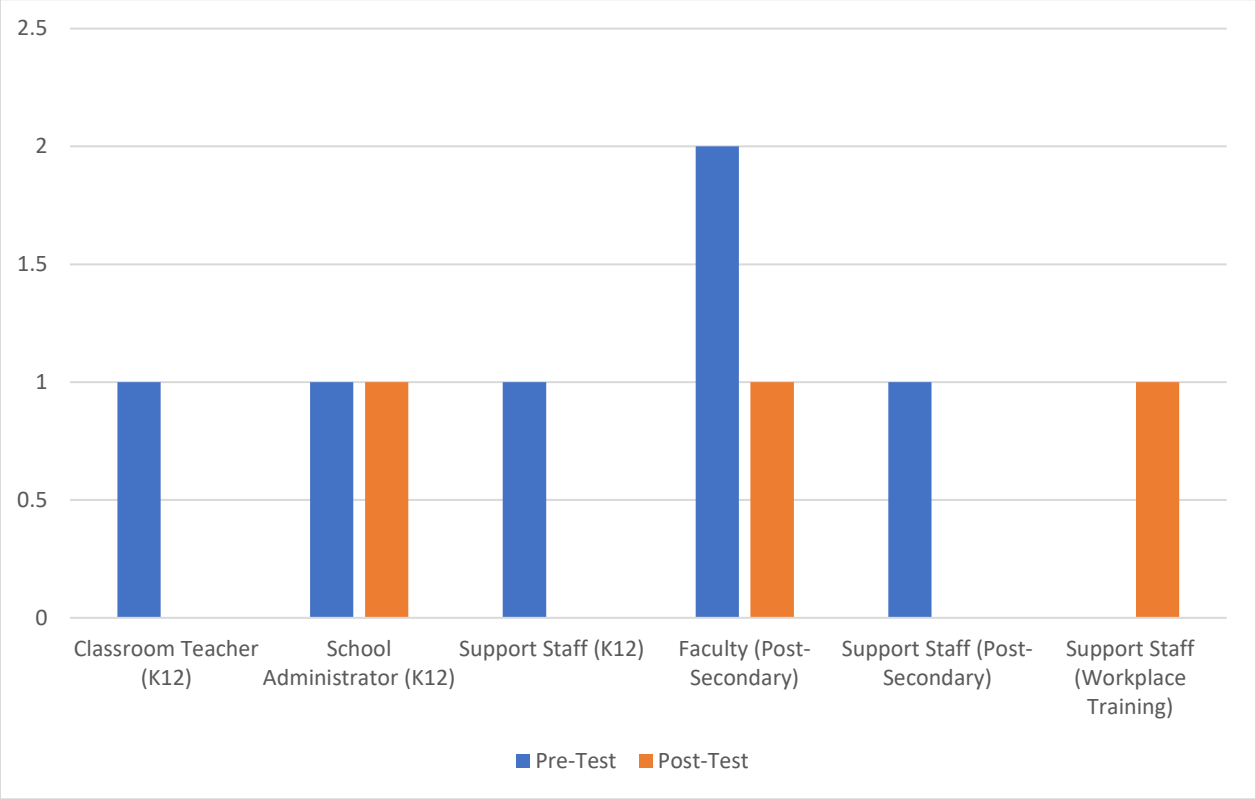
responses to the survey instrument, and students were assured that their participation in the survey would not impact their progress in the course.

Results

A total of 20 graduate-level students were enrolled in the Critical Issues in Education Leadership course at Ontario Tech University during the Fall 2023 term. All students participated in the four-stage course assignment using ChatGPT to generate an academic essay on a topic of their choice, which they then systematically critiqued and revised. All students were also sent invitations to participate in optional Chat-T pre-test and post-test surveys, with the assurance that their participation was strictly voluntary and anonymous. A total of n=6 (30%) students responded to the Chat-T pre-test survey, and a total of n=3 (15%) completed the post-test survey. Due to the anonymous nature of the surveys it was not possible to determine the reasons for the low response rates, although it is possible that response rates for the post-test Chat-T survey were lower than for the initial survey due to the timing of the invitation after the official completion of the course. Half of the pre-test respondents (n=3) indicated that they had less than five years of teaching experience, one respondent had between 5-10 years of teaching experience, and two respondents had more than 10 years of teaching experience. Among the post-test respondents, two participants indicated that they had between 5-10 years of teaching experience, and one participant had more than 10 years of experience. Figure 2 (below) shows a relatively even distribution of participant's roles within the K12, post-secondary, and workplace training sectors for both survey administrations.

Figure 2

Participant Roles in the Education Sector



Chat-T Analysis

Changes in self-efficacy scores for the TSES and Chat-T scales were calculated by comparing the mean scores for pre-test and post-test administrations for the student engagement, instructional strategies, and classroom management domains. Both the TSES and Chat-T scales use a 9-point Likert scale for each question, with self-score responses ranging from 1 (Not at All) to 9 (A Great Deal). As outlined in Table 1 (below), there were decreases in the levels of perceived self-efficacy for each domain for both scales. The largest decreases appeared under the domains of student engagement with the use of AI agents (M_{Change} = -1.13) and student engagement in general (M_{Change} = -0.86).

Table 1

Mean Changes in Self-Efficacy Scores

SCALES	Pre-Test	Post-Test	M_{Change}
TSES Scoring	$M_{Chat\text{-}T1}$	$M_{Chat\text{-}T2}$	M_{Change}
Efficacy in Student Engagement:	6.43	5.57	-0.86
Efficacy in Instructional Strategies:	7.40	7.08	-0.32
Efficacy in Classroom Management:	6.10	5.75	-0.35
Chat-T Scoring	$M_{Chat\text{-}T1}$	$M_{Chat\text{-}T2}$	M_{Change}
Efficacy in Student Engagement with AI:	5.80	4.67	-1.13
Efficacy in Instructional Strategies with AI:	6.85	6.04	-0.81
Efficacy in Classroom Management with AI:	5.97	5.67	-0.30

Without a control group, it was necessary to do additional calculations to isolate the impacts of maturation on the changes in self-efficacy scores reported by participants. Maturation (Kirk, 2004) refers to changes in perceptions of self-efficacy that naturally occur over time, as opposed to resulting from the effects of the intervention. Following the procedures outlined by Power (2015), Power et al. (2014), and Power et al. (2016), net changes resulting from the intervention (participants' exposure to the in-course ChatGPT training and essay analysis assignment) were calculated by subtracting the mean changes in each domain for the original TSES scale from those calculated for Chat-T scale, using the formula:

$$(\text{Chat-T}_2 - \text{Chat-T}_1) - (\text{TSES}_2 - \text{TSES}_1) = \text{Net Change}_{(\text{Intervention Effect})}$$

While the mean changes in self-efficacy scores (Table 1) showed the largest decreases for the domain of student engagement, Table 2 (below) shows that the largest net change in perceived self-efficacy was actually exhibited under the domain of instructional strategies with a decrease of -0.49.

Table 2
Net Changes (Intervention Effect) Accounting for Maturation

Domain	Pre-Test > Post-Test
Student Engagement	-0.27
Instructional Strategies	-0.49
Classroom Management	0.05

Open Response Questions

Four open response questions were included with the post-test survey. The first question asked about participants future intentions to use AI agents such as ChatGPT in their own teaching and learning. All three respondents indicated that they would most likely use ChatGPT to help them with idea and resource generation for their classes. While one respondent stated that they would use it to brainstorm "ideas for papers, emails, and cover letters," the others indicated they would use it "as a tool to generate materials for students to critique" and "in lesson planning and creating differentiated lessons."

The second question asked participants what they saw as the biggest challenges they would face when integrating ChatGPT in teaching and learning. One respondent noted "bias and lack of sources" and emphasized that "trust is a big issue." Another respondent stated that they "will need to rethink assignment evaluations," and that they expected challenges "helping students recognize how to effectively edit and proofread."

Asked what additional training or supports they would find useful in order to integrate AI agents in teaching and learning, survey respondents indicated they would seek out "conferences to see what others are doing" and "ideas for incorporating it into my teaching practice." One respondent expressed a desire for more support "to show how this is an assistive technology."

The final open response question asked participants about the advice that they would give to education leaders with respect to using AI agents in teaching and learning. One respondent stressed that "it's a tool - not a teacher. Use it, but don't blindly trust it," while another respondent recommended helping "students recognize that they cannot take this information at face value" and that "they need to be able to critically evaluate it."

Discussion

Impacts on Self-Efficacy and Intention to Use AI Agents

Throughout the Fall 2023 term, graduate students enrolled in a Critical Issues in Educational Leadership course at Ontario Tech University engaged with ChatGPT for a multi-stage small-group assignment. One of the explicit aims of the course was to "develop [students'] critical thinking and leadership skills, and to be prepared to undertake leadership roles in the education sphere outside of the context of this course" (in-course announcement, October 24, 2023). As such, the aim of the assignment was for students to use ChatGPT to produce and critique samples of academic writing. Students' analyses focused on elements such as challenges when crafting effective prompts, the relevance, depth, and accuracy of the resultant essays, and general formatting and writing style. The students then produced video presentations outlining their ChatGPT essay-writing process, the findings of their detailed analyses, their critiques of the use of ChatGPT for academic writing, and their recommendations for

educational leaders. The final stage was for the students to use their own findings to make appropriate revisions to the ChatGPT-generated essays.

The nature of the in-course training and activities align with Bond et al.'s (2024) and Celik et al.'s (2022) calls for teachers to become more involved with the hands-on use of AI agents, and Langreo's (2023*b*) suggestion that professional development should "facilitate exploratory experiences that develop and apply AI knowledge." Graduate students' engagement in the systematic critique of essays they produced using ChatGPT also aligns with MobileMind's (2024) call for teachers to go beyond "a foundational understanding of AI and how to use it on a basic level." Likewise, it reflects Langreo's (2023*b*) calls to "integrate critical examinations of AI technology into classroom experiences" and to "infuse these approaches into teacher prep programs." The assignment provided an opportunity to extensively explore the functionality, benefits, limitations, and implications of the use of ChatGPT. Students' post-course survey responses indicate their growing awareness of the types of appropriate complimentary roles that could exist between AI tools and educators identified by Jeon and Lee (2023). For instance, the role of ChatGPT as useful content provider is reflected in responses such as an intention to use it brainstorm "ideas for papers, emails, and cover letters," as a tool to "generate materials for students to critique, and in "creating differentiated lessons." Likewise, recognition was evident of the roles of teachers as orchestrators of resources and active student engagement. The role of teachers in "raising AI ethical awareness" (Jeon and Lee, 2023, p. 15873) was encapsulated by survey responses discussing the importance of helping "students recognize that they cannot take this information at face value" and that "they need to be able to critically evaluate it." Despite evidence of the awareness of effective complimentary roles between teachers and AI tools, responses to the Chat-T surveys indicated net decreases in participants' perceptions of self-efficacy with the use of AI agents for student engagement and instructional strategies. Participants reported less confidence with the use of AI agents in teaching and learning than they did before starting the activities.

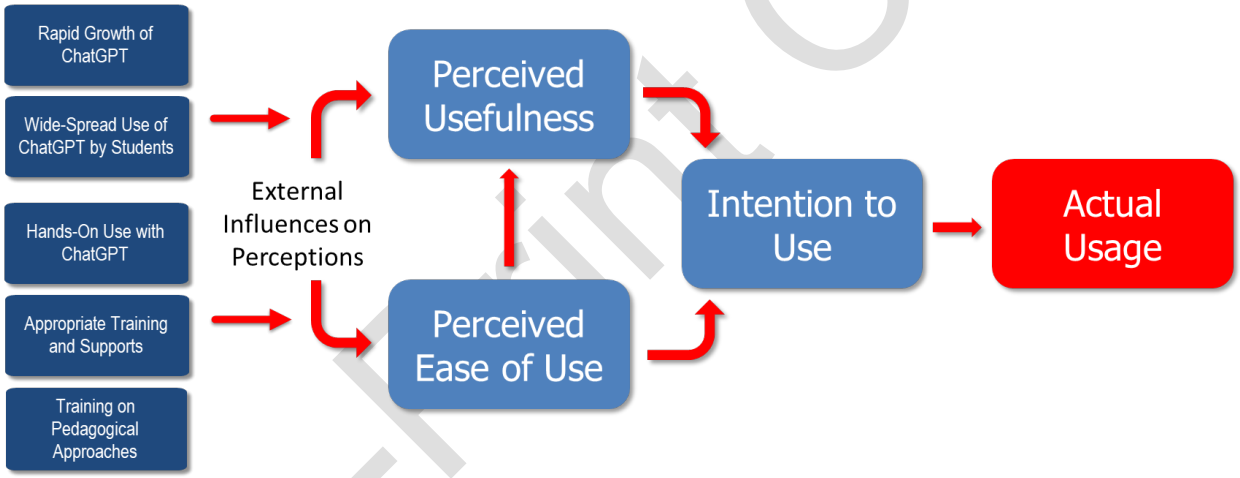
On one hand, given the low response rate it may be difficult to draw conclusions from the Chat-T survey results about the impact of the in-course ChatGPT training and subsequent assignment. The number of responses was too low for reliable and valid statistical analyses (Cohen et al., 2011). Additionally, the small sample sizes mean that the pre- and post-test survey responses may not represent the same samples of the total student population in the course. This creates the possibility that the post-test reports of perceptions of self-efficacy are, in fact, lower than what the original respondents to the pre-test survey would have reported. However, the net decrease in reported self-efficacy may be indicative of the success of the course activities in raising awareness of the strengths and limitations of AI agents and, as stated by MobileMind (2024), "what this means for their own instruction, student learning, and education as a whole." The decreases may be the result of heightened awareness of the implications of tools such as ChatGPT for teaching and learning practice. While post-test respondents stressed the challenges of "bias and lack of sources" when using AI agents to generate academic papers, and offered advice to education leaders to "use it, but don't blindly trust it," they also indicated a desire for additional supports that offered them insights into "what others are doing" and how they could use the tools in their teaching and learning.

The limitations to generalizability of the Chat-T survey results across all potential participants also mean that the results cannot be generalized beyond this case study. However, the findings are useful as indicators of areas for potential improvements to the design of the ChatGPT prompting and critical analysis activities that could be implemented for future course offerings. While further research is needed to validate the Chat-T instrument, these findings support the potential utility of the instrument in the planning of professional development activities and the subsequent analysis of their effectiveness with participant groups.

The students from the Critical Issues in Education Leadership course gained hands-on experience with how to use ChatGPT to generate an academic paper. While they saw the usefulness of the tool for this, and for other tasks such as creating lesson plans and resources for their own students, they also gained insights into how AI agents actually work, the limitations of the tools, and the vigilance required when employing them. As the focus of the course was on education leadership issues, students did not gain the exposure to training on the pedagogical applications of AI agents called for by Langreo (2023*a*) or on designing and teaching AI curriculum called for by Bond et al. (2024). Students' in-course activities addressed the perceived usefulness factor of TAM (Davis, 1989), and showed them how easily they can prompt AI agents to generate an essay. However, their systematic critiques of the ChatGPT output may have negatively impacted overall perceptions of ease-of-use. Survey respondents have indicated a willingness to integrate AI agents into their teaching and learning. However, the foci of their open-ended responses centered on awareness of the limitations of such tools and of their knowledge of how they are being used by other educators. These findings highlight the importance of including targeted professional development on the pedagogies of AI use to increase educators' confidence and actual integration of such tools (Figure 3).

Figure 3

Using TAM (Davis, 1989) with Pedagogical Training to Support Educator Adoption of ChatGPT



Using Chat-T to Plan and Gauge AI-Related Professional Development

The Chat-T instrument was developed as a variant of the TSES using the protocols established by Benton-Borghi (2006) and Power (2015). Previous studies using variants such as the mTSES (Power, 2015; Power et al., 2014; Power et al., 2016) showed that they are useful for identifying educators' perceived strengths and weaknesses with the use of specific technologies and practices. Their use can help identify areas of focus for targeted professional development. They can also be used to gauge the effectiveness of training and support interventions. Benton-Borghi (2006) and Power (2015) also established protocols for measuring the construct validity of their TSES variants compared to the original instrument and demonstrated a high degree of internal reliability and validity. Unfortunately, the sample size for this study was too small to determine construct validity. Further research with a larger sample size will be required to fully validate the Chat-T instrument. However, the results of the pre- and post-test survey administrations have provided useful insights into the impacts of graduate Education students' experiences with using ChatGPT. These insights align with recent concerns about the potential impacts of AI agents on teaching and learning (Foltynek et al., 2023), and the need for educators to use the tools themselves to gain an appreciation for their strengths, limitations, and implications (Bond et al,

2024; Langreo, 2023*a*, *b*; MobileMind, 2024). They also align with assertions that educators are currently ill-prepared to either confront the implications of AI agents, or to leverage them effectively (Bond et al., 2024; D'Andrea, 2023; Wilichowski & Cobo, 2023). While participants gained appreciation for the practicalities of using AI agents, their survey responses point to a desire for more support with pedagogical approaches to their integration in teaching and learning practice.

Limitations

This research explored the impacts of one type of extended in-course activity on the perceptions of self-efficacy of graduate Education students with the use of AI agents in teaching and learning. That activity gave them a background understanding of how tools such as ChatGPT work, and the opportunity to closely examine the strengths and limitations of such tools for academic writing. Participants were not provided with training on pedagogical approaches when using AI agents. While the findings from this case study may be useful for the identification of potential improvements to the design of the ChatGPT prompting and critical analysis activities for future offerings of the course examined in this case study, the small sample size resulting from the convenience sampling method, means that the findings may not be generalizable to larger educator populations. Similarly, the sample size prevented the determination of construct validity for the Chat-T instrument. Further research with a larger sample size and a more diverse target population will be needed to validate the Chat-T instrument.

Conclusions and Recommendations

Rapid growth in the number and variety of AI agents, combined with indications of their widespread use by students, necessitates the development of institutional guidelines. They also necessitate the preparation of educators with understandings of how such tools work, the implications of their use, and appropriate pedagogical strategies to leverage AI agents in their practice. This case study contributes to identified gaps in the body of research on preparing educators to effectively integrate AI tools by demonstrating how one group of graduate Education students explored the potentials and pitfalls of using the ChatGPT AI agent in academic writing. Results demonstrated a growth in their understanding of effective complimentary roles between AI tools and educators as described by Jeon and Lee (2023). The results also provided insights into the additional supports that the students may need to be better prepared to effectively integrate AI agents in teaching and learning. This case study also introduced the Chat-T research instrument. While further research is needed to verify the construct validity of the instrument, it did prove useful in identifying areas for strengthening the design of course activities. Further validation of the Chat-T instrument may result in a tool that can be beneficial as a tool for planning and evaluating AI-focused educator professional development.

Recommendations for Practice

Educational institutions recognize the urgency for the development of policies and guidelines on the ethical use of AI agents (Bond et al, 2024; Cowan, 2023; D'Andrea, 2023; HESA, 2023). However, educators and students need training on the benefits and limitations of AI "so they can use AI-powered tools responsibly in the classroom and as everyday consumers of the technology" (Langreo, 2023*a*). Additionally, the integration of tools such as ChatGPT requires support for educators that goes "beyond a foundational understanding of AI and how to use it on a basic level" (MobileMind, 2024). One of the aims of this case study was to show how a group of graduate Education students went beyond understanding the foundational use of ChatGPT for academic writing to critically evaluate its strengths and limitations, so that they could gain confidence as educational leaders. However, while participants expressed eagerness to integrate AI agents in their practice, they also expressed trepidation about their limitations and a desire for more training and support on effective pedagogical approaches. Explicit

pedagogical training is one of the essential elements of educator professional development highlighted by Langreo (2023*b*). Power and Kay (2023) show how gaining hands-on experience with novel technologies, combined with appropriate just-in-time supports, can help educators to move forward with Celik et al.'s (2022) call for them to be directly involved with "AI creation, development, and integration" (p. 617). Power and Kay (2023) also show how educators benefit from formal, institutionally-facilitated professional development focused on pedagogical practices. To promote the ethical and impactful integration of AI agents in teaching and learning practice, it is recommended that institutions look beyond establishing policies and towards the implementation of formal pedagogically-focused professional development opportunities.

Recommendations for Future Research

A second aim of this case study was to introduce a potential tool for evaluating the confidence and readiness of educators to use AI agents in their teaching practice, and identifying areas of focus for future professional development initiatives. The Chat-T instrument did provide insights into the impacts of hands-on tool use, and critical evaluation of ChatGPT generated academic writing, on the perceptions of self-efficacy among a group of graduate Education students. The net decrease in their expressions of confidence may be attributed to the lack of exposure to explicit pedagogical training, reiterating the importance of such support to promote the integration of AI agents in teaching practice. However, it will be necessary to evaluate the Chat-T instrument with a larger sample size to determine its construct validity in relation to the original TSES survey.

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Appendix R2: Higher Education Faculty Supports for the Transition to Online Teaching during the COVID-19 Pandemic (Power and Kay, 2023)

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Higher Education Faculty Support for Transitioning to Online Teaching During the COVID-19 Pandemic

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ABSTRACT

Canadian higher education institutions closed physical campuses in early 2020. It transitioned to online teaching and student service delivery because of the COVID-19 pandemic. For many faculty members and institutions unfamiliar with online teaching, this transition meant widespread innovation in digital technologies and pedagogical practices. While necessity created a perception of the usefulness of digital tools, faculty still needed to develop their technical skills and online teaching approaches. This research study found that faculty from two Canadian universities drew upon a combination of formal and informal support networks and resources to increase their technological self-efficacy. Faculty also found that formal professional development was most helpful when it focused on online teaching approaches rather than specific technical functionality. The barriers to innovation and changes to faculty use of digital tools and pedagogies point to recommendations for higher education institutions that must transition to online delivery.

Keywords: Community of Inquiry, communities-of-practice, COVID-19, Diffusion of Innovation, digital innovation, faculty supports, Fully Online Learning Community, online teaching, pandemic, professional development, TAM, TPACK

Introduction

Beginning in early 2020, many Canadian higher education institutions shifted to online course delivery and interactions with students (Masri & Sabzalieva, 2020; Rapanta et al., 2020). For many faculty and students, this represented their first time participating in online teaching and learning. Online course delivery required the use of technologies and

pedagogies unfamiliar to many. While there is a significant body of research on effective technology use and pedagogical approaches for online learning, adopting these tools and methods represented a substantial shift for those individuals with limited experience. As Salajegheh et al. (2022, p. 567) noted, “the unfamiliarity of faculty members with how to use virtual learning platforms is one of the challenges of holding virtual programs that may reduce their success." This research explored the effectiveness and impact of support available to faculty at two Canadian higher education institutions as they transitioned to teaching online during the COVID-19 pandemic.

Literature Review

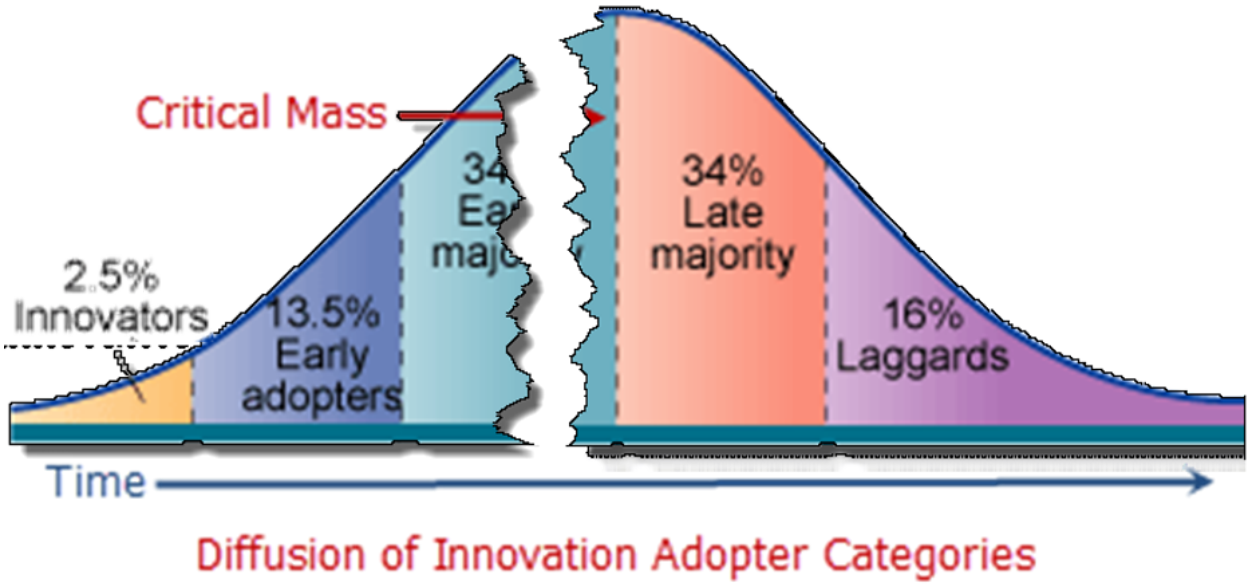
Reaching Critical Mass for Innovation with Technology

Rogers' (1974) Diffusion of Innovation Model tells us that higher education faculty members will adopt new technologies and innovative teaching methodologies at different rates. The Technology Acceptance Model (Davis, 1989) provides insight into educators' intentions to adopt new technologies and subsequent action to carry out such innovation based on necessity, perceived usefulness, and perceived ease of use. Previous research focusing on adopting mobile learning technologies and pedagogies indicated that educators are likelier to adopt innovative practices if they perceive a sense of self-efficacy with pedagogical approaches (Power, 2015, 2018a, b; Power et al., 2016). Faculty need to feel comfortable with the content and pedagogical knowledge before developing the technological expertise necessary to become thoroughly competent (Cavanaugh et al., 2013; Finger et al., 2010; Koehler & Mishra, 2006, 2008; Power, 2015, 2018a, 2018b; Power et al., 2016; tpack.org, 2021). This research also tells us that faculty's willingness to innovate with new technologies and approaches can be enhanced if they have a strong support network that includes organizational leadership, technology-based support, and a collegial community of practice (Power, 2015, 2018a, b; Power et al., 2016).

