THE INTERNATIONAL
REVIEW OF RESEARCH IN
OPEN AND DISTANCE LEARNING

Vol 22
No 3

August 2021

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 22, Number 3

August – 2021

Editorial - Volume 22 Issue 3

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Editor-in-Chief, Athabasca University

In a time of increased wariness caused by a pandemic, global warming, and international conflicts, it is a relief to read papers that focus on the effectiveness of educational technology innovations in online learning that feature collaboration among researchers and countries and the linkage of ideas and processes. Our first three articles do just that, specifically attending to issues around OER and open courses. Teacher presence is the focus of the next two articles, while the sustainability of learning technologies and the preferences of learners are discussed in the last two research articles. In addition, we have notes addressing business models and instructional design issues, followed by literature reviews on learning in museums, training mathematics teachers, and synchronous learning.

The first article by **Rodrigues, Schneider, Sokolovic, Brunsek Oré, Perlman,** and **Jenkins** refers to "open source courses" rather than the more accepted term "OER." Their research showed that the courses were effective in improving student achievement, with high student satisfaction. They discuss the implications for research and practice.

Kim, Bindoff, Farrow, McInerney, Borchard, and **Doherty** investigated the learning achievement of students in an English-language MOOC on dementia using the Dementia Knowledge Assessment Scale. To no one's surprise, the native English speakers scored significantly higher than the non-native English speakers. However, there was no significant difference in the course completion rates of the two groups.

Self-Determination Theory was used by **Werth** and **Williams** to determine the motivation of students taught using open pedagogy. They suggest that agency has an impact on motivation and make recommendations on autonomous forms of motivation. No data is provided on learning achievement.

A Community of Inquiry framework was used by **Flock, Maeda,** and **Richardson** to study teaching presence. Their investigation showed significant differences among individual teachers in their teaching presence scores, with one exception. They make suggestions for future research in this area.

Instructor presence is also the focus of **Glazier** and **Harris**'s paper, along with student satisfaction. They surveyed over 12,000 U.S. university students engaged in both online and traditional modes of learning. The survey results showed that students felt clear instructions and instructor availability were important. The authors recommended more training in course design for faculty. No data on student achievement was provided.

Using a Kaplan-Meier survival analysis, **Espino, Artal,** and **Betancor** investigate the useful life span and cost-effectiveness of video lectures. Their results suggest that video longevity is affected by production style and dynamic videos are associated with longer life spans. They recommend Screencast and make other practical suggestions.

Vasquez-Cano and **Diez-Arcón** investigated the level of satisfaction among university students using Facebook groups. Their survey results showed higher levels of satisfaction along with more interactions compared with students who only used the learning management system. Students using Facebook groups felt that they could better focus on learning and achieving better results; however, no data on test and examination results are provided.

The Notes section includes **Cisel** and **Pontalier's** analysis addressing the motivations and strategies of instructors and **Kartal's** book review on inclusive course design by Gunawardena, Frechette, and Layne.

The Literature Review section lists three papers covering distance/online education in museums by **Ennes** and **Lee**; **Nongni's** challenges for training mathematics teachers; and a meta-analysis on the effects of synchronous learning by **Martin, Sun, Turk,** and **Ritzhaupt.**

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Development and Evaluation of an Open-Source, Online Training for the Measurement of Adult-Child Responsivity at Home and in Early Childhood Education and Care Settings

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Abstract

Efforts to monitor and improve responsive caregiving for young children, because of its importance for child development, are part of the United Nations Sustainable Development Goals. Two brief observational measures of responsive caregiving have been developed and validated (Responsive Interactions for Learning—parent [RIFL-P] and educator [RIFL-Ed] versions), with the RIFL-P available in English, Portuguese, and Spanish. The aim of the current study was to present and evaluate two online training programs for the RIFL measures. These distance learning courses were designed as open-source and asynchronous to enable their use in low- and middle-income countries and remote areas. The following course components are used: readings, lectures, observation of interactions on video, coding practice with automated feedback on item coding, and quizzes. Of the 76 trainees who registered for one of the online courses, 58 (76%) completed all theoretical module components. Student performance was generally high. Marks on quizzes ranged between 83%–100%. Ninety percent of those who took the reliability tests passed (40/44). Student satisfaction during and after the course was high. The effective online training programs are available free of charge and the RIFL suite of measures is efficient to implement. Implications for research and practice are discussed.

Keywords: responsive caregiving, parental sensitivity, online learning, observational measurement, low- and middle-income countries

Introduction

Responsive caregiving, defined as sensitivity and stimulation, is one of the cornerstones of nurturing care and a prerequisite for achieving positive developmental outcomes for young children (Black et al., 2017; Britto et al., 2017; Jeong et al., 2021). This specific type of caregiving has reached global attention with directed efforts on behalf of international agencies and governments to implement programs to increase this aspect of caregiving (Santos et al., 2020; World Health Organization [WHO], United Nations Children's Fund [UNICEF], & World Bank Group, 2018). Responsive caregiving has been found to be important in home and educational contexts (Madigan et al., 2019; Vermeer et al., 2016). Despite international acceptance of the importance of responsive caregiver-child interactions, there is a clear need to refine and standardize measurements for this aspect of caregiving (Jeong et al., 2018, 2021). Proxy indicators (e.g., parental mental health, childcare availability, frequency of proxy activities with children; UNICEF & Countdown to 2030, 2020; Pierce, 2021) were initially used to assess the construct, but our group has developed efficient (8 minutes) and psychometrically strong instruments that can be used at the population level in home and educational contexts (Pauker et al., 2018; Prime et al., 2015; Schneider et al., 2021; Sokolovic et al., 2021a, 2021b).

In the current study, based on our measures, we examined whether we could develop asynchronous, online courses based on video recording examples of responsive interactions to teach professionals (with diverse cultural and linguistic backgrounds) how to reliably code responsive interactions. Evidence from the teachers' education field shows that video examples can be an effective way to teach and improve students' coding reliability and content accuracy (Prusak et al., 2010). This study represents a novel contribution to researchers, policymakers, and program leaders in charge of implementing the Nurturing Care Framework (WHO, UNICEF, & World Bank Group, 2018) in national and global spheres, because it presents and evaluates open-source training for a reliable and valid measure of responsive parenting.

This is particularly relevant for low- and middle-income countries (LMICs) where most of the world's children live. This aspect of caregiving is modifiable; however, there is an urgent need for efficient, psychometrically sound measurement of caregiving outcomes (including responsivity) that could be used at the population level across cultures (Jeong et al., 2018). Responsive interactions can only be reliably and validly measured through individual-level assessments that use observational methods (Lotzin et al., 2015). Most coding schemes typically require extensive training, and are complex, time-consuming, and expensive to administer and code (Bailey et al., 2017). This limits their usefulness for population-based studies.

An observational assessment of interaction quality—the Responsive Interactions for Learning (RIFL) measure (previously called Cognitive Sensitivity)—was originally developed using a Canadian sample of parents (Prime et al., 2015) and early childhood educators (Pauker, et al., 2018; Sokolovic et al., 2021b) interacting with young children. Since its development, the RIFL measures have been successfully adapted and tested in LMICs, including Brazil (Schneider et al., 2021) and Peru. This psychometrically sound measure assesses a person's ability to understand and respond appropriately (incorporating sensitivity and stimulation) to the thoughts and feelings of the person with whom they are interacting. This measure uses thin-slice methodology (popularized by Gladwell, 2005), which involves taking a highly complex psychological phenomenon that has been extensively researched, and operationalizing it in a rating that is brief and intuitive. Thin-slice ratings have been found to possess similar psychometric properties to much longer, labor-intensive coding schemes (Matias et al., 2014; Pederson et al., 1990; Prime et al., 2014a, 2015).

Description of the RIFL Measures

The RIFL is a unidimensional observational tool that assesses three interconnected caregiving skills, namely clear communication, mind reading, and mutuality building. Clear communication refers to communicating in a way that the interactional partner(s) can understand. It is operationalized as providing verbal and nonverbal directions that are meaningful to the activity, as well as promoting a mutual understanding about the goals and rules of the task. Mind reading denotes understanding partners' thoughts and feelings. It is operationalized through items related to an awareness of what the partner knows or understands, rephrasing to achieve understanding, and responsiveness to subtle requests for help. Finally, mutuality building captures the back-and-forth quality of interactions and includes the caregiver's ability to provide positively-valenced feedback and fostering turn-taking within the interaction. The version used to assess interactions between early childhood educators (ECEs) and multiple children includes additional items that capture an educator's ability to meet the needs of multiple children simultaneously.

For the parent (RIFL-P) and sibling (RIFL-S) versions of the measure, two people (e.g., a parent and a child ranging from 18 months to school age or two siblings) are asked to work together for 5 minutes to build a block structure, copying a design they are shown. The complexity of the design varies to ensure it is adequately challenging for different developmental levels. For 18-month-old children, a shape and color sorter is used. For children from 2.6 years of age and older, a Lego model is built, with each person only allowed to touch 2 colors. For the educator (RIFL-Ed) version, the educator is asked to lead either a structured or naturalistic activity with a group of children.

In both cases, interactions are video-recorded and trained coders later observe the 5-minute video. Coders view the video only once and then rate each of the 11 (parent, sibling versions) or 15 items (educator version) on a scale ranging from 1 (*not at all true*) to 5 (*very true*). A mean of the 11 or 15 items is calculated, yielding a composite score of responsive interactions that can range from 1 (*very low responsivity*) to 5 (*very high responsivity*). Most notably, viewing the 5-minute video and reliably carrying out the coding results in a psychometrically sound assessment of responsivity achieved in 8 (parents, siblings) or 10 minutes (RIFL-Ed). Other observational measures of responsivity, both in parents (e.g., PICCOLO; Roggman et al., 2013) and educators (e.g., CLASS; La Paro et al., 2009), take over an hour (Matias et al., 2014; Pederson et al., 1990).

The RIFL-P and RIFL-S have strong psychometric properties across languages. Specifically, in Canadian samples, scores on the RIFL-P have been found to correlate with other parental sensitivity measures, to be inversely associated with contextual risk, and to relate to child outcomes including receptive vocabulary, executive functioning, theory of mind, and academic achievement (Prime et al., 2014a, 2014b, 2015; Sokolovic et al., 2021a). The Brazilian-Portuguese version of the RIFL-P demonstrates high reliability (internal consistency $\alpha = .94$; inter- and intra-rater *r*'s between .83 and .94) and validity (correlations with the PICCOLO parenting measure *r*'s between .32 and .47; correlations with children's cognition, language, and behavior *r*'s between .17 and .29; Schneider et al., 2021). The Spanish version also shows good reliability (internal consistency $\alpha = .97$; inter-rater $r = .87$) and validity (correlations with parenting measures of autonomy support [Whipple et al., 2011] $r = .70$, and parental control $r = -.47$). The RIFL-Ed has also shown good reliability and validity (Pauker et al., 2018; Sokolovic et al., 2021b); notably, scores are associated with popular, validated measures of classroom quality such as the CLASS. No studies linking RIFL-Ed scores to child outcomes have been completed to date.

Open-Source, Online Training of RIFL Coding

Our research team developed multiple password-protected, open-source online courses to train new coders on the different RIFL measures, with the goal of providing a tool that could expand our ability to assess responsivity efficiently at a population level, especially in LMICs. Training for the RIFL-P is currently available in English, Portuguese, and Spanish, and training for the RIFL-Ed is available in English.

The course was designed based on findings from pedagogical research over the last half decade. Hattie (2008) meta-analytically synthesized the instructional methods from over 50,000 empirical studies to identify the most effective methods for student learning. These included learning goals that are explicit, narrow, and well-articulated; success criteria for students; multiple teaching strategies that triangulate the learning goal; and provision of feedback. Quality feedback relies on teachers being continuously aware of their students' learning status and providing directed and brief feedback (González et al., 2017; Molin et al., 2020). These findings are based on face-to-face delivery models, although those from online delivery suggest similar processes of design (Davis et al., 2018).

Systematic reviews and meta-analyses have demonstrated the advantages and disadvantages of online learning (Davis et al., 2018; Hrastinski, 2008; Means et al., 2009; Watts, 2016). The issues relate to maintaining student engagement, prevention of dropout, the provision of interactive elements to the learning, and the type of content to be learned. An early meta-analysis (Means et al., 2009) found that students who took all or part of their class online performed better, on average, than those taking the same course through traditional face-to-face instruction. The effect was strongest when the online learners were able to engage with course materials for longer periods of time. Findings with respect to synchronous versus asynchronous are similar. Asynchronous learners show more directed engagement with course content and deeper reflection of course issues. Synchronous learners experience less isolation, and receive more problem solving which may help them to persist with content (Hrastinski, 2008; Watts, 2016); however, it comes at the expense of achieving the narrow learning goal. Of course, the major advantages of asynchronous, online delivery include timing flexibility, geographical scope, and equalization of learning opportunities (Barteit et al., 2020; Chang et al., 2014).

The present asynchronous, online course was designed as a cost-effective, convenient way to provide training on responsive interactions, with the flexibility needed for uptake in a range of countries and time zones, in both urban and rural settings. It includes pre-recorded lectures, video clips of adult-child interactions, observational exercises with automated feedback, and reading materials. Videos in the English course are from North American samples, while videos in the Portuguese and Spanish versions of the course display Brazilian and Peruvian parents, respectively. Students are given explicit descriptions for each item on the scale, as well as criteria for how to score them along the entire range of the scale. A reliability test is given after the course has been completed, with the option of additional reliability testing if the coder does not pass the first round. There is also a module for rater drift that allows coders to recalibrate their coding every 10 videos.

In line with Hattie (2008), learning goals are explicit, narrow, and well-articulated; students are aware of and receive immediate feedback about whether they have been successful in achieving the learning goal. Multimedia presentation is used to encourage learning through modalities of text, verbal presentation, and observation, following face-to-face and online empirical evidence of learning (Davis et al., 2018; Hattie, 2008). In the current study, primary and secondary outcomes were articulated for the different versions of the course. The primary outcome was the achievement of reliability, which captures the accuracy with which trainees are able to identify the quality of caregiving observed in different videos. This provides a strong measure of the learning outcomes intended for the course. The secondary outcome was related to trainee engagement with the materials and satisfaction with the courses. This data was collected from end-of-course surveys given to trainees.

Materials and Methods

Course Descriptions

Both the RIFL-P and RIFL-Ed courses are based on coders observing many video clips of caregiver-child interactions. The RIFL-P shows interactions between one parent and one child, while the RIFL-Ed shows one educator interacting with multiple children. Videos of parent-child interactions were obtained in Canada and the U.S.A. (English versions), Brazil (Portuguese version), and Peru (Spanish version). Children's parents and educators consented to their interactions being available on a password protected site for educational purposes. The course completion times range from 6–8 hours for the RIFL-P course (Modules 1–4, one coding practice assignment, one reliability test) and 8–10 hours for the RIFL-Ed course (Modules 1–4, two coding practice assignments, two reliability tests). Learning goals and course components are outlined in Table 1. They involved lectures, observations of interactions on video, coding practice with automated feedback on item coding, and quizzes. Short video clips of caregiver-child interactions were presented with annotations highlighting the presence/absence of specific behaviors related to responsive caregiving. Practice coding assignments included automated feedback. That is, when the trainee rated an item, a pop-up window provided them with feedback on the accuracy of their coding as well as the expert coder's rationale for the item, which was determined by two or three independent coders. Two reliability tests are offered after course completion, and the agreement between the expert coder and the student coder is examined through Pearson Correlation (automatically done within the online platform). If the first test is passed at $r = .8$ or higher (Stemler, 2004), the student is deemed reliable and receives a certificate of completion. If the participant is not successful on the first reliability test, they are required to review parts of the course, engage in an additional coding practice, and take a second reliability test. The two reliability tests reproduce the previous and successful structure of the face-to-face RIFL training.

Table 1

Outline of Course Components

Component	Learning goal(s)	Instructional methods	Duration
Introductory Module	Understand the key behaviors that constitute responsive caregiving	• Didactic lecture • Read a short story	20 min
Module 1	Understand why responsive caregiving is important for children's development	• Didactic lecture • Quiz • Brief written reflection	40 min
Module 2	Code items from the first half of the scale	• Didactic lecture • Videos of poor/strong examples for each item • Quiz	50 min
Module 3	Code items from the second half of the scale	• Didactic lecture • Videos of poor/strong examples for each item • Quiz	30 min
Module 4	Understand key coding tips and the process of reliability testing	• Didactic lecture • Read "Best Practices for Coding"	20 min
Coding Practice #1	Develop coding competencies	• Code 5 videos • Write explanations for each item score • Automated feedback	60 min
Reliability Test #1	Demonstrate agreement with expert coder	• Code 10 videos (no feedback)	90 min
If Pearson $r \geq 0.8$ on reliability test #1, pass and course completed. If $r < 0.8$, continue to next module.			
Coding Practice #2	Refine coding competencies	• Code 5 videos • Write explanations for each item score • Automated feedback	60 min
Reliability Test #2	Demonstrate agreement with expert coder	• Code 10 videos (no feedback)	90 min
If Pearson $r \geq 0.8$, pass and course completed. If $r < 0.8$, complete Practice and Test #3 (RIFL-Ed only).			