To understand how faculty respond to adopting new technology, it is necessary to look at how technological innovations typically spread, the factors that influence a decision to adopt new technology, and the impacts of different types of support on educators' sense of self-efficacy with new technology. Rogers' (1974) Diffusion of Innovation Model explains that while faculty will adopt new technologies and innovative teaching methods at different rates under normal conditions, a small number of faculty (innovators) will readily adopt new technologies as they emerge, leading to a slightly larger group (early adopters and early majority) integrating those technologies and teaching practices. However, as Power (2018a) explained at Mobile Summit 2018, barriers often prevent most educators from adopting new technologies (Figure 1).

Figure 1

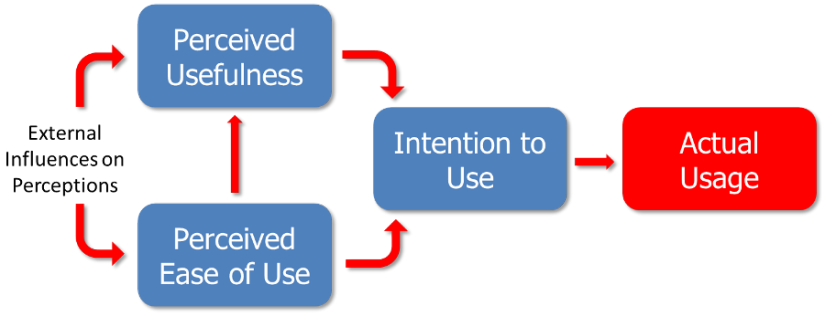
The Adoption Rate of Innovative Technologies And Teaching Practices In Higher Education And Rogers' (1974) Diffusion Of Innovation Model (Power, 2018a).



Power (2018a) noted that to reach critical mass and achieve widespread adoption, educators need to perceive the innovation as either beneficial or necessary. They also need to be confident in using those technologies and practices. Tschannen-Moran and Woolfolk Hoy (2001) emphasized the role played by a perception of self-efficacy in educators' ability to plan for technology adoption and their "willingness to experiment with new methods to meet the needs… of students" (p. 783). The impacts of these perceptions on innovative practice are reflected by the Technology Acceptance Model (TAM) (Davis, 1989, see Figure 2).

Figure 2

The Technology Acceptance Model (TAM) (Davis, 1989).



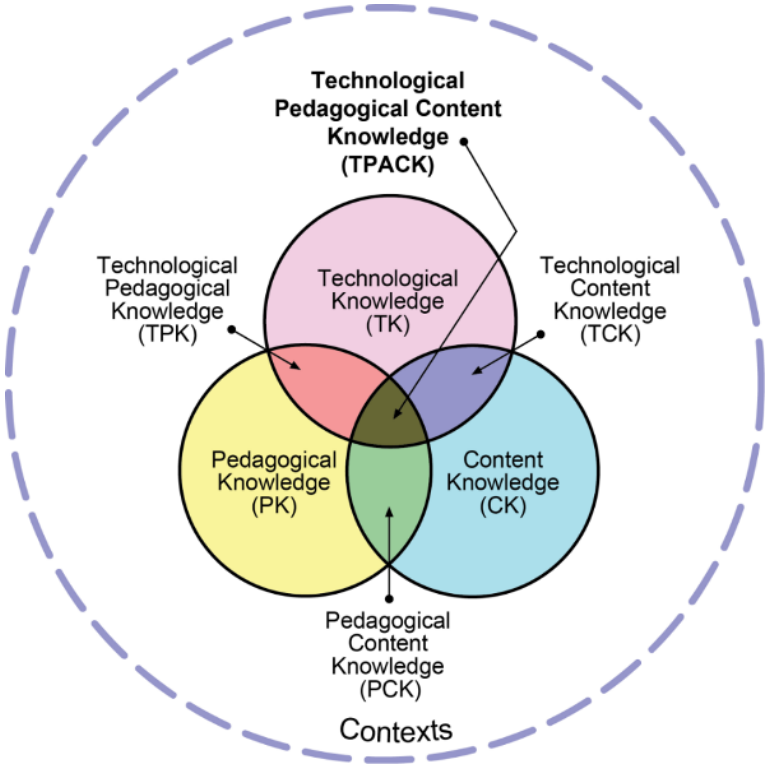
Supporting Faculty to Integrate Digital Tools and Pedagogies

Power (2018a) explored technological and pedagogical innovation in typical teaching and learning environments. However, the transition to online teaching during the COVID-19 pandemic was an unusual context that mandated adopting new technologies (Masri & Sabzalieva, 2020; Rapanta et al., 2020). Using TAM as a lens to examine faculty members' innovations, the emergence of the pandemic and subsequent institutional and government-level mandates can be seen as external influences on perceptions that established perceived usefulness. Mandates to shift instruction to online modalities develop a de facto "intention to use" specific digital tools and new teaching practices. Despite the novelty of the context, educators must overcome the "perceived ease of use" to successfully transition to online teaching.

Power (2018b) discusses the impacts of targeted professional development and access to knowledgeable peers and communities of practice on educators' progression through TAM. These factors, explored through the lens of the Technological-Pedagogical and Content Knowledge (TPACK) model, are presented in Figure 3 (Cavanaugh et al., 2013; Finger et al., 2010; Koehler & Mishra, 2006, 2008; Power, 2015, 2018a, 2018b; Power et al., 2016; tpack.org, 2021).

Figure 3

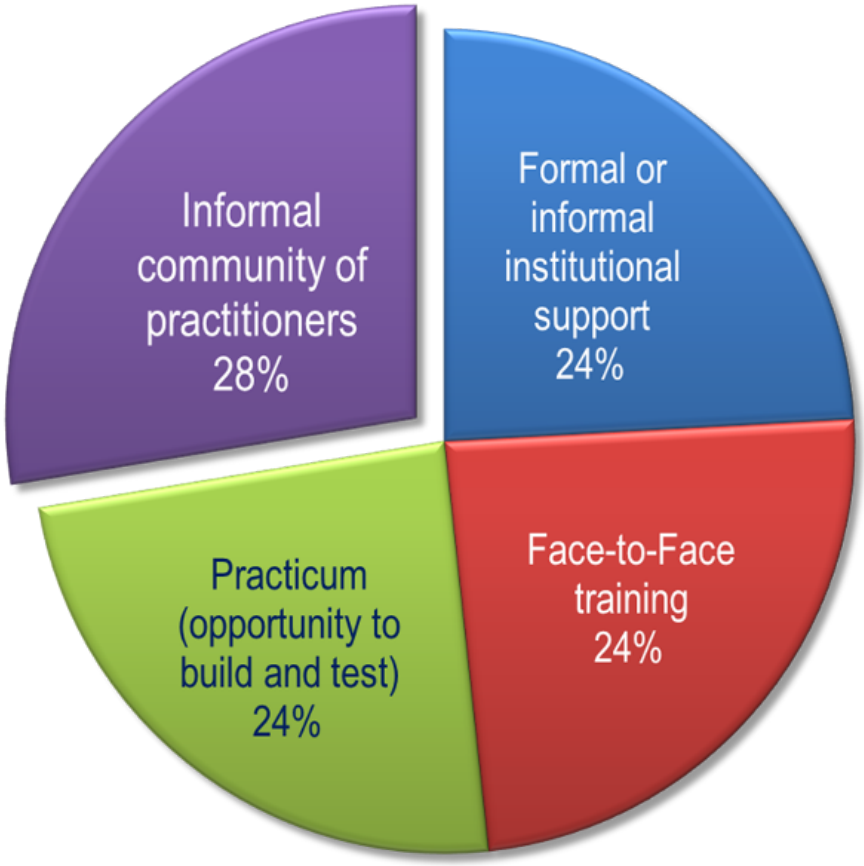
Components of the TPACK Framework. Reproduced with Permission (TPACK.org, 2021)



Power (2018b) notes that educators already perceive self-efficacy in teaching content areas. Many already have a good understanding of sound pedagogical practices in traditional contexts. To feel confident using technology to teach (such as transitioning to an online teaching modality), educators need support for their technology-related skills and understanding of practical pedagogical and instructional design approaches. Power (2018a, 2018b) demonstrated that educators often draw upon knowledgeable peers and participation in communities of practice to strengthen their confidence in technology-specific skills, such as learning functionality and getting support for using new digital tools. During the early stages of the COVID-19 pandemic, many institutions offered this support by identifying experienced online teaching mentors, creating resource repositories, and promoting online tools curated by knowledgeable peers and communities of practice (Kuntz et al., 2022; Walsh et al., 2021). Power (2015) (see Figure 4) showed that access to peers and communities-of- of practice was more critical to educators than formalized training.

Figure 4

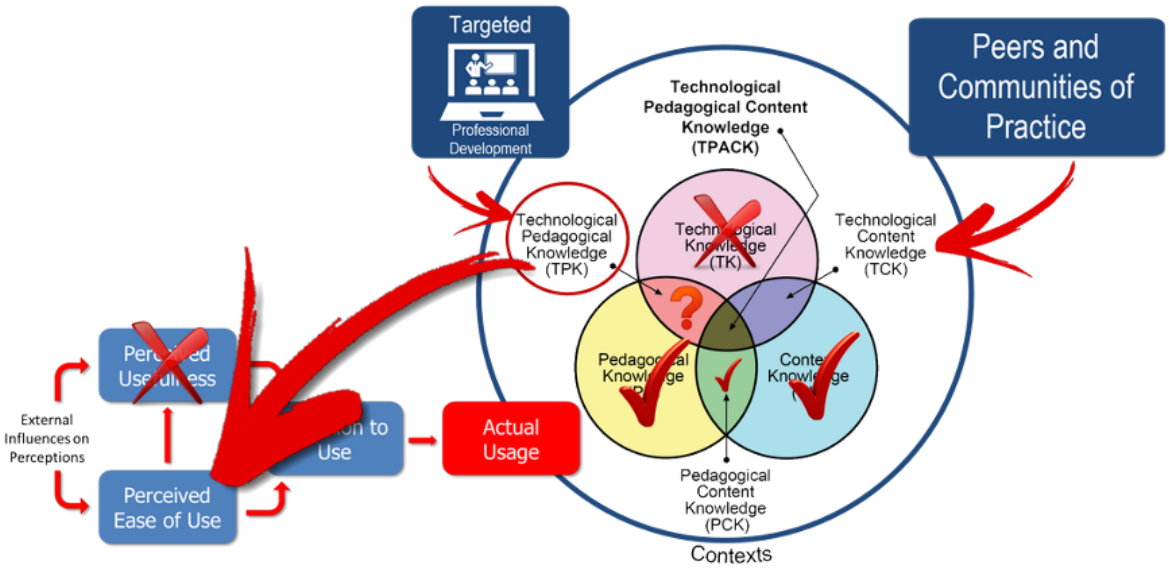
Supports Needed to Integrate Mobile Technologies and Strategies (Power, 2015).



Power (2015) showed that professional development focused on pedagogical approaches was essential to address educators' perceptions of efficacy with the Technological Pedagogical Knowledge domain of TPACK. Koh et al. (2017, p.1) observed "positive effects on teachers' confidence" with their ability to use appropriate pedagogical approaches to design meaningful learning experiences when they had access to targeted professional development support. During the COVID-19 pandemic, Walsh et al. (2001, p.2) found that "[a]cross a group of nursing faculty with varying levels of previous online teaching experience, those who took a seminar in online teaching had higher teaching self-efficacy… [and] online instructors who took a 6-week intensive course grew more confident in both their pedagogical and technological abilities." Power (2018b) reported that combining communities of practice for technology skill support and formal pedagogy-focused professional development resources could be an ideal approach to boosting overall self-efficacy. As illustrated in Figure 5, Power (2018a) explained that this combination could help achieve the critical mass required for the widespread adoption of new technologies and teaching approaches.

Figure 5

Addressing Gaps in Educators' Comfort Using Digital Tools and Pedagogies.



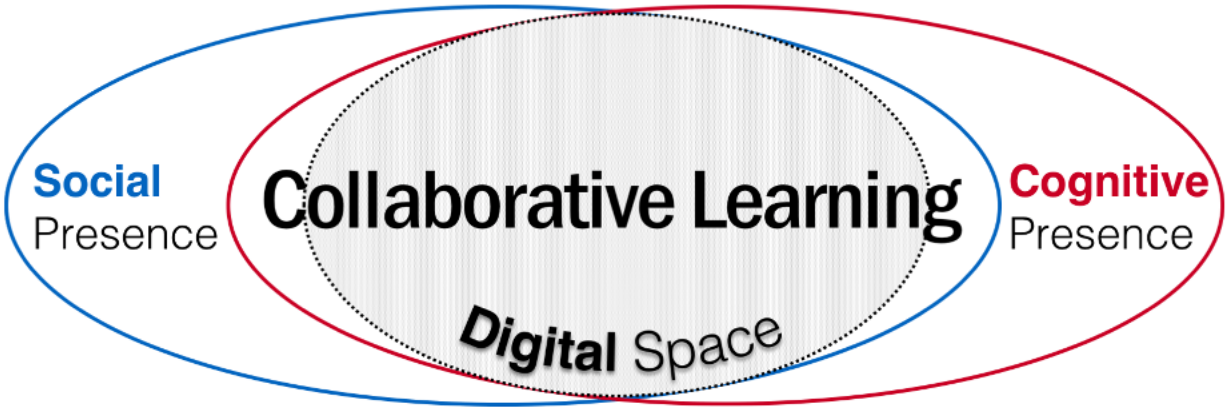
Transferring Supports to an Online Teaching Transition

Power (2015, 2018a, 2018b) explored the impacts on self-efficacy and willingness to adopt innovative tools and practices after professional development focused on a pedagogical framework for using mobile technologies in teaching. Higher education faculty transitioning to online teaching could benefit from professional development targeting

frameworks for creating effective online teaching and learning environments. One of the most widely recognized frameworks for online education is the Community of Inquiry (CoI) model (Athabasca University, n.d.; Garrison et al., 2000; Kineshanko, 2016). The CoI model describes the importance of maximizing teacher, social, and cognitive presence to create an ideal learning environment. Kineshanko (2016) outlines how widely the CoI model has influenced discourse about effective instructional design for online learning, including its impact on formal courses and professional development in online teaching and learning. More recently, researchers from Ontario Tech University have expanded on the CoI model with the Fully Online Learning Community (FOLC) model (Blayone et al., 2017; EILAB, 2022; Webb et al., 2019). The FOLC model also emphasizes the importance of the social and cognitive presence domains in online learning. However, as illustrated in Figure 6, the FOLC model highlights the critical role of digital spaces co-created by students and instructors (or facilitators) in promoting effective collaborative learning environments.

Figure 6

The Fully Online Learning Community (FOLC) Model (EILAB, 2022)



The CoI model is widely used to focus on professional development for effective online teaching practices. The FOLC model also represents a good tool for promoting higher education faculty members' confidence in their Technological Pedagogical Knowledge skills within the TPACK framework.

A transition to online teaching and the adoption of related technologies was necessitated at many higher education institutions because of the COVID-19 pandemic. “Just as each institution's courses needed to pivot to remote instruction, so did many faculty development offerings” (Kuntz et al., 2022, para. 7). In this context, it was less important to directly address perceptions of the usefulness of online teaching technologies in influencing adoption rates. However, it was still necessary to maximize faculty members' perceptions of confidence using new technologies and pedagogical approaches. According to Walsh et at.

(2021, p.2), at the onset of Covid 19, some departments relied on more experienced online instructors to “experienced online instructors to serve as experts” and guide inexperienced faculty." Kuntz et al. (2022) noted that workshops and just-in-time resources were offered to help faculty transition to remote teaching. One remaining question is whether the support described by Power (2015, 2018a, 2018b) during the COVID-19 pandemic was effective.

Statement of the Problem

The COVID-19 pandemic forced Canadian higher education faculty and institutions to shift to online course delivery and interactions with colleagues and students (Masri & Sabzalieva, 2020; Rapanta et al., 2020). This shift represented the need to adopt new technologies and pedagogical practices. In this study, we investigated the levels of support for this transition perceived by faculty members at Canadian higher education institutions.

Research Questions

1. What supports have higher education faculty had available during the transition to online teaching due to the COVID-19 pandemic?
2. What supports did higher education faculty use?
3. Which supports did higher education faculty find valuable? Why?
4. Which supports did higher education faculty find less valuable? Why?
5. What additional supports do higher education faculty feel would have been valuable to them during the transition to online teaching due to the COVID-19 pandemic?

Significance of the Research

This research examined the impacts of perceived support on adopting new technologies among teaching faculty at two Canadian higher education institutions. The results of this research provide valuable information to administrators, policymakers, and others involved with planning for and supporting online teaching and learning programs and faculty who teach online.

Methodology

This research employed a mixed-methodologies approach. In Phase 1 (Summer and Fall 2021), we distributed an anonymous survey to the faculty of Cape Breton University and Ontario Tech University. The survey collected demographic data about participating faculty to determine if there were differences in faculty's perceptions of support for changes in technology adoption and teaching practices based on various demographic lines. The survey also included open-ended questions to solicit information on participants' perceptions of

available supports for adopting new technology. We provided survey participants with a link to an optional secondary survey. They could provide their name and contact information if they wished to be contacted for participation in a follow-up focus group session.

Phase 2 (Fall 2021) involved preliminary data analysis from the primary Phase 1 survey instrument and institutional data on available supports and participation. This phase was followed by facilitating two focus group discussions that further explored faculty's perceptions and use of available supports for their transition to online teaching.

Participant Selection

The target participants for the Phase 1 survey instrument were teaching faculty from Cape Breton University and Ontario Tech University. Participants were selected after responding to a link to an online survey made available to higher education faculty. They were given a letter of informed consent and an opportunity to decline participation before proceeding to the survey questions. The Deans of the five academic Schools forwarded the survey invitation to the faculty at Cape Breton University. The survey invitation was sent to faculty at Ontario Tech University directly using an email distribution list compiled from the university's publicly available faculty directory (University of Ontario Institute of Technology, 2022c). After participants completed the primary survey, we provided a link to an optional secondary survey instrument. In addition, we presented primary survey participants with an option to provide their contact information to participate in a follow-up focus group. There was no way for the researchers to connect data from the primary Phase 1 survey instrument to responses to the secondary contact information survey.

Results

Organizational Context

This research looked at the responses of Cape Breton University and Ontario Tech University faculty to the transition to online teaching due to the COVID-19 pandemic. The two institutions are located in different Canadian provinces and have different histories with the pre-pandemic delivery of online courses. Both universities formally decided to transition all course delivery to an online mode in the early stages of the pandemic. While there were some operational differences, both institutions provided support and training resources to help faculty transition to online teaching.

Cape Breton University

Founded in 1974, Cape Breton University (CBU) is located in Sydney, Nova Scotia. As of March 2019, CBU had 227 full-time teaching faculty ("Cape Breton University," 2022). Enrollment for 2021 was listed at 4,478 students ("Cape Breton University," 2022). CBU offers undergraduate and graduate-level programs through five schools, including the School of Arts

and Social Sciences, the School of Education and Health, the School of Nursing, the Shannon School of Business, and the School of Science and Technology (Cape Breton University, 2022a). Pre-pandemic, the majority of CBU's undergraduate courses were delivered on-campus. Some graduate-level programs offered asynchronous courses using the Moodle (n.d.) learning management system. In April 2020, CBU announced that it would temporarily halt all on-campus classes. While some programs conducted online courses during the Spring/Summer term, the university fully transitioned all in-person courses to online delivery for the Fall 2020 term. To facilitate this, CBU used a combination of the Moodle LMS for asynchronous content delivery and the Microsoft Teams (Microsoft, 2022) platform for synchronous class sessions and collaborations. Online delivery of programs continued throughout the 2020-2021 academic year, returning to on-campus instruction beginning during the Fall 2021 term.

Many resources and training opportunities were formally implemented beginning in the Spring/Summer 2020 term to support faculty during the transition to online teaching. Table 1 lists the formal supports described by participants in this research study, CBU's Center for Teaching and Learning (Cape Breton University, 2020), and CBU's Moodle LMS (Fraser et al., n.d.; Howard & Power, n.d.).

Table 1

Formal Online Teaching Transition Supports at CBU

Resource	**Type of Support**
University Teaching Program	Professional development course
Transitioning to Online Learning	Community of Practice course/support group
Faculty Trouble-shooters	Faculty contracted to curate resources and provided on-demand 1:1 technical and pedagogical support
Student Assistants	Students contracted to provide technical and session moderation support during synchronous virtual classes
Dedicated Help Desk Line	Dedicated IT Support team members to provide immediate technical support during synchronous virtual classes
Start Smart! 2020 (Cape Breton University (2022*b*)	Non-credit online course to provide student orientation before participating in online synchronous and asynchronous learning

The University Teaching Program and Transitioning to Online Learning courses represented the major formal professional development initiatives organized at CBU ahead of the fully online Fall 2020 academic term. The University Teaching Program was revised to focus on using technology to support pedagogical practices. A total of 245 users were self-enrolled into the University Teaching Program's Moodle LMS space as facilitators, formal course participants, or faculty who informally availed of the curated lesson materials and resources (Fraser et al., n.d.). Transitioning to Online Learning was created by a Community of Practice within CBU's Department of Education, which delivered fully online courses in May 2020. Later, it expanded to include faculty throughout the School of Education and Health. A total of 38 users were self-enrolled into the Transitioning to Online Learning Moodle LMS space as Community of Practice members (Howard & Power, n.d.). That professional development initiative included a guided asynchronous learning space using the Moodle LMS and weekly synchronous virtual meetings. Asynchronous lessons and virtual meetings focused on providing technical and pedagogical support as participants first developed their online teaching resources and then facilitated their courses throughout the Spring/Summer 2020 term.

Ontario Tech University

Ontario Tech University (OnTechU) is in Oshawa, Ontario. Formally known as the University of Ontario Institute of Technology, OnTechU was founded in 2002 ("Ontario Tech University," 2022). With an enrollment of over 10,000 students ("Ontario Tech University," 2022) and 358 full and part-time academic faculty (University of Ontario Institute of Technology, 2022c), OnTechU offers undergraduate and graduate programs through seven faculties, as well as several other departments, including the Faculty of Business and Information Technology, the Faculty of Education, the Faculty of Energy Systems and Nuclear Science, the Faculty of Engineering and Applied Science, the Faculty of Health Sciences, the Faculty of Science, and the Faculty of Social Science and Humanities (University of Ontario Institute of Technology, 2022a, d). While many of OnTechU's programs were traditionally delivered on-campus pre-pandemic, the university offers partially or entirely online programs at the undergraduate, graduate, and continuing education levels (University of Ontario Institute of Technology, 2022e). Like CBU, OnTechU transitioned to online delivery for most of its previously in-person courses for the Fall 2020 term. The university used the Canvas (Instructure, 2022) learning management system to facilitate this transition to host asynchronous instructional content and interactions. In addition, synchronous class sessions and collaborations were facilitated using either Google Meet (Google, n.d.), Kaltura Classroom (Kaltura, 2022), or Zoom (2021) video conferencing platforms. By the Fall 2021 term, the university had resumed some on-campus activities, using online modalities for larger lecture sessions.

Ontario Tech University's Teaching and Learning Center (University of Ontario Institute of Technology, 2022f) and participants in this research study described some formal

organizationally-provided training opportunities implemented to support faculty during the transition to online teaching. Like CBU's two formal professional development courses, OnTechU offers a Certificate in University Teaching program (University of Ontario Institute of Technology, 2022b). The program is described as "open to sessional/part-time, teaching-focused, and tenure-track faculty members who are eager to support student success through effective teaching." While the six-part cohort-based professional development program is fully-online, its emphasis on digital technologies is described as "using technology tools to create and support the classroom experience." No survey respondents or focus group participants from OnTechU indicated either awareness of or participation in the Certificate in University Teaching program. However, participants referenced other professional development opportunities at OnTechU that focused on using specific digital tools for teaching and learning. These included curated how-to guides and workshops on using tools such as the Canvas LMS, Kaltura Classroom and the Kaltura Media platform, Google Meet and Google applications, and the Respondus (2022) assessment tools.

Demographic Data

We received 35 responses for the Phase 1 survey from faculty from Cape Breton University (n=20) and Ontario Tech University (n=15). As illustrated in Table 2, the most significant number of respondents from both institutions came from the Engineering and Applied Sciences subject area (n=10), followed by Arts and Social Sciences (n=8). There were equal numbers of respondents from the Education and Health Sciences areas (n=7).

Table 2

Subject Area of Faculty Respondents

	CBU	OnTechU	TOTAL	%
Arts and Social Sciences	6	2	8	23%
Business	0	2	2	6%
Education	2	5	7	20%
Engineering and Applied Sciences	7	3	10	29%
Health Sciences	4	3	7	29%
Other	1	0	1	3%
TOTAL	20	15	35	100%

Six survey respondents later participated in one of two focus group sessions. They provided further insights into their initial survey responses.

We also asked survey respondents to indicate their years of teaching experience before the COVID-19 pandemic. Most respondents from both institutions had more than 15 years of teaching experience (46%). Equal numbers of respondents indicated they had between 2-5 years, 5-10 years, and 10-15 years of prior teaching experience (17%). Most of the survey respondents from CBU indicated some previous experience with online teaching (n=13, 65%). Approximately half (n=8, 53%) of respondents from OnTechU stated that they had previous online teaching experience, while nearly half (n=7, 47%) had no experience teaching online.

Supports Used for the Transition to Online Teaching

We asked faculty from CBU and OnTechU to list the types of support available within their institutions to help them transition to teaching online during the COVID-19 pandemic. Respondents from both universities indicated they could draw upon knowledgeable colleagues and informal conversations with their peers. Faculty at CBU and OnTechU also indicated that they could avail of one-to-one consultations, group support, and workshop and seminar sessions provided by a dedicated Teaching and Learning Center. While respondents from OnTechU indicated they had access to faculty-level support for online teaching methods, respondents from CBU described more formalized professional learning communities or communities of practice. Respondents from CBU listed access to two formal professional development courses offered ahead of the Fall 2020 term and access to dedicated IT Helpdesk support, a faculty trouble-shooter support team, and student assistant support while running live virtual class sessions. Faculty from CBU also noted investment in technical infrastructure to support their transition to online teaching and the provision of hardware (laptop computers, headsets) to enable them to work remotely. The types of institutional-level supports used by faculty as they transitioned to online teaching are listed in Table 3.

Table 3

Institution-based Supports Available to Faculty

CBU	**OnTechU**
Knowledgeable colleagues	Discussions with colleagues
Professional Learning Community/Community of Practice	Faculty-level support on online teaching methods
Centre for Teaching and Learning staff support	Teaching and Learning Centre staff support

Resource repository (videos, how-to guides, resource links)	Seminars and workshops from the Teaching and Learning Centre
University Teaching Program PD course	LMS (Canvas) transition resources
Transitioning to Online Teaching PD course	Help guides for Google Meet
IT Help Desk	Canvas Commons
University-provided hardware	
University investment in infrastructure	
Faculty troubleshooting support	
Student assistants	
Coffee/Lunch-n-Learn sessions	

All respondents from CBU indicated that they had used one or more of the institutional-level supports listed in Table 3. Respondents from CBU described the ability to receive quick responses from colleagues and dedicated support staff, access to curated repositories of video resources, and participation in formal, practical professional development opportunities as the supports that they found most valuable as they transitioned to online teaching. One faculty member noted, "knowing that supports were available was great." However, some faculty from CBU indicated having difficulty navigating the curated resource repositories and that the range of multimedia support resources provided was "too many, and it was overwhelming."

Respondents from OnTechU most frequently cited one-on-one consultations and conversations with colleagues as the most helpful support. For example, during a focus group session, one participant described how conversations with a colleague mentor were his immediate "go-to" and how they were instrumental in boosting his comfort with transitioning to fully online teaching:

I had a mentor who introduced me to Kahoot! (2022) pre-pandemic. So I started using Kahoot! in the classroom pre-pandemic. So when, when we got that, you know, 48-hour notice that, you know, Monday you're going to be online, it was actually a fairly easy chunk for us because we, the whole classroom was built around that EdTech product. Going into that into the summer, summer of 2020, I saw my mentor for more help because I knew we're going to

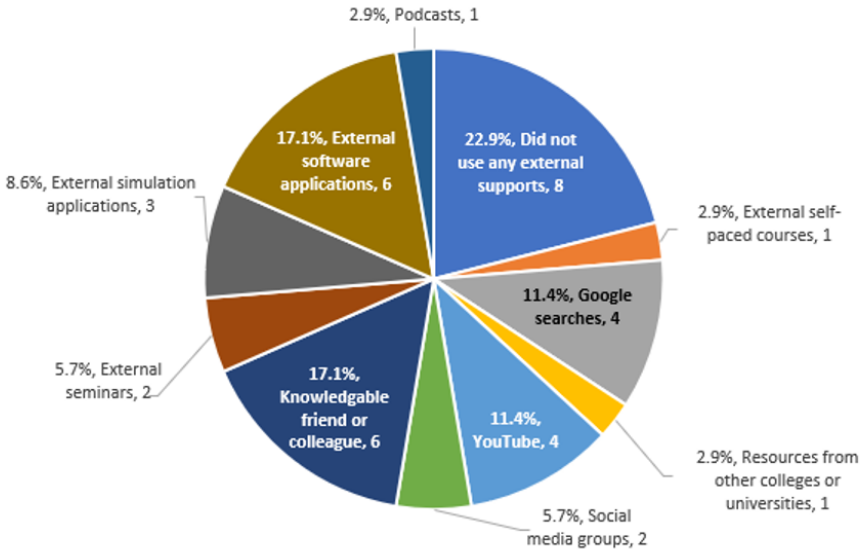
fully online. And she introduced me to Nearpod (n.d.), and I have been using Nearpod for the last year and a half and feel very comfortable using Nearpod right now.

Two survey respondents from OnTechU indicated they were unaware of the types of support available to faculty within their institution. In contrast, one OnTechU faculty member described the range of support provided within their institution as "very limited." In addition, one OnTechU faculty member noted that the types of seminars provided by the Teaching and Learning Centre "were only marginally helpful," while another faculty member noted that the timing of the formal training sessions was too far in advance of their Fall 2020 teaching schedule and their access to start preparing online teaching resources in mid-August.

We also asked faculty to indicate if they had used external resources (not provided or supported by their university) to help them transition to online teaching. Figure 7 shows the range of external resources used by faculty from CBU and OnTechU. Four respondents from each university (n=8, 23%) indicated that they did not make use of any help outside of what was provided within their institution, with one faculty member noting that they "did not think it was appropriate for faculty members to be expected to pay out of pocket for additional tools." The most frequently cited external supports were consultations with knowledgeable friends or colleagues (n=6, 17%) and external software applications to create teaching and learning resources (n=6, 17%). General searches using Google (n=4, 11%) and YouTube (n.d.) (n=4, 17%) were also frequently cited, as were participation in external seminars or self-paced training courses and consulting resources provided through other colleges or universities.

Figure 7

External Resources Used to Support the Transition to Online Teaching.

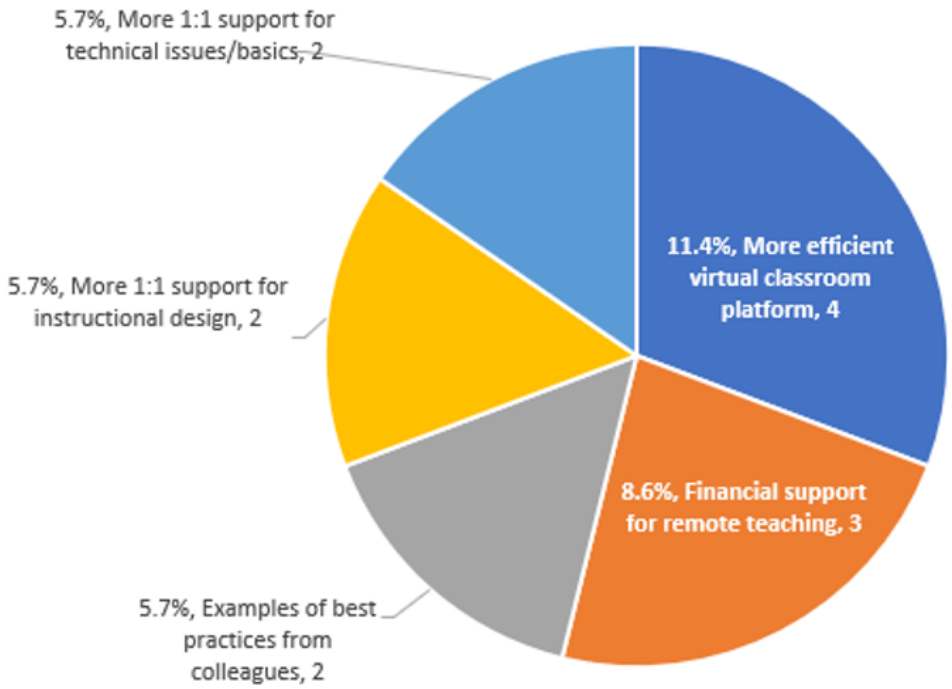


*percentage values of overall number of respondents

Figure 8 shows the types of additional resources faculty from both universities most frequently indicated they felt would have helped their transition to online teaching during the COVID-19 pandemic. The most commonly cited need was access to a more efficient virtual classroom environment (n=4, 11%). Two respondents stated they were frustrated that they could not access an institutionally provided Zoom account. One faculty member from CBU noted that using Microsoft Teams was often a source of frustration and that it "promised more than it delivered" regarding virtual classroom management capabilities. Direct financial support to offset the costs incurred when teaching remotely was listed as something that some faculty (n=3, 9%) would have found useful. An equal number of respondents (n=2, 6%) noted that they would have benefited from more one-on-one support for basic technical skills and issues, direct instructional design support, and more exemplars of best practices using an LMS or conducting a live virtual class. Other desired supports listed by faculty included smaller online class sizes, access to moderators for live virtual classes, institutionally-managed multimedia (video) repository, a peer-mentoring system, and training and support for ergonomics while working remotely.

Figure 8

Additional Supports That Faculty Would Have Liked Available



*percentage values of overall number of respondents

Discussion

Power (2018a, 2018b) used the Technology Acceptance Model to explain the barriers to educators adopting innovative digital tools and pedagogical practices. He explained that faculty need to perceive the usefulness of the tools and approaches and feel confident in their ability to use them. Research during the COVID-19 pandemic has reflected the importance of faculty members' sense of self-efficacy with both technological tools and pedagogical approaches (Kuntz et al., 2022; Salajegheh et al., 2022: Walsh et al., 2021). The knowledge domains that faculty must be confident in when teaching online or integrating technology into practice are illustrated by the TPACK framework. Faculty must be skilled with technology, subject-matter content, and the pedagogies of technology-facilitated teaching. The results of this research emphasize the importance of the approaches to supporting faculty described by Power (2018a, b), Kuntz et al. (2022) and Walsh et al. (2021). Specifically, they highlight the importance of different roles played by mentorship and communities of practice, curated just-in-time technical support resources, and extended formal pedagogical professional development. In the context of a large Albertan polytechnic institution, Derkson (2022, p. iii) emphasized that if institutions "embedded mentorships and support networks into their future crisis plans, this would… provide a safety net for wellness and professional development."

In the context of the COVID-19 pandemic, the usefulness of digital tools was a given due to necessity. However, faculty also appreciated the usefulness of online teaching tools and pedagogies through interactions with their peers and their first-hand experiences using the tools (Kuntz et al., 2022; Walsh et al., 2021). As Power (2018a, 2018b) and Walsh et al. (2021) noted, faculty found the support of their knowledgeable colleagues, communities of practice, and just-in-time guidance resources valuable in developing their fluency within the Technological Knowledge Domain of TPACK. They also drew heavily upon formal professional development opportunities like the ones described by Kuntz et al. (2022) to increase their fluency and efficacy within the Technological Pedagogical Knowledge domain. Participants in this study perceived these supports as critical. They shifted from perceiving the usefulness of online learning tools and approaches to feeling confident with their ability to use them and adopting innovative practices. Participants from CBU expressed appreciation for the pedagogical focus of formal professional development opportunities such as the University Teaching Program and the Transitioning to Online Learning course. As evidenced by user enrollment data for both of these courses, most faculty from CBU either participated in these formal professional development programs in preparation for their first term of fully online teaching or used the course resources as just-in-time support tools. In contrast, survey respondents and focus group participants from OnTechU indicated a heavier reliance on knowledgeable colleagues and informal communities of practice to learn about pedagogical best practices.

Participants also identified several barriers that hindered their progress towards making innovations and additional supports that they would have found beneficial. One significant perceived barrier was a lack of awareness amongst some participants of the availability of formal, online teaching pedagogy-focused professional development opportunities. For instance, while OnTechU's Teaching and Learning Center hosts a formal Certificate in University Teaching program, that program is not described as focusing on pedagogical approaches to online teaching. No participants expressed an awareness of or participation in that program. Relating awareness of the university's formal training supports, one survey respondent said there were "not many that I knew of or used." Other participants cited the need for more time to prepare before their first term teaching online, smaller and more manageable online class sizes, and greater real-time teaching assistant support while conducting live virtual classes. Some participants needed direct instructional design support to develop their online teaching resources. Some survey respondents also indicated a need for more direct financial support for faculty teaching remotely, mainly to help with equipment and internet connectivity costs.

Limitations

This research study explored the supports available to faculty for the transition to online teaching during the COVID-19 pandemic at two Canadian universities. Results are limited to the contexts of the support for online teaching at Cape Breton University and Ontario Tech University. Results do not reflect the potential benefits or barriers to innovative use of technology that may have arisen based on the unique contexts and faculty support measures implemented at other higher education institutions. Additionally, invitations to participate in the initial Phase 1 survey were forwarded individually to 357 faculty at OnTechU and all faculty at CBU via internal email distribution lists. Total responses to the initial survey included 15 responses from faculty at OnTechU and 20 responses from Faculty at CBU. A total of six faculty from both CBU and OnTechU participated in Phase 2 focus group sessions. Therefore, the results presented in this paper may exclude the supports, benefits, and barriers to technological and pedagogical innovation experienced by some higher education faculty members.

Conclusions and Recommendations

Many Canadian higher education institutions mandated a transition to online teaching during the early stages of the COVID-19 pandemic. This necessity pushed faculty past the perception of the utility of digital tools and innovative teaching approaches. However, faculty from Cape Breton University and Ontario Tech University still needed to draw upon informal and formal support to help them develop their self-efficacy with Technological Knowledge and Technological Pedagogical Knowledge described by the TPACK model. Likewise, Derkson

(2022) noted a need for improvement in staff resources and high-quality professional development. Kuntz et al. (2022) urged that the lessons learned about the support provided during the pandemic should be applied to future online teaching and learning.

Recommendations for Practice

Like Power's (2018a, 2018b) summary of the professional development and support needs of faculty making voluntary innovations with specific digital tools, the results of this research point to recommendations for practice for higher education institutions creating wide-scale transitions to online teaching. It is recommended that institutions:

- Ensure sufficient lead time before shifting to online instruction for faculty to provide technical and pedagogical support and prepare online instructional resources.
- Provide robust and easily navigable curated technical support resources, including recommended digital tool lists, how-to guides, tutorials, and troubleshooting guides.
- Promote the use of communities-of-practice at subject-area, departmental, school/faculty, and cross-curricular levels to share technical and pedagogical expertise and create informal collegial support networks.
- Provide just-in-time technical support for faculty teaching synchronous virtual classes, including teaching assistant support for moderating larger virtual classes and dedicated IT support for technical troubleshooting during live virtual classes.
- Provide short-duration seminars and workshops focused on the technical functionality of specific digital tools.
- Provide longer-duration formal or semi-formal, cohort-based professional development opportunities focused on pedagogical and instructional design best practices for online teaching.

Formal or semi-formal professional development focused on pedagogical approaches is available at many higher education institutions, such as the University Teaching Program at CBU and the Certificate in University Teaching at OnTechU. CBU's University Teaching Program was redeveloped explicitly at the start of the COVID-19 pandemic to emphasize pedagogical approaches to online teaching, integrating digital tools to demonstrate the implementation of those approaches. The high participation rate in that program indicates a desire and appreciation amongst faculty and a recommendation for the continued use of a pedagogy-centric approach to such professional development. Participants in this research study also drew attention to the need to explore pedagogical practices further, particularly within the context of frameworks such as the Community of Inquiry (CoI) model or the Fully Online Learning Community (FOLC) model, both of which are increasingly used as the foundations of pedagogy-centric professional development for online teaching and learning.

Other Canadian higher education institutions draw upon the Instructional Skills Workshop (ISW) (ISW Network, 2022) program as a cornerstone of providing foundational pedagogical professional development for faculty members (and as part of larger post-secondary instructional certification initiatives). The ISW program has been adapted to provide faculty with a grounding in instructional approaches in blended and online teaching contexts (ISW Network, 2022; Western University, 2022). Membership in the ISW network and the integration of ISW training may be an appropriate solution for institutions that do not already have a pedagogy-centric professional development program or seek to augment their existing professional development catalogues

Recommendations for Further Research

This research reflects the contexts and experiences of faculty from two Canadian universities. Further research is recommended to explore faculty experiences from other post-secondary institutions. This research could provide insights into additional barriers to technological and pedagogical innovation and additional recommendations for faculty transitioning to online teaching.

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Appendix R3: The Effects of COVID-19 on Higher-Education Teaching Practices

(Power, Kay & Craig, 2023)

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The Effects of COVID-19 on Higher-Education Teaching Practices

Dr. Rob Power, Dr. Robin Kay, Chris Craig

Abstract: In 2020, Canadian higher education institutions shifted to online teaching due to the COVID-19 pandemic. While many instructors were unfamiliar with online teaching, this transition resulted in widespread innovation in the use of digital technologies and pedagogical practices. This research study focused on the significant impact of the shift to online teaching on three areas: digital tools use, immediate teaching practice, and future teaching practice. Data from 35 survey respondents and six focus group participants indicated that most instructors were comfortable with the new tools they used online, but experienced specific challenges with breakout rooms and students understanding their role in the learning process. Specific changes in immediate teaching practice included co-creating learning spaces, different ways of connecting with students, and the democratization of learning. Perhaps the most significant impact of the COVID-19 transition period was on future in-person teaching including increased use of digital tools, structural reorganization of classes, enthusiasm for teaching, and an increased appreciation for in-person environments.

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Keywords: community of inquiry, communities-of-practice, COVID-19, diffusion of innovation, digital innovation, faculty supports, fully online learning community, online teaching, pandemic, professional development, TAM, TPACK, transactional distance theory, UDL, universal design for learning

Les effets de la COVID-19 sur les pratiques pédagogiques dans l'enseignement supérieur

Résumé : En 2020, les établissements d'enseignement supérieur canadiens sont passés à l'enseignement en ligne en raison de la pandémie de COVID-19. Alors que de nombreux enseignants n'étaient pas habitués à l'enseignement en ligne, cette transition a donné lieu à de nombreuses innovations concernant l'utilisation des technologies numériques et les pratiques pédagogiques. Cette recherche s'est centrée sur l'impact notable du passage à l'enseignement en ligne dans trois domaines : l'utilisation des outils numériques, la pratique immédiate de l'enseignement et la pratique future de l'enseignement. Les données issues de 35 réponses à un questionnaire et de six groupes de discussion ont montré que la plupart des enseignants étaient à l'aise avec les nouveaux outils qu'ils utilisaient en ligne, mais qu'ils rencontraient des difficultés particulières avec les salles de réunion et la compréhension par les étudiants de leur rôle dans le processus d'apprentissage. Les changements apportés à la pratique immédiate de l'enseignement comprenaient la co-création d'espaces d'apprentissage, différentes façons de se connecter avec les étudiants et la démocratisation de l'apprentissage. L'impact le plus important de la période de transition relative à la COVID-19 est peut-être celui concernant l'avenir de l'enseignement en classe, notamment l'utilisation accrue des outils numériques, la réorganisation structurelle des classes, l'enthousiasme pour l'enseignement et l'appréciation accrue des environnements présentiels.

Mots-clés *:* Communauté d'enquête, communautés de pratique, COVID-19, diffusion de l'innovation, innovation numérique, soutien aux enseignants, communauté d'apprentissage entièrement en ligne,

enseignement en ligne, pandémie, développement professionnel, TAM, TPACK, théorie de la distance transactionnelle, UDL, conception universelle de l'apprentissage,

Introduction

Following a rare, world-changing pandemic, education systems in Canada and around the globe had to adapt to meet student needs rapidly. The COVID-19 pandemic resulted in a historic disruption and educational crisis that affected over 1.6 billion students worldwide, forcing remote education opportunities through television, radio, and, most commonly, online (The World Bank et al., 2021). While broadly used, the term *online learning* in this study refers to education, including both teaching and learning, that is delivered digitally through the internet (Singh & Thurman, 2019). In terms of global responses, educator and student access, experience, and quality varied based on funding and access (Gamage et al., 2020; The World Bank et al., 2021).

With access to funding and infrastructure support, Canadian universities pivoted to online learning to support student learning in early 2020 (Masri & Sabzalieva, 2020; Rapanta et al., 2020; Statistics Canada, 2020). While the shift accommodated many student needs, some aspects of the transition were disruptive due to restrictions on experiential learning, access to digital technologies, and the internet bandwidth required for whole households to be able to work and study simultaneously (Statistics Canada, 2020, 2021). People in the educator role including professors, instructors, and teaching assistants were expected to rapidly adapt to the dynamic reconstruction of higher education to

limit disruption and support student success through various digital technologies (Gamage et al., 2020; The World Bank et al., 2021).

This research investigated how the transition to teaching online impacted technological and pedagogical practice among 35 teaching faculty at two Canadian universities. This research also investigated how faculty perceived their experiences during the COVID-19 pandemic would impact their teaching practices after returning to in-person instruction. This research will be useful to administrators, policy-makers, and others who plan and support online teaching and learning programs, and who support faculty needing to shift to online teaching.

Literature Review

Research from this study was situated in four key areas: diffusion of technology innovation, instructional design frameworks for online education, Universal Design for Learning principles, and supports for faculty learning. The instructional design frameworks for online education included the Transactional Distance Theory, the Community of Inquiry Model, and the Fully Online Learning Community Model. Each of the four key areas will be discussed in turn.

Technology Diffusion in Canadian Higher Education

While Canadian higher education institutions are amongst the first to adopt new digital technologies, their educators are typically not prepared and

require further exposure and training, which has historically resulted in a low rate of adoption (Jean-Louis, 2015). Early adopters are individuals or entities that rapidly integrate a new innovation. Adoption rate refers to the pace at which a new technology is acquired by a target demographic (Rogers, 1976, 2003). The rate and stage of adoption are aspects of diffusion, which is the process of dynamically creating and sharing information about an innovation with others in a channel within a social system (Rogers, 2003).

Another issue that inhibits educator adoption of new technologies is the need for coherent and cohesive support and guidance because national, provincial, regional, and institutional initiatives are often fragmented or sporadic (Borokhovski et al., 2011). More recently, educators have also noted that a lack of funding to learn about and integrate new technologies has been a limiting factor in using new technologies (Irhouma & Johnson, 2022). However, the insight extends beyond Canada because the diffusion of online learning before the pandemic was similar worldwide.

eLearning Diffusion Factors

Higher education institutions have traditionally lagged behind the rate of digital technology use in mainstream society (Singh & Hardaker, 2014). While the COVID-19 pandemic and "the resulting pivot to online learning in higher education increased mainstream adoption of many education technology tools" (Kelly, 2021), Paykamian (2022) notes that "many institutions will need to adjust

priorities in order to scale up tech adoption" to meet the continued demands of students and other stakeholders.

Prior to the pandemic, Singh and Hardaker (2014) conducted a systematic review to explore the macro- and micro-level insights that have influenced adoption from over 300 articles focusing on education through digital technologies (in other words, eLearning) in higher education globally. The authors found that strategy development, organizational cultural configuration, motivation, and support are the most critical aspects of eLearning diffusion. These factors continue to play prominent roles in organizational technology adoption, with cultural configuration influencing individual faculty motivation, and support influencing faculty trust and perceived ease-of-use of new technologies (Garaika & Margahan, 2020; Power & Kay, 2023).

First, all levels of education stakeholders develop strategies to address critical requirements at multiple levels to ensure each stakeholder can take ownership in the decision-making process. The ability to influence the decision-making process then reflects organizational cultural configuration. Specifically, top-down or bottom-up approaches can position obstacles to success through a lack of awareness or ownership (Singh & Hardaker, 2014). For example, a top-down decision may reflect a need to meet regulatory requirements; however, the importance of the insight may be unknown to those receiving the information. In contrast, a bottom-up approach may focus on the immediate needs of the situation, but lack the context of administrative budgets or

licensing agreements. The lack of communication can then inhibit psychological and pragmatic motivations (Singh & Hardaker, 2014). As a result, the breakdown of communication, understanding, and motivation often reduces the support required for eLearning success (Singh & Hardaker, 2014).

Instructional Design Frameworks

Online Learning Communities

With the emergence of digital technology in the 1980s, two influential instructional design models began to evolve to support best practices in teaching and learning. First, the *Transactional Distance Model* proposed by Moore (1991) describes the need to reduce perceptions of the relational distance between students and their instructors, peers, and learning content to maximize engagement for distance learning. Building on the concept, Garrison et al. (2000) realigned the model into the *Community of Inquiry* framework. The Community of Inquiry framework includes an online context and promotes presence within the *Teacher, Social,* and *Cognitive* domains (Moore & Miller, 2022).

In the following decades, the Community of Inquiry Model has formed the cornerstone of research and professional development of effective online teaching and learning (Athabasca University, n.d.; Garrison et al., 2000; Kineshanko & Madelaine, 2016; Moore & Miller, 2022; Power, 2023a). Another Transactional Distance Theory variation is the *Fully Online Learning Community Model* (Blayone et al., 2017; Webb et al., 2019). The Fully Online Learning

Community Model highlights the importance of social and cognitive presence, and promotes the critical role of instructors and students in co-creating digital collaborative learning spaces.

Figure 1: The Fully Online Learning Community Model (EILAB, 2022)

Universal Instructional Design Principles

Universal Design for Learning was first proposed in the 1990s (CAST, 2022a, 2022b; Orkwis & McLane, 1998). It focuses on three pillars of instructional design: the *why*, *what,* and *how* of learning. Universal Design for Learning aims to promote complete access to meaningful and effective learning experiences for diverse student audiences (Power, 2023b), and to "allow all learners to achieve their optimal learning experience" (Navaitienė & Stasiūnaitienė, 2021, p. 22). As the three pillars in Figure 2 show, learning design should provide students access to multiple means of engagement, representation, and action

and expression. For each pillar, Figure 2 describes three critical areas where online educators should provide options for students.

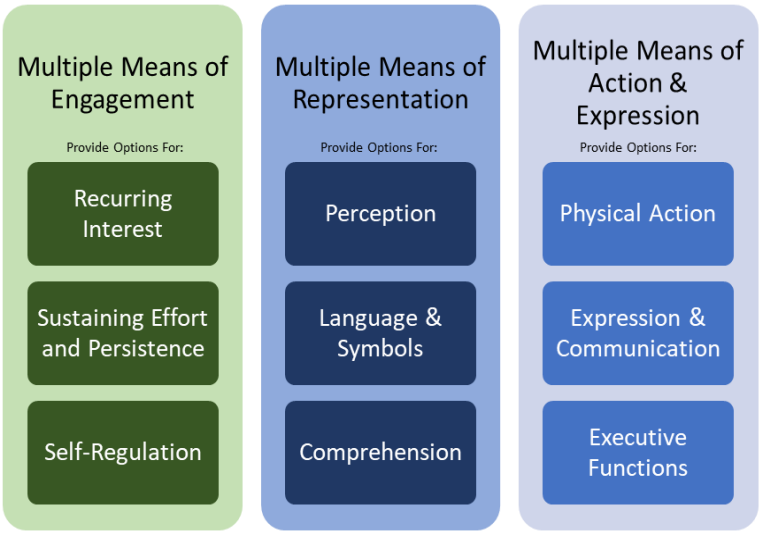

Figure 2: The Pillars of Universal Design for Learning (Adapted from CAST, 2022b). Image description available.