Monitoring Drift	Maintain reliability over time	• Code one video for every 10 completed on own project.	N/A
If total score is within 0.5 points of the expert score, reliability is maintained. If not, instructed to review Module 2 & 3 and Coding Practice #1.			

Procedure

The commencement date for the training courses for the RIFL-P in English, Portuguese, and Spanish were as follows: October 2018, June 2019, and June 2020. Although the course is now available in Spanish, no evaluations were carried out on the Spanish version of the course (because of the pandemic). The training course for the educator measure (RIFL-Ed) began in January 2020.

Evaluations were carried out during and after the courses. During the courses, at the end of each module, students provided feedback by answering four questions (rated on a 5-point scale) regarding their satisfaction with the module (overall satisfaction, usefulness of content, clarity, and mode of delivery). As the correlation between items within the modules was high (mean r = .6), we created a mean composite. Assessing satisfaction at the end of each module led to the inclusion of everyone who had taken the module (see Figure 1), allowing for high representativeness of these ratings.

A post-course anonymous survey was designed to assess participants' satisfaction with different course components, ask participants to contrast their experience with other face-to-face coding trainings in which they may have previously participated, determine whether they had used the measure after completing the training, and obtain feedback for improvement. Closed-ended questions were used to assess satisfaction (on a 5-point scale, from 1 = *strongly disagree* to 5 = *strongly agree*), as well as previous experiences and use of the measure (yes/no questions). Open-ended questions were used to understand challenges and recommendations for improvement with the course experience; we used inductive coding to aggregate these comments. The survey took less than 10 minutes to complete. Participants received a $20 (in Canadian dollars) gift card as compensation for their time. All procedures were approved by the University of Toronto Research Ethics Board.

Sample

Requests for use of the RIFL-P and RIFL-Ed measures led to the development of the online courses. Trainees included research assistants (undergraduate and graduate students in psychology and education), academic principal investigators, and professionals working in hospital and government settings. Trainees have been from a range of countries: Canada, the United States, United Kingdom, Israel, China, Peru, and Brazil.

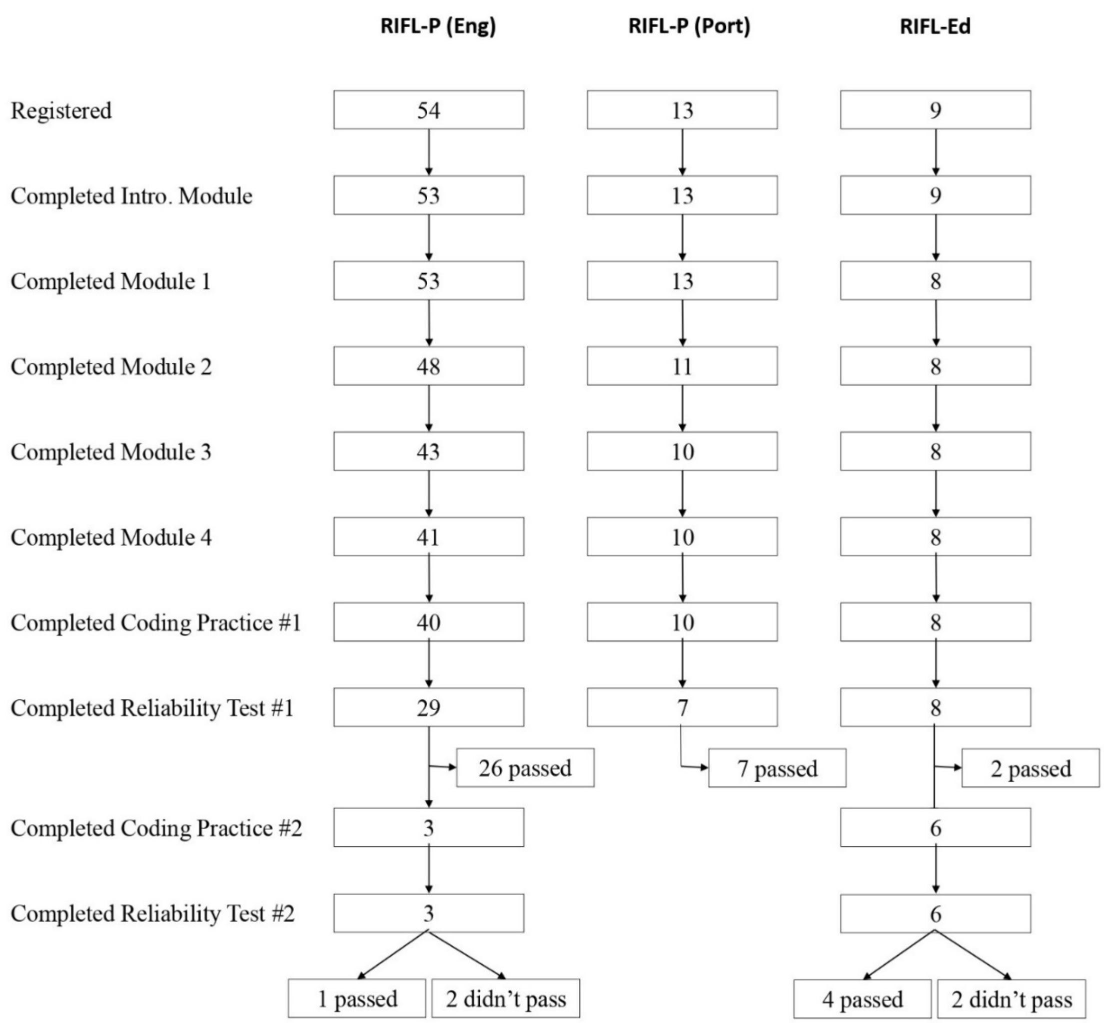
Results

Course Completion

The sign-up and completion rates for the three courses are presented in Figure 1. Access to the course was given to all professionals who expressed interest. While some requested it because they wanted to use the RIFL instrument in their research or professional practice (and thus achieve reliability), others were simply curious about online reliability training, learning about observational coding, etc. Unfortunately, we did not track these different motivations, but it is possible to see a substantial dropout (18/76 = 24%) from initial log-on to Coding Practice #1 completion.

Figure 1

Completion and Pass Rates



Note. RIFL-P (Eng.); RIFL-P (Port.); and RIFL-Ed = Responsive Interactions For Learning, English Version for Parents; Portuguese Version for Parents; and English Version for Educators.

Primary Outcome: Student Performance

Performance on module quizzes was high, with accuracy ranging from 83% to 100% (see Table 2). These quizzes involved simple, factual, multiple-choice or true-false questions about the material that was covered in the preceding online lecture. The high accuracy indicates that participants were actively paying attention to and understanding the material presented in the online lectures.

Table 2

Module Quiz Performance: Accuracy Rates

Quiz	RIFL-P (Eng.) % accurate	RIFL-P (Port.) % accurate	RIFL-Ed % accurate
Quiz 1	96	95	99
Quiz 2	96	83	98
Quiz 3	95	100	96

Note. RIFL-P (Eng.); RIFL-P (Port.); and RIFL-Ed = Responsive Interactions For Learning, English Version for Parents; Portuguese Version for Parents; and English Version for Educators.

The English version of RIFL-P course (*N* = 29) had a 93% pass rate (27/29), while the Portuguese version (*N* = 7) had a 100% pass rate. All but two participants across both RIFL-P courses (34/36) passed the reliability tests. The RIFL-Ed course (*N* = 8) had a 75% pass rate. Of those who passed, one third did so on the first reliability test and two thirds on the second reliability test.

Secondary Outcome: During Course Satisfaction

Satisfaction for all modules for the parent course was high and ranged between 4.6 to 4.94 out of 5, with little difference in ratings across modules. Satisfaction for the educator course was also high, and ranged between 4.38 to 4.79 out of 5. See Table 3 for satisfaction rates for all modules across the various courses.

Table 3

During Course Satisfaction Ratings

Module	RIFL-P (Eng.)	RIFL-P (Port.)	RIFL-Ed
Intro. Module	4.60 (0.72)	4.62 (0.74)	4.60 (0.53)
Module 1	4.83 (0.44)	4.94 (0.24)	4.67 (0.51)
Module 2	4.77 (0.66)	4.61 (0.69)	4.46 (0.79)
Module 3	4.89 (0.32)	4.80 (0.41)	4.38 (0.70)
Module 4	4.89 (0.37)	4.60 (0.67)	4.79 (0.41)

Note. Values are reported as mean (*SD*) on a 5-point Likert scale. Intro. Module = Introductory Module; RIFL-P (Eng.); RIFL-P (Port.); and RIFL-Ed = Responsive Interactions For Learning, English Version for Parents; Portuguese Version for Parents; and English Version for Educators.

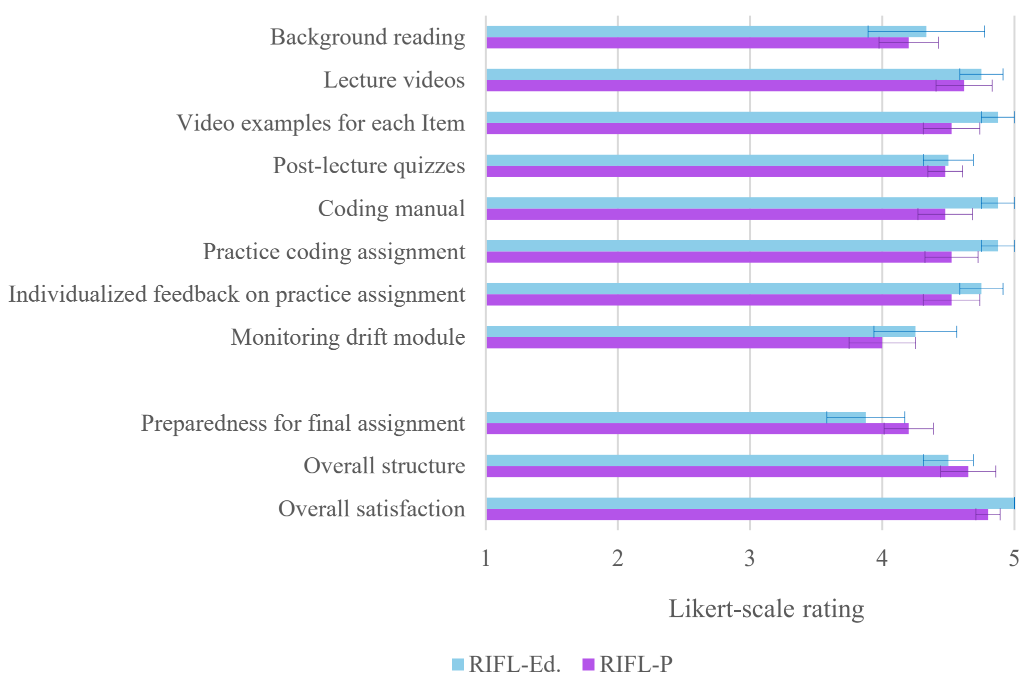
Values are the mean across four questions: overall satisfaction, usefulness of content, clarity of presentation, and mode of delivery. The consistent satisfaction across all modules suggest that all the course content was equally valuable to participants and there was not repetition or fatigue over time.

Satisfaction Post Course

Twenty-one participants (of 29; 72% response rate) completed the survey about the RIFL-P and eight participants (100% response rate) completed the survey about the RIFL-Ed. Results can be seen in Figure 2. A single anonymous link was sent to all RIFL-P course participants and we were unable to disaggregate those who completed the English vs. Portuguese versions of the course. Overall, post-course satisfaction was high (4.80 for the RIFL-P, 5.00 for the RIFL-Ed, on five-point scales). Participants seemed to especially value the lecture videos (4.62 and 4.75 for the RIFL-P and RIFL-Ed, respectively), video examples for each item (4.52, 4.88), coding manual (4.48, 4.88), coding practice (4.52, 4.88), and automated individualized feedback (4.52, 4.75). The background reading (4.20, 4.33) and monitoring drift modules (4.00, 4.25) were rated as less helpful, on average, and individuals did not feel fully prepared for the first reliability trial (4.20, 3.88). The majority of participants in both courses thought all course components were necessary and would not recommend removing or shortening any section.

Figure 2

Survey Results: Overall Retrospective Satisfaction



Note: Error bars show standard errors.

Eight participants who completed the RIFL-P course had also previously been trained in a different coding measure that required them to achieve interrater reliability. More than half of participants said they were able to grasp the theoretical construct and learn to code more quickly in this course compared to their other course, while most others said it was about the same in both courses. One participant said it was easier to learn when training was delivered face-to-face. For the RIFL-Ed, only two participants had previous interrater reliability training experience—one said they learned faster in the RIFL-Ed course, while the other said the ease and rate of learning was similar in both courses.

Eleven participants who completed the RIFL-P course used the measure to code dyadic interactions in their own research projects, which required coding of between 20 and 4,000 videos. Two participants who completed the RIFL-Ed began using the measure in the short time between completing the course and completing the satisfaction survey.

Themes from the open-ended comments were as follows: requests for more videos that illustrate the midpoint of the scales (RIFL-P), more practice videos before the reliability test (RIFL-P & RIFL-Ed), shortened introductory lectures (RIFL-P & RIFL-Ed), and an expert explaining their coding of all items in a 5-minute video (RIFL-Ed). Other challenges that were noted were the inability to ask questions to obtain clarification (RIFL-Ed) and the need for increased age and ethnicity variation in taped examples (RIFL-P).

Discussion

Although research has consistently shown the importance of responsive caregiving for children's cognitive and socioemotional development (Britto et al., 2017; Jeong et al., 2021; Scherer et al., 2019), there remains a gap in ways to assess this aspect of caregiving at the population level. Having psychometrically strong, quick to train in and administer, and widely accessible measures of responsive caregiving is essential for monitoring, evaluating, and improving programs and policies designed to improve child outcomes. The aim of the current study was to evaluate whether it is possible to train students, researchers, and practitioners to reliably assess responsivity in parent-child and educator-child interactions (using the RIFL measures) in an asynchronous online course.

The high pass rates for the RIFL-P (English and Portuguese versions) course reveal that people can effectively learn how to reliably code responsivity in parent-child interactions using an online training model. Indeed, it is notable that most participants passed the reliability test on their first attempt, learning how to code responsivity in less than 10 hours. Pass rates for the RIFL-Ed course were also high, but in contrast to the RIFL-P course, the majority of participants required two reliability tests before being deemed reliable. These results were not surprising given the increased complexity of learning how to code interactions in which one educator is displaying different behaviors towards multiple children with varying cognitive and socioemotional skills, compared to dyadic interactions between one parent and one child.

The high pass rates across the RIFL-P and RIFL-Ed may in part be attributable to our choice to design the online platforms based on findings from the literature on effective teaching via face-to-face and online delivery models (Davis et al., 2018; Hattie, 2008). For instance, learning goals for each course component were explicit and narrow, multiple teaching strategies were incorporated into each module, video clips with annotations illustrated the learning goals, and practice coding assignments provided immediate feedback on the learning goals. Importantly, for all courses, an effort was made for the courses to be culturally appropriate and diverse with videos obtained from Brazil, Peru, Canada, and U.S.A., and from different socioeconomic strata. Capturing illustrative parental and educator behavior across countries and social strata was our most significant challenge, and we continue to refine content as new videos become available.

In addition to the high success rates, participants reported being very satisfied with their overall training experience. Across both courses, participants were satisfied with the multimedia design of the course and found the various aspects such as lectures, videos, and feedback helpful to their learning. Participants provided meaningful feedback during the course surveys, such as displaying interactions that include children in the middle childhood period, illustrating the mid-points of the scale, and providing an additional set of optional videos to review prior to completing the reliability tests. These suggestions are currently being incorporated into the existing courses as we expand our library of available videos.

Given the effectiveness and feasibility of the current courses, we can conclude that online asynchronous training may be the cheapest, most equitable and efficient approach to global reliability training for observational assessments. Achieving reliability on an observational instrument appears to be an apt fit for asynchronous, online teaching, particularly when the course content is focused and detailed (Chang et al., 2014; Hrastinski, 2008; Watts, 2016).

For both the English and Portuguese versions of the RIFL-P course, the average completion time ranged from 6 to 8 hours. While participants took longer, on average, to complete the RIFL-Ed course (8 to 10 hours), these results were not surprising given the additional coding practice and reliability test required for participants to pass the course. In person trainings can often be quite lengthy, with many responsivity measures requiring multiple days of training (e.g., PICCOLO, CLASS), resulting in large labor costs associated with compensating both trainers and trainees. Furthermore, in-person reliability trainings require trainers and coders to be in the same place, often resulting in large travel costs. The online courses presented in this paper reduce these costs and barriers by providing a quick and effective manner to train coders remotely, giving coders flexibility to do so in their own time, and with the only expense being compensation for the trainee's time.