Supporting Faculty Learning

Drawing upon the *Technology Acceptance Model* (Davis, 1989) and the *Technology, Pedagogy, and Content Knowledge Model* (Cavanaugh et al., 2013; Finger et al., 2010; Koehler & Mishra, 2006, 2008; Power et al., 2016; tpack.org, 2021), Power (2015, 2018a, 2018b) reported that educators increase their confidence with technology-specific skills through informal support networks, communities of practice, and curated just-in-time resources. Furthermore, participation in formal professional development focused on instructional approaches can increase the willingness of higher education faculty to innovate

with technology (Power, 2015, 2018a, 2018b). Finally, pedagogical innovations that reduce transactional distance (Moore, 1989, 1991) promote the establishment of Communities of Inquiry and draw upon the principles of Universal Design for Learning (Power, 2015, 2018a, 2018b).

Statement of the Problem

This study outlines faculty reflections at two Canadian universities following the emergency shift to online learning during the COVID-19 pandemic. Furthermore, it explores adopting new digital technologies and adapting professional practice. Research guides include a pragmatic philosophy that seeks practical insight for future application and the *Population, Exposure, Outcome* framework. The Population, Exposure, Outcome framework helps formulate an answerable question for qualitative research (Bettany-Saltikov, 2016). Our guiding research question was: *What are educator* (P) *perceptions of using new technologies during the COVID-19 pandemic* (E), *and how did and will it impact teaching practices* (O)*?*

Methodology

Design

This study follows a two-stage convergent, mixed-methods design, combining qualitative and quantitative approaches to better understand the study focus (Creswell & Creswell, 2018). Qualitative and quantitative data

collection occurred in stage one through an online survey. This data then provided context for further qualitative data collection in stage two, the focus group.

Ethical Considerations

The authors completed van der Steen et al.'s (2018, 2019) taxonomy of bias determinants and reported low potential bias. Also, faculty participation presented minimal risk, given that the data collection process did not pose any potential harm greater than what the participants might encounter daily (Cavanaugh et al., 2013). There was not any financial compensation for responding; the only benefit was the opportunity to share insight into personal experiences with the rapid transition to online learning during a global pandemic.

Throughout the study, participants had "free, informed, and ongoing consent" (Canadian Institutes of Health Research et al., 2022, p. 6). For the survey, participants received a survey link and an explanation indicating that they were not required to participate. They could withdraw at any point without repercussion by closing the browser tab and the survey would not capture any identifying information. Only after completing the survey, were respondents invited to share their contact information if they wished to participate in a focus group session. The focus group session targeted a more qualitative exploration of themes and issues related to changes in the respondents' instructional

practices while teaching online. The participants' contact information was not linked to their survey responses. Participants who opted to provide their contact information were invited to one of two focus group sessions held in Fall 2021. There was one session for faculty affiliated with Cape Breton University (CBU) and another session for faculty affiliated with Ontario Tech University (OTU). People invited to focus groups were again allowed to provide informed consent and withdraw from participation at any point. (They were told that if they withdrew, their responses during the live focus group sessions would be deleted from the session transcripts.)

Organizational Context

Participants in this research study came from CBU and OTU. Each institution is located in a different Canadian province and has a different pre-pandemic history with online courses. Founded in 1974, CBU is located in Sydney, Nova Scotia. As of March 2019, CBU had 227 full-time teaching faculty, and enrolment for the 2021 academic year of 4,478 students ("Cape Breton University," 2022). Most of CBU's undergraduate programs were delivered in person before the COVID-19 pandemic, with some graduate-level programs offered through online, asynchronous courses (Cape Breton University, 2023).

Founded in 2002, OTU is located in Oshawa, Ontario. It has 341 full- and part-time teaching faculty (Ontario Tech University, 2023c) and over 10 thousand students ("Ontario Tech University," 2022) enrolled in programs offered through

seven faculties (Ontario Tech University, 2023a, 2023c). Pre-pandemic, many of OTU's programs were traditionally delivered on-campus. However, the university does have several undergraduate, graduate, and continuing education programs offered partially or entirely online (Ontario Tech University, 2023d).

Participants

The target participants for the Phase 1 survey instrument were teaching faculty from CBU and OTU. The survey invitation was forwarded to faculty at CBU by the Deans of the five academic Schools. The survey was sent directly to faculty at OTU using an email distribution list compiled from the university's publicly available faculty directory (Ontario Tech University, 2023b). Primary survey participants were given the option of providing their contact information if they wanted to consent to participate in a follow-up focus group. However, there was no way for the researchers to connect data from the primary survey instrument to the contact information provided for focus group participation.

Instruments

Survey

A survey invitation was forwarded to faculty at the former institution by the Deans of the five academic schools and through a public email distribution list for the latter. The survey included questions about basic demographic data, and open-ended questions to solicit qualitative data on participants' adoption of

technology and new pedagogical approaches. Survey participants were given the option to provide their contact information if they wanted to consent to participate in a follow-up focus group in Fall 2021.

Focus Group

The focus group sessions further explored the research questions related to changes in the participants' teaching practices during the COVID-19 pandemic and anticipated changes to their teaching in a classroom environment. Two online focus group sessions were held during Fall 2021. One session for faculty affiliated with CBU was facilitated virtually using the Microsoft Teams (Microsoft, 2023d) web-conferencing platform (the platform used to facilitate synchronous online classes at CBU). A second session for faculty affiliated with OTU was facilitated using the Zoom (2023) web-conferencing platform (the platform used to facilitate synchronous online classes at OTU). To avoid perceptions of conflict of interest or potential influences on participants' responses, each session was facilitated by one researcher who was affiliated with the other institution. Each session was recorded with automatic transcription features enabled, and the transcripts were extracted from the recordings after the conclusion of each session. Automatically generated transcripts were manually verified for accuracy by the researchers using the session recordings.

Data Analysis

Microsoft Excel (Microsoft, 2023c) was used to sort and analyze the survey data according to demographic variables and the respondents' level of comfort with various technology types and applications. Transcripts were exported from Microsoft Teams (Microsoft, 2023d) and Zoom (Zoom Video Communications, 2023) to analyze focus group responses. The researchers manually verified transcripts by comparing text transcripts to session recordings. Transcripts of the sessions were then organized based on participants' responses to specific researcher questions and coded according to themes related to participants' expressed levels of comfort with different technologies, the pedagogical approaches employed, the benefits realized, the challenges experienced, and plans for future use of tools and pedagogical approaches.

Results

Demographic Data

In the first data collection phase, 35 responses to the survey were completed by the combined faculty from CBU (*n*=20, response rate = 9%) and OTU (*n*=15, response rate = 4%). Six of those respondents further participated in one of two focus group sessions in the second phase. With respect to overall teaching experience, 46% (n=16) of faculty had more than 15 years, 17% (n=6) had 10 to 15 years, 17% (n=6) had 5 to 9 years, and 17% (n=6) had 2 to 4 years.

Regarding prior experience, 65% of respondents from CBU (*n*=13) and 47% from OTU (*n*=8) indicated that they had taught online courses before the pandemic. In summary, the sample consisted of experienced instructors, 60% of whom had previous online teaching experience.

Digital Tool Use

Comfort Level

Participants were asked to list the digital technologies they used in their teaching during the COVID-19 pandemic. Most respondents said they had used one or more virtual classroom or meeting applications such as Google Meet (Google, n.d.), Microsoft Teams (Microsoft, 2023d), Zoom Video Communications (2023), as well as learning management systems such as Blackboard (Anthology, 2022), Canvas (Instructure, 2022), or Moodle (2020). Other frequently used digital tools included video creation and sharing applications and collaborative document creation tools.

Most respondents (*n*=24, 69%) indicated they were comfortable using learning management systems as they transitioned to online teaching. A similar number (*n*=23, 66%) also indicated they were comfortable using video conferencing or virtual meeting software to host live classes. During a focus group session, Participant C, who self-identified as a "complete neophyte in terms of online teaching" described how comfortable they had become with the

use of the core features of virtual meeting applications to host synchronous classes:

> *I would say that my Zoom abilities have gone from minimal to average. So, I think I'm quite comfortable with it now. I don't utilize all the tools yet but I'm, you know, quite comfortable running online courses and we are using it both in a hybrid model and a totally online model.*

Overall, most instructors felt comfortable using digital tools for online teaching. This result may not be surprising given the online expertise level of the sample. About one-third of the instructors (*n*=10, 29%) indicated that there were no tools that they did not feel comfortable using. Another 20% (n=7) noted they were uncomfortable using various miscellaneous proprietary tools. Twenty percent (n=6) remarked they were uncomfortable using virtual meeting software, including breakout rooms. Finally, about 15% (n=4) of instructors felt uncomfortable using Flip (Microsoft, 2023a) video creation software or Microsoft Office (Microsoft, 2023b).

Table 1: Comfort Level of Higher Education Faculty Using Online Digital Tools (n=35)

Tool	n	% Not Comfortable with Tool
All digital tools used	10	29%
Miscellaneous tools	7	20%
Virtual meeting tools	7	20%
Flipgrid	2	6%
Video creation/use	2	6%
Microsoft Office	1	3%

Most survey respondents with more than 15 years of teaching experience (*n*=15) reported that they were least comfortable using specific digital tools for online teaching, most commonly citing learning management system platforms (*n*=3). Faculty with 5 to 10 years of teaching experience (*n*=4) were the most likely to indicate that they had no digital tools they felt uncomfortable using. There were no differences in the frequency of respondents indicating comfort or discomfort with using specific digital tools, based on their reported home School/Faculty or subject area specialization.

Challenges

Focus group Participant A described their struggles with using the breakout room features of virtual meeting applications while hosting synchronous online classes:

> *I would say one of the greatest struggles that I've had in terms of using a technology or perhaps part of a tool would be . . . the actual breakout rooms. And perhaps it works well at, say, [at] a graduate level. But for undergraduate students, and especially when I'm teaching first-year and second-year students, I think the learning curve almost for them as they try to adapt to some of these teaching technologies and digital tools that we may introduce to them, like something like a breakout room where you're actually expecting students to communicate with each other . . . I find that to be a struggle.*

The participant elaborated on how technical glitches and students' lack of familiarity with the expectations of using breakout rooms impacted their actual use of those tools:

> *Initially, I found the breakout rooms difficult to use, but I think that was just the initial introduction of Kaltura (2022) Classroom had a lot of kinks in it that other faculty had reported as well. It wasn't just me. And so, I avoided it during the first term or the first couple of terms with the pandemic. But then this year, I actually, or this fall, I've actually revisited it with Google Meets, and I have found it to be successful on my end. But perhaps not as successful from the student perspective. Some students like it. Others, I don't get the sense that they're actually communicating and doing what they're supposed to do.*

Focus group Participant B summarized a similar observation, noting, "I got the impression it wasn't necessarily the technology that was the issue. It was the students to actually engage with the kinds of activities that you were putting in front of them." Participant C explained that their frustrations stemmed more from a "nuts and bolts piece, rather than a program piece" when it came to transitioning between activities and resources during virtual class sessions:

> *For me personally, it's more of the transition from, you know, whatever activity we're doing to a different technology and back . . . and, you know, practising something at home in my program, and then getting it there and then it doesn't quite move as smoothly as it did when I was doing it at home. And it just becomes easier to sidestep some of them. So, it's more of a fluency issue, rather than individual program issue.*

Impact on Teaching Practice

General

Faculty from both universities indicated that the transition to online teaching during the COVID-19 pandemic impacted their teaching practices. Some survey respondents (n=5, 14%) noted that the change had made teaching more difficult and time-consuming, with much more time needed for preparation ahead of a live class and follow-up after a class. Respondent H stated that their "entire course delivery had to be re-planned", and that the "methods of evaluations were changed as well." Respondent N described how they have "spent a lot more time working through videos and trying to create more engaging slides (through animations)" and how they "also spent a lot of time setting up quizzes and activities on Moodle."

Two faculty indicated that they found it "reasonably easy to switch from in-classroom teaching to online teaching," with Respondent I noting that they were "fairly new to teaching labs" before the pandemic, so they "didn't have any particular habits that I couldn't break to be able to teach online." Some respondents described how they were able to try new tools and new approaches, with Respondent D noting that the transition "has made me focus more on flipped classrooms and constructivist approaches to learning." Respondent J described how the transition to online teaching has given them "many more options for how courses could be delivered . . . broadened my

perspective in terms of what is acceptable learning modalities or assessments . . . and encouraged me to accommodate learners consistently and in different ways." Finally, Respondent R noted that teaching online has "increased my awareness of the need for flexibility for both students and myself," while Respondent Q indicated that, "It made us question everything and build a better system as a result."

Co-Creation of Teaching and Learning Spaces

Focus group participants elaborated on how their practices had evolved while teaching online. For example, Participant C highlighted how they drew upon student collaboration and co-creation to expand their own skill sets, explaining that "three of our students each week present[ed] a tech tool, so . . . while they're building up their repertoire of tech tools, so am I."

Focus group Participant D referenced the Fully Online Learning Community Model (Blayone et al., 2017; EILAB, 2022; Webb et al., 2019) to highlight how the impacts of transitioning to online teaching during the pandemic extended beyond gaining comfort with using digital tools and altered the actual nature of interacting with students:

> *We can't continue to have a hierarchical structure within the educational context. And as a consequence, what we're trying to do is develop the skills of everybody within the community simultaneously, while doing some modelling at the beginning, so that you actually take on those kinds of roles in assessment, providing critical feedback, allowing individuals to*

> *actually take a facilitation kind of role within their small teams, etcetera . . . so that collaborative kind of piece extends, not only to the use of technology, but also to all of the other pedagogical aspects of learning within a community.*

Connecting with Students

In contrast to survey respondents and focus group participants who described the positive changes they had seen from online teaching during the pandemic, some survey respondents described feeling less confident in their teaching practice. Respondent J noted they "feel less confident in the learning assessments, less connected with students, and it has reduced my ability/confidence to manage large classrooms." Respondent J noted that part of their teaching "needs to be very hands-on, and so it was difficult to create lived/relatable experiences virtually in many cases."

While some survey respondents indicated that they felt "connected more with individual students" while teaching online, Respondent F speculated that the "bond between students . . . was no doubt much weaker." Focus group Participant A explained that making connections has proven most difficult with first-year students:

> *I have found it somewhat difficult at points to make contact with first-year students to understand their level of understanding or their level of engagement. To being able to reach those students who are in difficulty or perhaps having more challenges than others during the pandemic. I've tried to make a number of attempts to closely monitor students that I*

> *know that are at risk. But how do we really know who, especially when you have larger classes . . . And how can students within your class feel comfortable making connections when all they've really ever know[n] is kind of a remote classroom at the university level? And, so I think that's been a difficult or challenging piece for me to address.*

Participant B also noted issues with engagement levels, but speculated that it was not always the result of barriers created by the affordances of technology such as virtual meeting tools:

> *I'm convinced it's not necessarily about the technology. It probably is more about their particular circumstances. The situation that they find themselves in that maybe their education is not necessarily the highest priority, or that has been overtaken by other things that have occurred within their lives, you know, family member falling ill, or something along those lines. So that question of how to actually bring them in is still very active.*

Classroom Democracy

Survey Respondent Q explained that online teaching has helped them recognize how innovative use of technology "means the end of serial form, Socratic Q+A in class" because "it is replaced with virtual whiteboards where students can answer questions publicly in parallel." Similarly, focus group Participant A noted, "the other piece to this, and I think you're touching on it with this whole idea of the flipped classroom, is the opportunity to extend educational context beyond just the classroom." Survey respondents noted that their experience with online teaching during the pandemic has "really underlined

the two-way nature of teaching," that it has helped them to be "more conscious of the students who attend, but don't fully participate," and that it has underscored the importance of developing "new strategies to engage more of this sub-set." Respondent B indicated that they "will make more extensive use of online interactions as a supplement to what happens in the classroom" because they "think this will have particular benefit in reaching/encouraging students who are reticent about participating in the classroom, but are more comfortable sharing their thoughts and opinions in a class forum." Some faculty members expressed the importance of flexibility, especially for "students that may struggle with a traditional university experience." Focus group Participant A stated, "I think that's where we're going. I can never see myself ever having a situation where I will have a classic in-person class that puts it as there's no other option, whether you can travel to where I am." Participant C described how the experience of teaching online highlighted possibilities for greater use of online delivery methods to increase student access and equity in higher education:

> *I know there's always certain courses we could do online because we had a semester that was online. But there are significantly more courses that we're doing that we have completed online that I could see staying permanently online and maybe cutting the number of days that our students have to come into campus. That allows them sort of the flexibility to work more . . . so not having to come in for some of the courses has been probably an equity issue, and I think it allowed more students to have a better quality of personal life.*

Survey Respondent R indicated that they would "use online tools more and try to keep flexible assignments and deadlines," while Respondent Q noted that "the normalization of online learning" and technology used to facilitate assessments "renders final exam dates almost meaningless. Instead, students can write final exams when they are ready (but before the deadline)."

Future Impact on Teaching In-Person Classroom

General Impact

The final survey question asked faculty to speculate on how their experiences with online teaching during the COVID-19 pandemic would impact their future teaching practices for in-person classrooms. The majority of the responses reflected themes expressed by Respondent G who stated, "I will carry forward much of what I learned," and Respondent N who explained, "I think I will keep some aspects of the online classroom for some activities and assignments." Respondent M stated that "it will improve how I use Moodle and other technologies, and I will continue using some of the pedagogical methods I explored last year." At the same time, Respondent I noted that "I believe my communication skills have greatly improved, [e]specially when trying to create course content that is for universal learning."

Digital Tool Use

Many respondents indicated that they felt more confident using a variety of specific digital tools in their teaching now, with Respondent Z stating that, "it brings my teaching practices closer to the skill sets my students already have." Focus group Participant A described how beneficial the use of technology during the pandemic has been for students and how important it is to continue integrating technology even in classroom-based teaching by stating that:

> *The skills that they have developed and are now using fluently . . . they like likely wouldn't have had those for five or 10 more years if it hadn't been for the pandemic and, you know, necessity being the mother of invention.*

Regardless of any frustrations or difficulties encountered while teaching online, survey respondents expressed that they saw benefits to integrating some of the digital tools and pedagogical approaches they had used into their classroom teaching practices. Respondent K explained that "one complements the other. I know that I want my students to communicate, collaborate, and learn from each other. I make these situations happen in the classroom and in the online experience." One beneficial strategy noted by respondents was increased use of pre-recorded mini-lectures, representing "more efficient use of time for me" and allowing them to "utilize class time as case or problem time." Respondent P noted that they "may pre-record all lectures in future and do more active learning, small-group activities, and review during synchronous

class." Focus group Participant B indicated that they are delivering a course with two online sections and one on-campus section. While they explained that they have not yet started recording their in-person sessions, they have taken to live-streaming the last in-person session each week to increase access for their online students.

> *I have started streaming that class. It wasn't scheduled, and it's not mentioned in the Course Guide as an in-person class. But I'm in a room where I can stream, so why not? So, if you miss a class earlier in the week, at that time, you can come take an in-person class.*

Participant B also explained that they continue to use Nearpod (n.d.) to increase engagement during in-person classes and post those resources online so that students can revisit the in-class resources and activities as often as needed.

Structural Organization

Survey Respondent D stated that their experiences with online teaching "have made me think more structurally about my course offerings," including the importance of "ensuring that scaffolding is clearly used." Focus group Participant C described how they had used their experience with online teaching to rethink how they scaffold courses to meet their students' individualized learning needs and goals. They explained that integrating technology has made it easier for them to facilitate individualized learning pathways:

> *I came up with this idea that students can choose your own grade. So I developed pathways. I call it co-ordinated advanced pathways. And a core pathway gets you to a "C." And you do this amount of work, you get to "C." And then, I developed this advanced pathway. So if you do . . . core work, and then do the advanced work, you can get an "A" or a "B." You make the choice. It's entirely up to you. There's nothing . . . embarrassing about getting a "C" in this course.*

Focus group Participant D described the impact that this use of core and advanced pathways has had on the amount of content available to students in their courses:

> *So, whereas all my colleagues were concerned because going online . . . I can't get as much volume of content into the course online as I could when we were in person . . . I've actually added 50 percent content to my course because I didn't realize it. So, I have a two-for-one. I have a core course, and I have an advanced course. It's actually a lot more content in my course, and it's working out extraordinarily well so far.*

Appreciation for In-Person Teaching

In addition to expressing increased comfort with the use of digital tools and recognizing benefits to the use of new pedagogical approaches, some faculty noted that they would "cherish in-classroom sessions more than before" and that their experiences would "probably strengthen my ability to teach virtually while also highlighting the important aspects of in-person teaching such as student engagement." Respondent H indicated that they "will use a combo of my classic teaching methods with the online tools." Others expressed a growing

appreciation for the conveniences of using digital platforms such as a learning management system. They "will be more inclined to use online assignments in favour of paper ones."

Enthusiasm for Teaching

The majority of faculty respondents expressed positive online teaching experiences and optimistic appraisals of the impacts of those experiences on their future classroom teaching. Respondent X stated that they are "better for the experience," while Respondent Y indicated that they felt it would "enhance student learning." However, two survey respondents indicated that their online teaching experiences would not likely impact their classroom practices. Respondent U noted that they "do not have the same energy and enthusiasm as I had before," but indicated that they would "probably use some of the tools, such as posting videos and having some lessons completed online" and that they "may offer at least part of an exam as an open-book online section so that students can use their computers to complete the questions, and so that I can ask more in-depth programming questions."

Discussion

Following insight from 35 faculty from two Canadian universities, this research built on the question: What are educator perceptions of using new technologies during the COVID-19 pandemic, and how did and will it impact teaching practices? The findings presented in this paper highlight changes in

teaching practices during the pandemic and participants' perceptions of how these innovations will impact their post-pandemic teaching. The pedagogical innovations include practices that reduce transactional distance, promote the establishment of online learning communities of inquiry and presence, promote the co-creation of digital learning spaces, and draw upon the principles of Universal Design for Learning. This research is helpful to stakeholders such as administrators, policy-makers, and faculty involved with planning and supporting online teaching and learning programs in unique and traditional scenarios.

Diffusion of Innovation

As with adopting any innovative tools or practices, Rogers' (1976) Diffusion of Innovation Model tells us that some higher education faculty will be more eager and willing than others to integrate digital technologies and online teaching pedagogies. Even in a context such as the COVID-19 pandemic, where faculty were forced to innovate by practical necessity and organizational mandates, the presence of what Rogers described as "innovators" and "early adopters" was evident. This can be seen in comments from focus group participants who expressed their willingness to allow students to take the lead on introducing new technologies, and their eagerness to build their digital toolkits and "explore what can this thing do, what are the affordances of this particular tool that I haven't come across before."

Innovations in Online Teaching Approaches

Access to informal and formal supports did translate into technological and pedagogical innovation for faculty at both CBU and OTU. Those innovations exhibited characteristics of effective online pedagogy described by Transactional Distance Theory, the Community of Inquiry Model, and the Fully Online Learning Community Model. They also included the principles of increased access espoused by Universal Design for Learning. Survey and focus group responses indicated a greater appreciation for providing students with more communication channels and integrating greater flexibility into the range of learning resources, assessment methods, and grading practices used. While some participants lamented the challenges of forging connections with and between students in an online learning context, others expressed an appreciation for the affordances of technology to promote increased engagement. Focus group participants elaborated on how online teaching has allowed their students greater flexibility to engage with content, and transfer their knowledge and skills to their contexts. Focus group participants also noted that they could enhance social and cognitive presence when working with some courses. However, they also noted that they found it challenging to increase engagement when using specific approaches with novice students, such as collaborative breakout room activities. Overall, participants described changes to their teaching practices during the pandemic that positively impacted their students' learning experiences. Survey Respondent P also noted that their

experience with online teaching during the pandemic had left them eager to undertake a "more in-depth evaluation of teaching practices" in the future.

Innovations in Classroom Teaching

Faculty indicated that their experiences during the pandemic would impact how they approach teaching in an in-person classroom. For example, some participants described how they would use pre-recorded instructional materials to integrate more flipped learning approaches into their classrooms and provide students with increased flexibility and access to the resources for review purposes. Focus group Participant C outlined how their experience and use of technology have transformed their approach to delivering their courses by enabling scaffolded differentiated pathways for students to meet their learning goals. Survey Respondent E indicated they would continue using digital tools to create and submit assessments. At the same time, survey Respondent Q explained that the innovative use of digital tools had rendered traditional examinations and due dates "meaningless," allowing students in online or in-person contexts to complete assessments at any point before the end of the term. Participant A described how tools, such as Nearpod, were valuable to increasing engagement and formative assessment for online teaching and would be of equal value in an in-person classroom. While participants described numerous ways that the use of online teaching and learning technologies enabled them to be innovative, focus group Participant A drew upon the Fully

Online Learning Community Model to explain that going forward, it was no longer a question of knowing how to use specific tools or what those tools could do:

> *I don't think it's the technology or the ability of the technology to do certain kinds of things. It's the opportunities that students have and that all of us have to actually reconceptualize the way that activities can actually be undertaken using the technologies as a moderating or a facilitating kind of force that is available. So that's the piece that I think that we all need to struggle with. How do we wrap our heads around the abilities that are present within the technologies, so that we can make good use of them to carry out whatever activity, collaborative or otherwise, that we actually have in front of us?*

Participant A's observations are significant because they demonstrate that in the aftermath of the pandemic shift to online teaching, faculty have changed their focus from technical features and capabilities towards pedagogical affordances and support for relationships within learning communities.

Limitations

While insights from this study are beneficial for future research into online learning and emergency educational scenarios, we recognize three primary limitations:

1. The findings may only be generalizable in the context of Canadian institutions.

2. Given the extraordinary impact of the COVID-19 pandemic, results may not apply to traditional higher-education learning scenarios.
3. Our survey response rate was low and may not reflect the experiences of some unresponsive university faculty.

However, insights from this study are beneficial for future research evaluating emergency preparedness and responses, along with the diffusion of innovation in higher education.

Conclusions and Recommendations

Individual success with technological and pedagogical innovation depends on whether faculty perceive digital tools and pedagogies to be helpful. So too does the success of higher-education institutions with achieving critical mass for widespread innovation. Innovation also requires faculty confidence in using digital tools functionally and pedagogically.

Findings from this study reflect pre-pandemic research on eLearning and online learning as outlined by Singh and Hardaker (2014). Notably, a lack of a cohesive technology diffusion strategy or communication between various university stakeholders can be disruptive to providing effective learning experiences. However, peer and student insight can be positive motivational factors for educators adopting new technologies through informed support.

Furthermore, findings from this study resemble those described by Power (2018a; 2018b) in pre-pandemic studies. Notably, faculty members' self-efficacy

increases with innovative teaching approaches such as promoting Communities of Inquiry or Fully Online Learning Communities, or integrating Universal Design for Learning principles. Higher education institutions should provide access to longer-duration formal or semi-formal professional development programs that focus on pedagogical and instructional design best practices for online teaching to support future best practices.

Recommendations for Further Research

This research reflects the experiences with online teaching of faculty from two Canadian universities. Further research is recommended to explore faculty experiences from other higher education institutions. This research could provide insights into the impacts of unique contexts on faculty members' adoption of technology and innovative teaching practices for online teaching during the COVID-19 pandemic and beyond.

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Image Descriptions

Figure 2 image description: An illustration of the following pillars of UDL:

- Multiple means of engagement: recurring interest, sustaining effort and persistence, and self-regulation
- Multiple means of representation: perception, language and symbols, and comprehension
- Multiple means of action and expression: physical action, expression and communication, and executive functions

[Back to Figure 2]

Appendix R4: Design of Mobile Teaching and Learning in Higher Education: An Introduction (Power, 2019)

Design of Mobile Teaching and Learning in Higher Education: An Introduction

Robert Power

Abstract

The rapid evolution of mobile technologies has been accompanied by equally rapid changes in how people interact with each other, and with society. These changes have implications for teaching and learning. They also present exciting possibilities for changes to how educators, instructional designers, and students themselves approach teaching and learning. Despite this, many questions remain as to how best to design learning environments and resources to meet changing demands, and leverage emerging resources. This chapter provides an overview of some of the issues and trends reflected in this section of the Handbook of Mobile Teaching and Learning, which focuses on recent experiences and innovations in the design of mobile teaching and learning in higher education. Introductions are provided for the seventeen chapters that make up this book section, which cover topics ranging from pedagogical perspectives on the transformation of face-to-face learning to mobile contexts, to how to design effective mobile lessons, business models for mobile teaching and learning, and new instructional design frameworks.

Mobile technologies have rapidly evolved in recent years. Alongside this, evolution has been dramatic changes in how people interact with information, technology, and each other. These changes have had impacts across many sectors, including in the fields of formal and informal education. The increasing penetration of mobile devices has led to increased interest in mobile teaching and learning (m-learning). This increased interest has caused scholars to focus on a range of technical and pedagogical issues that need to be addressed in order to effectively leverage mobile technologies in education. Some of the problems that scholars have identified include questions of how to transform traditional curricula and resources into digital

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content, and how to appropriately design content for mobile platforms and teaching methodologies. There are also questions of a more technical nature, such as how to improve interactivity and communications functionality, how to ensure the stability and security of network connectivity, and how to protect intellectual property (IP) and confidential information. Importantly, there are also questions of how to prepare educators to integrate mobile technologies and approaches into their practices, and how to ensure students are engaged with learning resources and activities, instead of distracted by games, social media, or other features of mobile devices.

Designing appropriate mobile learning curricula and applications requires an understanding of students' needs and requirements. It also requires an understanding of the technologies that are available, the affordances and limitations of those technologies, and issues of technology access (include affordability). Some instructional content and activities can easily be adapted into digital and mobile-friendly formats. Other practical teaching and learning activities may remain inappropriate for mobile learning approaches. For instance, developing competence with medical procedures may require a more hands-on approach, with in-person observations to certify competency. In some cases, even resources that could easily be digitized may not be appropriate for mobile delivery, such as long text-based documents, or digital media content or learning artifacts that require large amounts of storage space, or bandwidth to transmit. The ease of reading text on smaller screens, the expense of bandwidth needed to access resources, the overall stability of network connectivity, and even physical and data security for users must be carefully considered when making decisions about mobile learning approaches. Fortunately, there is a growing body of research and resources available to provide guidance with these considerations.

The development of mobile learning programs and resources can be a detailed process that involves the design, production, and testing efforts of curriculum and instructional designers, software application developers, and learners themselves. These efforts can have important payouts as a result of the special affordances of mobile technologies, including social connectivity, cooperative and collaborative interaction, multimedia resource access, general mobility, and the ability to situate learners and learning scenarios in the right time and space for a learning experience. These attributes have the potential to engage students in self-motivated and self-directed learning. They have the potential to increase engagement, as well as assist with the learning process itself, and increase efficiency for students. Features available in mobile devices can also be leveraged to increase the accessibility of learning for students with special needs. Mobile technologies provide greater access to teaching and learning resources, and have the potential enhance performance and to make learning a more personalized experience. However, factors such as affordability and access to technology and connectivity, safety, security and privacy concerns, and the time and effort needed to develop appropriate curricula and resources, continue to limit what can be achieved.

In the chapters that follow, the some authors present reviews of literature on traditional teaching methods, newly developed mobile learning programs, and summaries and recommendations for the design and delivery of mobile learning in

higher education. Other authors discuss the advantages and disadvantages that have been noted when using mobile learning strategies. Frameworks to provide guidance with mobile instructional and curriculum design are presented. Some of the chapters that follow focus on existing technologies and their potential for mobile learning, while others explore the potential of new and emerging technologies for future educational endeavors. The authors present viewpoints from multiple disciplines and regional perspectives, and discuss the challenges that can be expected in future mobile learning initiatives.

Many educators are familiar with traditional face-to-face teaching methods. In decades past, students were often active during class sessions, communicated with their instructors, and read a lot of text-based resources. In the chapter "► Transformation of Traditional Face-to-Face Teacher to Mobile Teaching and Learning: A Pedagogical Perspective," Dr. Jan Turbill describes the experience of transforming approaches to suit a new generation of learners. These learners frequently come to class with their mobile devices in tow and use those devices to do much of their reading, searching, and learning. Dr. Turbill describes the need to change teaching methods to keep up with new learner profiles and the resources they are accustomed to using. Dr. Turbill needed to design and develop online and mobile-compatible curricula from traditional teaching resources. Many teachers and tutors became involved with what turned out to be a successful endeavor. Students were asked to bring their background knowledge and beliefs about what they were going to learn, and that underpin their existing knowledge, attitudes, and actions. These factors were challenged and informed by new information, actions, and practices. All of these dimensions were brought together to inform the development of a new online model. Dr. Turbill's chapter reviews the literature on traditional classroom learning and introduces the transformation to a technology-integrated approach. Dr. Turbill also compares the differing perspectives of traditional and technology-integrated teaching, and presents the advantages from both models.

In the chapter "► Characteristics of Mobile Teaching and Learning," Dr. Aimee Zhang introduces the process of mobile technology development, along with the strengths and limitations of mobile technology. Zhang provides an overview from the literature and empirical studies on the development of mobile teaching and learning that focuses on its advantages and disadvantages. The chapter suggests some important determinants of a good mobile learning program from a designer's view, including the need for both the designer and educator to have the technical skills and knowledge to design curriculum and content for mobile teaching and learning. Due to current hardware and connectivity limitations, Zhang points out how not all digital content is suitable for mobile delivery. She also notes that learners from different countries are situated in different social, cultural, economic, and technical contexts, all of which influence the types of content and pedagogical approaches that might be appropriate. Empirical studies in Australia and China revealed differences in market shares amongst students, as well as different levels of adoption of mobile learning approaches. Students from different contexts also have differing views on what should be implemented to increase engagement and

enhance impacts on learning. Zhang also presents the limitations and barriers faced by mobile learning programs, discusses potential solutions, and presents future design considerations for mobile teaching and learning.

Geographic dispersion can create unique challenges for mobile teaching and learning. In their chapter "▶ Use of Mobile Devices for Learning and Student Support in the Pacific Region," Dr. Bubhya Sharma and Dr. Anjeela Jokhan describe how short message notification service (SMS) was integrated into a mobile learning model at the University of the South Pacific in 2011. The SMS service is designed to link with the MOODLE learning management system already in widespread use at the university. The authors discuss the administration of a student survey about their mobile learning experiences. Feedback from students appears positive for the use of the SMS service in teaching and learning, as well as for its adoption by other university departments such as Campus Life, Student Administration Services, Campus Directors, Marketing, and the Emergency Working Group. The authors indicate that mobile learning has had a positive contribution to teaching and learning at the university, and throughout the region. They also demonstrate how SMS services can be integrated to support both teaching and learning practices, as well as general student and campus support services in higher education.

The Open University is becoming increasingly popular because of its efforts to open knowledge and learning opportunities to people in many different countries. In the chapter "▶ Mobile Learning and Education: A Synthesis of Open Access Research," Dr. Teresa Cardoso and Renato Abreu discuss the use of mobile technology in the Open University. Mobile technologies increase the ability of learners to study at a distance. This chapter focuses on the characteristics of mobile learning types and environments, and includes a SWOT (strengths, weaknesses, opportunities, and threats) analysis on mobile learning. The authors explore students' and teachers' perceptions and practices, and the determining factors they consider important to the use of mobile devices in teaching and learning. A comparison is presented of 15 journals and databases for mobile or online education, showing that teachers overwhelmingly lack motivation to promote mobile learning approaches. Teacher training and policy supports are shown to be important factors in the acceptance and promotion of mobile learning. The authors shed light on future development and design of a mobile open knowledge framework.

Dr. Sanja Pupovac, Dr. Lina Xu, and Dr. Corinne Cortese from the University of Wollongong extend the notion of the "flipped" classroom to subject assessment. In their chapter "▶ Applying Open-Book-Open-Web Assessment in Postgraduate Accounting Subject: Flipping the Test," Pupavoc, Xu, and Cortese describe how they adopted a "flipped" approach in all assessments in a postgraduate accounting course, including final exams. The idea was to encourage collaborate learning, increase student engagement, and develop critical thinking skills. The authors review research on peer-learning in accounting education and focus on six key streams. They discuss the use of mobile technology in learning and assessment, and the solutions it presents. Feedback to the flipped approach to assessment was positive, with students expressing a belief that the flipped model enhanced their learning experience. The authors also show that international students in particular benefited

from the flipped model. The flipped approach reduced pressure to memorize content and increased the potential for engagement in deeper learning. The authors note that the teacher plays an important role when adopting peer-based learning approach such as flipped learning. Their findings represent important considerations for future development of mobile education programs and resources for learning and assessment.

Kimberley Vincent-Layton from Humboldt State University argues that educators should play a vital role in the development of mobile lessons to support authentic learning that incorporates collaboration and critical thinking. Vincent-Layton shares a case study of mobile teaching and practice in the chapter "► Mobile Learning and Engagement: How to Design and Effective Mobile Lesson." The chapter outlines a mobile lesson template that was adopted for the Scavenger Hunt Mobile Lesson on Motivational Appeals. The proposed template includes the assignment name, goal, learning outcomes, materials/resources, instruction, assessment, weighting of the assignment, submitting assignment for evaluation, time commitment, deadline, feedback expectations, examples, and technology considerations. After demonstrating how the lesson template was used in the case study, the author advocates for increased collaboration in mobile learning activities across course and curricula in higher education.

Jason Haag and Peter Berking discuss how mobile technologies can assist the learning process for special mobile curriculum design in the chapter "► Design Considerations for Mobile Learning." The authors review the literature and discuss definitions of mobile technologies and mobile learning. They note that learners are now leveraging mobile devices for support and self-directed learning. With an emerging paradigm shift that offers new opportunities for improving performance and augmenting skills, the authors argue that the current analysis, design, develop, implement, and evaluate (ADDIE) framework of curriculum design is not the best model for curriculum design for mobile learning. Current gaps in design knowledge for educators, instructors, and instructional designers are important considerations. The authors present a new learner-centered design approach to mobile learning design. With the ability to satisfy users, many interfacing with different screen sizes and hardware configurations, as a key factor in determining the utility of a mobile learning solution, the authors argue that the designers of mobile learning interfaces should be encouraged to work closely with instructional designers. The chapter categorizes and compares mobile learning on different devices. It also emphasizes the importance of spaced learning in mobile learning contexts and reviews relevant learning theories and conceptual frameworks for mobile instructional design. The authors conclude that mobile learning has the greatest potential to offer rich, contextual learning experiences. Their chapter offers valuable insights and a new framework for mobile curriculum design.

Dr. Cassey Lee believes that it is important to address the financial aspect of offering and accessing mobile learning. In his chapter "► Business Models for Mobile Teaching and Learning," Lee proposes new business models for e-commerce teaching and learning. These models provide insights for financial sustainability for mobile teaching and learning. Lee surveys the types of business

models and relates them to mobile learning services, and proposes that the key factors for financial sustainability of mobile learning in higher education and other industries.

Dr. Oscar R. Boude Figueredo and Dr. Jairo A. Jimenez Villamizar from La Sabana University discuss the difficulties facing teachers in mobile teaching design and implementation in their chapter "► Framework for Design of Mobile Learning Strategies." They review previous theoretical and empirical works, and design a new model for mobile teaching and learning. Their model includes six stages: recognition, analysis, identification, bases, design, and implementation. The importance of teacher awareness of the educational process, benefits, and limitations using mobile technologies is emphasized.

Dr. Ekaterina (Katya) Pechenkina focuses on micro-credentials and mobile learning in the chapter "► Micro-credentialing in Mobile Learning: Implications for Impactful Design." Pechenkina discusses the literature and empirical studies on micro-credentials and mobile learning, and identifies the gaps between the studies linking them. With micro-credentialing, larger programs are split into smaller units of study. Mobile learning is described as having the benefit of providing "anytime/anywhere" access to learning opportunities. The author argues that while both micro-credentialing and mobile learning try to make learning more flexible, the two approaches are rarely considered in tandem. The chapter explores various intersections between the two approaches and considers key elements for impactful instructional design. The author emphases the importance of mobile micro-credentials in formal institutional course design.

An augmented reality mobile learning game is introduced in the chapter "► The Graduation Game: Leveraging Mobile Technologies to Reimagine Academic Advising in Higher Education." Tressa M. Haderlie, Dr. Apporva Chauhan, Whitney Lewis, and Dr. Breanne Littsfrom Utah State University describe the Graduation Game. The aim of the project was to leverage AR to introduce and provide meaningful earlier connections between students and their academic advisors and institution. The chapter describes how the Graduation Game was designed, tested, and implemented to improve students' advising experiences. An email distribution of the game in 2017 was not successful. However, a distribution of the game at a university orientation saw higher response rates, and the evaluation of the project has been positive. The authors argue that utilizing mobile technologies for advising in higher education has great potential to enhance the critical role played by advising in promoting positive perceptions, and increasing student persistence through their education.

The influence of parents' education on their children's academic experience is the focus of Dr. Aimee (Yu) Zhang's chapter "► Parental Education: A Missing Part in Education." Zhang explores the literature and empirical studies that focus on parents' education and notes its significant impact on children's academic performance, behavior, and general development. The author also notes that while many jurisdictions do now emphasize parental education, it is still undervalued. While some programs and resources are available online, they are not easily accessible or well-promoted. Zhang discusses the benefits of parental education, which include spill-

over effects such as enhanced standard of living for families, and the prevention of social, criminal, and mental health issues in the community. The author proposes a possible solution for parental education using mobile technologies, which are increasingly widely available to most parents. The existing availability of mobile devices means a reduced startup cost for access to parental education resources. Additionally, most parents are already familiar with the technical use of their own devices, further increasing the ease of dissemination and access. Zhang notes that parents are ready and willing to learn to assist their children's learning.

Dr. Aimee (Yu) Zhang, along with Ms. Wangweilai Xiang and Ms. Qifang Xue, introduce the design and implementation of a Chinese teaching and learning second language program in an Australian language school in their chapter "► Design and Implementation of Chinese as Second Language Learning." The authors describe the challenge of designing and implementing a teaching program for students who came from different cultural and linguistic backgrounds and who had varied experience and knowledge with the Chinese language. The initial learning program goal was established as increasing awareness of Chinese culture and interest in learning the Chinese language. A further goal was to meet the challenge of teaching Chinese writing, which includes strokes derived from ancient drawing, and which required plenty of repeated practice. A mobile learning application was developed and implemented in 2016, and met with a successful response. Students appeared to be highly engaged in in-class learning activities that included both practice and competition, and were eager to continue with the competitive tasks outside of the classroom. The project demonstrates that mobile learning approaches can generate positive results in language teaching and learning.

Mobile-assisted language learning (MALL) is the focus of the chapter "Foreign Language Teachers as Instructional Designers: Customizing Mobile-Assisted Language Learning Technology," by Jennica Grimshaw, Michael Barcomb, and Dr. Walcir Cardoso, from the Concordia University, Canada. The authors introduce the three levels of teacher involvement with MALL technology. This involvement includes *adapting* pre-made materials at Level 1, *modifying* pre-made materials at Level 2, and *creating* new materials at Level 3. The chapter illustrates the implementation of the three levels of teacher involvement in a MALL environment. It also introduces examples of MALL resources to foreign language teachers as instructional designers, including Duolingo, Quizlet, and Moodle. One of the challenges faced by the foreign language teachers was limited time and resources, while the MALL implementation itself required long-term dedication and sustained effort. Grimshaw, Barcomb, and Cardoso argue that instructional design is more important than technology in helping students to achieve learning outcomes, and the purpose of their chapter is to provide teachers with a potential solution for foreign language instruction.

The role of the Mobile City Science (MCS) project in developing new spatial literacies through the study of local issues is the focus of the chapter "► Learning and Researching Across Places in Mobile City Science." Deborah Silvis, Dr. Jeremiah Kalir, and Dr. Kate Headrick Taylor from the University of Washington and University of Colorado Denver discuss the MCS project, which

brought together university-based researchers and youth-serving organizations in three US cities. The MCS project used location-enabled mobile devices, GPS-enabled action cameras, and mapping technologies to locate and represent places of personal interest in participants' local neighborhoods. Among the benefits of the MCS project described by the authors was a more in-depth and critical understanding of smart and connected cities. The authors also argued that the project supported youth to envision smarter cities by involving them in data collection and scientific inquiry.

The chapter "► Flexible Spaces and Sustainable Opportunities: Designing Online Profession Learning for Sessional Teachers" introduces two professional development programs at the University of Wollongong in Australia. Dr. Bonnie Dean, Dr. Kathryn Harden-Thew, Dr. Janine Delahunty, and Dr. Lisa Thomas provide insights from their empirical projects as to shift in professional development from traditional modes of delivery to a more practice-based focus. The chapter reviews the literature on methods of supporting sessional teachers at Australian universities. The authors discuss the importance of building technical professional skills at an institutional level, as well as addressing the needs of individual sessional teachers. They highlight a practical, flexible teacher training module. The authors also demonstrate the vital importance to mobile teaching and learning of technical skills and professional knowledge with online and mobile technologies, as well as the importance for both institutions and staff to have the same goals and training plans for new challenges.

In the wake of *The Civic Potential of Video Games* report, Dr. Renee Jackson and Emily Sheepy believe that there is a relationship between social impact game playing and positive citizenship outcomes. The authors introduce the social game, *Get Water!* in the chapter "► Learning from Social Impact Games to Support Integration into Middle School Classrooms." The chapter presents a qualitative study involving players and parents of the *Get Water!* game. Most participants showed a positive response to the game, which they described as fun and addicting. The authors note that there needs to be a balance between gamification and learning, and indicate that there is a critical role for the teacher to play. In terms of learning, the experiences and technical skills of a teacher are vital in such gamified education. The authors draw upon some suggestions from participant students to provide guidelines for the design of social impact games. They argue that by enabling exploration of issues of global and public concern, social impact games such as *Get Water!* play an important role in increasing political knowledge, volunteerism, and the preparation of informed participants in democratic processes.

The views and experiences of mobile teaching and learning design shared by the authors in this section show that methods of mobile teaching and learning vary in different countries and institutions. These differences in development, design, and delivery are influenced by many factors. Geographic location, available technologies, mobile device adoption rates and preferences, connectivity rates and costs, organizational goals, and the skills of designers and educators all play roles in determining mobile teaching and learning design practices. The chapters in this section bring together different viewpoints, new frameworks, and new ideas for the

design and development of mobile teaching and learning. While one design model is not suitable for either mobile devices or mobile learning programs, the resources presented in this section may provide insights into general rules for mobile teaching and learning design. The knowledge and experiences shared by the authors may also open a door for future cross-country learning system design and skills training for designers and educators.

Appendix R5: Using the mTSES to Evaluate and Optimize mLearning Professional Development (Power et al., 2016)

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Using the mTSES to Evaluate and Optimize mLearning Professional Development

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Abstract

The impact of targeted professional development activities on teachers' perceptions of self-efficacy with mobile learning remains understudied. Power (2015a) used the Mobile Teacher's Sense of Efficacy Scale (mTSES) survey instrument to measure the effects of a mobile learning themed professional development course on teachers' confidence with and interest in mobile learning. The current study looks at changes in perceptions of self-efficacy amongst participants in another open course about mobile learning called *Instructional Design for Mobile Learning* (ID4ML), which took place from May 4 – June 6, 2015 (Power, Bartoletti & Kilgore, 2015). The purpose of this study is to verify the reliability and construct validity of the mTSES instrument developed by Power (2015a, 2015b) and Power, Cristol and Gimbert (2014), and to explore trends in self-efficacy changes amongst a more diversified participant population. This paper reports on the findings from the analysis of data collected using the mTSES tool. The findings provide useful feedback on the impacts of participating in the ID4ML course. They also provide further support for the utility of the mTSES instrument as a measure of perceptions of self-efficacy with mobile learning. These findings point to the potential utility of the mTSES as a tool for both planning and evaluating mLearning professional development training for teachers.

Keywords: CSAM, mLearning, mobile learning, mTSES, professional development, self-efficacy, teacher training

Introduction

Despite increasing calls for wider integration of mobile technologies into formal education, one of the most significant determinants of teachers' willingness to adopt mobile learning strategies remains understudied (Kenny, Park, Van Neste-Kenny, & Burton, 2010). A strong sense of confidence in their own abilities increases the likelihood that teachers will experiment with new technologies or teaching

approaches (Tschannen-Moran & Woolfolk Hoy, 2001a). This study examined changes in participants' perceptions of self-efficacy after participating in a Massive Open Online Course (MOOC) called *Instructional Design for Mobile Learning* (ID4ML) (Power, Bartoletti, & Kilgore, 2015). The Mobile Teacher's Sense of Efficacy Scale (mTSES) (Power, Cristol, & Gimbert, 2014; Power, 2015a, 2015b) was used to gauge perceptions of self-efficacy before and after participation in the mobile learning themed professional development. The results revealed that the course had helped participants gain confidence in their abilities to use mobile devices and applications to increase student engagement. However, ID4ML participants showed decreased confidence in their abilities with designing instruction and classroom management for mobile learning. The results were compared to those reported for participants in a recent MOOC with an explicit focus on a framework for pedagogical decisions about mobile learning design (Power, 2015a). Analyses of demographic trends in mTSES results from the two courses point to areas where changes could be made to increase the likelihood that participants will integrate mobile learning into their teaching practice. The results of this study demonstrate the utility of the mTSES instrument as a tool for assessing the effectiveness of mobile learning focused professional development. They also highlight the potential for the mTSES to be used by professional development planners to design training to meet the specific needs of target audiences. The mTSES instrument has the potential to compliment other professional development planning and evaluation tools, allowing planners to specifically target perceptions of confidence alongside other intended learning outcomes.

Background

Teachers' adoption of new instructional technologies and pedagogical strategies is influenced by confidence in their ability to do so effectively. This perception of confidence is referred to as a teacher's sense of self-efficacy by Tschannen-Moran and Woolfolk Hoy (2001a), who defined it as "a judgement of… capabilities to bring about desired outcomes of student engagement and learning" (p. 783). Perceptions of self-efficacy can influence a teacher's "levels of planning and organization" and "willingness to experiment with new methods to meet the needs… of students" (p. 783). Higher levels of self-efficacy amongst teachers have also been demonstrated to be predictors of "persistence when things do not go smoothly and their resilience in the face of setbacks" (p. 783). In contrast, lack of a sense of confidence on one's abilities results in greater tendencies amongst teachers to abandon new strategies and tools, or even to leave the profession altogether. Addressing perceptions of self-efficacy appear crucial in any effort to increase the adoption of new techniques and technologies.

The imperatives to integrate mobile technologies and mobile learning strategies are becoming increasingly commonplace in discourse on how to meet the changing needs of learners and education systems (Ally & Prieto-Blázquez, 2014; Traxler, 2012; Groupe Spécial Mobile Association, 2012). However, Ally and Prieto-Blázquez (2014, pp. 145-146) warned that current teacher training programs continue to be based on an outdated education system model that does not adequately prepare teachers to integrate mobile technologies into teaching practice. Teachers' perceptions of self-efficacy can be negatively impacted by a lack of training in instructional design for mobile learning (Kenny et al., 2010). Negative perceptions of self-efficacy have been highlighted as a significant hindrance to wider-spread adoption of mobile learning strategies amongst teachers and education systems (Ally, Farias, Gitsaki, Jones, McLeod, Power & Stein, 2013; Kenny et al., 2010; Power, 2015a). Despite this, the concept of

perceptions of self-efficacy "does not yet appear to have been examined in any detail in a mobile learning context" (Kenny et al., 2010, p. 2).

Power, Cristol and Gimbert (2014) and Power (2015a) have attempted to address the absence of discourse about the promotion of teachers' perceptions of self-efficacy with mobile learning. One tool that has been developed is the Mobile Teacher's Sense of Efficacy Scale (mTSES). The mTSES instrument is based upon Tschannen-Moran and Woolfolk Hoy's (2001a, 2001b) Teacher's Sense of Efficacy Scale (TSES). The original TSES instrument consists of 24 questions. It uses a nine-point scale to measure teachers' levels of confidence with their ability to complete common, critical teaching tasks on the sub-domains of Student Engagement, Instructional Strategies, and Classroom Management. The mTSES consists of 38 questions, and uses the same nine-point scale and sub-domains. It provides teachers' scores with respect to common instructional tasks for the original TSES scale, as well as with respect to the integration of mobile learning strategies (Power, 2015a, 2015b). By providing scores for the original TSES and the mTSES scales, the mTSES instrument compares teachers' perceptions of self-efficacy with teaching in general to their perceptions about the use of mobile learning strategies.