The RIFL-P and RIFL-Ed measures are psychometrically robust, quick to train in, and easy to administer, which allows them to be used at a population level. Indeed, with free, online training available in multiple languages, researchers and practitioners worldwide can learn to use and apply these measures. For instance, responsivity can be assessed and used as a marker to identify families with children at risk for developmental difficulties, for targeted prevention or intervention efforts. The RIFL measures can also provide an efficient manner to monitor, improve, and evaluate programs designed to increase responsive caregiving. Indeed, the RIFL-P is currently being used to evaluate a national home-visiting program and in large, longitudinal cohort studies in Brazil (Hallal et al., 2018). Finally, having parallel measures that capture the same construct across different caregivers in young children's lives is another advantage of the RIFL measures.

Completion rates for courses have been found to be lower in asynchronous online training than in face-to-face environments (Khalil & Ebner, 2014; Paton et al., 2018). It is notable that only 76% (58/76) of the trainees who signed up for the RIFL training courses completed the coding practice #1, and only 58% (44/76) went on to the reliability test. While this is likely to be, in part, a reflection of trainee motivations to take the course, it also likely reflects the challenge of keeping students engaged during asynchronous learning (Davis et al., 2018). From students' satisfaction ratings both during and post completion of the course, as well as their grades on quizzes, it is clear that the course design suited student learning needs; however, there was still significant dropout. Given that this is a ubiquitous finding in online learning, remedial suggestions such as building the interactive element with synchronous or asynchronous discussion boards and adding an element of competition as in a gaming framework (Burgos et al., 2018; Davis et al., 2018) may also help improve completion rates in the RIFL. Future research should evaluate such social components to reliability training on a measure to reduce dropout.

Several limitations of this study should be noted. First, the sample size was small, particularly for the RIFL-Ed (recently live) and therefore, it is important to continue to monitor completion rates as well as participant satisfaction. This information will guide continuous improvement of the online courses. Second, the post-course survey results were not representative of the population that began the course, and because the survey was anonymous, data cannot be linked with the course results and satisfaction rates. Finally, the predictive validity of the RIFL-Ed measure, which was developed more recently, has yet to be tested.

Conclusion

The RIFL measures and online training are particularly timely due to the unprecedented global attention on the topic of responsive caregiving, as well as the current trend of exploring technology-based platforms for massive online training. The RIFL measures, because of their efficiency, advance the assessment of caregiver responsivity, while the development of an open-source, online training builds capacity in LMICs and remote settings. Helping children to survive and thrive relies on our ability to efficiently train a workforce to measure (and eventually improve) responsive caregiving.

Acknowledgments

We are grateful to the families (in Brazil, Canada, Peru, and the United States of America) and educators (in Canada) who gave their time so generously and consented to have their filmed interactions used for educational purposes. We extend our gratitude to the partner institutions of the video library (in Canada, the George Brown College, Children's Services, City of Toronto; in Brazil, the Postgraduate Program in Epidemiology at the Federal University of Pelotas; in Peru: the Grupo de Análisis para el Desarrollo-GRADE, and Fundación Baltazar y Nicolas; and in the United States of America, the Tufts University). We thank Daniela Rodrigues for her technical assistance and the Education Commons team at the Ontario Institute for Studies in Education/University of Toronto. We also extend our gratitude to the Bernard van Leer Foundation (grant agreement LAT-2017-098) and the Social Sciences and Humanities Research Council of Canada (grant number 890-2015-2031) for supporting this project.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 22, Number 3

August – 2021

Is the *Understanding Dementia Massive Open Online Course* Accessible and Effective for Everyone? Native Versus Non-Native English Speakers

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Abstract

Most massive open online courses (MOOCs) are offered in English, including those offered by non-English speaking universities. The study investigated an identified English language dementia MOOC's accessibility and effectiveness in improving the dementia knowledge of non-native English speaker participants. A total of 6,389 enrolees (age range 18–82 years; 88.4% female) from 67 countries was included in analyses. Dementia knowledge was measured by the Dementia Knowledge Assessment Scale (DKAS) before and after the MOOC completion. Rates of completion were also compared. Native English speakers (n = 5,320) were older, more likely to be female, less likely to be employed, and had lower educational attainment than non-native English speakers (n = 1025). Native English speakers were also more likely to care for or have cared for a family member or friend living with dementia than were non-native English speakers. Native English speakers had a significantly higher DKAS score both pre- (M = 33.0, SD = 9.3) and post-MOOC (M = 44.2, SD = 5.5) than did non-native English speakers (M = 31.7, SD = 9.1; and M = 40.7, SD = 7.7 for pre- and post-MOOC, respectively). Non-native English speakers with low pre-MOOC dementia knowledge scores gained significantly less dementia knowledge following course completion than did native English speakers (p <.001, adjusted for age and education). There was no significant difference between the two groups in their likelihood of completing the MOOC. Our findings suggest that non-native English speakers are motivated and able to complete the MOOC at similar rates to native English speakers, but the MOOC is a more effective educational intervention for native English speakers with low dementia knowledge.

Keywords: massive open online course, dementia, effectiveness, accessible, non-English speakers, MOOC

Introduction

Globally, approximately 50 million people have dementia, with this number expected to almost triple by 2050 (Alzheimer's Disease International, 2019). Many more people's lives are affected by the condition physically, psychologically, and economically, as dementia not only affects those people living with dementia but their family members, friends, and the professionals working with them as well.

However, in most countries there is a lack of awareness and understanding of dementia, resulting in negative attitudes or stigmatisation of people living with dementia, and barriers to diagnosis and care (World Health Organization, 2015). Some studies have shown that the general public demonstrates a reasonably good level of awareness and knowledge about dementia (McParland et al., 2012) or common dementia symptoms (Cahill et al., 2015; Loi & Lautenschlager, 2015). However, the public has expressed uncertainty about less known or early symptoms, treatments, risk factors, and care (Breining et al., 2014; Ludecke et al., 2016; McParland et al., 2012; Roberts et al., 2014; Robinson et al., 2014). There is thus a need to educate people about wider aspects of dementia to improve outcomes for prevention, diagnosis, and care.

Dementia can be experienced and constructed in diverse ways (Faure-Delage et al., 2012). For instance, some cultures consider dementia as a normal part of ageing, while others perceive dementia as a mental illness, or linked to supernatural or spiritual beliefs (Batsch & Mittelman, 2012). Ethnic or cultural differences have also been found in dementia knowledge and perspectives. Ethnic minority groups in predominantly white/Caucasian English speaking countries are reported to both lack knowledge about dementia (Ayalon, 2013; Ayalon & Arean, 2004; Connell et al., 2007; Low et al., 2010), and hold more negative attitudes or stigma toward people living with dementia (Lee et al., 2010; Low et al., 2010). This is especially so for those less acculturated and/or who do not speak English. An Australian national survey found that those who spoke a language other than English had a lower level of knowledge regarding dementia risk reduction behaviours than did English speaking respondents (Smith et al., 2014). One-third of Australians have come from culturally and linguistically diverse backgrounds (Australian Institute of Health and Welfare, 2016); this is of particular interest in that country. Even so, other more global factors such as the projected rate of increase in dementia being greatest in regions such as Africa and Asia (Prince et al., 2015) serve as additional imperatives to explore ways to meet the dementia information needs of those from non-English speaking backgrounds.

Massive open online courses (MOOCs) are a scalable and accessible mode of education as they can offer world-class teaching and educational resources beyond geographical and social boundaries (Hone & El Said, 2016). Anyone can access MOOCs, in many cases free of cost, provided they have Internet access, along with sufficient computer and language proficiency (Liyanagunawardena & Williams, 2014). The potential benefits may be equalising for those people in developing countries, where attending classes at top universities face-to-face is often not possible. MOOCs have the potential to democratise education and transform the higher educational landscape (Rambe & Moeti, 2017).

Most MOOCs are offered in English (Liyanagunawardena & Williams, 2014), even those offered by non-English speaking universities (Altbach, 2014). MOOCs on dementia are no exception. There are a total of 19 dementia-related MOOCs in English and one in Spanish (Class Central, 2020). This situation may exclude many potential learners who do not speak either language (Altbach, 2014). MOOCs have been criticised both for their low completion rates and being mainly for so-called privileged people from the world's most affluent countries who already have access to digital technologies, international language learning opportunities, and information about MOOCs (Kizilcec et al., 2017; Liyanagunawardena et al., 2013). Furthermore, as the optimal language for learning is believed to be the learner's native tongue (United Nations Education, Scientific and Cultural Organization [UNESCO], 2008), the effectiveness of MOOCs may vary depending on the language in which the course is offered. However, little is known about the likelihood of non-native English speakers completing such courses and the accessibility of these courses. We know little about whether people with different language backgrounds are able to perceive, understand, navigate, and interact with a MOOC (Web Accessibility Initiative, 2019). The current study therefore investigated how accessible and effective an identified dementia MOOC was for non-native English speakers (i.e., English is not their first language) compared to native English speakers for whom English is their first language.

Materials and Methods

Participants and Procedures

In 2017, 29,025 people from around the world enrolled in the *Understanding Dementia* MOOC (UDMOOC). The UDMOOC, developed in 2013 by the Wicking Dementia Research and Education Centre at the University of Tasmania, is a highly ranked (Class Central, 2019) nine-week online course that provides content about dementia pathology, symptoms, risk factors, medical management, progression, and care across three modules (King et al., 2014). For this study, 15,783 enrolees consented for their data to be used for research purposes. Consenting enrolees were excluded from all analyses if they did not complete both the sign-up survey and Dementia Knowledge Assessment Scale (DKAS) questionnaire before completing the first UDMOOC module, leaving a sample of 6,389 participants from 67 countries.

The course was offered to anyone who wished to enrol. Participants received reminder and notification e-mails about new modules being released and the closing date for the course as it progressed. Participation in this research was voluntary. This project received ethical approval from the University of Tasmania's Human Research Ethics Committee.

Data Collection

This study collected four main sets of data. Sociodemographic information was collected, including (a) age; (b) gender; (c) country of residence; (d) employment status (i.e., currently working vs. currently not working); (e) education level (i.e., high school and below, pre-tertiary, undergraduate university degree, postgraduate degree, and other); and (f) English language background (i.e., native vs. non-native). Participants' relationships with people living with dementia were also examined. Data was collected about whether they (a) were a person living with dementia themselves, (b) had a family member living with dementia, (c) had a friend living with dementia, (d) had ever provided care for someone living with dementia, and (e) had ever worked professionally with people living with dementia.

Dementia knowledge was measured using the DKAS (Annear et al., 2017), a 25-item English-language validated scale with five response options per item: *false*, *probably false*, *probably true*, *true*, and *don't know*. The DKAS comprises statements about dementia that are both factually correct (e.g., Alzheimer's disease is the most common form of dementia) and incorrect (e.g., dementia is a normal part of the ageing process). Participants received two points for a correct *true* or *false* response, one point for a correct *probably true* or *probably false* response, and zero points for an incorrect or *don't know* response. Total scores ranged from 0 to 50. Completion of the course was recorded by obtaining a score of 70% or higher on end-of-module quizzes for all three MOOC modules.

Analysis

Demographic characteristics for native and non-native English speakers were compared with independent samples *t* tests for continuous variables and chi-square tests for categorical variables. Logistic regression was used to examine the association of demographic characteristics and baseline dementia knowledge with the completion of the course. A penalised regression spline was fitted for age, as the association between age and expected probability of completion was not linear. Linear multiple regression was used to examine the association between post-UDMOOC DKAS scores and demographic variables, adjusted for baseline DKAS scores. A penalised regression spline was fitted for age, as again the association between age and post-UDMOOC DKAS scores was not linear. Interaction models were fitted to assess differential rates of completion and post-UDMOOC dementia knowledge gain among non-native and native English speakers at different levels of educational attainment and baseline DKAS scores. Analyses were conducted in R version 3.6 and in STATA version 15.

Results

Table 1 shows descriptive characteristics for native English speakers (n = 5320), and non-native English speakers (n = 1025). Native English speakers were older, more likely to be female, less likely to be employed, and had lower educational attainment than did non-native English speakers. Native English speakers were also more likely to care for or have cared for a family member or friend living with dementia (26%) than were non-native English speakers (21%). In addition, most non-native English speakers reported living in either Australia (61%) or another English-speaking country (28%).

Table 1

Sample Characteristics of the UDMOOC Enrolees: Comparing Native and Non-Native English Speakers

	Number (percent)			Statistics; *p* value
Characteristic	Total (N = 6,389)	Native English speaker (n = 5,320)	Non-Native English speaker (n = 1,025)	
Age group				$\chi(3) = 435.69$; $p < 0.001$
30 years and younger	1,650 (25.8)	1,122 (21.1)	514 (50.1)	
31 to 40 years	1,796 (28.1)	1,495 (28.1)	285 (27.8)	
41 to 50 years	1,941 (30.4)	1,787 (33.6)	144 (14.0)	
Older than 50 years	1,002 (15.7)	918 (17.2)	82 (8.0)	
Gender				$\chi(1) = 47.55$; $p < 0.001$
Male	733 (11.6)	549 (10.4)	183 (17.9)	
Female	5,606 (88.4)	4,742 (89.6)	838 (82.1)	
Country of residence				$\chi(2) = 422.38$; $p < 0.001$
Non-English-speaking country	153 (2.4)	37 (0.7)	115 (11.2)	
Australia	4,622 (72.3)	3,966 (74.5)	625 (61.0)	
Other English-speaking country	1,614 (25.3)	1,317 (24.8)	285 (27.8)	
Employed	5,021 (79.0)	4,161 (78.5)	838 (82.1)	$\chi(1) = 6.80$; $p < 0.01$
Education				$\chi(4) = 188.29$; $p < 0.001$
High school and below	710 (11.4)	664 (12.8)	43 (4.3)	
Pre-Tertiary	2,491 (39.9)	2,173 (41.8)	294 (29.2)	
Bachelor's degree	1,516 (24.3)	1,129 (21.7)	379 (37.6)	
Postgraduate	1,438 (23.0)	1,151 (22.1)	280 (27.8)	
Other	94 (1.5)	82 (1.6)	11 (1.1)	
Person with dementia	29 (0.5)	28 (0.5)	1 (0.1)	$\chi(3) = 11.41$; $p < 0.05$
Family with dementia	3,446 (54.7)	3,038 (57.9)	382 (37.8)	$\chi(1) = 137.79$; $p < 0.001$
Friend with dementia	3,309 (52.4)	2,835 (53.9)	450 (44.3)	$\chi(1) = 30.99$; $p < 0.001$
Provided care	1,612 (25.4)	1,383 (26.2)	216 (21.3)	$\chi(1) = 10.95$; $p < 0.005$
Work with people with dementia	4,366 (68.9)	3,630 (68.8)	711 (69.6)	$\chi(1) = 0.30$; $p = .586$
Pre-DKAS score (*M*, *SD*)	32.78 (9.29)	33.01 (9.33)	31.65 (9.07)	$t(6,343) = -4.28$; $p < 0.001$
Post-DKAS score (*M*, *SD*)	43.62 (6.02)	44.18 (5.47)	40.70 (7.71)	$t(1,948) = -9.59$; $p < 0.001$

Note. Regarding discrepancy in total number compared to number of native versus non-native English speakers, 44 participants did not respond as to whether or not English was their first language.

Completion Rate

There was no significant difference between the two language groups in terms of their likelihood of completing the UDMOOC, (*OR* = .97 [95% CI: .84, 1.12]; *p* =.694), with an unadjusted completion rate of 65.5% and 65.4% for native and non-native English speakers, respectively. Females, Australian residents, and people with higher baseline dementia knowledge scores were significantly more likely to complete the UDMOOC. Educational attainment was significantly associated with course completion; rates of completion increased with levels of educational attainment (Table 2). However, there were no significant interactions between non-native English speaking and education (χ^2_3 = 6.6, p = .084) or baseline DKAS scores (χ^2_1 = .4, p = .509), as illustrated in Figure 1a.

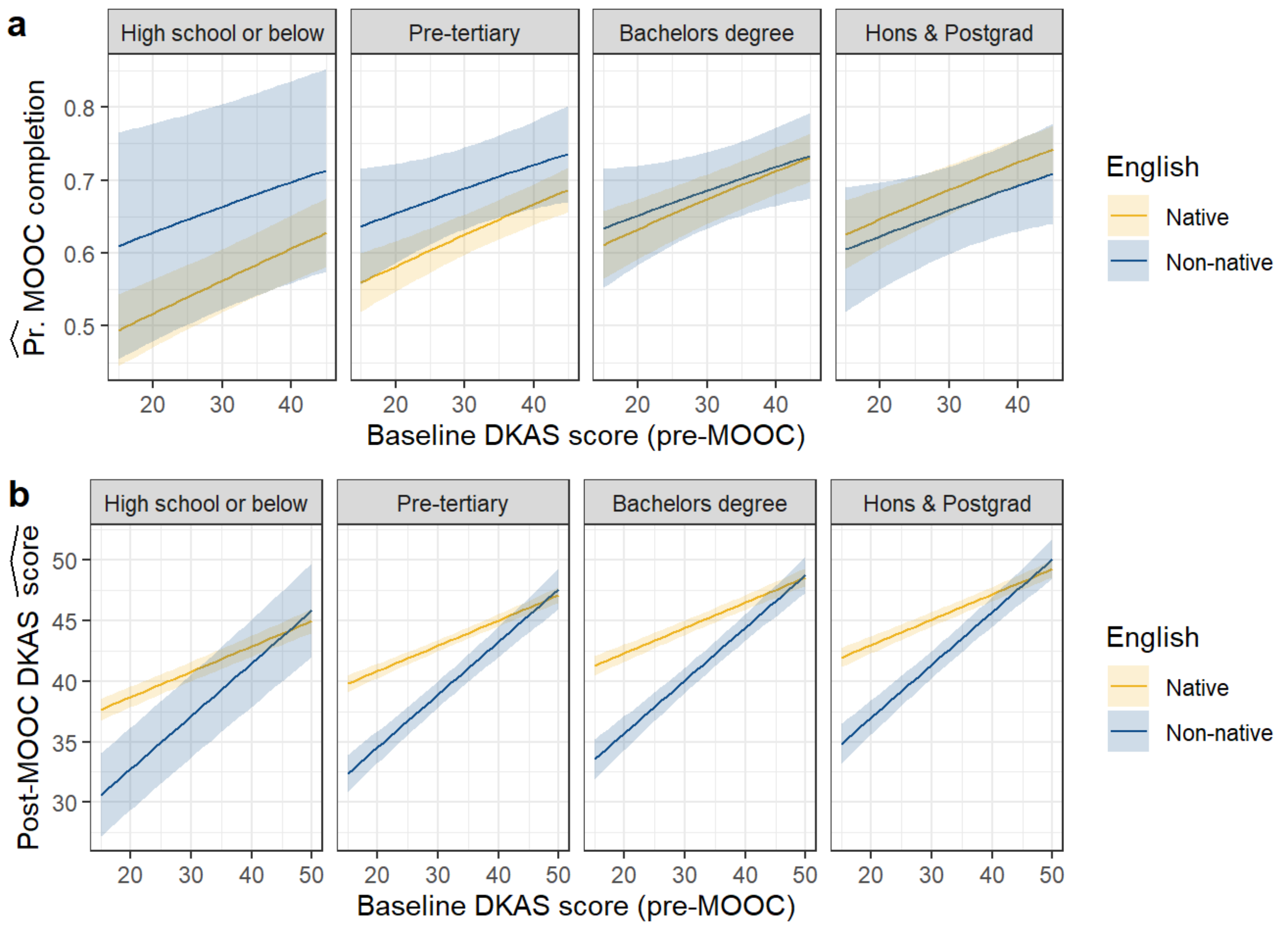
Table 2

Odds Ratios with 95% Confidence Intervals for Expected UDMOOC Completion

	UDMOOC Completion														
Predictor	Odds ratio	CI	*p*	Odds ratio	CI	*p*	Odds ratio	CI	*p*	Odds ratio	CI	*p*	Odds ratio	CI	*p*
(Intercept)	1.9	1.79 – 2.01	**<0.001**	1.92	1.80 – 2.06	**<0.001**	1.28	1.10 – 1.48	**0.002**	0.92	0.75 – 1.14	0.464	1.1	0.78 – 1.56	0.58
English (non-native)	0.97	0.84 – 1.12	0.694	1.13	0.98 – 1.32	0.101	1.06	0.91 – 1.23	0.448	1.4	0.83 – 2.34	0.205			
Carer				0.9	0.79 – 1.01	0.082									
Age (penalised spline)				135.9		**<0.001**	157.3		**<0.001**	142.8		**<0.001**			
Education: Pre-tertiary							1.39	1.17 – 1.65	**<0.001**						
Education: University							1.71	1.42 – 2.07	**<0.001**						
Education: Honours and postgrad							1.76	1.45 – 2.12	**<0.001**						
DKAS score (pre-UDMOOC)										1.02	1.02 – 1.03	**<0.001**			
Non-native English x DKAS score (pre-UDMOOC)										0.99	0.98 – 1.01	0.471			
Female													1.23	1.05 – 1.45	**0.012**
Australian resident													1.53	1.10 – 2.12	**0.011**
Resident of other English-speaking country													1.23	0.87 – 1.72	0.232
Observations			6,113			6,068			6,113			6,113			6,108
Akaike information criterion			7,888.7			7,762.8			7,789.0			7,779.3			7,861.1

Figure 1

UDMOOC Completion and Dementia Knowledge Scores



Note. Estimated proportion of UDMOOC completion (a) and post-UDMOOC dementia knowledge score (b) at different levels of educational attainment and baseline dementia knowledge (shown on x-axes). Age held at mean for the cohort (39 years).

Dementia Knowledge

Native English speakers had significantly higher DKAS scores both pre- (M = 33.0, SD = 9.3; $t(6343)$ = -4.3; p < 0.001) and post-UDMOOC (M = 44.2, SD = 5.5; $t_{(1948)}$ = -9.6; p < 0.001) than did non-native English speakers (M = 31.7, SD = 9.1 and M = 40.7, SD = 7.7 for pre- and post-UDMOOC, respectively). Adjusted for baseline DKAS score and age, non-native English speakers obtained lower post-UDMOOC DKAS scores by an average of 3.1 points ([95% CI: 2.4, 3.7], p < .001). Education was significantly positively associated with post-UDMOOC DKAS scores (Table 3), however caring for a person with dementia was not. In contrast to results for completion rates, there was a significant interaction between non-native English speaking and baseline DKAS scores (χ^2_1 = 36.3, p < .001); native English speakers with low baseline DKAS scores obtained significantly greater increases in DKAS scores following UDMOOC completion (illustrated in Figure 1b). This result was consistent after adjusting for education and for caring for a person with dementia. The observed difference in slopes was .22 points (95% CI: .15, .30) per baseline DKAS point.

Table 3

Unstandardized Regression Coefficients with 95% Confidence Intervals for Post-UDMOOC Dementia Knowledge Scores

	Post-UDMOOC DKAS score											
Predictor	β	CI	*p*	β	CI	*p*	β	CI	*p*	β	CI	*p*
(Intercept)	35.28	34.36 – 36.20	**<0.001**	34.4	33.29 – 35.51	**<0.001**	36.41	35.43 – 37.39	**<0.001**	33.77	31.65 – 35.88	**<0.001**
DKAS score (pre-UDMOOC)	0.27	0.24 – 0.29	**<0.001**	0.21	0.18 – 0.24	**<0.001**	0.23	0.21 – 0.26	**<0.001**	0.26	0.24 – 0.29	**<0.001**
English (non-native)	-3.07	-3.74 – -2.40	**<0.001**	-10.7	-13.17 – -8.31	**<0.001**	-10.3	-12.80 – -7.78	**<0.001**	-2.95	-3.64 – -2.26	**<0.001**
Age (penalised spline)	1		**0.026**	2.8		**0.002**	1		**0.02**	1		**0.034**
Education: Pre-tertiary				2.13	1.28 – 2.97	**<0.001**						
Education: University				3.53	2.63 – 4.43	**<0.001**						
Education: Honours and postgrad				4.34	3.45 – 5.23	**<0.001**						
Non-native English x DKAS score (pre-UDMOOC)				0.22	0.15 – 0.30	**<0.001**	0.22	0.15 – 0.29	**<0.001**			
Carer							-0.31	-0.88 – 0.27	0.294			
Australian resident										1.73	-0.06 – 3.53	0.059
Resident of other English-speaking country										1.36	-0.48 – 3.20	0.147
Female										0.02	-0.77 – 0.81	0.962
Observations			1,891			1,891			1,883			1,879
Akaike information criterion			11,720.5			11,585.3			11,640.9			11,641.6

Discussion

This study explored how accessible and effective the UDMOOC is in providing dementia education for non-native English speakers compared to native English speakers. The results indicated that the UDMOOC was accessible to people around the world who were able to perceive, understand, navigate, and complete course modules. However, the characteristics of the UDMOOC enrolees who were native and non-native English speakers were significantly different. The UDMOOC attracted non-native English speakers who were relatively young, highly educated, employed, living in an English-speaking country, and who had fewer personal relationships with people living with dementia. This suggested that the UDMOOC may not have reached more disadvantaged non-native English speaking learners who would not ordinarily have access to educational opportunities (Emanuel, 2013). Instead, we recruited a profile of non-native English speakers similar to the profile reported as typical of English-speaking participants in other MOOCs (Kizilcec et al., 2017; Liyanagunawardena et al., 2013). While providing education online may maximise reach, its participants are inevitably those with Internet access.

The completion rate for the UDMOOC we studied was much higher than in other studies (Goldberg et al., 2015; Jordan, 2014) due to including only those who completed the DKAS. However, our findings that completion rates did not differ between native and non-native English speakers demonstrated that the UDMOOC module content was accessible to non-native English speakers. This is in line with another dementia MOOC with a higher completion rate than MOOCs addressing different subject matter, such as digital literacy (Hadi & Rawson, 2016). This suggests that dementia is a topic of interest for many people around the world, and that those interested in learning about dementia may be, for various reasons, more motivated or likely to complete the course than those who sign up for MOOCs on other areas topics.

Although the UDMOOC was accessible to anyone who understands English, the findings from this study of a greater increase in dementia knowledge for native English speakers suggests that it was a more effective tool for this cohort. This was despite non-native English speakers having higher educational attainment than native English speakers, while education attainment associated with increased post-UDMOOC knowledge scores and greater likelihood of course completion. Caring experience, however, did not have a significant effect on improvement of post-UDMOOC DKAS scores when native and non-native English speakers were compared. This is in line with previous research where education through the UDMOOC was significantly associated with post-UDMOOC DKAS scores regardless of previous experience of dementia (Eccleston et al., 2019).

Our findings support the claim that the optimal language for learning is the learner's native language (UNESCO, 2008). This supports the case for translation and culturally appropriate adaptation (Altbach, 2014) of this course, both to enhance learners' understanding as well as reach additional communities and learners needing dementia education. Our results suggest that this will be especially important for attracting and effectively educating non-English speakers who have lower educational attainment, such as the many older care workers currently working in Australia (Mavromaras et al., 2017) and overseas (Hart & Mareno, 2014; Small et al., 2015; Walsh & Shutes, 2013). Such modifications might serve to improve understanding of dementia and the care provided to people living with dementia.

Limitations

First, proficiency in English was not measured. It was assumed that those who reported English was not their first language would be less proficient in English. Future studies should therefore seek information on participants' level of English proficiency in order to examine the role this might play when learning through English language MOOCs. In addition, to explore whether the lower post-UDMOOC DKAS scores in non-native English speakers found in this study were due to language barriers, a randomised controlled trial should be conducted wherein non-native English speakers are randomly assigned to either the course in English or in their native language. A second possible limitation was that data came from those enrolees who consented to the research, and who completed both the initial (mandatory) survey and the DKAS questionnaire (optional). As a result, these enrolees might have been more interested or motivated to complete the course than those who did not complete the optional DKAS questionnaire. This may partly explain the high completion rate (65.4%) found in this study compared to previously reported overall 38% completion rate for the UDMOOC (Goldberg et al., 2015), which includes those who enrolled but did not progress to this point in the course.

Conclusion

Despite the limitations above, this study contributes towards current literature on the strengths and weaknesses of MOOCs, and the potential benefits of conducting dementia education through a MOOC platform. The UDMOOC encouraged learners to learn autonomously with the support of the massive number of other learners in the course, as well as interaction with lecturers, which might contribute to the UDMOOC's high learner satisfaction rates (Doherty et al., 2018). The UDMOOC, however, was likely unable to reach many non-English speakers who need dementia education, due to language barriers or inability to access the Internet or MOOCs. Future iterations of this MOOC therefore should consider being available in multiple languages with appropriately and culturally adapted content, with active promotion in non-English speaking countries to help more people know about and gain access to greatly needed dementia education.

Acknowledgements

This work was supported by the J. O. & J. R. Wicking Trust.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 22, Number 3

August – 2021

What Motivates Students About Open Pedagogy? Motivational Regulation Through the Lens of Self-Determination Theory

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Abstract

Open pedagogy is growing in popularity as an instructional method to decentralize classroom power dynamics, engage students, and provide greater meaning to student work. To investigate the impact of open pedagogy on motivation, interviews were conducted with first-year college students at a four-year liberal arts college after completing a semester-long project based on this pedagogical approach. Student responses were assessed using self-determination theory as a theoretical framework, particularly in relation to the motivation regulatory styles displayed by research participants. Results indicate that students experienced various forms of extrinsic motivation during the project based on open pedagogy, with autonomous forms of regulation being more prevalent than controlled regulation. Interview data also suggest that agency plays a role in mediating the internalization of student motivation. Based on these findings, suggestions are provided to the design of assignments in general and open pedagogy specifically to enhance development of autonomous forms of motivation.

Keywords: OER-enabled pedagogy, open pedagogy, motivation, self-determination theory, non-disposable assignment

Introduction

During the first year of college, students face financial, social, and academic stress (Mudhovozi, 2012; Pillay & Ngcobo, 2010). These pressures can be particularly strong in underrepresented and traditionally at-risk populations such as minorities and first-generation students (Alessi et al., 2017; Jenkins et al., 2020; Lightweis, 2014; Pulliam & Gonzalez, 2018). Engaging and motivating students can helps address student skill gaps, provide positive psychological benefits, and potentially reduce attrition (Dewey, 2018; Hanover Research, 2014; Reynolds & Weigand, 2010; Reeve, 2006; Robbins et al., 2004; Roberts & Styron, 2010). Tragically, the gaps we have been trying to eliminate will likely widen due to COVID-19 (Hess, 2020; Polikoff et al., 2020).

Open pedagogy engages students as cocreators of knowledge while making education more meaningful, participatory, and democratic (DeRosa & Robison, 2017; Hegarty, 2015; Wiley et al., 2017). A key element of open pedagogy is student creation of non-disposable/renewable assignments (NDAs). NDAs are those that provide value to others, are available to wider audiences, and may be licensed openly (Wiley & Hilton, 2018). Using NDAs may allow learners to attribute greater value to their efforts (Al Abri & Dabbagh, 2019; Allan et al., 2018; Farzan & Kraut, 2013; Hilton et al., 2019; Jhangiani, 2017; Sheu, 2020). Evidence suggests that this approach has the potential to positively impact student skill, achievement, and engagement (Hilton et al., 2019; Marsh, 2018; Sheu, 2020; Wiley et al., 2017).

Although mounting research substantiates the impact of open pedagogy, existing studies are largely quantitative or theoretical. Relatively few have used a qualitative approach. While many aspects of open pedagogy would benefit from investigation, motivation has been described as an area where research is needed (Baran & AlZoubi, 2020).

This article details interviews of students who participated in a project based on open pedagogy. The purpose of the study, conducted with first-year students, is to fill gaps in literature related to the types of motivation students experience with this approach. Although there are various models for motivation, this research uses self-determination theory, which allows for the examination of intrinsic versus extrinsic motivation and manifestations of extrinsic motivation based on the degree to which an individual internalizes regulatory behaviors (Deci & Ryan, 2008). Actions that were once externally motivated, common in education, may become internally regulated by fostering the basic psychological needs of competency, autonomy, and relatedness (Deci & Ryan, 2008). In turn, intrinsic motivation impacts students' academic and psychological health (Froiland et al., 2012; Reeve, 2012; Vansteenkiste et al., 2018).

The theoretical frameworks guiding this study were open pedagogy and self-determination theory. Results provide us with insight into how various elements of open pedagogy motivate students, as well as ways educators may structure such activities to make them most beneficial. As various forms of extrinsic motivation have been associated with different student outcomes (Howard et al., 2020; Wang et al., 2020), results also provide an opportunity to construct learning environments that enhance student academic performance, foster transfer and maintenance of skills, and promote student psychosocial well-being.

Reflexivity

Reflexivity is the understanding that we are not neutral observers as researchers (Creswell, 2007). We wish to be transparent in our identities as it impacts our interconnectedness to participants, the methodological approach, and interpretation of results. We recognize we wield power as both researchers and practitioners and desire to shift power dynamics of traditional education. Doing so disrupts hegemonic approaches common in education and give voice to the marginalized.

Literature Review

Open Pedagogy and OER-Enabled Pedagogy

Open pedagogy is an evolving concept with the goal of making education more meaningful, participatory, and engaging (Cronin & MacLaren, 2018; DeRosa & Robison, 2017; Hegarty, 2015; Lane, 2009; Wiley et al., 2017). Distributed learning, participatory technology, and collaborative approaches are central to open pedagogy (Hegarty, 2015; Inamorato dos Santos et al., 2016). This approach aligns with critical pedagogy and social justice in education (Bali et al., 2020; DeRosa & Robison, 2017).

Although frequently discussed, open pedagogy has proven difficult to define. The variety of conceptualizations makes communication between practitioners or researchers difficult. Wiley and Hilton (2018) propose the term *OER-enabled pedagogy* to specifically refer to practices that are only possible within the 5R permissions of OER: retain, revise, remix, reuse, and redistribute (Wiley, n.d.). A project fitting this description must meet the following characteristics:

1. Students create new learning objects.
2. The work has value beyond the creator.
3. Students are invited to share work publicly.
4. Students may use open licensing in distributing works. (Wiley & Hilton, 2018)

Open pedagogy may foster critical thinking skills, self-direction, and overall enjoyment of education (Dermody, 2019; Hegarty, 2015; Hilton et al., 2019; Tillinghast, 2020; Wiley et al., 2017).