Power (2015a) used the mTSES instrument to measure the impact of professional development training on participants' perceptions of self-efficacy with the integration of mobile learning strategies. The professional development consisted of a MOOC called *Creating Mobile Reusable Learning Objects Using Collaborative Situated Active Mobile (CSAM) Learning Strategies* (Power et al., 2014; Power, 2015a). The three week long MOOC introduced the CSAM learning design framework (Power, 2013; Power et al., 2014), and explored the use of the framework to guide instructional design decisions about the integration of mobile reusable learning objects (RLOs) into participants' own teaching contexts. Participants built prototype mobile RLOs, and also used the CSAM framework as a post-assessment tool for their prototypes. The mTSES instrument was integrated as a learning activity at both the beginning and the end of the MOOC. Participants were provided with a tool to self-score their mTSES surveys, and were asked to reflect upon changes in their perceptions of self-efficacy. Power (2015a) analyzed participants' pre-course and post-course mTSES scores, and found an overall increase in their perceptions of self-efficacy with mobile learning in comparison to their original TSES sub-domain scores. While those gains diminished when the mTSES was re-administered as a follow-up three months after the completion of the course, Power (2015a) found that participants still had stronger perceptions of self-efficacy with mobile learning strategies than could be accounted for through maturation alone. Qualitative data were also collected to help gain a better understanding of how participation in the CSAM MOOC impacted perceptions of self-efficacy. Power (2015a) used open-response survey questions and follow-up interviews to ask about participants' perceptions of the CSAM MOOC, its impact upon their perceptions of self-efficacy, and what they perceived as necessary going forward to adopt mobile learning strategies. The mTSES results and qualitative data were used to identify potential improvements to the design of the professional development MOOC, as well as to make recommendations for further research and future professional development practice.

The CSAM MOOC studied by Power (2015a) had a total of 72 registered participants, who came from a relatively homogeneous North American background. The pre-course mTSES survey was completed by 36

study participants, and the post-course mTSES was completed by 22 participants. One of the recommendations for further research proposed by Power (2015a) was that the mTSES instrument be used to study mobile learning self-efficacy perceptions amongst a larger, more diverse sample of teachers and instructional developers. This paper presents findings from the use of the mTSES with participants in a free MOOC called *Instructional Design for Mobile Learning* (ID4ML) (Power et al., 2015).

ID4ML was conducted from May 4 – June 6, 2015, using the *Canvas*™ (Canvas, n.d.; Instructure, n.d.) open learning management system. The course consisted of five modules, as outlined in Table 1:

Table 1

Course Modules for Instructional Design for Mobile Learning (ID4ML)

Week	Module
Week 0	Introduction to the Course
Week 1	Defining and Understanding Mobile Learning
Week 2	Instructional Design Principles for mLearning
Week 3	Hands on Mobile Learning
Week 4	Course Wrap Up

The primary focus of the ID4ML MOOC was on exploration of a variety of mobile applications and mobile learning tools, and discussion of the potential for integration of those resources into participants' teaching and learning practices. A specific focus on pedagogical design for mobile learning was limited to the Week 2: Instructional Design Principles for mLearning module. Content for the Week 2 module was drawn from the CSAM MOOC (Power et al., 2014; Power, 2015a). However, participants were not required to dedicate as much time to personal instructional design projects as in the original CSAM MOOC. Nor were they asked to design, produce, or evaluate a prototype mobile RLO using the CSAM framework.

A total of 2231 people were enrolled in ID4ML. Course participants came from all global regions. All course participants were invited to participate in the current research study through an information letter and a link to an online informed consent form posted in the Week 0 course orientation module. Research participation was strictly voluntary. Participants were provided with links to an online pre-course mTSES survey in the Week 0 module, and to an online post-course mTSES survey in the Course Wrap Up module.

Research Questions

This paper builds upon the findings from the use of the mTSES instrument by Power (2015a). The mTSES was administered to participants in the ID4ML MOOC with the aim of exploring its utility as a tool for

planning and evaluating professional development about using mobile learning resources and strategies. The specific research questions explored were:

1. Are measures of the construct validity and reliability of the mTSES tool consistent with previous measurements?
2. What effect did participation in ID4ML have upon participants' perceptions of self-efficacy with the use of mobile learning strategies in teaching practice?
    a. Are there differences in the effects of participation in ID4ML upon participants' perceptions of self-efficacy with mobile learning strategies based upon demographic characteristics?
    b. How do changes in ID4ML participants' perceptions of self-efficacy with mobile learning strategies compare to those reported by Power (2015a)?

Methodology

Quantitative data were collected for this research using pre-course and post-course administrations of the mTSES instrument. Volunteers from the ID4ML course were invited to participate in the study, and to complete the two mTSES surveys. Participants used hyperlinks within the course to access the online mTSES surveys. The hyperlinks to the pre-course and post-course administrations of the mTSES were only available during designated times in the Week 0: Introduction to the Course and the Week 4: Course Wrap Up modules, respectively. Access to the surveys outside of these times was blocked so that all pre-course and post-course mTSES submissions measured perceptions of self-efficacy following uniform periods of exposure to the ID4ML training. Course participants who enrolled in ID4ML after the initial orientation week did not participate in the research study, and participants were unable to complete the post-course survey beyond the course completion date.

Changes in participants' perceptions of self-efficacy were determined using the procedures outlined by Power (2015a). Data from the pre-course and post-course administrations of the mTSES were analyzed using *Microsoft™ Excel™*. Mean scores were calculated on a nine-point scale for each of the 38 question items from the aggregate data from each mTSES administration. The overall mean scores were then used to calculate mean scores for each of the TSES and mTSES sub-domains. Mean TSES and mTSES scores were also calculated based upon the demographic categories of years of teaching experience, participant status, geographic region, and gender. Aggregate mean scores for the TSES and mTSES domains and sub-domains, as well as those for the different demographic categories, were compared to determine initial and post-course differences in perceptions of self-efficacy with teaching in general versus the use of mobile learning strategies. The aggregate and demographic category pre-course and post-course TSES and mTSES scores were also compared to determine the extent of changes in perceptions of self-efficacy along each scale.

Participant Demographics

Participants in the ID4ML study came from more diverse demographic backgrounds than those from Power (2015a). Participation in the ID4ML study was voluntary. Of the 2231 registered participants in the ID4ML MOOC, a total of 105 completed the pre-course mTSES survey, and 37 completed the post-course

mTSES survey. Table 2 presents a comparison of the total number of participants and the demographic breakdowns of participants between Power (2015a) and the ID4ML study.

Table 2

Demographic Breakdowns of Participants in Power (2015a) and ID4ML

	Power (2015a)		ID4ML	
	1st mTSES	2nd mTSES	1st mTSES	2nd mTSES
Gender				
Female			62	20
Male			43	17
Region				
Africa - Middle East			7	4
Asia (Far East)			6	2
Australia / New Zealand			6	4
Europe			18	9
North America	36	22	59	12
South / Central America			9	6
Status				
Student	5	1	13	7
Undergraduate education student			3	3
Graduate education student			10	4
Faculty	23	16	43	15
K-12 teacher			13	5

Post-secondary instructor			30	10
Private sector training professional			17	4
Not currently employed			4	0
Other	8	5	28	11
Years of Teaching Experience				
0-5 years	9	4	37	13
6-10 years	7	4	11	6
11-15 years	8	5	26	8
> 15 years	12	9	31	10
Total	36	22	105	37

Response rates were lower for the post-course mTSES administrations for both Power (2015a) and the ID4ML study. However, such recidivism is not unusual in research studies involving repeated survey or questionnaire administrations (Cohen, Manion, & Morrison, 2011). The attrition in survey submission rates was also lower than typical MOOC participant attrition and completion rates (Jordan, 2014; Parr, 2013).

Results

Construct Validity and Reliability of the mTSES

Determination of the construct validity and reliability of the mTSES instrument was conducted using the procedures outlined by Benton-Borghi (2006) and Power (2015a). *Microsoft™ Excel™* was used to calculate total survey Cronbach's alpha scores for both the TSES and mTSES domains for the pre-course and post-course administrations. Cronbach's alpha scores were also calculated for the sub-domains of Student Engagement, Instructional Strategies, and Classroom Management, for both the TSES and mTSES domains. These scores were compared to the Cronbach's alpha scores obtained by Tschannen-Moran and Woolfolk Hoy (2001a, 2001b) for the original TSES instrument, by Benton-Borghi (2006) for the Teacher's Sense of Inclusion Efficacy Scale (I-TSES), and by Power (2015a) for the TSES and mTSES. The reliabilities of the various survey instruments are presented in Table 3.

Table 3

TSES, I-TSES and mTSES Reliabilities (Cronbach's alpha)

SCALES	Cronbach's alpha (α)			
	Engagement	Instruction	Classroom Management	Total
TSES (Tschannen-Moran and Woolfolk Hoy, 2001)	.85	.89	.91	.93
I-TSES (Benton-Borghi, 2006)	.86	.89	.88	.93
First TSES (Power, 2015a)	.86	.87	.78	.93
First TSES (ID4ML)	.89	.89	.91	.96
Second TSES (Power, 2015a)	.91	.87	.93	.95
Second TSES (ID4ML)	.89	.92	.90	.96
First mTSES (Power, 2015a)	.88	.84	.77	.92
First mTSES (ID4ML)	.90	.90	.90	.96
Second mTSES (Power, 2015a)	.90	.89	.91	.96
Second mTSES (ID4ML)	.90	.89	.89	.96

The Cronbach's alpha reliability scores were generally consistent for the total scales, as well as for the three sub-domains, across all instrument administrations. Power (2015a) noted that the comparability of reliability scores for the total scales as well as for the sub-domains "supports the conclusion of comparable construct validity between the TSES and the modified mTSES" (p. 135). This conclusion is further supported by the consistency of the reliability scores obtained from the ID4ML surveys. The similarities in the reliability scores and construct validities mean that researchers can place confidence in comparisons of total scale and sub-domain scores between the original TSES (self-efficacy with common teaching tasks) and the mTSES (self-efficacy with the use of mobile learning strategies). The similarities in reliability also mean that researchers can place confidence in the use of the mTSES as a tool for measuring changes in teachers' perceptions of self-efficacy with mobile learning.

Domain Score Analysis

Participants' mean scores on the sub-domains of Student Engagement, Instructional Strategies, and Classroom Management were calculated for both the TSES and mTSES scales for the pre-course and post-course administrations of the mTSES instrument. Mean scores for the pre-course mTSES were subtracted from those for the second survey administration to determine the mean change in scores for each sub-domain from the beginning of the course to the end of the course. Table 4 reports the mean sub-domain scores for each scale as obtained by Power (2015a), as well as for the participants from ID4ML.

Table 4

Changes in TSES and mTSES Subdomain Scores Between 1st and 2nd Administrations

SCALES	1st Admin	2nd Admin	M_{Change}
TSES Scoring (Power, 2015a)	M_{mTSES1}	M_{mTSES2}	M_{Change}
Efficacy in Student Engagement:	6.04	6.23	.19
Efficacy in Instructional Strategies:	6.94	7.25	.31
Efficacy in Classroom Management:	6.86	6.87	.01
mTSES Scoring (Power, 2015a)	M_{mTSES1}	M_{mTSES2}	M_{Change}
Efficacy in Student Engagement with mLearning:	5.90	6.48	.57
Efficacy in Instructional Strategies with mLearning:	6.59	7.27	.68
Efficacy in Classroom Management with mLearning:	6.78	6.89	.11
TSES Scoring (ID4ML)	M_{mTSES1}	M_{mTSES2}	M_{Change}
Efficacy in Student Engagement:	6.40	6.91	.51
Efficacy in Instructional Strategies:	6.87	7.50	.64
Efficacy in Classroom Management:	6.60	7.09	.49
mTSES Scoring (ID4ML)	M_{mTSES1}	M_{mTSES2}	M_{Change}
Efficacy in Student Engagement with mLearning:	6.44	7.07	.64

Efficacy in Instructional Strategies with mLearning:	6.80	7.43	.62
Efficacy in Classroom Management with mLearning:	6.62	7.07	.45

The mean scores obtained for each sub-domain for the first mTSES administration for participants in ID4ML were consistent with those reported by Power (2015a). Most sub-domain scores for the ID4ML group varied between .1 and .2 points on the nine point scale from those reported by Power (2015a), with only two sub-domain scores showing a greater difference (the Efficacy with Student Engagement score on the TSES scale was .36 points higher on the first administration for participants in the ID4ML group, and .54 points higher for the Student Engagement subdomain on the mTSES scale for participants in the ID4ML group). A similar trend was observed for the mean scores obtained for each sub-domain for the second mTSES administration. For the second administration, sub-domain scores for the ID4ML group and Power (2015a) typically varied between .05 and .18 points on the nine point scale. Again, the greatest differences in scores between the ID4ML and Power (2015a) groups were observed for the Student Engagement subdomain (the mean ID4ML score for the TSES was .68 points higher than the that of Power (2015a) group, and the mean score for the mTSES scale was .59 points higher). However, the mean changes in scores (M_{Change}) were greater for the ID4ML participants than those reported by Power (2015a) for all three sub-domains on the TSES scale. The mean changes in TSES sub-domain scores for participants in Power (2015a) ranged between .01 and .31 points, compared to mean changes ranging between .49 and .64 amongst the ID4ML participants. There was less variance in the changes in the mTSES subdomain scores between the two groups. M_{Change} on the mTSES scale for the Power (2015a) participants ranged from .11 to .68 points. The ID4ML participants recorded M_{Change} scores on the mTSES scale ranging from .45 to .64 points.

Net Changes Accounting for Maturation

Changes in participants' mean scores on the mTSES scale sub-domains appear generally consistent between the ID4ML participants and those reported by Power (2015a). However, participants in Power (2015a) showed lower mean changes in their scores on the TSES scale sub-domains. The procedures outlined by Power (2015a) were used to determine the actual extent to which ID4ML participants' perceptions of self-efficacy with mobile learning strategies (the mTSES scale) had changed as a result of participation in the professional development. The mean changes in each sub-domain score for the TSES scale ($TSES_2 - TSES_1$) were subtracted from the mean sub-domain score changes for the mTSES scale ($mTSES_2 - mTSES_1$) to yield the net change accounting for the effects of maturation upon participants. Table 5 reports the net change (intervention effect) for participants from ID4ML, as well as those reported by Power (2015a).

Table 5

Net Change (Intervention Effect)

Domain	Net Change $(mTSES_2 - mTSES_1) - (TSES_2 - TSES_1)$
Power (2015a)	
Efficacy in Student Engagement	.38
Efficacy in Instructional Strategies	.37
Efficacy in Classroom Management	.11
ID4ML	
Efficacy in Student Engagement	.12
Efficacy in Instructional Strategies	-.01
Efficacy in Classroom Management	-.04

Power (2015a) reported net increases in participants' perceptions of self-efficacy with mobile learning strategies for all three sub-domains. Participants' scores on the mTSES scale showed net changes for the Student Engagement (.38 points) and Instructional Strategies (.37 points) sub-domains. The Classroom Management sub-domain showed a smaller increase of .11 points on the nine point scale. In contrast, participants from ID4ML only showed a net increase in their perceptions of self-efficacy for the Student Engagement sub-domain (.12 points). Net decreases in perceptions of self-efficacy were observed for both the Instructional Strategies and Classroom Management sub-domains. The differences in the net changes per sub-domain between Power (2015a) and ID4ML are illustrated in Figure 1.

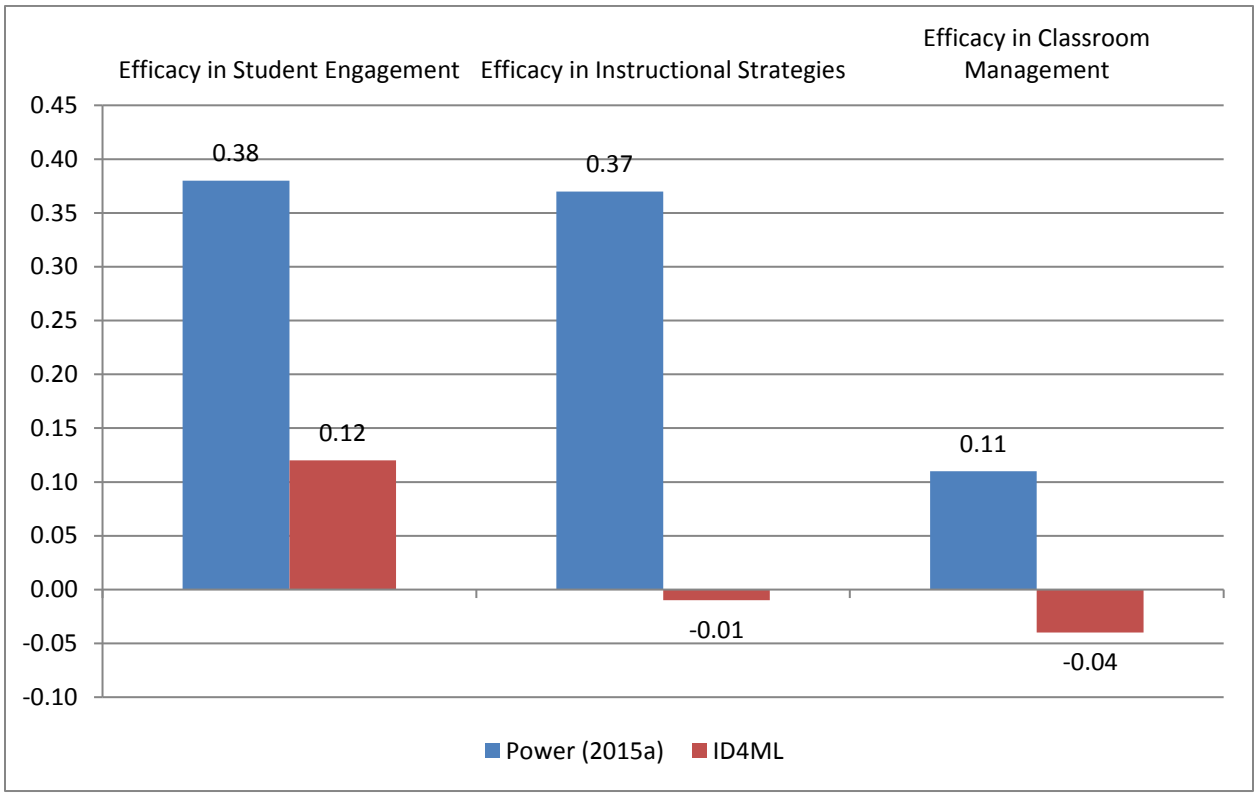

Figure 1. Differences in net sub-domain score changes (9-point scale) for Power (2015a) and ID4ML.

Demographic Analyses

Changes in perceptions of self-efficacy were further analyzed along four different demographic categories, including participants' years of teaching experience, status (with respect to the education profession), geographic region, and gender. These changes were compared to similar demographic analyses reported by Power (2015a).

Years of Teaching Experience

Participants from both research studies with less than five years of teaching experience were the least likely to show increases in their perceptions of self-efficacy. Mean scores for participants with less than five years of teaching experience in both ID4ML and Power (2015a) showed decreases on two of the three mTSES scale sub-domains. Participants with less than five years of teaching experience from Power (2015a) also showed decreases in their mean scores on all three TSES sub-domains, while the mean TSES scores for participants from ID4ML showed almost no increase on two sub-domains, and a small decrease for the third sub-domain. Participants with between 5-10 years of teaching experience, and those with between 10-15 years of teaching experience, showed the most frequent and largest increases in their perceptions of self-efficacy with the use of mobile learning strategies. Amongst participants from both groups, decreases in mean scores for perceptions of self-efficacy with mobile learning strategies were most frequent for the Classroom Management sub-domain. However, participants with between 10-15 years of teaching experience were the only ones from ID4ML to show an increase in their mean mTSES sub-

domain score for Instructional Strategies. Table 6 reports the changes in TSES and mTSES scores for participants from both ID4ML and Power (2015a) according to years of teaching experience.

Table 6

Changes in TSES and mTSES Scores by Years of Teaching Experience

Teaching Experience	TSES Domains			mTSES Domains		
	Student Eng.	Instr. Strategies	Classroom Mgt	Student Eng (mobile)	Instr. Strategies (mobile)	Classroom Mgt (mobile)
Power (2015a)						
0-5 years	-.01	-.06	-.51	-.15	.06	-.31
5-10 years	.83	.91	.41	1.25	1.49	.48
10-15 years	-.18	-.09	-.02	.39	.39	.14
>15 years	-.03	.25	-.13	.49	.60	-.09
ID4ML						
0-5 years	.05	.00	-.01	.17	-.05	-.10
5-10 years	-.31	-.14	.02	.02	-.08	.14
10-15 years	.08	-.03	.02	.20	.14	-.15
>15 years	.13	-.14	.06	.23	-.28	.09

The procedures outlined by Power (2015a) were used to determine the net changes in participants' perceptions of self-efficacy with the use of mobile learning strategies accounting for the effects of maturation. Table 7 reports the net changes (intervention effect) for participants from both ID4ML and Power (2015) based upon years of teaching experience.

Table 7

Net Change (Intervention Effect) According to Years of Teaching Experience

Teaching Experience	Net Change $(mTSES_2 - mTSES_1) - (TSES_2 - TSES_1)$		
	Student Eng (mobile)	Instr. Strategies (mobile)	Classroom Mgt (mobile)
Power (2015a)			
0-5 years	-.14	.12	.20
5-10 years	.42	.58	.07
10-15 years	.57	.48	.16
>15 years	.52	.35	.04
ID4ML			
0-5 years	.11	-.05	-.09
5-10 years	.33	.05	.13
10-15 years	.12	.17	-.17
>15 years	.10	-.14	.03

Perceptions of self-efficacy with mobile learning strategies on the Student Engagement sub-domain showed a net decrease of -.14 points on the nine point scale for participants from Power (2015a). In contrast, participants with less than five years of teaching experience from ID4ML showed a net increase in their mean scores of .11 points for the Student Engagement sub-domain. However, the ID4ML participants with less than five years of teaching experience showed net score decreases for both remaining sub-domains. Participants from all other teaching experience groups from Power (2015a) showed net score increases across all three sub-domains, with those participants with between 10-15 years of experience showing the greatest overall increases. Only those participants from ID4ML with between 5-10 years of teaching experience showed net score increases for all three mTSES scale sub-domains.

Participant Status

Participants from Power (2015a) who identified themselves as graduate-level education students showed increases in mean scores for all three sub-domains on the mTSES scale. Student participants from Power (2015a) showed an increase in their mean score on the Student Engagement sub-domain of 1.19 points on the nine point scale. Those participants from Power (2015a) who identified themselves as teachers showed a small overall decrease in their mean score on the Classroom Management sub-domain for the mTSES scale. In contrast, ID4ML participants who identified themselves as either undergraduate or graduate-level education students showed more frequent decreases in their mean sub-domain scores on both the TSES and mTSES scales. ID4ML participants who identified themselves as K12 teachers, or as private-sector training professionals, also showed frequent decreases in their perceptions of self-efficacy. Those who identified themselves as post-secondary instructors from the ID4ML group showed increases in their mean scores for two of the three TSES scale sub-domains, and for all three mTSES scale sub-domains. Table 8 presents the mean changes by participant status in TSES and mTSES sub-domain scores for ID4ML participants, as well as those from Power (2015a).

Table 8

Changes in TSES and mTSES Scores by Participant Status

Status	TSES Domains			mTSES Domains		
	Student Eng.	Instr. Strategies	Classroom Mgt	Student Eng (mobile)	Instr. Strategies (mobile)	Classroom Mgt (mobile)
Power (2015a)						
Teacher	-.03	.26	-.13	.28	.56	-.01
Student	.68	.34	.25	1.19	.85	.35
ID4ML						
Undergraduate education student	-.40	.58	-.20	-.07	.04	-.17
Graduate education student	-.07	-.04	-.05	.06	-.31	-.10
K-12 teacher	.23	-.06	-.02	.31	-.18	.01

Post-secondary instructor	.02	-.05	.07	.24	.04	.01
Private sector training professional	-.07	-.15	-.01	-.22	-.41	.37
Other	.11	-.09	.04	.28	.05	-.13

Net changes accounting for the effects of maturation based upon participant status are presented in Table 9.

Table 9

Net Change (Intervention Effect) According to Participant Status

Status	Net Change $(mTSES_2 - mTSES_1) - (TSES_2 - TSES_1)$		
	Student Eng (mobile)	Instr. Strategies (mobile)	Classroom Mgt (mobile)
Power (2015a)			
Teacher	.31	.30	.12
Student	.51	.51	.10
ID4ML			
Undergraduate education student	.33	-.54	.03
Graduate education student	.12	-.28	-.05
K-12 teacher	.08	-.12	.03
Post-secondary instructor	.22	.08	-.07
Private sector training professional	-.15	-.25	.38

Other	.17	.14	-.17

Net score increases for perceptions of self-efficacy with mobile learning strategies were reported for all mTSES sub-domains for participants from Power (2015a). Five of the six participant status groups from ID4ML showed net score increases for the Student Engagement sub-domain. Only those participants who identified themselves as private sector training professionals showed a net decrease (-.15 points on the nine point scale) for the Student Engagement sub-domain. In contrast, private sector training professionals from ID4ML showed the greatest net score increases (.38 points) for the Classroom Management sub-domain. ID4ML participants who identified themselves as undergraduate education students and K12 teachers both showed net score increases of .03 points for the Classroom Management sub-domain. All other categories of ID4ML participants showed net score decreases for Classroom Management. For the Instructional Strategies sub-domain, only those ID4ML participants who identified themselves as post-secondary instructors, or as belonging to the "Other" category, showed net score increases. Undergraduate education students from the ID4ML group showed a net score decrease of -.54 points for the Instructional Strategies sub-domain.

Region

Participants from Power (2015a) were affiliated with four educational institutions. Three institutions were based in either Canada or the United States. The fourth institution was based in Qatar. However, the instructional faculty from the Qatari institution were comprised exclusively of Canadian educators employed on one to three year teaching contracts. Thus, all participants from Power (2015a) are categorized as belonging to the North America category in Table 10 (below). Participants from ID4ML were asked to self-identify their geographic region when completing the pre-course and post-course mTSES administrations. Table 10 reports changes in sub-domain scores for both the TSES and mTSES scales for participants from both ID4ML and Power (2015a).