Non-Disposable Assignments

NDAs are central to open pedagogy. As student work extends beyond the student–teacher relationship and potentially benefits others, NDAs are hypothesized to increase student engagement and motivation (Al Abri & Dabbagh, 2019; Allan et al., 2018; Farzan & Kraut, 2013; Hilton et al., 2019; Jhangiani, 2017; Seraphin et al., 2019; Sheu, 2020; Stommel, 2015; Wiley, 2013). Students acting as content creators has the added benefit of fostering learner agency and shifting the course structure to a more student-empowered, student-centered experience (DeRosa & Robison, 2017).

There is evidence that NDAs positively impact students (Hilton et al., 2019; Marsh, 2018; Sheu, 2020; Wiley et al., 2017). Hilton et al. (2019) indicate that learners report mastery of academic content, skills in collaborative learning, critical thinking and problem solving, effective communication, and learning how to learn as benefits of Open Pedagogy. Sheu (2020) reported that when given a choice, the majority of students elected to complete an NDA over a disposable alternative.

Motivation and Self-Determination Theory

Motivation can be defined as an internal factor that elicits focused behavior toward a goal (Woolfolk, 2019). Common elements in motivational theories include the importance of competency, self-determination, and perceived meaning (Seifert, 2004). Generalizations may also be made as to effective instructional design, namely, the importance of building the following: (a) self-efficacy and competence, (b) control, (c) intrinsic and extrinsic motivation, (d) value, and (e) goals (Pintrich, 2003).

Self-determination theory (SDT) posits that three fundamental human needs drive motivation: competence, relatedness, and autonomy (Deci & Ryan, 2000; Ryan & Deci, 2000). SDT focuses not only on the amount and type of motivation one experiences but also how environment impacts motivation (Deci & Ryan, 2008). It differentiates between autonomous and controlled motivation. Autonomous motivation may be either intrinsic or extrinsic and relates to behavior that is driven by an internalization of the value of the activity (Deci & Ryan, 2008). Controlled motivation results from situations in which one is prompted by external pressures (Deci & Ryan, 2008).

SDT states that different regulatory processes exist with motivation (Deci & Ryan, 2000; Plant & Ryan, 1985; Ryan, 1982; Ryan & Deci, 2000). Extrinsic motivation includes four processes, differentiated by the level of integration of the behavior with internal values (see Table 1). Intrinsic motivation consists of a single regulatory style, characterized by an internal locus of control, participation in a behavior being volitional and for personal enjoyment/fulfillment, and complete integration of the behavior with the concept of self (Deci & Ryan, 2000; Ryan & Deci, 2000; Vansteenkiste et al., 2018).

Table 1

Intrinsic and Extrinsic Motivation Regulatory Processes

Motivation	Regulatory process	Description
Extrinsic	External regulation	Obtain a tangible reward or avoid punishment.
	Introjected regulation	Consequences driving behavior are derived from the person themselves, such as increasing self-worth or avoiding shame.
	Identified	Individuals see the personal value of a behavior.

	regulation	
	Integrated regulation	The value of a behavior has been integrated with existing values and identity. Behaviors are done to attain some external outcome rather than for enjoyment itself.
Intrinsic	Intrinsic regulation	Behaviors are engaged in voluntarily due to inherent enjoyment as opposed to obtaining some external outcome.

Adapted from "Fostering personal meaning and self-relevance: A self-determination theory perspective on internalization" by M. Vansteenkiste et al., 2018, *Journal of Experimental Education*, *86*. Copyright 2018 by Taylor & Francis.

Open Pedagogy and SDT in the Present Study

In designing this project, care was taken to align student experience with literature on open pedagogy. Hegarty (2015) outlines eight attributes of open pedagogy, which we employed in relation to student experience:

1. Participatory technology: collaboration using the learning management system (LMS) and other tools for student communication;
2. People, openness, and trust: student agency, group work, and autonomy-supporting teaching;
3. Innovation and creativity: student research and freedom to create an artifact of their choosing;
4. Sharing ideas and resources: class discussions, student-led research;
5. Connected community: student connections made in and out of the classroom;
6. Learner generated: student-generated content and ideas throughout the project;
7. Reflective practice: weekly student reflective exercises; and
8. Peer review: draft review with rubric in the LMS.

Efforts were made to be open, transparent, collaborative, and social (Couros & Hildebrandt, 2016) as well as learner driven, permitting students to help create the body of knowledge in which they were partaking (DeRosa & Jhangiani, n.d.). The project fits the definition of OER-enabled pedagogy (Wiley & Hilton, 2018), while the final artifact is a non-disposable assignment (Seraphin et al., 2019; Wiley & Hilton, 2018). agencyFor clarity purposes, the project will be henceforth described as *OER-enabled pedagogy*.

Methods

Research Context

This study was conducted at a liberal arts institution in the United States. All students attending this institution are required to take a first-year studies course. The course has been through iterations using various pedagogical approaches. It has also used a variety of readers, including faculty-designed course packs and traditional textbooks. Seeking to empower and motivate students, as well provide them with fundamental academic skills, the class was restructured around OER-enabled pedagogy. In this way, students could build academic skills, view work as having greater value than a grade, and create resources to replace paid text material in future classes.

The first-year studies course is traditionally taught face-to-face. Extensive use of the LMS, Canvas, allows students to collaborate outside of class and provides structure to the flow of the course. Considering that the institution has a large number of commuter students, flexible delivery options within the LMS was critical at all stages of the project. During class, students selected a topic they would have liked to have known more about when beginning college. Individually or in small groups, they developed an artifact of their choosing (e.g., video, infographic) to be included in an e-book. During the semester, students developed a research plan, submitted a proposal, gathered information about their topic, and conducted peer reviews. Those teaching the class's 18 sections were asked to maintain the structure of the common assignment including all assignment stages. The project then was intended to provide students autonomy, relatedness, and an opportunity to build competency.

To ensure ethical standards were upheld, the study was approved by the institution's institutional review board. This included maintaining student confidentiality in all stages of the research.

Data Collection

Interviews and Coding Framework

Semi-structured interviews were conducted with 16 students—7 male and 9 female. Seven students were identified because they responded to an invitation to all students to take part in research. To increase the sample size, students were randomly selected from course rosters and contacted for interviews. Nine additional participants were thus recruited. The average age of participants was 18.7 years. All students were offered a $10 gift card for participation. Following 16 interviews, data collection ceased due to lack of new themes emerging. Verbatim transcripts were created from audio recordings and analyzed using the qualitative program Dedoose.

Researchers reviewed transcripts collaboratively taking an inductive and line-by-line approach (Charmaz, 2012; Skjott Linneberg & Korsgaard, 2019). Open coding was followed by axial coding to develop categories/themes (Khandkar, n.d.). Following the description of motivation found in SDT, codes were categorized by the type of regulatory process they represented (see Table 2).

Table 2

P*rimary and Secondary Codes Used in Transcript Evaluation*

Extrinsic motivation processes	Code categories
External regulation	Tangible reward[a]; avoid a threat of punishment[a]
Introjected regulation	Approach; avoidance[b]
Identified regulation	Pragmatic skill acquisition; aid in skill development of others; career advancement; choice and personal interest motivate me
Integrated regulation	Helping others aligns with my personal values; we should strive to improve ourselves; I value individualism and agency; lifelong learning; being truthful is central to who I am

[a] Ryan and Deci (2000); Deci and Ryan (2000). [b] Assor et al. (2009).

Results

During interviews, it was discovered that instructors in one section, teaching approximately a quarter of the first-year cohort, changed the project. While the other students' assignment was designed to maximize agency, these instructors assigned students a topic related to a future career and dictated how the final artifact was structured. In our research, 12 students were part of the high-agency group while four were in the cohort with limited agency. Although both projects met the definition of OER-enabled pedagogy, data are desegregated based on the amount of agency awarded to students.

Table 3 displays a summary of the regulatory processes identified. No student response was coded to intrinsic motivation; however, all participants displayed a variety of forms of extrinsic motivation, and all indicated a response indicative of either identified or integrated regulation at least once. Thus, all students could be classified as at least partially autonomously regulated (Vansteenkiste et al., 2018).

Table 3

Number of Participants Demonstrating External Regulatory Processes

	n	External regulation	Introjected regulation	Identified regulation	Integrated regulation
High agency	12	4 (33%)	11 (91.6%)	11 (91.6%)	5 (41.6%)
Limited agency	4	4 (100%)	3 (75%)	4 (100%)	1 (25%)
Total	16	8 (50%)	14 (87.5%)	15 (93.8%)	6 (37.5%)

Of all the respondents, 50% had a statement coded to external regulation, which was further subdivided into responses indicating pursuit of a reward or punishment avoidance (Ryan & Deci, 2020). The most common external regulation subtype was motivation to gain a reward, although two students indicated motivation based on it being a requirement, and one, completing schoolwork to get a high-paying job (see Table 4).

Table 4

Prevalence of External Regulation in Participants

External regulation code	High agency (n = 12)	Limited agency (n = 4)	Total (n = 16)
	n (%)		
Tangible reward	Grade—2 (16.7)	Grade—4 (100)[a] Future earnings—1 (25)[a]	6 (37.5)
Avoid a threat of punishment	Required—2 (16.7)	0 (0)	2 (12.5)
Total			8 (50)

[a] One student indicated both grade and future earnings.

Introjected regulation was desegregated into an avoidance and approach subtype. In avoidance introjection, an individual attempts to avoid a negative outcome, such as shame or guilt. An individual in another approach subtype is motivated by an attempt to feel pride or increase one's view of self-worth (Assor et al., 2009). Students were evenly split, with half reporting an avoidance or approach mentality (see Table 5). Most students in this study (87.5%) showed evidence of being motivated through introjected regulation, with the majority either mentioning an avoidance or approach subtype, although a few individuals displayed both.

Table 5

Prevalence of Introjected Regulation in Participants

Introjected regulation subtype	High agency (*n* = 12)	Limited agency (*n* = 4)	Total (*n* = 16)
	n (%)		
Approach	7 (58.3)	2 (50)	9 (56.3)[a]
Avoidance	7 (58.3)	2 (50)	9 (56.3)[a]

[a] Respondents were able to indicate both approach and avoidance.

The most common extrinsic motivation regulator was identified regulation. Student responses related to four themes: pragmatic skill acquisition, aiding in the acquisition of skills by others, career advancement, and a general feeling that choice and personal interest are motivating. Results are displayed in Table 6. Most students (87.5%) felt motivated to gain skills they saw as being useful. A majority of participants (56.3%) indicated motivation to help others gain knowledge, while nearly a third were motivated by the ability to choose assignments they found interesting. Only a quarter of those interviewed mentioned the project as building skills related to a future career.

Table 6

Prevalence of Identified Regulation in Participants

Identified regulation themes	High agency (*n* = 12)	Limited agency (*n* = 4)	Total (*n* = 16)
	n (%)		
Pragmatic skill acquisition	10 (83.3)	4 (100)	14 (87.5)
Aid in others' skill acquisition	8 (66.7)	1 (25)	9 (56.3)
Career advancement	2 (16.7)	2 (50)	4 (25)

Choice and personal interest motivate me	4 (33.3)	1 (25)	5 (31.3)

Relatively few students indicated integrated regulation. This is reasonable considering that reaching this level takes "considerable awareness, self-understanding, and maturity" (Vansteenkiste et al., 2018, p. 32). In integrated regulation, an individual performs a behavior not only because of its perceived value but due to its alignment with more deeply held values. As indicated in Table 7, the following values were evident in student responses: (a) helping others aligns with personal values, (b) we should strive to improve ourselves, (c) there is inherent value in individualism and agency, (d) we should be lifelong learners, and (e) truthfulness is central to the concept of self.

Table 7

Prevalence of Integrated Regulation in Participants

Integrated regulation themes	High agency (n = 12)	Limited agency (n = 4)	Total (n = 16)
	n (%)		
Helping others aligns with my personal values	3 (25)	0 (0)	3 (18.8)
We should strive to improve ourselves	2 (16.7)	1 (25)	3 (18.8)
I value individualism and agency	1 (8.3)	0 (0)	1 (6.3)
We should be lifelong learners	0 (0)	1 (25)	1 (6.3)
Being truthful is central to who I am	1 (8.3)	0 (0)	1 (6.3)

Discussion

Implications of Student SDT Characteristics

External Regulation

This project was intended to provide various motivational elements, particularly identified and integrated regulation, as these result in more autonomously regulated learning and the most positive outcomes

(Vallerand et al., 2008). The assignment, however, was graded, meaning external regulation existed. Vansteenkiste et al. (2018) state that students need not progress through SDT elements like stages. Thus, external regulation is not necessary as a first step to intrinsic motivation. They also state that no evidence suggests external pressure will lead to higher levels of integration.

While this study was not designed to assess this dynamic, evidence here suggests that students' view of the project changed over time from controlled to more autonomous motivation. For example, when asked about his view at the start of class, Student 11 indicated, "I thought that it was, you know, going to be a lot of work, but something I had to get done." Later during the same interview, the student stated, "We can change somebody's life or change their … concept on the whole thing." Similarly, Student 9 indicated, "At first, I kind of thought it was like busy work … I was like, this is just, they are trying to find something else to give us a grade on." But later in the interview, the same student said, "Uhm, yea just most that at first, and then I started doing it and it was kind of like, well it kind of makes you want to think about what you want to do a little bit more." When reflecting back on the project, both of these students initially indicated external regulation but by the end of class demonstrated higher levels of integration. This does not mean all extrinsically motivated behavior will be internalized, generally or with OER-enabled pedagogy. However, we did see evidence that some students were initially externally regulated but later displayed autonomous regulation.

Introjected Regulation

A central component of OER-enabled pedagogy is the creation of an NDA. This element had a significant impact on students, manifesting as introjected regulation. Students were split between those who saw this negatively (avoidance) and more positively (approach). In relation to a project being visible publicly, Student 1 stated,

> Knowing that people are going to see it from all over the place, it makes you want to make it look nicer, have more accurate information stuff, you don't want to mess something up that potentially globally is going to be viewed … It makes a difference when you know that someone is going to grade it and give it back to you, like it doesn't really matter that much, but if everyone is going to see it, definitely makes you want to put … more work in to it.

On the other hand, Student 12 viewed publicity as a positive motivator:

> The most interesting part of the project was the whole development of like, how are you going to put this out there? 'Cause at first, it's like OK, you make a project, throw it out there, done. But then it was like, so this is you, like, like you are labeling yourself with this project. This is a piece of you at UPIKE. This is your first step of showing people what you can do.

Although one of these students felt pressured out of concern for being embarrassed while the other saw the opportunity to establish themselves, neither of these responses indicate a greater likelihood of regulatory transfer and maintenance. While introjected avoidance motivation has a more negative impact than introjected approach motivation, both are less positively correlated with student engagement, well-being, and mastery or goal attainment than integrated regulation (Assor et al., 2009).

Some degree of introjection is inherent in OER-enabled pedagogy in NDA creation. However, to facilitate a more autonomous regulatory pattern, neither external nor introjected regulation should constitute a student's dominant motivational process. This is particularly important as transfer and maintenance decrease when pressures associated with controlled regulation are removed (Deci & Ryan, 1985), which occurs when students complete an assignment or class.

Identified Regulation

While controlled motivation (external and introjected regulation) were evident, autonomous forms of motivation (identified and integrated regulation) appeared more dominant. All but one participant had a statement coded to identified regulation, and six students demonstrated integrated regulation. Regarding identified regulation, students viewed the project as helping build skills they saw as valuable. Student 4 stated,

> It actually helped a pretty good amount because, uh coming to college, I didn't really know how to study ... so I got a pretty good like, uh, group of information about how to study for certain classes because I went and asked all my teachers, and they tell me how to study for their class, and I asked some students who got good grades, and I talked to them and they told me how they studied, and it actually helped me quite a bit.

Other students saw the project as a way to help colleagues build skills. Thus, even if one does not find an activity enjoyable, it may be viewed as a worthy endeavor (Vansteenkiste et al., 2018). Considering that identified regulation has been correlated with positive student outcomes (Burton et al., 2006; Howard et al., 2020; Vallerand & Bissonnette, 1992; Vallerand et al., 2008), the number of students indicating this is promising.

Integrated and Intrinsic Regulation

Relatively few individuals clearly connected the project to deeply held personal beliefs (integrated regulation). When present, the most evident value expressed was that we should help others and that we should continually improve ourselves. Other students had general views about the value of agency and freedom, as Student 12 did:

> Normally when you get a project for science or something, somebody tells you what to do. It's like, I'm doing this for them, but seeing that I had the option to pick the topic that I wanted to do, it made me have, like, free will.

The small number of participants displaying integrated regulation is not surprising. Integrated regulation requires a significant amount of self-awareness, self-understanding, and maturity and may be more easily achieved by older individuals (Sheldon & Kasser, 2001; Vansteenkiste et al., 2018). Here, 6 of 16 first-semester students had responses suggesting motivation rooted in deeper personal values.

No individuals had responses coded to intrinsic motivation, defined as behaviors that are engaged in because of a person's inherent interest and enjoyment of the activity (Ryan & Deci, 2020). While the students displaying integrated regulation demonstrated maturity, there was no indication that if external pressures were removed they would complete the project.

Agency's Impact on Motivational Characteristics

While generalizations on the role of agency cannot be drawn from this study alone, it, along with previous research, has implications for open educators. Autonomy is a basic psychological need in SDT that must be encouraged to foster development of intrinsic motivation. Instructors may support student autonomy by giving them choice in activities (Niemiec & Ryan, 2009). Students report benefits of autonomy-supporting teachers over controlling instructors, including academics, motivation, engagement, and perseverance (Reeve, 2006).

All the individuals in the limited-agency group, but only 2 of 12 in the high-agency classes, mentioned motivation based on earning a grade. This dynamic existed even though the project constituted a larger part of the final grade for the high-agency cohort. One explanation is that when permitted, students chose a topic that fit their interests. When learners see the meaning, relevance, and value of an assignment, they are more likely to exhibit identified or integrated regulation (Vansteenkiste et al., 2018). This may be easier when students have agency. In relation to introjected regulation, it is not surprising that results for the groups were identical. A major source of introjected regulation in OER-enabled pedagogy is in creating an NDA. This dynamic existed regardless of the level of student agency.

It is encouraging that all but one of the research participants had a response coded to identified regulation. Although more research is warranted to determine if these findings persist, the largest difference between high- and limited-agency classrooms was the number of students who mentioned their project being useful to others (see Table 6). This is interesting as both groups completed projects with the understanding that it would be available to future students. If confirmed, the findings would align with past research suggesting that autonomy support better facilitates self-regulation and engagement in prosocial behaviors (Gagne, 2003). Greater choice in selecting assignment topics may help students see the value of their work in helping others.

Finally, a greater proportion of individuals in the high-agency group displayed integrated regulation. Integration relates to bringing a behavior into congruence with deeply held values. It is plausible that having agency allows someone to select a topic that aligns with their existing values. Those in the limited-agency group were assigned a project aimed at connecting behaviors to career goals. Coherence between career aspirations, interests, and values is believed to enhance integrated regulation (Vansteenkiste et al., 2018). Here, aligning the project to career aspirations did not increase integration over those free to select a topic. This may indicate an interplay between autonomy and competence. Provided with agency, a student may select a topic in which they feel more competent. A first-year student discussing a future career may feel less competent in achieving a lofty goal, however.

Although comparisons based on student agency here are exploratory, results point to a few important considerations. Primary among these is that while OER-enabled and open pedagogy are student-centered approaches, not all activities are equally effective in fostering motivation. The potential for growth in autonomy, competency, and relatedness may differ significantly. If educators wish students to move toward intrinsically motivated behaviors, care must be taken in how activities are designed.

Practical Application

OER-enabled pedagogy may invoke external and introjected regulation. However, when students are encouraged to consider value to self *and* to others, an increase in autonomous regulation may occur. Seraphin et al. (2019) note that the use of NDAs provides an opportunity for innovation, which may help students to see greater value to themselves and others.

As mentioned, not all OER-enabled pedagogy is motivationally equal. One example of common NDAs is student-generated test banks, where students write questions to be used in tests within the semester and in future courses. While this activity likely holds higher value than a disposable assignment, if the dominant source of student motivation is the possibility of scoring higher on a later exam, this activity may not facilitate the growth of autonomous motivation.

A second example is the high-agency and limited-agency forms of open pedagogy assessed here. We found differences in how students perceived motivation when they had a high degree of freedom. Similarly, Sheu (2020) highlights how students felt autonomy was desirable when they were allowed to choose between writing test questions (NDA) or a paper (disposable assignment). It seems likely that in both instances, had greater autonomy been given to students, this freedom would have increased the potential for identified and integrated regulation to develop. Faculty engaging in OER-enabled pedagogy should involve students *directly* in the assignment process from conception to completion (Sheu, 2020). A more revolutionary approach may be to transition to ungrading, making the grade itself secondary to learning (Stommel, 2014).

Finally, we should be cautious how we use concepts such as value and motivation and realize that not all forms of motivation are equally beneficial. While no form of motivation may be bad, past research indicates that identified regulation is most effective in enhancing student performance and perceived knowledge transferability (Burton et al., 2006; Howard et al., 2020; Wang et al., 2020), while more intrinsic forms are better for student psychosocial well-being (Burton et al., 2006; Howard et al., 2020). In addition, as evidenced in this research, students may experience different forms of motivational regulation simultaneously. Taking the test question NDA example, students who engage in this activity may find the assignment valuable. However, while perceived value may increase the likelihood of assignment completion, this may not foster more beneficial forms of motivation. Even students who report being motivated may not refer to forms that transcend an individual class.

Limitations

This research has several limitations. The study was conducted with students at one institution. It is unknown if results are transferable to other institutions and student groups. As stated previously, open pedagogy may be implemented differently. Results from assignments constructed another way may yield different results. Finally, while we believe interviews are an effective way to determine student motivation, data in this study are self-reported perceptions.

Conclusion

Student interviews suggest that OER-enabled pedagogy holds promise to engage students and foster autonomously regulated motivation. Decades of research outline academic, social, and psychological benefits of being autonomously regulated as well as how this impacts transfer and maintenance. Our results indicate that even in the presence of external regulation, students experience greater levels of identified and integrated regulation when participating in OER-enabled pedagogy. Moreover, students initially motivated by grades may begin to see greater value to their effort. These are promising findings as recent research suggests that during the first year of college, autonomous regulation may decrease and controlled regulation increase (Henderlong Corpus et al., 2020). OER-enabled pedagogy may be a method for counteracting this trend.

To be most effective, OER-enabled pedagogy must be structured in a way that allows autonomy, competence, and relatedness. Assignments may align to this philosophy but emphasize controlled regulators. Additionally, while OER-enabled pedagogy holds the potential to disrupt hegemony, it may do so most effectively when aligned with the principles espoused by SDT. Finally, specifically addressing how OER-enabled pedagogy and SDT can be used to enhance student motivation in distributed learning environments may further the field's understanding of how delivery modality impacts student success.

Future research should examine the relationship between student motivation and the use of OER-enabled pedagogy, particularly as it relates to those of diverse backgrounds and the agency given to students. Research should also address the various ways this pedagogical approach is applied and how these strategies impact development of autonomously regulated behavior.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 22, Number 3

August – 2021

Instructor Impact on Differences in Teaching Presence Scores in Online Courses

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Abstract

Using three interdependent constructs: social, cognitive, and teaching presence, the Community of Inquiry framework is a theoretical process model of online learning. Specifically, teaching presence contains three sub-elements—(a) facilitation of discourse, (b) direct instruction, and (c) instructional design and organization—that work together to create a collaborative-constructivist learning environment. Data from the Community of Inquiry survey from 160 learners in 11 course sections were analyzed using a one-way analysis of variance (ANOVA) to determine whether statistically significant differences existed in teaching presence scores between sections of two online courses with identical course design taught by different instructors. Results showed significant differences between individual instructors' teaching presence scores for each of the two courses. Specifically, significant differences were found in each sub-element of teaching presence except for one course's instructional design and organization. Conceptual and methodological explanations of the findings are provided, and implications and suggestions for future research are discussed.

Keywords: online learning, Community of Inquiry framework, teaching presence, higher education, direct instruction

Introduction

The rapid growth of online educational courses has created changes in class communication and community dynamics. In face-to-face courses, learners can physically see and immediately receive feedback from instructors, whereas in online courses, communication lacks the vocal tones, nuances, and immediacy of responses (Hailey et al., 2001). These issues have led students to report areas of concerns such as feelings of alienation or disconnectedness with others (Boston et al., 2010; Hart, 2012; Phirangee & Malec, 2017). As such, the increase in online educational courses, online communication, and learner isolation issues have driven research into the role of community building, presence, and instructor interaction with learners in online environments (Phirangee et al., 2016).

Specifically, interaction between online learners and instructors is of great importance to community building, learner success, and course satisfaction (Akyol & Garrison, 2008; Arbaugh, 2008). The Community of Inquiry (CoI) framework provides guidelines on how to develop online communities of inquiry for meaningful and effective learning environments (Garrison et al., 2000). A CoI is "a group of individuals who collaboratively engage in purposeful critical discourse and reflection to construct personal meaning and confirm mutual understanding" (Garrison & Akyol, 2013, p. 105). Garrison et al. (2000) developed the CoI framework as a working, dynamic model with three core presences: cognitive, social, and teaching. Garrison et al. (2000) state that while both social and cognitive (content-related) presences and interactions are vital for learners in online contexts, teaching presence is needed to help guide and focus interactions toward meeting the course goals and objectives (Arbaugh, 2008) and is used as "a mechanism for bridging the transactional distance between learner and instructor commonly associated with distance education" (Arbaugh & Hwang, 2006, p. 17). Of the three presences, teaching presence is of great consequence because "what instructors do in the classroom is critical to learners' sense of scholarly 'belonging' and ultimate persistence in their academic pursuits" (Shea et al., 2006, p. 176).

Literature Review

Community of Inquiry

The CoI framework represents a collaborative-constructivist model of learning in online environments (Castellanos-Reyes, 2020). *Social presence* refers to how connected, both socially and emotionally, learners are with others while in an online course or environment (Swan et al., 2008). *Cognitive presence* is the extent to which learners construct meaning in online environments where reflection and discourse are used (Swan et al., 2008). *Teaching presence* is defined as the design, facilitation, and direction of cognitive and social processes to support learning and is considered a key element in the establishment of online community (Garrison et al., 2000; Garrison & Arbaugh, 2007).

Teaching presence has three sub-elements: (a) facilitation of discourse, (b) direct instruction, and (c) instructional design and organization (Anderson et al., 2001; Caskurlu et al., 2020). However, it is important to note that some researchers (e.g., Shea et al., 2006) argue that teaching presence consists of only two sub-elements: (a) instructional design and organization and (b) facilitation of discourse and direct instruction combined. The authors of this study view the teaching presence sub-elements as independent concepts; therefore, in this research, we explored students' perceptions of the three teaching presence sub-elements across different instructors of the same online course to add to the existing research base.

Teaching Presence

The first sub-element, *facilitation of discourse* (FD), is defined as the methods or means instructors use to help students engage with the content, course information, and instructional materials (Anderson et al., 2001). Frequently, FD occurs within the discussion board, where the instructor can work with students to develop a shared understanding of course topics. When facilitating discourse among learners, instructors make observations of the students and act accordingly: they may raise additional questions, change the direction(s) of discussion, manage ineffective student comments, encourage considerations from different points of view, draw out inactive students, and comment on and answer students' concerns (Anderson et al., 2001; Brower, 2003; Coppola et al., 2004; Swan et al., 2008).

Furthermore, research shows learners are likely to feel an increased sense of community and feel more connected to their instructors when instructors are active in the discussions (Epp et al., 2017; Phirangee et al., 2016; Rovai, 2007). Watson et al. (2017), in conducting a case study, found that 60% of teaching presence scores in a massive online open course were dedicated to facilitating discourse, showing the importance of learners' desire for instructor guidance during discussion participation. However, the instructor alone cannot guarantee a learner's engagement with course materials and content. As Anderson et al. (2001) state, "The teacher shares responsibility with each individual student for attainment of agreed upon learning objectives" (p. 7). Therefore, to encourage peer interactions within FD, the instructor can model appropriate behaviors, match students with similar ideas to elicit conversations, and provide opportunities for peer-to-peer interactions (Anderson et al., 2001; Richardson et al., 2009; Stewart, 2017).

The second sub-element, an instructor's *direct instruction* (DI), is characterized as sharing of subject matter knowledge or expertise with students in the form of candid intellectual and scholarly leadership (Anderson et al., 2001). Sometimes confused with FD, DI goes beyond facilitating discussions and discourse to include providing intellectual reasoning. Specifically, as the subject matter expert, the instructor "must play this role because of the need to diagnose comments for accurate understanding, inject sources of information, direct discussions in useful directions, and scaffold learner knowledge to raise it to a new level" (Garrison & Arbaugh, 2007, p. 164). Thus, it is not surprising that DI is typically associated with feedback and assessment as it provides learners with the necessary guidance to advance to complex topics while navigating through course materials, helping the students to achieve the courses' learning objectives. DI can also be given by peers, especially in situations where "students exchange and negotiate multiple perspectives with a group of knowledgeable peers," allowing for "opportunities for constructing new knowledge" (Stewart, 2017, p. 69). Particularly in online environments, Gurley (2018) found that DI by itself was not enough for learners to be able to construct knowledge; all three sub-elements of teaching presence (facilitation of discourse, direct instruction, and instructional design and organization) are critical for effective development of "critical thinking and practical inquiry" skills in online learners (p. 199).

Last, Anderson et al. (2001) explain that the third sub-element, *instructional design and organization* (DO), is an aspect of teaching presence that involves the design, structure, process, interaction, and evaluative elements of an online course. These include the personalized facets the instructor places into the course such as organization, communication plans, explanation of activities, and assignments, all typically individualized by each instructor. Generally, the element of course design is developed and created prior to the start of the course (preplanned). Stewart (2017) explains that using the CoI framework is crucial in helping "instructors more consistently design activities that put students in situations where they are likely to benefit from interacting with peers" (p. 68), a key component within teaching presence. Peer-to-peer design activities include opportunities where instructors can create, apply, and use collaborative learning principles within course assignments, activities, group work, and course discussions (Lowenthal & Parscal, 2008; Richardson et al., 2009).

Numerous studies (Coppola et al., 2004; Palloff & Pratt, 1999; York & Richardson, 2012) have noted the need for instructors to clearly design their course, being as "transparent" as possible, "because the social cues and norms of the traditional classroom are absent" from online courses (Arbaugh & Hwang, 2006, pp. 11–12). Shea, Pickett, et al. (2003) state, "Good learning environments are *knowledge centered* in that they are designed to achieve desired learning outcomes" (p. 63). While course design is often preplanned, DO elements can (and should) be implemented and/or adjusted during the live course so that instructors can actively guide learners toward meeting the learning outcomes (Shea, Pickett, et al., 2003).

Purpose of the Study and Research Question

As learner enrollment in online courses increases, it is important to understand how the instructor contributes to teaching presence scores, specifically focusing on the three sub-elements (FD, DI, and DO) (Anderson et al., 2001). Previous studies have explored the relationships between teaching presence and online discussions (Blignaut & Trollip, 2005; Collison et al., 2000; Lowenthal & Parscal, 2008; Watson et al., 2017); however, an instructor's teaching presence goes beyond just discussion board activity. As Fiock (2020) states, "we must not exclude how an instructor's presence can be established in other aspects of the course (i.e., course announcements, weekly overviews, feedback to students or student groups, or design of assignment and course activities)" (p. 140). DI activities, such as giving detailed feedback to the learner, providing additional resources as needed, and serving as the content expert (Richardson et al., 2010), may have a greater influence than design elements of teaching presence on students' reported perceptions. Therefore, understanding the perceived differences in the three teaching presence sub-elements is an important first step in helping instructors focus their attentions on specific strategies and use of course activities when challenged with designing, facilitating, and directing online learning—especially since, as Stewart (2017) states, "CoI also helps instructors focus on what they can control—they may not be able to ensure that students will be considerate or task-oriented, but they can ensure that the activity design sets students up for success" (p. 79).

Commonly, there are two models for online course development in large online programs: (a) courses designed by instructors and (b) "standard" or "canned courses" (Puzziferro & Shelton, 2008, p. 130). In the first model, where courses are designed by the instructor, the faculty member or instructor who is teaching the course develops all the course materials and activities. In the second model, "standard" or master courses are designed by one or more instructors in unison and then copied or cloned in the learning management system to multiple sections of the same course, which then may be taught by different instructors. As no two instructors are the same, typically the instructional design and organization of class materials will vary from course to course and from instructor to instructor, especially in courses designed by the instructor. In situations where standard or canned courses are used, there are multiple sections of the same course that share the same design elements, and therefore, it may be possible to assess teaching presence differences due to instructor variability.

As such, the purpose of this study was to determine if there are statistically significant differences in teaching presence scores among multiple sections of a "standard" course where each section has identical course design but is taught by different instructors. Currently, the number of teaching presence studies focusing exclusively on the three sub-elements are small, and results are inconclusive (Caskurlu et al., 2020). Therefore, we focused on instructor differences by controlling for the variation in course contents and design as we used the data from multiple sections of the same course (i.e., "standard" courses). Consequently, the course sections as initially launched were identical, with room for differences occurring during the implementation with the various instructors and their actions. The research questions for this study were as follows:

To what extent do students report different teaching presence (TP) scores in different sections of the same course having identical design but with different instructors?

1. To what extent do student perceptions of FD of different sections of the same course vary due to the instructors?

2. To what extent do student perceptions of DI of different sections of the same course vary due to the instructors?

3. To what extent do student perceptions of instructional DO of different sections of the same course vary due to the instructors?