Table 10

Changes in TSES and mTSES Scores by Region

Region	TSES Domains			mTSES Domains		
	Student Eng.	Instr. Strategies	Classroom Mgt	Student Eng (mobile)	Instr. Strategies (mobile)	Classroom Mgt (mobile)
Power (2015a)						
North America	.19	.31	.01	.57	.68	.11

ID4ML						
Africa - Middle East	.19	.21	-.04	.10	.03	-.08
Asia (Far East)	-.25	-.17	-.08	-.04	.19	-.02
Australia / New Zealand	.09	-.12	.00	.11	-.19	-.05
Europe	.15	-.13	.03	.31	-.15	-.04
North America	-.04	-.08	.05	.15	-.08	.02
South / Central America	.43	.08	-.08	.14	-.02	-.02

North American participants from both ID4ML and Power (2015a) showed the strongest increases in their reported perceptions of self-efficacy with mobile learning strategies. Mean scores for the Student Engagement sub-domain increased by .57 points on the nine point scale for North American participants from Power (2015a), and by .15 points for participants from the same region from ID4ML. For the North American groups, mean scores for the Instructional Strategies sub-domain on the mTSES scale increased by .68 points for participants from Power (2015a), but decreased by -.08 points for participants from ID4ML. North American participants from Power (2015a) showed an increase of .11 points on the Classroom Management sub-domain on the mTSES scale, compared to an increase of .02 points for North American participants from ID4ML. However, unlike their counterparts from Power (2015a), the North American participants from ID4ML showed marginal decreases (-.04 and -.08 points) for two of the three sub-domain scores on the TSES scale.

ID4ML participants from Africa and the Middle East showed the most frequent increases in their mean scores across the TSES and mTSES scales. On both scales, African and Middle Eastern participants showed increased mean scores for both the Student Engagement and Instructional Strategies sub-domains, and marginal decreases (-.04 and -.08 points) for their mean Classroom Management sub-domain scores. Participants from all other regions showed overall decreases in their mean scores for either three or four of the six combined TSES and mTSES subdomains.

The trend of decreases in ID4ML participants' mean sub-domain scores is also demonstrated after calculating for the net changes accounting for maturation during the course. Table 11 presents the net changes in participants' mTSES sub-domain scores from both ID4ML and Power (2015a).

Table 11

Net Change (Intervention Effect) According to Region

Region	Net Change $(mTSES_2 - mTSES_1) - (TSES_2 - TSES_1)$		
	Student Eng (mobile)	Instr. Strategies (mobile)	Classroom Mgt (mobile)
Power (2015a)			
North America	.38	.37	.10
ID4ML			
Africa - Middle East	-.08	-.18	-.04
Asia (Far East)	.21	.35	.06
Australia / New Zealand	.02	-.06	-.05
Europe	.15	-.03	-.07
North America	.19	.00	-.03
South / Central America	-.29	-.10	.06

North American participants from Power (2015a) showed net increases for all three mTSES sub-domains after accounting for the effects of maturation. ID4ML participants from four out of six regions showed net score decreases for the Instructional Strategies and Classroom Management sub-domains. ID4ML participants from the Africa – Middle East and South / Central America regions showed net score decreases on the Student Engagement sub-domain. Net sub-domain score increases that were observed for participants from ID4ML were also smaller than those observed amongst the participants from Power (2015a).

Gender

Differences in TSES and mTSES sub-domain scores were not reported by gender by Power (2015a). Table 12 reports the mean pre-course and post-course TSES and mTSES sub-domain scores for female and male participants from ID4ML, as well as the changes in participants' mean scores for each sub-domain.

Table 12

Changes in TSES and mTSES Scores in ID4ML by Gender

Gender	TSES Domains			mTSES Domains		
	Student Eng.	Instr. Strategies	Classroom Mgt	Student Eng (mobile)	Instr. Strategies (mobile)	Classroom Mgt (mobile)
Female						
1st Administration	6.38	6.91	6.61	6.48	6.80	6.68
2nd Administration	7.01	7.65	7.14	7.06	7.39	7.17
Change	.63	.74	.52	.58	.59	.49
Male						
1st Administration	6.42	6.81	6.58	6.39	6.81	6.53
2nd Administration	6.79	7.33	7.04	7.10	7.47	6.96
Change	.37	.52	.46	.71	.66	.42

Mean scores for both the TSES and mTSES scale sub-domains were fairly homogeneous between female and male participants, with variance in sub-domain scores ranging between .01 and .15 points on the nine point scale. However, there were differences between genders as to the scales for which each group showed greater increases. Female participants showed greater increases in their mean sub-domain scores for the TSES scale from the beginning of ID4ML to the end of the course. In contrast, male participants showed greater increases in their mean scores for the sub-domains on the mTSES scale. The procedures outlined by Power (2015a) were used to calculate the net increases in mean sub-domain scores for each gender accounting for the effects of maturation. Table 13 reports the net changes (intervention effect) in mTSES sub-domain scores by gender.

Table 13

Net Change (Intervention Effect) According to Gender

Domain	Net Change $(mTSES_2 - mTSES_1) - (TSES_2 - TSES_1)$
Female	
Efficacy in Student Engagement	-.05
Efficacy in Instructional Strategies	-.15
Efficacy in Classroom Management	-.03
Male	
Efficacy in Student Engagement	.34
Efficacy in Instructional Strategies	.14
Efficacy in Classroom Management	-.04

Calculations of the net changes (intervention effects) show that male participants from ID4ML displayed increases in their mean scores of .34 points on the nine point scale for the Student Engagement sub-domain, and .14 points for the Instructional Strategies sub-domain. Mean scores for the Classroom Management sub-domain decreased by similar margins for both female (-.03 points) and male (-.04 points) participants. Female participants also displayed marginal overall decreases in their mean scores for the Student Engagement and Instructional Strategies sub-domains.

Discussion

Verification of the construct validity and reliability of the mTSES instrument was the first objective set out by this study's research questions. The total scale and sub-domain reliability scores obtained from ID4ML participants' mTSES survey submissions were consistent across the TSES and mTSES scales for both the pre-course and post-course administrations. The reliability scores obtained were also consistent with those reported by Tschannen-Moran and Woolfolk Hoy (2001a), Benton-Borghi (2006), and Power (2015a). The consistencies of the reported reliability scores support confidence in the use of the mTSES instrument as a tool to measure perceptions of self-efficacy with mobile learning strategies, and in comparisons between participants' TSES and mTSES sub-domain scores. The mTSES instrument is useful for comparing teachers' perceptions of confidence with common teaching tasks to their perceptions of self-efficacy with mobile learning strategies.

The second research question relates to what the mTSES survey administrations reveal about the effects of the ID4ML MOOC upon participants' perceptions of self-efficacy. Many participants supplied enthusiastic endorsements of the perceived value of the course through social media and the MOOC's LMS platform. For example, once participant commented:

> Thank you for ID4ML! I'm not a teacher but as a web developer / lifelong learner I found the class exceptionally well done. I've been taking MOOCs… for several years now and this course ranks near the top for an engaging mix of media types and interactive projects (Canvas user, May 30, 2015).

This study wanted to determine if the enthusiasm expressed by some ID4ML participants corresponded with real changes in confidence in their abilities to adopt mobile learning in teaching practice. Participants' mean pre-course and post-course mTSES scores, and changes in their mean mTSES scores, were compared across the demographic categories of years of teaching experience, participant status, geographic region, and gender. The ID4ML mTSES results were also compared to those reported by Power (2015a). The analyses provide insights into the impact of the ID4ML MOOC. They also provide insights into the potential of the mTSES instrument as a needs assessment tool, and as a post-training assessment tool, when planning mobile learning themed professional development for specific target audiences.

The analysis of the net mTSES scale score changes revealed that participants in ID4ML did not show the same improvements in perceptions of self-efficacy with mobile learning strategies as participants from Power (2015a). However, analysis of participant demographics from each group point to possible reasons for these differences. Participants from Power (2015a) were almost exclusively practicing K12 or post-secondary teachers, or graduate-level education students. In contrast, just over half of the respondents to the pre-course mTSES from the ID4ML group were comprised of K12 or post-secondary teachers and teacher-training students. The remaining ID4ML respondents consisted of private-sector training professionals, participants who were not currently employed, and participants who identified themselves as "other." Similar ratios were seen amongst ID4ML respondents for the post-course mTSES. It is possible that participants who had previous training and experience with educational theory and practice were better prepared to benefit from the professional development experience. This possibility is supported by analysis of net mTSES sub-domain score changes based on participants' years of teaching experience. For both the ID4ML and Power (2015a) groups, participants with more years of teaching experience tended to show the greatest score increases for all three sub-domains.

Another potential contributor to the differences between the ID4ML and Power (2015a) groups observed net mTSES score changes is the structure and content of the training itself. Participants in the Power (2015a) MOOC were exposed to three weeks of training focused exclusively on making, implementing, and evaluating instructional design decisions for mobile learning. Participants in the four week ID4ML MOOC were exposed to a one week module that introduced the same instructional design framework (the CSAM learning design framework) as presented in Power (2015a). However, they were not required to use

the framework to either prepare a detailed instructional design plan, or to evaluate a mobile learning instructional design plan once a prototype had been implemented. The ID4ML MOOC placed a greater degree of emphasis on ranges of available applications for mobile learning, and hands-on experiences with the mechanics of using selected mobile applications. Perceptions of self-efficacy with mobile learning strategies amongst participants from Power (2015a) may have increased to a greater degree because their training focused more on pedagogical decision-making than did that of their counterparts in ID4ML.

The impact of the differences in focus of the ID4ML and Power (2015a) MOOCs is also evidenced in analyses of the net score changes for the three individual mTSES sub-domains. Whereas participants from Power (2015a) showed equal net score increases for both the Student Engagement and Instructional Strategies sub-domains, participants from the ID4ML group only showed a net score increase for the Student Engagement sub-domain. Net score changes for the Instructional Strategies and Classroom Management sub-domains showed decreased perceptions of self-efficacy amongst participants from ID4ML. These changes indicate that the exposure to various mobile learning applications in ID4ML increased participants' confidence in the ability of mobile learning tools and strategies to engage their students. However, the training did not leave participants with more confidence in their abilities to design mobile learning instruction, or to manage a classroom where mobile learning strategies were being used. Confidence in classroom management abilities for mobile learning was also lower than in the Student Engagement and Instructional Strategies sub-domains for participants from Power (2015a). This lower net sub-domain score points to a need for more emphasis specifically on classroom management skills for mobile learning in future professional development for teachers.

Geographic region does not appear to play as significant a role as other demographic factors in participants' perceptions of self-efficacy with mobile learning strategies for either the pre-course or post-course mTSES administrations, or in observed levels of net sub-domain score changes. North American participants from Power (2015a) showed greater net score changes than those observed for any regional group from ID4ML. Amongst ID4ML participants, mTSES respondents from the North American and Asia (Far East) regions showed net score increases for the most mTSES sub-domains. Net score decreases were observed on either two or three of the three mTSES sub-domains for ID4ML participants from all other regions. However, the majority of the ID4ML group's net sub-domain score changes (14 of 18 scores) varied within a range only .31 points on the nine point scale. The two most extreme net sub-domain score changes varied by a difference of .66 points.

Differences in mTSES score changes were not reported by gender for the Power (2015a) MOOC. However, female and male participants from ID4ML did perform differently on the TSES and mTSES scales. Female ID4ML participants showed greater increases over the duration of the training in their perceptions of self-efficacy on the TSES scale (common teaching related tasks) than did their male counterparts. In contrast, male ID4ML participants displayed greater increases in their sub-domain scores on the mTSES scale (perceptions of self-efficacy with the use of mobile learning strategies). Compared to their male counterparts, changes in female ID4ML participants' sub-domain scores were more consistent across both the TSES and mTSES scales. Female participants' sub-domain score changes across both the TSES and mTSES scales varied within a range of .25 points, whereas the TSES and mTSES sub-domain score

changes for male participants varied within a range of .34 points. When analyzed for the effects of maturation, only the male ID4ML participants showed any net sub-domain score increases. Net score increases were observed for two of the three mTSES sub-domains for male participants, compared to net score decreases on all three sub-domains for female participants.

Recommendations for Research and Practice

The ID4ML MOOC (Power et al., 2015) and the CSAM MOOC (Power, 2015a) had different instructional focuses, and different demographic compositions. Further research is recommended to compare trends in mTSES score changes between more similar professional development courses and demographic groups. It is also recommended that future research into the effects of mobile learning themed professional development include a mixed-methods approach, as outlined by Power (2015a). Quantitative data analyses from mTSES survey administrations should be augmented with qualitative analyses of open-response questionnaires and participant interviews in order to gain a broader understanding of how particular professional development programs affect perceptions of self-efficacy. Power (2015a) attempted to minimize the effects of cognitive load associated with device and application mastery, in order to focus on the effects of scaffolding pedagogical decision-making on teachers' perceptions of self-efficacy. Additional research would be beneficial to explore the degree to which lack of device and application mastery affects self-efficacy and subsequent adoption rates of mobile learning strategies. Additionally, follow-up surveys and interviews with participants in Power (2015a) inquired as to their interest in and intentions to adopt mobile learning strategies. Longitudinal research to explore actual adoption rates would be beneficial with target groups such as those from both the Power (2015a) and the ID4ML groups. An examination of differences in adoption rates compared to changes in specific mTSES subdomain scores would help to identify which subdomains of self-efficacy, if any, have the greatest impact on integration into teaching and learning practice.

How Can Professional Development Planners Use the mTSES to Improve Targeted PD?

Teachers are more likely to integrate new technologies and new instructional strategies if they feel confident in their abilities to do so (Tschannen-Moran & Woolfolk Hoy, 2001a). If the aim of a professional development program is to increase the adoption of mobile technologies and mobile learning strategies, then professional development planners must aim to increase participants' perceptions of self-efficacy. The mTSES instrument can be used by professional development planners to determine the extent to which a training intervention has impacted upon perceptions of self-efficacy with mobile learning. This information can point to potential training program revisions. It can also be used to help make decisions about follow-up support and additional training for participants. For instance, participants from ID4ML most consistently showed increases in their confidence in the use of mobile learning strategies to engage their students. But they demonstrated less confidence in their own abilities with mobile learning instructional design, and with classroom management. For participants demonstrating such trends as these, professional development planners could look to integrate more content and learning activities into ID4ML targeting these two sub-domains. Planners could also develop further training interventions targeting the Instructional Strategies and Classroom Management sub-domains.

Professional development planners need not wait until a training program has been developed and implemented to make use of the mTSES instrument. The mTSES could be administered with target participants during a needs assessment phase. The results from target participants' sub-domain scores could then be used to make decisions about preparedness for a training intervention, and areas of focus for the intervention. The mTSES tool could also be re-administered at the onset of the developed training program, and the end of the program, and as a longer-term post-training assessment of the impacts on perceptions of self-efficacy.

Conclusions

Education stakeholders are calling more frequently for the integration of mobile technologies and mobile learning strategies into instructional design in formal education systems. However, teachers' perceptions of confidence in their abilities to use mobile learning strategies has been cited as a barrier to larger scale adoption of mobile learning (Ally et al., 2013). At the same time, there has been a lack of research into self-efficacy with respect to mobile learning (Kenny et al., 2010). The Mobile Teacher's Sense of Efficacy Scale (mTSES) instrument was developed in an attempt to address the lack of mobile learning self-efficacy research (Power et al., 2014; Power, 2015a, 2015b). The mTSES instrument has been shown to have consistent reliability and construct validity compared to previous versions of the original TSES scale (Benton-Borghi, 2006; Tschannen-Moran & Woolfolk Hoy, 2001a, 2001b). The use of the mTSES showed changes in teachers' perceptions of self-efficacy with the use of mobile learning strategies amongst participants in the CSAM MOOC (Power, 2015a). However, the mTSES tool revealed that participants from the ID4ML MOOC showed increases only in their levels of confidence with their abilities to use mobile learning to improve student engagement. Analyses of changes in the mTSES sub-domain scores for ID4ML participants point to a need for more emphasis in future professional development training on instructional design decisions and strategies. The mTSES changes reported for both ID4ML and Power (2015a) also revealed that participants from both courses remain least confident with their classroom management skills for mobile learning. Use of the mTSES instrument pointed to potential improvements that professional development designers could make for the ID4ML and Power (2015a) MOOCs.

Future teacher professional development endeavors related to mobile learning must focus on increasing perceptions of self-efficacy. It is recommended that professional development planners utilize the mTSES instrument as a needs assessment tool to determine the preparedness of target participants for proposed training. The mTSES survey can also be used to gauge the success of training interventions at increasing teachers' confidence in their abilities to use mobile learning strategies. Effectively assessing teachers' training needs, and impacts upon their perceptions of self-efficacy, is a critical precursor to increasing the integration of mobile learning into teaching practice.

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Appendix A

Combined Teacher's Sense of Efficacy Scale (TSES) and Mobile Teacher's Sense of Efficacy Scale (mTSES) Survey[1]

Introduction

This questionnaire is designed to help gain a better understanding of your level of comfort with the kinds of tasks that you would need to do when integrating technology-based resources (such as mobile devices and mobile reusable learning objects) in school activities. Indicate your opinion about each of the statements below.

Teacher Beliefs	How much can you do?

[1] Power, R. (2015). *A framework for promoting teacher self-efficacy with mobile reusable learning objects* (Doctoral dissertation, Athabasca University), 220-224. Retrieved from http://hdl.handle.net/10791/63

		Nothing		Very Little		Some Influence		Quite a Bit		A Great Deal
1	How much can you do to get through to the most difficult students?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2	How much can you do to control disruptive behavior during collaborative learning activities?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
3	How much can you use alternative (technology-based) resources to motivate students who show low interest in school work?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
4	How much can you gauge student comprehension of content delivered using technology resources?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

5	How much can you use alternative (technology-based) resources to get through to the most difficult students?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
6	How well can you respond to difficult questions from your students?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
7	How much can you do to adjust your lessons to the proper level for individual students?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
8	To what extent can you craft good collaborative learning activities for your students?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
9	How well can you provide appropriate challenges for very capable students?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
10	How well can you respond to defiant	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

	students?									
11	How much can you do to calm a student who is disruptive?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
12	How much can you use alternative (technology-based) resources to help your students value learning?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
13	How much can you do to get students to follow classroom rules?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
14	How well can you implement alternative (technology-based) strategies in your classroom?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
15	How much can you use a variety of technology-based assessment strategies?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

16	How much can you use alternative (technology-based) resources to help your students think critically?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
17	To what extent can you make your expectations clear about student behavior?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
18	How much can you gauge student comprehension of what you have taught?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
19	How much can you do to foster student creativity?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
20	How much can you use a variety of assessment strategies?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
21	How well can you implement alternative strategies in your	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

	classroom?									
22	How much can you assist families in helping their children do well in school?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
23	How well can you establish a classroom management system with each group of students?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
24	How much can you do to improve the understanding of a student who is failing?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
25	How much can you do to help your students think critically?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
26	How much can you do to motivate students who show low interest in school work?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
27	How well can you establish routines to keep activities running	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

	smoothly?									
28	How much can you do to help your students value learning?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
29	How much can you use technology to foster student creativity?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
30	How much can you use alternative (technology-based) resources to improve the understanding of a student who is failing?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
31	How much can you use technology to adjust your lessons to the proper level for individual students?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
32	To what extent can you provide an alternative explanation or example when students are confused?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

33	How well can you keep a few problem students from ruining an entire lesson?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
34	How much can you do to get students to believe they can do well in school work?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
35	How much can you do to control disruptive behavior in the classroom?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
36	To what extent can you craft good questions for your students?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
37	How well can you keep a few problem students from ruining an entire collaborative learning activity?	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
38	How well can you use technology to provide appropriate challenges for	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

very capable students?

Directions for Scoring the combined Teacher's Sense of Efficacy Scale (TSES) and Mobile Teacher's Sense of Efficacy Scale (mTSES)

(adapted from Tschannen-Moran, & Woolfolk Hoy, 2001)

Factor Analysis.

It is important to conduct a factor analysis to determine how your participants respond to the questions. We have consistently found three moderately correlated factors: *Efficacy in Student Engagement, Efficacy in Instructional Practices*, and *Efficacy in Classroom Management*, but at times the make-up of the scales varies slightly.

Subscale Scores.

To determine the *Efficacy in Student Engagement, Efficacy in Instructional Practices*, *Efficacy in Classroom Management, Efficacy in Student Engagement with mLearning, Efficacy in Instructional Practices with mLearning,* and *Efficacy in Classroom Management with mLearning* subscale scores, we compute unweighted means of the items that load on each factor. Generally these groupings are:

TSES

Efficacy in Student Engagement: Items 1, 19, 22, 24, 25, 26, 28, 34

Efficacy in Instructional Strategies: Items 6, 7, 9, 18, 20, 21, 32, 36

Efficacy in Classroom Management: Items 10, 11, 13, 17, 23, 27, 33, 35

mTSES

Efficacy in Student Engagement with mLearning: Items 3, 5, 12, 16, 22, 29, 30, 34

Efficacy in Instructional Strategies with mLearning: Items 4, 6, 8, 14, 15, 21, 32, 38

Efficacy in Classroom Management with mLearning: Items 2, 10, 11, 13, 17, 23, 27, 37

Reliabilities.

In Tschannen-Moran, M., & Woolfolk Hoy, A. (2001). Teacher efficacy: Capturing and elusive construct. *Teaching and Teacher Education, 17,* 783-805, the following were found**:**

	Mean	SD	alpha
OSTSES	7.1	.94	.94
Engagement	7.3	1.1	.87
Instruction	7.3	1.1	.91
Management	6.7	1.1	.90

Appendix R6: Accessibility in Online Learning (Power, 2022)

CHAPTER 10

Accessibility in Online Learning

ROB POWER

INTRODUCTION

I have been designing and building online courses and digital learning resources for many years, and I am still learning new ways to make my resources as engaging and effective as possible for all of my students. An important area that I have been concentrating on in recent years is Digital Accessibility. I have learned that it can be fairly easy to maximize the accessibility of our courses by following a few simple guidelines.

WHY ACCESSIBILITY MATTERS

For me, accessibility issues started as a professional interest. While working as an instructional developer at the College of the North Atlantic-Qatar, I had the opportunity to learn about creating accessible documents through a professional development opportunity hosted by the *Mada Assistive Technology Centre* (Mada, 2017). While working with the Online Learning team at the Fraser Health Authority, I had the opportunity to explore accessibility issues in education more deeply by participating in the University of Southampton's Digital Accessibility: Enabling Participation in the Information Society course (Wald et al., n.d.). But, in recent years, my interest has become more personal because I have two children with very different accessibility needs. I have also worked with students who have had documented accessibility needs, and I suspect that there have been many others who had needs that they either had not disclosed or were not even aware of.

You will likely be working with students who have either documented, undisclosed, or perhaps undiagnosed needs that will be impacted by how you prepare and present your digital learning resources. As Doyle (2021) points out, "22% of Canadians over the age of 15 live with at least one disability that limits their everyday activities" (para. 1). According to Dyslexia Canada (n.d.), 15-20% of the population has a language-based learning disability, meaning that nearly one in five of your students will likely be impacted by basic readability accessibility accommodations when creating your digital learning resources. Many Canadian jurisdictions have already enacted legislation dictating Digital Accessibility standards for instructional design of courses and digitally-mediated communications with our students, their parents, colleagues, and the general public. In Canada, Ontario was the first province to explicitly codify Digital Accessibility standards through the Accessibility for Ontarians with Disabilities Act (AODA, 2005). Provinces such as Manitoba, Nova Scotia, and Quebec have similar existing laws, while others, such as British Columbia, have legislation in the proposal stages (Doyle, 2021). Most of the standards these provinces have put forth are based on the World Wide Web Consortium's Web Content Accessibility Guidelines (W3C, 2022).

It is unreasonable to expect that all teachers will be well-versed in all of the web-content authoring guidelines or the range of digital tools available to support their students' variety of accessibility needs. However, everyone needs to be aware of basic accessibility standards. In some jurisdictions, you may be required to meet these basic standards whether or not you are aware of a particular student who needs accommodations (Ontario Human Rights Commission, 2016). These efforts represent small changes in practice that benefit all of our students, not just those with diagnosed needs.

GUIDELINES FOR CREATING ACCESSIBLE LEARNING RESOURCES

The following guidelines are based on the WCAG 2.1 standards (W3C, n.d.). Without investing in specialized software or learning additional web-coding skills, these are steps anyone can take.

- **Properly format and tag headings and text**. Whether you are creating a word processor document, a PDF, a PowerPoint presentation, or a web page (including a page in a learning management system), avoid manually formatting the font, size, or colour of your text to create document headings (Pennsylvania State University, 2021). Use the formatting toolbar in your word processor or web editor to tag your headings as *Heading 1, Heading 2, Heading 3,* etc., and your main text as *Paragraph.* These tags will allow digital screen reader applications to navigate your document or web content using a keyboard or digital switch. Sticking to the default paragraph and heading tags will also enable your students to use their device's accessibility settings or browser plugins. An example is the Open Dyslexic font (abbiecod.es, 2021; OpenDyslexic.org, n.d.), which adjusts your digital reading materials to meet individual needs.
- **Add ALT-text and avoid embedding a lot of text within images**. If you include an image in your document or web page, be sure to add alternate (ALT) text to the image (Harvard University, 2022). You can usually do this by selecting the appropriate option when inserting the image or by right-clicking on the image. Your ALT-text should be a short (1-2 sentences, at most) description of the image. This text will be read aloud to students using a screen reader application, which is beneficial to visually impaired students. If the image is purely decorative, and your document or web editor provides the option, check the box to tag the image as *decorative* so that a screen reader will ignore it. Keep in mind that any text in the image itself is not machine-readable – so it is not accessible. Thus, avoid embedding important text within an image.
- **Be careful when using colour**. Colours do not always display how we intend them to on everyone's screen. Some of our students may also have visual impairments that make it challenging to read coloured text (Morton, 2016). With this in mind, you should avoid using coloured text to create emphasis, as that emphasis will not be apparent to some students. You should also be careful to maximize the contrast ratio (called colour-contrast ratio) between your text and the background. Some colour combinations may make it difficult to read the text. When in doubt, stick to black text on a white background. Many learning management systems will point out colour-contrast issues when using the built-in accessibility checker. You can also use a free *Color Contrast Analyzer* like the one shared by the Paciello Group (n.d.) to check your documents and web pages.
- **Check your reading order**. When you create a document, PowerPoint presentation, or web page, the intended reading order for your content may be apparent to *visual* readers. However, this may not be the case for anyone using a screen reader application (Colorado State University, 2022). Reading order is often impacted by the order in which you placed the items on the page when creating the document (especially when creating slideshow presentations). One trick to ensure the correct reading order is to keep things linear on the page or screen, as screen readers will read the content from top to bottom by default. Another strategy is to avoid using tables to present content unless you

offer statistical data as tables need to be correctly formatted with tagged header rows or columns, or they become confusing to a screen reader. Built-in Accessibility Checkers in word processors, PowerPoint, PDF editors, and web editors often can identify potential issues with the reading order of content.

- **Make sure videos have Closed Captions**. Many users may not be able to hear the narration in videos you choose or create to add to your course or web-based content. Many other users frequently decide to watch videos with the sound turned off. Make sure you select videos that have Closed Captions available. Use your video editor or YouTube's closed captioning tools (Google, 2022) to add captions to your videos.
- **Use an Accessibility Checker**. Most word processing such as Microsoft Word (Microsoft, 2022a), web editing applications, and learning management systems such as Canvas (Instructure, 2022) now include an Accessibility Checker tool. It is often as easy to use as the spell checker. While an Accessibility Checker may not detect compatibility issues with some students' advanced accessibility tools, it will pick up many common issues. Some examples include colour-contrast ratios for text, missing table headers, and missing ALT-text for images. The Accessibility Checker will often provide suggestions or simple click-through options to help you resolve any issues detected.

These general guidelines are summarized in Power's (2020) downloadable Digital Accessibility Cheat Sheet [PDF].

ACTIVITIES

ACTIVITY 1: TESTING WITH A SCREEN READER

Overview

Let's look at how accessible the readability is for some of your digital learning resources. We will examine any material that you want to share with your students electronically for this activity. It can be a word-processed document, a PowerPoint slide deck, or web-based reading content. We want to determine if your materials are optimized for accessibility or if there are any potential barriers that you can easily remove.

Description

You can try this activity as often as you like, with various digital learning resource types. We want to determine if your students can easily access the materials using the most common accessibility tools, such as screen readers and browser extensions.

Try out a basic screen reader. Once you have one of your digital learning resources available, try using a screen reader application to read the text to you. Most applications are compatible with built-in text-to-speech tools or your device's accessibility features. Let's start with some of these basic tools.

For a Microsoft Word or PowerPoint document, go to the *Review* tab and click on the *Read Aloud* icon.

For web-based content, such as a document in Google Classroom or a page in a learning management system, try installing and using a screen reading browser extension such as Google's (2021) Screen Reader.

- Try using the *play, rewind,* and *forward* options to navigate through your materials.

- Does the application read all of the text?
- Are there any text or images that are not read aloud? How might this impact your students' understanding of the materials?

Try out a full-featured screen reader. Now, let's try an application with more accessibility features some of your students may want to use, including document navigation tools. NVDA (NV Access, 2021) is a free, fully-functional screen reader application. Try downloading and installing NVDA, using it to navigate your digital learning materials.

- Try using the navigation tools to navigate between sections of your document.
- Does the application read all of the text?
- Are there any text or images that are not read aloud? How might this impact your students' understanding of the materials?
- Are there any major headings or sections that you cannot navigate easily? How might this impact your students' ability to read the materials? Can you fix navigation issues by adding proper heading tags in your materials?

Possible Challenges

The activities described here assume that you are using either a recent version of the Microsoft Office suite or the Chrome browser on a Windows computer. Older versions of Word or PowerPoint may not have the built-in Read Aloud feature. But, you can still try these activities using an add-on tool such as NVDA. Likewise, you may need to look for a screen reader plugin or extension for your preferred web browser.

Resources

- Google Chrome Screen Reader Extension (Google, 2021)
- Listen to Your Word Documents (Microsoft, 2022)
- NVDA Free Screen Reader (NV Access, 2021)

ACTIVITY 2: TESTING FONTS AND COLORS

Overview

Some of your students may use their device's accessibility features or web browser extensions to make digital reading materials more easily accessible for visual reading. It is good to test your materials to determine if things like font or colour choice might create unintended barriers to learning.

Description

For this activity, let's look at some materials you have posted online (such as a web page or content page in a learning management system). We will examine whether your students can manipulate the fonts of your text or if the colours of your text might impact accessibility.

Try manipulating the text size. Some of your students may use accessibility tools to make the text easier to read. One of the most common ways is to enlarge the text. If you are viewing your materials in a desktop web browser, try using the built-in zoom feature to enlarge the content. If you are viewing your materials on a touch screen device (such as a phone or tablet), try *pinching and zooming* on the page.

- Does your text get bigger when you zoom in on the screen?
- Does your text extend off the side of the screen, forcing students to scroll left to right to read everything?

If you encounter these issues, you may need to reformat your text, determine if the text is in a text box with a *hardcoded* width, or determine if the content is inserted as text or contained within an image.

Try changing the display font. Another commonly used tool for students with language-based learning disabilities is a browser extension or plugin such as the OpenDyslexic font (abbiecod.es, 2021; OpenDyslexic.org, n.d.). This tool changes the default text font on a web page to a font that is easier for some students to read. Try installing the OpenDyslexic plugin for the Chrome browser, and use it to view your online content.

- Does your content display with the updated font when you use the extension?

If your text does not display with the updated font, you may need to reformat your text to revert to the default paragraph text formatting.

Try checking your colours. Colour contrast can impact the accessibility of your learning materials for some students who are colorblind or who have other visual acuity issues (Morton, 2016). For this exercise, you can use either web-based content or a word-processed document, PDF, or PowerPoint slide deck that you want to share with your students digitally. Download the Paciello Group's (n.d.) free Color Contrast Analyzer tool. Use the colour pick to check the contrast of your text or image (foreground) against the page's background colour.

- Does your colour-contrast ratio pass WCAG 2.1 standards for AA or AAA accessibility?

If your colour combination does not pass accessibility standards, you may need to change your text or background colours. Remember, when in doubt, stick to black text on a white background for the highest possible contrast ratio (and accessibility).

Possible Challenges

The text font plugin activity described above draws upon a browser plugin for the Chrome browser. You may need to search for the OpenDyslexic font for your preferred web browser. Suppose you are testing the colour contrast ratio for your online content in a learning management system. In that case, you may not be able to alter the default font colours set by your system administrator.

Resources

- OpenDyslexic for Chrome (abbiecod.es, 2021)
- OpenDyslexic Font Resources (OpenDyslexic.org, n.d.)
- Color Contrast Analyzer (CCA) (The Paciello Group, n.d.)

GENERAL RESOURCES

- Accessible Digital Documents and Websites and Accessibility in E-Learning: The Council of Ontario Universities (2017a, b) provides many excellent resources to help you make your online teaching, and learning resources are accessible to all learners and AODA compliant.
- BCampus Open Education Accessibility Toolkit: BCampus (Coolidge et al., 2018) recently published an Open Access eBook on making digital learning resources, such as eBooks, compliant with digital accessibility guidelines.
- Google for Education Accessibility Resources: Want to learn more about maximizing Digital Accessibility in your Google Classroom or using Google Apps for Education? Google for Education (n.d.) provides a two-page PDF with overviews and links to their accessibility resources for teachers and students.
- Power Learning Solutions Digital Accessibility Resources: Are you looking for more tips, tricks, and resources to help you improve the Digital Accessibility compliance of your digital learning resources? You can find an ever-growing list of resources on my website, including recorded webinar presentations, tutorial videos, and links to tools (Power, 2022).
- Understanding WCAG Compliance Checkers and Their Shortfalls: Want to evaluate the Digital Accessibility compliance of your web-based learning resources, but there is no Accessibility Checker built into your platform? Essential Accessibility (2018) provides a good overview of how online accessibility checkers work, along with links to some free online accessibility checking tools, and a good must-have WCAG compliance checklist.

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Appendix R7: Creating Online Learning Modules (Power, 2022)

CHAPTER 16

Creating Online Learning Modules

ROB POWER

INTRODUCTION

When asked to write this chapter on creating learning modules, I admit that the idea seemed a bit overwhelming. After all, I teach graduate-level courses where we spend an entire term exploring the principles of the instructional design process, design, build, and test prototype online modules. We spend a great deal of time not just on the theoretical aspects of good instructional design but also on helping each other select appropriate learning activities and digital tools and mastering how to use those tools to construct a solid product. How do I encapsulate those elements into a concise chapter with practical tips for busy teachers? With the great variety of learning management systems such as Blackboard, Brightspace (D2L), Canvas (Instructure), Moodle, or Google Classroom: How do I keep things relevant when many of you use a range of different platforms to create and host your modules?

Then I realized many of the theoretical and technical issues we explore in my instructional design courses are already covered elsewhere in this eBook. There are chapters on everything from designing learning activities and assessments to using technology to provide meaningful feedback and selecting useful digital tools to meet all of your teaching and learning needs throughout an online module. So, I will focus this chapter on the process of designing, creating, and launching your learning module.

THE MODULE DEVELOPMENT PROCESS

The processes that I follow with my instructional design students are those that I use when developing learning modules for clients or my courses. Creating modules is independent of the platform used. It does not matter if you build a module inside a learning management system, create a module for your Google Classroom, or use an advanced eLearning content authoring system like Adobe Captivate or Articulate Storyline. There are two sets of guidelines to follow. The first will guide the module development "project" itself. The second will show what your learning module looks like and how your students interact with it.

GUIDELINES FOR THE MODULE DEVELOPMENT PROJECT

Most instructional designers follow a standardized sequence to design, develop, and launch a learning module. I like to follow the ADDIE model (Branson, 1978; Culatta, 2022; Kurt, 2018). ADDIE stands for:

- **Analyze** (determining what you need in your module),

- **Design** (creating a map of what the module will look like),
- **Develop** (building the module in whatever platform you choose),
- **Implement** (launching your module for your students), and
- **Evaluate** (looking at what works, what does not work, and how to make things better).

The traditional descriptions of the ADDIE model depict it as a linear or waterfall process, yet dynamic interplay between each aspect can be very effective and potentially more timely (Tripp & Bichelmeyer, 1990). Figure 1 outlines a modified interrelated interpretation of the linear model.

Figure 1. *ADDIE as a Cyclical Process*

The guidelines below outline some practical ways to use the ADDIE model to guide you towards creating your learning module.

- **Analyze your needs**. Determine what you need from your learning module before deciding what activities to include and what resources and tools to create it. You want to make sure that you cover the desired learning outcomes and target the right student audience. Create a list of these things to make sure you meet all your needs and do not try to do too much in one learning module. Think of this as doing a bit of pre-planning before starting a home repair or home renovation project. If you do not know what you need to tackle, you cannot determine what supplies you will need and what steps to follow.
- **Design your module before you start building it**. Plan your module in detail before you start building it. I cannot emphasize this step enough! Instructional designers create a blueprint, map, or storyboard before developing anything (Aura Interactive, 2022). This plan can be as simple as pen-and-paper sketches of what should be on each page or slide. Some designers use PowerPoint slides to create a non-functioning mock-up of what things will look like in the learning management system or on a web page. I prefer to use a table in a Word document or a spreadsheet, where each row represents one page of content and activities. Similarly, Google Docs and Sheets afford increased collaborative opportunities with active linking, which can save time as well. I also strongly recommend including as much detail as possible at this stage, including scripts of the text you will put on each page, the media you will embed, and links to any digital resources you will need. If you do not have these links or need a new media resource, list it here to keep track of these requirements. As you list your media and resource requirements, it is good to keep track of any copyright issues, subscriptions or accounts needed, and any potential student privacy considerations. This stage is often the

most time-consuming part of the process, but it is worth it. Mapping everything out before you start building will accomplish three things:

- It will make sure that you cover all your learning objectives and needs.
- It will prevent you from suffering from "scope creep," a phenomenon of constant growth occurring as you find new things you think would be nice to include (Adeboye, 2014). Often, it gets to the point where it becomes difficult for you to finish the project, and the module will likely have too much for your students to handle.
- It will make it much easier for you to build the learning module in whatever platform you choose because you can focus on how to build it in that platform rather than on what to include.

- **Develop your learning module**. With a plan in place, you can focus on the process of building your learning module in whatever platform you choose. At this stage, do not build anything that you have not included in your plan. Focus on putting everything together and on learning how to use the specific digital tools you have chosen (if needed). I find it helpful to do this methodically, focusing on one technical aspect at a time.
  - Create your skeleton structure, adding blank pages as placeholders for everything in your storyboard or blueprint.
  - Add the text to each page, focusing on getting the text on the page and formatting it consistently throughout the module.
  - Insert any images needed on the content pages or slides, focusing on adequately embedding, sizing, and adding ALT-text to each image. This is also a good stage to model curriculum standards and standardized referencing processes (e.g., APA citation, hyperlinking).
  - Insert any embedded media such as audio or video links to external resources.
  - Check each content page or slide for Digital Accessibility compliance and potential barriers for your students (refer to the chapter Accessibility in Online Learning in this eBook).

I also find it helpful to stop after I have built a small chunk of my learning module to evaluate what works, what does not work, and what needs to be redesigned or improved by rapid self-testing the content. Suppose you create a short learning module (something that students could complete in a few minutes or even an hour or so). In that case, it is okay to build everything before moving on to the Implementation and Evaluation stages. But, if you are working on something larger (like an entire unit or even a whole course), it is far better to stop and evaluate what needs tweaking before going too far. There will be far less for you to fix if you make changes to your general design now, rather than waiting until you build everything.

If you are developing your learning module before teaching a course, you may have the luxury of pretesting the module before your actual students interact with it. If not, that is okay. You can always view your first run with a learning module as a pilot test for future terms. If you can, ask a colleague or a group of "pilot" students to try out the module to give you some feedback.

- The **implementation** phase is the action phase of the learning process, where we share the content with the students. For our situation, this phase includes:
  - **Preparing the learning environment ensures** that what we have planned works as anticipated and changes as required. Examples include reflecting on content adaptiveness (e.g., does screen size impact the content), potential privacy issues (e.g., will students be required to set up an account), and low-fi backups if there are connectivity issues (e.g., having a PDF

of your video lectures).

- **Preparing the student** includes providing insights into what is anticipated and required. During this time, you will want to ensure that you have provided time to know how to use the tools, understand processes or workflows, or acquire other assets (such as headphones) that lead to their success.

- **Evaluate how things went**. Use your observations of how your students (or colleagues) interacted with your learning module. This evaluation can be done informally (chatting with users) or through a short feedback survey. I find it helpful to revisit my storyboard or blueprint and add these notes to have an updated map of the changes I need to make before using the learning module. I also find it helpful to categorize my potential changes as either "must do now," "nice to do now," "nice to do for next time," and "not possible to do." You can use a separate column for each category at the end of each row (content page) in your blueprint, or you can colour-code the notes for quick reference. Whatever your process is, make sure that you budget time for this stage as it is essential for future success.

GUIDELINES FOR THE STRUCTURE OF YOUR LEARNING MODULE

The previous guidelines help manage the learning module design and building phase. But, how should the module look? Regardless of the learning content, I find it helpful to follow some guidelines for the general structure of my learning modules, similar to the general design of a good lesson plan. I like to follow the BOPPPS model developed by the Instructional Skills Workshop program (Pattison & Day, 2006).

GENERAL GUIDELINES

- **Bridge into the learning.** Before you ask your students to engage with any learning resources or activities, you must capture their attention. Your learning module should begin with introducing the topic and piquing their interest. This introduction can be as simple as a brief overview, focusing on why the topic is relevant to them. Or it could be a video overview that you find online or record yourself. Potentially, you can engage students with provocative questions as well.
- **State the outcomes clearly.** Once you have your students' attention, you should list the outcomes for the module. What will students learn? What should they be able to do by the end of the learning module? Or, if you follow a constructivist approach, you can recruit student insights to support self-concepts and motivation to learn.
- **Pre-test your students' knowledge.** What do your students already know about the topic? What misconceptions do they have? By integrating an activity that checks students' knowledge, you can better determine if you need to provide additional resources or spend more time with them (perhaps in a live instructional session). In some cases, you may find that your students can already demonstrate mastery of the learning outcomes. When creating an online learning module, you can use this feedback to allow some students to skip ahead to another topic or provide them with advanced activities and resources to keep them engaged while other students focus on the primary activities. It is up to you to determine the best way to integrate a knowledge pre-test. I frequently use discussion forum postings to self-scoring and self-paced quizzes.
- **Participatory learning activities** are the primary learning resources and activities your students will engage with throughout the module. These activities can include background readings, multimedia resources, and individual or group tasks (e.g., discussions, peer-assessment, or group projects).

- **Post-test students' knowledge**. It is essential to determine if students have achieved the learning outcomes before moving on to another topic (or completing a course). You can draw upon many technology-mediated assessment activities, including some explored elsewhere in this eBook.
- **Summarize the learning**. Don't just leave things hanging. It is essential to provide students with a summary of what they have ideally learned at the end of your module. It is also helpful to provide your students with a quick overview of what is coming next with a simple email overview or a multimedia presentation such as a video.

ACTIVITIES

This book has many resources to help you choose digital tools for your module to share content, facilitate learning activities or learner interaction, or assess student learning. The emphasis of this chapter is on the planning or designing aspects of creating your learning module, as there are many tools available to help you translate your plans into a live module. The planning stage takes the most time, which is crucial in creating a meaningful and effective learning experience. Similarly, the evaluation stage is often overlooked when creating learning modules. But we should avoid skipping this stage as it provides valuable insight into whether the module we have designed is accomplishing what we had intended. The following activities focus on the Design and Evaluate stages in the ADDIE cycle.

ACTIVITY 1: PLANNING YOUR LEARNING MODULE

Overview

So, you are going to build an online learning module. Like an architect or a construction contractor, you will need a plan. Without a good plan, you will likely miss something important or exhaust your time building far more than you need to. Let's create a storyboard for your learning module.

Description

For this activity, choose a lesson or a unit for which you would like to create an online learning module for your students. The following steps will help you create a storyboard that can detail the page (or slide) details and resources required to bring it to life.

- **Choose a template**. Storyboarding or blueprinting can seem overwhelming, especially if you have not done it before. How do you decide what goes on each page or slide when you don't even know what pages or slides you need yet? It is helpful to use a ready-made template that will help you keep track of these things, make sure that you don't miss anything, and help you to avoid scope creep. I have provided links to a couple of templates below that I have created for designing modules (or even whole courses) using the Canvas and Moodle learning management systems.
- **Modify the template as needed**. The templates that I am providing here are optimized for Canvas and Moodle. But they follow the same general structure and can be quickly modified to meet the specific requirements of whatever platform you will be using. It is good to make a few customizations to the template before populating it. For instance, you may want to do something as simple as adding a "notes" column on each page, or you may need to add a column to list settings requirements for each page in your chosen platform.
- **Populate the template in stages**. I find it helpful to start with the basics, such as listing the module

(or chapter) titles, the page titles, and the types of content pages that I need to add to my learning module. Then, I go back and add the text script for each of these pages, including placeholders in the script where I think that I will need to embed links or media. Then, go back and list all the resources and media you will need for each page.

- **Align your template to your outcomes**. Review your completed storyboard. Ensure that every content page, learning activity, and assessment is connected to at least one of your learning outcomes. If it is not, reconsider whether you need content or activity. Ensure that all your required outcomes are covered at least once somewhere in your storyboard. If outcomes are not covered, you may need to add some content or activity before building your design. The process of creating a Table of Specifications [PDF] may also be beneficial, which helps us reflect on the validity of our efforts (Fives & DiDonato-Barnes, 2013).
- **Keep track of student time requirements**. You may have covered all of your learning outcomes and created a plan to keep you on track when the time comes to build your module. But have you designed too little or too much for your students to handle? Review your storyboard to estimate how much time it might take the average student to engage with the planned content and activities. I find it helpful to add at least 10 to 20 percent extra time to my estimate and use that to help me determine if I need to add more to my module or start paring things down.
- **Keep track of resource requirements**. The templates I have provided include a column listing your resource needs throughout your module. But listing these resources is not enough. Using these resources may present challenges, which you should keep track of to avoid running into problems when it comes time to build what you have planned. I find it helpful to keep a master list of all of my resource requirements, including the (I have included a link below to a template that I developed to help keep track of these requirements):
    - costs;
    - copyright requirements;
    - permissions that I may need from either my IT team or the school district; and
    - potential privacy issues that might impact my students.

Possible Challenges

One challenge you may face is that your chosen storyboard or blueprint template may not reflect all the requirements to consider for the platform in which you will end up creating your learning module. It can be difficult to determine such shortcomings at the planning stage, especially if you do not have extensive experience using your authoring platform. you should understand that weaknesses are perfectly okay. Complete all of the sections of your storyboarding template. You can always revisit the template to add a new column as you discover platform-specific considerations. The benefit is that you will not be overwhelmed with figuring out what your module should look like and what it should include as you are learning the technical nuances of the platform that will host your module.

Resources

- Education – Microsoft Templates
- Google Slides: Online Slideshow Maker
- Storyboarding Template for Canvas [Spreadsheet]

- Storyboarding Template for Moodle [Spreadsheet]
- ETICPC – The Educational Technology Integration Copyright and Privacy Considerations Template (MS Word) (MS Word) (PDF)

ACTIVITY 2: EVALUATING YOUR LEARNING MODULE

Overview

Depending on your context, you may or may not have the luxury of being able to pilot test your learning module before using it in one of your courses. Students and colleagues can provide insights that can be critical assets in the development process. Colleagues can provide insight into how well your module meets course requirements. Those with instructional design or technology experience can also provide insight into the technical aspects of implementing your module design. Your students can give critical insights into what works for them and what you can add, modify, or remove to make your learning module as effective as possible.

DESCRIPTION

We will assume that you have created an online learning module based on a storyboard that you have already developed for this activity. Once you have built at least part of your module, we will get some "expert" feedback before using the module with your students. By "expert," we mean input from the perspective of a colleague who is either a fellow subject-matter expert or one who has experience designing and building learning modules. You can use this feedback to help tweak your module before launching it. Once you have a polished version of your module ready for your students, we will ask them for feedback. You can use this feedback to help tweak things before using the module with different students.

- **Get some *expert* feedback**. Ask one or more colleagues to review your learning module. Ask them to provide feedback on the content, the learning activities, and the overall functionality of the module. It is helpful to use a targeted feedback form or rubric. Suppose your school or organization is a member of the Quality Matters (2021a) consortium. In that case, you may be able to avail of the QM Rubric (Quality Matters, 2021b) or submit your learning module for review by a QM-trained peer review expert. For our purposes, I have included a link below to a targeted feedback form based on Northcote and Seddon's (2011) MOOBRIC self-evaluation tool. I frequently use this form with participants in my instructional design courses to provide peer feedback to develop their own prototype modules.
    - Provide your colleague with access to your learning module.
    - Provide them with a copy of a rubric or feedback form to record their observations.
    - Add notes from the feedback you receive to your storyboard or blueprint document. These notes will make finding where you need to make the necessary changes easier.
    - Implement any of the changes that may be needed.
- **Get student feedback**. If your context permits, ask some students to pilot test your learning module before using it in your actual course. Consider your first run with your learning module like a pilot test for future terms or school years if this is not possible. Once your students have completed the module, get their feedback. You can do this through informal observations. However, it is valuable to collect formal feedback at this stage using a targeted student feedback form. I have provided a link below to a student feedback form based on Northcote and Seddon's (2011) MOOBRIC self-evalua-

tion tool and a standardized student feedback form based on the Community of Inquiry framework (Athabasca University, 2014). I frequently use this form with participants in my instructional design courses to facilitate structured feedback for prototype modules.

- Provide your students with access to your learning module.
- Provide them with a copy of a rubric or feedback form to record their observations.
- Add notes from the feedback you receive to your storyboard or blueprint document. These notes will make finding where you need to make changes easier.
- Implement any of the changes that may be needed.

Possible Challenges

The biggest challenge that you are likely to encounter is the time to conduct evaluations of your learning module. You may be pressed for time to complete your module and implement it in your course. Your colleagues and students may not have adequate time to provide structured feedback. However, the return on time investment on your part to collect this feedback is worth it. This feedback is critical to knowing whether your module has succeeded in meeting your needs and determining what, if any, improvements may be needed.

Resources

- Online Teaching Course Setup Peer Review Form (MS Word)
- Online Teaching Course Setup Peer Review Form (PDF Version)
- Online Teaching Module Delivery Peer Review Form (MS Word)
- Online Teaching Module Delivery Peer Review Form (PDF Version)

ADDITIONAL RESOURCES

- Are you looking to build your online learning modules of courses using either your organization's Canvas learning management system or the Canvas Free for Teachers [Login page] (Instructure, n.d.) platform? Creating Your Courses in Canvas includes insights such as:
  - basic Canvas configuration settings to manage users creating content pages;
  - organizing your activities;
  - embedding interactive content; and
  - creating branching or differentiated learning pathways.
- Do you want to use Google Classroom to turn your storyboard into an interactive learning module? This Google Classroom User Guide [PDF] contains everything you need to learn how to set up your own Google Classroom space (if your organization does not provide one) and create your content and learning activities.
- Do you want to learn more about organizing your digital learning resources in your modules, including tracking potential copyright and privacy issues? Check out The free ETICPC template from Power Learning Solutions to learn more about the open-access Educational Technology Integration Copyright and Privacy Considerations Template (ETICPC) template.

- The Power Learning Solutions ID Resources site is a curated collection of instructional design templates I have used when developing online learning modules and as resources for my instructional design students.
- eLearning course developers need to plan in detail before creating any media or building a course inside an LMS. In the Using Storyboards to Develop eLearning Courses [10:30] video, I demonstrate a storyboarding process to:
    - Create a blueprint
    - Complete with a page-level script (before even logging into the LMS to build a course)
    - How the map translates into reality
- In A Simple Guide to Creating an eLearning Storyboard, Aura Interactive (2021) summarizes a storyboard and how to get started creating one for your learning module or course.
- Learn more about the Quality Matters (2021a) consortium, including how you or your organization can become a member. This organization has provided training and resources related to quality assurance in instructional design for online learning modules since 2002.

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