Method

Study Setting and Data Source

We used part of a sizable archival data set collected by an online master's program in the field of instructional design offered by a large Midwestern public university. The program was the first to go fully online at the university in 2011. Once admitted to the program, learners take 8-week long courses for five semesters. On average, 250 students per year are enrolled in the online program (with three admission start periods during the spring, summer, and fall semesters). While minimal demographic information was collected from the participants during data collection, students enrolled in the online program are generally full-time professionals and part-time students. Students range from 21 to 60 years of age, with a mean age of 37.5 years and a gender breakdown of 67.7% female and 32.3% male.

The data used for this study were obtained from two purposively selected graduate-level education courses in the fall 2017 semester. The two courses used for this study were (a) Course A: An Introduction to Learning Design and Technology, and (b) Course B: A Program Assessment and Evaluation course. The introduction course serves as launch into the field and the master's program covering broad topics such as learning theories, instructional design models, and emerging trends in the field. The assessment and evaluation course helps learners to develop their expertise in program evaluation design, using evaluation models to examine and create learning and performance interventions.

Student perceptions of TP were measured with the CoI survey (Arbaugh et al., 2008) every semester in the master's program. The survey was administered during the last week of the learners' online courses (week eight) as part of the program's course evaluation. Learners were offered 2% extra credit if 90% of students completed the survey. As part of the course evaluation process, the entire fall 2017 student population received the survey via an e-mail or course announcement, with at least one reminder e-mail or course announcement. For the study, 160 students voluntarily completed the survey (n = 57 among four sections in Course A, 57% response rate; n = 103 among seven sections in Course B, 65% response rate). Anonymity was assured as no personal or identifiable information was asked of the learners, and the survey was sent by anonymous link.

Dependent Variables

The CoI survey contains 34 items measuring presence in online courses using the three constructs (teaching, social, and cognitive presence). This study focused only on TP and its three sub-elements (FD, DI, and DO; see Appendix). The dependent variables in this study were the three sub-elements of TP. Items 1–4 addressed DO, items 5–10 addressed FD, and items 11–13 addressed DI (see Appendix for item descriptions in each sub-element). Students responded on a Likert-type scale (5 = strongly agree; 4 = agree; 3 = neutral; 2 = disagree; 1 = strongly disagree). Sub-element scores were computed by taking an average of the responses on the items relevant to the specific sub-element. Arbaugh et al. (2008) reported high Cronbach's alpha for internal consistency of .94 for TP (M = 3.34, SD = 0.61) based on all 13 items and also reported construct validity evidence for supporting the three-factor structure of the CoI with principal components analysis in graduate-level courses. For our study, Cronbach's alpha reliability index for internal consistency was computed for each sub-element, which supports a high internal consistency with the current sample. The FD sub-element (5 items) had a Cronbach's alpha for Course A, α = .954, and Course B, α = .956. The DI sub-element (3 items) had a Cronbach's alpha for Course A, α = .887, and Course B, α = .817. The DO sub-element consisted of four items and had a Cronbach's alpha for Course A, α = .906, and Course B, α = .893.

Independent Variable

The instructor of the course served as an independent variable in this study. There were four instructors in Course A and seven instructors in Course B. As shown in Table 1, the instructors for this study had varied backgrounds and experiences but all held doctoral degrees in the field of instructional design (e.g., learning design and technology, learning technologies, instructional technologies, or distance education). Prior to teaching for the university in this study, all instructors went through a vetting process to ensure program and instructor quality. This vetting process included participation in a mentor/mentee program if the instructor had no or limited online teaching experience to ensure they were prepared to teach in the program.

Table 1

Summary of Instructor Demographics by Course

Instructor	Gender	Experience
Course A		
1	F	10 years instructional design, 3 years higher ed teaching
2	F	9 years higher ed teaching, 2 years K–12 teaching
3	F	6 years higher ed teaching, 22 years in business
4	F	9 years instructional design, 4 years higher ed teaching
Course B		
5	M	17 years of instructional design, 12 years of online and face-to-face teaching
6	F	9 years online programing, 5 years K–12 teaching, 5 years higher ed teaching
7	F	6 years K–12 teaching, 5 years higher ed teaching
8	M	17 years in corporate training, 9 years higher ed teaching
9	F	7 years higher ed teaching, 6 years instructional design
10	F	25 years higher ed teaching, 6 years instructional design
11	F	9 years higher ed teaching, 6 years instructional design, 3 years K–12 teaching

Note. F = female; M = male.

Statistical Analysis Procedure

Analyses focused on participating students' self-reported TP scores in relation to the instructor who taught their course. A one-way univariate fixed-effect between-subjects analysis of variance (ANOVA) was conducted to compare the instructor effect on TP sub-elements (i.e., FD, DI, and DO) in courses with the same instructional design and organization, but different facilitation of discourse and direct instruction. The decision was made to conduct a separate univariate analysis by course and by sub-element instead of the application of multivariate analysis for the following reasons. First, we were not interested in comparing the TP differences by course. The analysis of the two courses aimed to cross-validate the findings and to verify if the same conclusion was reached for the different courses. Second, while the sub-elements of TP were highly correlated in our study, ranging from r = .699 (DO and DI for Course B) to r = .930 (DI and FD for Course A), we view these sub-elements as independent concepts within TP (Anderson et al., 2001). Third, our focus of the analysis was to shed light on each element in TP, instead of TP as a whole, to understand its potential variation by the instructor. While we acknowledge the risk of committing a Type I error by conducting multiple ANOVA analyses, Huberty and Morris (1989) support the use of multiple ANOVAs as used in this study.

Prior to the ANOVA analysis, a series of descriptive analyses were conducted to explore the impact of the outliers in dependent variables and to examine if underlying data assumptions for ANOVA were satisfied. In checking for the equality of variances, Levene's test showed that unequal variances were detected for Course A—FA: $F(3, 54) = 4.849$, $p = .005$; DI: $F(3, 53) = 4.231$, $p = .003$; and DO: $F(3, 54) = 4.786$, $p = .005$. Moreover, Course B showed unequal variances for FA—$F(6, 97) = 2.052$, $p = .066$—and DO—$F(6, 97) = 2.238$, $p = .046$—but equal variances for DI—$F(6, 96) = 2.359$, $p = .036$. This seems to be mainly due to the existence of the outliers, which also contributed to negatively skewed distributions. In addition, we observed that score distributions for some instructors were affected by a ceiling effect, which may have restricted the score range for these distributions. We carefully evaluated these outliers and decided not to exclude them because we did not detect any issue with the data entries and considered them aligned with reported responses from the population. Consistent with the observations of outliers, a set of Kolmogorov–Smirnov normality tests indicated that none of the TP sub-element data from each course followed a normal distribution. Course A showed the following: FD: $D(57) = 0.244$, $p < .001$; DI: $D(57) = 0.302$, $p < .001$; and DO: $D(57) = 0.259$, $p < .001$. And course B showed the following: FD: $D(103) = 0.152$, $p < .001$; DI: $D(103) = 0.207$, $p < .001$; and DO: $D(103) = 0.219$, $p < .001$.

With some evidence of nonnormality of data and unequal variances among instructors, we first explored the instructor variation on TP sub-elements with the application of a Kruskal–Wallis test, a nonparametric alternative to the one-way ANOVA (e.g., Harwell et al., 1992; Khan & Rayner, 2003). Because the statistical conclusions drawn from the results of the nonparametric test were consistent with those based on the ANOVA, and the ANOVA is usually robust to normality assumption violation with even with small sample size unless the kurtosis statistic is high (Khan & Rayner, 2003), we concluded that any effect of these assumption violations is inconsequential, and therefore we only report the results of the ANOVA. The statistical significance for all inferential tests was evaluated with alpha level of .05.

Results

Tables 2, 3, and 4 show descriptive summaries for each TP sub-element as functions of both course and instructor, as well as the ANOVA results.

Table 2

Descriptive Statistics of Facilitation of Discourse (FD) Scores as a Function of Instructor and Course

Course	Instructor	*n*	*M*	*SD*	*F*	*p*
A	1	10	4.38	0.778	3.745	.016*
A	2	16	4.86	0.318		
A	3	16	4.39	0.614		
A	4	16	4.01	1.021		

B	5	10	4.65	0.552	2.346	.037*
B	6	24	3.81	1.073		
B	7	10	3.67	0.926		
B	8	19	4.04	0.821		
B	9	16	3.79	0.830		
B	10	14	4.70	1.241		
B	11	10	4.70	0.436		

* $p < .05$.

Table 3

Descriptive Statistics of Direct Instruction (DI) Scores as a Function of Instructor and Course

Course	Instructor	*n*	*M*	*SD*	*F*	*p*
A	1	9	4.63	0.611	3.430	.023*
A	2	16	4.85	0.365		
A	3	16	4.42	0.639		
A	4	16	4.08	0.993		
B	5	10	4.83	0.360	2.663	.020*
B	6	24	3.81	1.063		
B	7	10	4.00	0.609		
B	8	19	3.98	0.842		
B	9	16	3.98	0.767		
B	10	14	4.67	0.938		
B	11	10	4.67	0.667		

* $p < .05$.

Table 4

Descriptive Statistics of Instructional Design and Organization (DO) Scores as a Function of Instructor and Course

Course	Instructor	*N*	*M*	*SD*	*F*	*p*
A	1	10	4.48	0.731	4.415	.008*
A	2	16	4.91	0.272		
A	3	16	4.31	0.814		
A	4	16	4.13	0.626		
B	5	10	4.80	0.468	1.934	.083
B	6	24	4.21	0.803		
B	7	10	4.15	0.412		
B	8	19	4.49	0.852		
B	9	16	4.23	0.790		
B	10	14	4.84	0.896		
B	11	11	4.84	0.358		

* $p < .05$.

In looking at the overarching research question—To what extent do students report different TP scores in different sections of the same course having identical design but with different instructors?—we found statistically significant differences. Specifically, results from the ANOVA found statistically significant differences in DI scores by instructors for both courses for the first research sub-question—To what extent do student perceptions of DI of different sections of the same course vary due to the instructors?—Course A showed $F(3, 53) = 3.430$, $p = .023$, $\omega^2 = 0.11$, and Course B, $F(6, 96) = 2.663$, $p = .020$, $\omega^2 = 0.09$. The second research sub-question—To what extent do the student perceptions of FD of different sections of the same course vary due to the instructors?—found statistically significant differences in both Course A, $F(3, 54) = 3.745$, $p = .016$, $\omega^2 = 0.12$, and Course B, $F(6, 96) = 2.346$, $p = .037$, $\omega^2 = 0.07$. Last, in answering the third research sub-question—To what extent do student perceptions of DO of different sections of the same course vary due to the instructors?—results from the ANOVA were split. Course A showed significant differences by instructor—$F(3, 54) = 4.415$, $p = .008$, $\omega^2 = 0.15$—but Course B—$F(6, 97) = 1.934$, $p = .083$—albeit trending toward significant, was not statistically significantly different. In summary, statistically significant instructor variation was observed among all TP sub-elements except the DO for Course B. The effect sizes, represented as Omega-squared (ω^2), which is known as a conservative estimate of the proportion of explained variance due to the independent variable (e.g., Privitera, 2017), are relatively small, ranging from 0.07 to 0.15. Thus, about 7% to 15% of the variation in students' perceptions on the TP sub-elements are attributed to the different course instructors.

Discussion and Implications

As the growth of online courses continues to rise, investigations into teaching presence are of great importance. Explaining how deep and meaningful learning occurs within a community through the interaction of the three presences (cognitive, social, and teaching), the CoI framework "describes and measures the elements of collaborative online learning experiences" (Caskurlu, 2018, p. 1). TP is crucial to students' perceived and actual learning and satisfaction (Caskurlu et al., 2020; Garrison & Cleveland-Innes, 2005); therefore, determining the extent to which students report different TP scores in different sections of the same course with identical design but different instructors is important; and the findings from this study reveal that students do recognize differences in instructors' direct instruction, facilitation of discourse, and the course's instructional design and organization (Garrison & Arbaugh, 2007). Using a one-way ANOVA to compare students' teaching presence scores (FD, DI, and DO), our findings show a significant instructor influence on students' reported TP scores. Next, we discuss potential explanations as to what factors may have led to our findings.

First, and not surprising, our findings align with previous CoI framework research by showing that students do recognize differences between instructors of the same course for DI. As discussions are a medium in which instructors, as subject matter experts, provide DI by sharing "intellectual and scholarly leadership" (Caskurlu, 2018, p. 3), directing and providing feedback on the discussion boards is one way to ensure learners correctly understand and apply course topics (Garrison & Arbaugh, 2007). Beyond discussion commentary, the role of learner feedback or assessment from the instructor is one focus of DI. While normally an individualized and personalized aspect, the use of "canned" feedback could demotivate students (Cole et al., 2017). York and Richardson (2012) state that "timely, relevant, and adequate feedback can influence a learner's perception of interaction" (p. 88); feedback characteristics, style, and use could explain differences in reported DI scores.

Additionally, discussions are the focus, in general, when investigating TP in online contexts (see Shea et al., 2010). Therefore, in cooperation, the peer and instructor's activity in the discussion boards may have influenced both DI and FD scores and the variance we found. The difference between the design of the discussion questions (prior to the start of the course) and instructors' FD in discussions is in how instructors effectively guide and direct students to connect with course content in their learning. Both Course A and Course B showed significant differences between instructors of the same course, leading us to believe the instructor or peer activity in the course discussions played a role in the differences we found, as they should. Further research, such as the use of qualitative analysis of discussion content and the role of peers, is required to confirm our hypothesis.

Typically, FD includes activities where instructors "review and comment upon student responses, raise questions and make observations to move discussions in a desired direction, keep discussion moving efficiently, draw out inactive students, and limit the activities of dominating posters when they become detrimental to the learning of the group" (Garrison & Arbaugh, 2007, p. 164). Therefore, how students accept or interpret these interactions from their instructor may explain the reported differences we found. In a study conducted by Morgan (2011), considerable variation was found in how instructors perceive and use the discussion boards (e.g., active instructor discussion participation vs. minimal activity). This variance in instructor participation could also be amplified by an instructor's FD. Arbaugh and Hwang

(2006) explain that "Facilitating Discourse can be done by anyone with facilitation training and skills, but only content experts can recognize content-related misconceptions or refer students to additional materials relevant to course material" (p. 12). While each instructor had a variety of teaching and professional experience (see Table 1), it is unclear whether any instructor held additional training or skills, specifically in facilitation, which may have impacted learners' perceived differences.

Dispersed between the instructor and students, TP helps to "provide students practical insights on how to be actively involved in the course thereby constructing their knowledge through collaboration, interaction with others, and experiencing others' points of views" (Caskurlu et al., 2020). While TP is most often thought of in terms of the instructor, and the CoI survey items all refer to the instructor's actions, an often-overlooked component of FD is the role of peer interactions and influence on reported FD scores. Focused on the meaningful (collaborative-constructivist) learning experience (Swan et al., 2009) in a CoI, the role of peer interactions could be a factor in the differences found between the FD and DI scores between individual instructors in both courses in this study—not necessarily the instructors' actions alone. Both instructor and peer interactions may have contributed to the 7% to 15% effect size variation in students' perceptions on the TP sub-elements. This possibility is supported by Shea, Fredericksen, et al.'s (2003) results: they found students' reported perceptions of effective peer discourse facilitation was almost as high as the instructor of the course (i.e., peer FD scores were close to the same as the reported instructor FD scores).

A finding we were not expecting was significant differences between course instructors for the DO sub-element. Since the courses in this study follow the model of using "standard" courses (i.e., courses designed by a lead instructor and then copied across multiple sections), we were not expecting to find differences. While Course B supported this hypothesis, Course A showed significant differences between instructors. A possible explanation is that Course A, as an introductory course, serves as launch into the field, providing learners opportunities to explore a range of instructional design topics, including some of their own choosing. More specifically, the course lead for Course A advised individual instructors to bring in outside resources, information, and points of view. The instructor flexibility to add in their own content into the course (via additional content, resources or required readings) may have led students to report these differences as part of the design and organization of the course. Nonetheless, the findings indicate that teaching matters, and good teaching is likely to occur when good course design is in place.

Furthermore, as instructors had varied backgrounds (e.g., Instructor 1 had 10 years of instructional design experience, and Instructor 3 had 22 years of business experience), the content and resources added to the course by each individual instructor (e.g., adding resources, creating videos, changing readings or focus of weekly topics, etc.) could be wildly different and could spark (or deter) interest in the student population, thereby explaining the significant difference and explained variance. This possible explanation aligns with Anderson et al.'s (2001) study, where they found that "the students and the teacher have expectations of the teacher communicating content knowledge that is enhanced by the teacher's personal interest, excitement and in-depth understanding of the content" (p. 8), which, based on each individual instructor's background, may be different from instructor to instructor. As described earlier, each course started with the same DO. However, while generally part of the planned portion of the course or pre-course, DO *can* occur while the course is running as it is meant to be flexible and adaptable based on meeting student needs

(Shea, Fredericksen, et al., 2003). Therefore, the changes each individual instructor made to the live, running course could have impacted the DO scores, leading to the reported differences seen in Course A.

Last, in looking specifically at the three sub-elements, Shea et al. (2006) argue that TP consists of only two sub-elements: (a) DO and (b) FD and DI combined. Caskurlu (2018) supports this claim in findings from a confirmatory factor analysis that yielded a high covariance between the two sub-elements. Especially at the undergraduate level, Garrison and Arbaugh (2007) found in their study that students may not be able to differentiate between FD and DI. Caskurlu (2018) further explains this as students not being able to distinguish between the items used to measure both FD and DI. In our study, we also found high correlations between these two (e.g., r = .930 for Course A).

Limitations and Future Research

While our findings provide unique insights into the instructional design by revealing variation in TP for the same course taught by different instructors, the study is not free from the potential threats to internal and/or external validity. First, as this was an exploratory study on the data retrieved from one online master's program in education, the interpretation of the findings may be limited to programs with similar students and instructors. Additional studies in various online settings, courses, or disciplines are warranted to enhance the findings' generalizability.

Second, while we found variation in students' TP by instructors, it is still unknown what factors contributed to the observed variations and how the peer interactions interplay in the variation. Thus, qualitative investigations will be crucial in helping us develop further understanding of these findings—for example, what specific strategies did each instructor use in their course (e.g., using audio and video elements, actively participating on discussion boards, answering e-mails quickly, providing frequent feedback, sharing of personal experiences, etc.) (Argon, 2003)?

Finally, along with the explosion of online learning opportunities, discussion of the CoI framework from theoretical and psychometric perspectives has been evolving (see Kozan & Caskurlu, 2018). The results of this study suggest further opportunity for exploration with the CoI survey redesign as TP is defined as being "distributed between students and instructor" (Garrison et al., 2000, as cited in Caskurlu et al., 2020, p. 11), yet the TP items on the CoI survey only refer to "the instructor" in the question stems (Caskurlu et al., 2020, p. 11). Additionally, Caskurlu et al. (2020) state that research into these peer interactions within a CoI are vital as they "provide students practical insights on how to be actively involved in the course thereby constructing their knowledge through collaboration, interaction with others, and experiencing others' points of views" (p. 11). Therefore, in its current state, by only focusing on the instructor, the CoI instrument misses out on measuring other dynamic interactions (e.g., peer-to-peer) crucial in a CoI (Kozan & Caskurlu, 2008). Moreover, our reported high correlations also illustrate that the three sub-elements of TP (FD, DI, and DO scores) have sizable conceptual overlaps or dependency among them. We anticipate further development of and active discussions on defining TP will continue in the field, which may lead to a better indicator of the role that the instructor plays versus peers' roles in online teaching presence scores. While these limitations would set a boundary on the contributions of the current quantitative findings for implications, they also suggest key directions or potential foci for future studies to develop deeper understanding of how TP is cultivated through the dynamic interactions of course design, instructors, and students. We hope our empirical quantitative evidence provides new insights into future research on TP.

Conclusion

Previous research (see Anderson et al., 2001; Archer, 2010; Shea et al., 2010) has called for additional inquiry into online course examinations focusing on TP and its sub-elements; this study was designed to fill this void. By using the CoI framework, we found statistically significant differences in TP scores between sections of two online courses with identical course design taught by different instructors. While reasons for the significant differences are discussed, we call for and anticipate further research to define TP and its sub-elements, especially regarding peer interactions and the role it plays in a CoI. Ultimately, our hope is that this study and its findings help move both conversations and research forward regarding TP and its sub-elements.

Acknowledgments

We would like to acknowledge and thank Dr. James Lehman for his help and guidance on this paper.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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Appendix

Community of Inquiry Survey Instrument (draft v. 14)

Teaching Presence

Design and Organization

1. The instructor clearly communicated important course topics.

2. The instructor clearly communicated important course goals.

3. The instructor provided clear instructions on how to participate in course learning activities.

4. The instructor clearly communicated important due dates/time frames for learning activities.

Facilitation

5. The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.

6. The instructor was helpful in guiding the class toward understanding course topics in a way that helped me clarify my thinking.

7. The instructor helped to keep course participants engaged and participating in productive dialogue.

8. The instructor helped keep the course participants on task in a way that helped me to learn.

9. The instructor encouraged course participants to explore new concepts in this course.

10. Instructor actions reinforced the development of a sense of community among course participants.

Direct Instruction

11. The instructor helped to focus discussion on relevant issues in a way that helped me to learn.

12. The instructor provided feedback that helped me understand my strengths and weaknesses relative to the course's goals and objectives.

13. The instructor provided feedback in a timely fashion.

Social Presence

Affective Expression

14. Getting to know other course participants gave me a sense of belonging in the course.

15. I was able to form distinct impressions of some course participants.

16. Online or Web-based communication is an excellent medium for social interaction.

Open Communication

17. I felt comfortable conversing through the online medium.

18. I felt comfortable participating in the course discussions.

19. I felt comfortable interacting with other course participants.

Group Cohesion

20. I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.

21. I felt that my point of view was acknowledged by other course participants.

22. Online discussions help me to develop a sense of collaboration.

Cognitive Presence

Triggering Event

23. Problems posed increased my interest in course issues.

24. Course activities piqued my curiosity.

25. I felt motivated to explore content-related questions.

Exploration

26. I used a variety of information sources to explore problems posed in this course.

27. Brainstorming and finding relevant information helped me resolve content-related questions.

28. Online discussions were valuable in helping me appreciate different perspectives.

Integration

29. Combining new information helped me answer questions raised in course activities.

30. Learning activities helped me construct explanations/solutions.

31. Reflection on course content and discussions helped me understand fundamental concepts in this class.

Resolution

32. I can describe ways to test and apply the knowledge created in this course.

33. I have developed solutions to course problems that can be applied in practice.

34. I can apply the knowledge created in this course to my work or other non–class-related activities.

5-Point Likert-Type Scale

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 22, Number 3

August – 2021

Instructor Presence and Student Satisfaction Across Modalities: Survey Data on Student Preferences in Online and On-Campus Courses

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Abstract

Post-COVID-19, many, if not most, college and university instructors teach both online and face-to-face, and, given that online courses historically have higher attrition rates, designing and facilitating effective online courses is key to student retention. Students need online and on-campus courses that are well designed and facilitated, but even well-designed classes can be ineffective if students feel lost in the course or disengaged from the instructor. We surveyed 2,007 undergraduate students at a public, metropolitan university in the United States about the best and worst classes they had taken at the university. The resulting data revealed important consistencies across modalities—such as the importance of clear instructions and instructor availability. However, students responded that instructors matter more in face-to-face courses, where they can establish personal relationships with students, whereas assignments "stand in" for instructors in online classes. These findings support the need for increased faculty professional development in online course design and facilitation focused on student experience as well as faculty expertise.

Keywords: online education, survey research, online student, online instructor, online accessibility, face-to-face

Introduction

Some elements of good teaching are not modality-dependent. Effective communication and instructor availability are important for both face-to-face and online classes. Other factors, however, differ by modality: technology access, contact hours, amount and type of written communication, and student control of the learning process. Beyond instructor and student issues lie problems outside of anyone's control, such as the COVID-19 pandemic of 2020. But as research by Glazier et al. (2019) indicates, the more online courses a postsecondary student takes, the less likely they are to succeed (see also Shea & Bidjerano, 2018). Studies indicate that the most common factors impacting online student retention are student motivation and faculty/student interaction or engagement (Seery et. al., 2021). Our research questioned whether we could apply what we know of faculty/student interactions from face-to-face education to inform our online pedagogy and improve retention.

In order to explore the similarities and differences between face-to-face and online classes from a student perspective, we employed a multi-method approach to collect both qualitative and quantitative data via surveys of 2,007 students at the University of Arkansas at Little Rock (UA Little Rock), a major metropolitan university, to ask them about the "best" and "worst" classes they had taken at that university. With 58% of students at UA Little Rock taking at least one online class, the resulting data contained responses about both online and face-to-face best and worst classes. These data made it possible to answer the following questions:

1. What elements of the classroom, teacher, and learning experience contribute to students indicating that a class was the best or worst class?
2. In what ways are the best online classes different from the best face-to-face classes?
3. How can we recognize and translate good face-to-face teaching to online environments?

This study contributes to the growing literature in online and distance learning both by centering student voices comparing their online and face-to-face learning experiences and by taking a multi-method approach to understanding the best practices across modalities.

Retention in Online Classes

Online students may struggle to stay in school for a variety of personal and educational reasons. Fewer students persist in online courses than in face-to-face courses, with attrition in online classes reaching as high as 50% (Carr-Chellman & Duchastel, 2000; Levy, 2007; McLaren, 2004; Tello, 2007). Across differences in course and program type, students in online courses consistently fail or drop their classes at higher rates (Bolsen et al., 2016; Glazier, 2016; Jaggars, 2014; Patterson & McFadden, 2009). While overall retention and completion of college degrees can be improved by the availability of online courses (Glader, 2013), individual courses themselves still face lower retention rates than their face-to-face counterparts.

On the surface, technology is the most obvious difference between online and face-to-face courses. For those faculty teaching online with little or no preparation, technology can be a significant impediment to effective online teaching (Magda et al., 2015). When technology is used well, on the other hand, it can positively impact student engagement, making students more likely to respond positively to academic challenges, active and collaborative learning, and student-faculty interaction, generally making for a more supportive campus environment (Chen et al., 2009).

However, when technology is not just a tool, but the only way to communicate with the instructor and other students in the class, a very high level of transactional distance (TD) is created. Moore (2013) found that TD was the single biggest predictor of student satisfaction in online classes, a finding confirmed by more recent research as well (Weidlich & Bastiaens, 2018). Low online retention rates are explained, in part, by the potentially high barrier to contact and relationship-building between faculty and students in online courses. Online rapport has only recently begun to be defined (Murphy & Rodríguez-Manzanares, 2012), measured (Lammers & Gillaspy Jr., 2013), and evaluated (Kanasa, 2017; Kupczynski et al., 2010; Sher, 2009), but it appears to be more difficult to create rapport in online classes than in face-to-face classes. In a study of community college students, Jaggars (2014) found that face-to-face courses had better peer-to-peer and student-instructor interaction than online courses, and that the students preferred to take more important or difficult courses face-to-face.

Faculty recognize that building relationships with students in online classes is time-consuming (Aquila, 2017; Worley & Tesdell, 2009). Sometimes those efforts are not rewarded. For instance, Preisman (2014) demonstrated that the additional time spent in developing instructor presence through video lectures, audio feedback, and increased discussion board participation did not lead to significant gains in student grades or course evaluations. Skurat Harris et al. (2019) found that students lack understanding of how course tools and content, such as discussion boards and videos, connect to their instructor and instruction in online courses. They found that students were most satisfied when provided direct feedback from faculty compared to engaging in either discussion boards or peer review activities (see also Gaytan, 2015). In short, immediacy is simply harder to create in an online environment (Preisman 2014).

This study sought to further understand the benefits of and barriers to student satisfaction with online classes. While satisfaction is only one element in a complex web of factors related to online learning success (Gering et al., 2018), lower retention rates in online classes prompted us to try to understand how to teach online classes so that students will stay in them.

Building rapport in online classes to improve engagement and retention is challenging, given the TD of online modalities, so we expected that the most important difference between online and face-to-face classes was the distance between the instructor and the student. In face-to-face classes, students personally interact with the instructor and are more likely to develop a relationship with the instructor through both formal and informal opportunities for human connection. Specifically, given the key difference of distance between instructors and students in online classes, we posited three hypotheses:

- Hypothesis 1: Online courses will be less likely to be considered “best” courses.

- Hypothesis 2: Instructors will be more important for "best" course designation in face-to-face courses, compared to online courses.
- Hypothesis 3: Students who emphasize the instructor of the course will be more likely to designate the course as a "best" course.

Method

A Multi-Method Approach to Comparing Best and Worst Online and Face-to-Face Classes

In order to better understand students' views of the differences between online and face-to-face classes, we surveyed graduate and undergraduate students at the University of Arkansas at Little Rock. UA Little Rock is a metropolitan university in the capital city of the state of Arkansas with an undergraduate and graduate student population of 8,473 at the time of the survey (spring 2018). UA Little Rock offers many online courses and 58% of the student body was enrolled in at least one online class in spring 2018, making the educational profile of UA Little Rock an excellent fit for an examination of the differences between online and face-to-face classes.

After gaining approval from the university's Institutional Review Board (IRB# 18-001-R4) and access to the university's list of student email addresses, every enrolled student received two email invitations: one to participate in a survey about the best class they had ever taken at UA Little Rock and one to participate in a survey about the worst class they had ever taken there. A total of 2,007 students responded: 1,070 completed the survey about the worst class (53.31% of our total sample) and 937 completed the survey about the best class (46.69% of our sample). The content of the two surveys was the same, with the best/worst language adjusted as needed. Students were allowed to complete both surveys but, due to confidentiality, we do not know how many did.

We were particularly interested in how student perceptions of the characteristics and actions of the instructor influenced their evaluations of a class. We measured these perceptions through a series of survey questions. Full question wording, summary statistics, and coding are available in Table A1 in the Appendix.

First, in order to measure student perceptions of instructor communication, we asked how much students agreed with the statement "The instructor communicates effectively with me" (coded on a Likert scale from 1=*strongly disagree* to 5=*strongly agree*). We also asked students what contributed the most to their evaluation of the course as the best/worst course and provided them with four forced-choice response options (interest in the subject; the instructor; the assignments, readings, and activities in the course; and, personal circumstances at the time they took the class). We created a binary variable for each of these response options. For instance, those students who picked the instructor as the factor that most influenced their evaluation of the course as the best/worst were coded one on the "instructor most important" binary variable, with all others coded zero.

In a separate question, we asked students to rank which was most important to their evaluation of a class as the best/worst: instructor relationship, instructor attitude, instructor engagement, or course organization. Students ordered the four options 1 to 4, with numbers closer to 1 indicating more importance.

We were also interested in how student perceptions of instructor availability might influence their evaluations of the class. We asked students how available their instructor was to them in person, in video conference, on the phone, and through email. These four communication methods were then summed up into a single measure of instructor availability. Thus, for example, a professor who was available through all four would have a score of 4 compared to a score of 1 for a professor who was only available through email.

We included a number of controls to account for the characteristics of the course. Most importantly, we asked students whether the course was taught face-to-face or online. We also asked students whether the class was in their major, whether the course was a university-required core course, the grade they earned (or expected to earn) in the course, and their interest in the subject of the course.

Beyond the course and the instructor, student characteristics could have influenced their selection of a class as best/worst. We considered the demographic variables of gender, age, and race/ethnicity. We also included two student academic variables: their year in college (sophomore, junior, etc.) and their GPA. Question wording and summary statistics are provided in Table A1 in the Appendix.

In both surveys, students were provided with space to write open-ended comments about the course and the vast majority did (92.2%; n = 1,851). We wanted to capture the data provided by each individual thought students wrote in the open-ended comments, so we used sentence fragments as the units of analysis (n = 4,096). The qualitative answers were open and axial coded by both authors (Strauss & Corbin, 1998) to develop categories with similar descriptive traits. Individual student comments were identified as being primarily about the course or about the instructor. Then, the comments were organized by phenomenon within those categories. Each unit was coded for both substance (e.g., enthusiasm, communication, etc.) as well as for tone (i.e., negative, neutral, or positive). A random subset of 75 responses was evaluated to determine inter-coder reliability (Cohen's Kappa = 0.857). Four codes from the open-ended data were used in the analysis: mentions of the instructor as caring, enthusiastic, engaged, and communicative. The full codebook is available from the authors upon request.

Results and Discussion

We turn first to quantitative data and difference of means tests to understand the variables that impact student satisfaction with their courses. About two thirds of respondents told us about a face-to-face class and about one-third told us about an online class. Of those who responded about a face-to-face class, 714 or about 52% said it was the best and 662 (about 48%) said it was the worst. For those describing an online class, only 223 or about 35% said it was a best class. The data indicate that fewer students chose online classes as the best classes they had ever taken, but there were fewer instances in which students talked about online classes. More detailed data are presented in Table 1.

Table 1

Student Respondent N *by Course Designation and Modality*

Course modality	Worst	Best	Total
Face-to-Face	662	714	1,376
Online	408	223	631
Total	1,070	937	2,007

These data indicate that online classes were significantly less likely than face-to-face classes—35% to 51%—to be categorized as a best class, a finding supportive of Hypothesis 1. Yet, about 24% of all best classes chosen were online classes, which is not an insignificant number: almost 1,000 students chose to tell us about their best class and nearly a quarter picked an online class.

How are the best face-to-face and the best online classes similar and different? For the variables presented in the following four tables, we first calculate the mean scores for each survey question and each modality. In the column furthest to the right, we display the difference between the online and face-to-face class means. An asterisk indicates whether these differences are significant (i.e., whether there is no overlap between the 95% confidence intervals of the two mean scores). The first set of comparisons is in terms of how the instructors of the courses are viewed (Table 2).

The means comparisons in Table 2 provided our first opportunity to evaluate Hypothesis 2 (H2)—that instructor characteristics matter more for face-to-face than online classes. We see only two variables that reach statistical significance in Table 2: students who selected a face-to-face class as the best were more likely to leave an open-ended comment mentioning the enthusiasm and caring of the instructor.

Table 2

Difference of Means Tests Comparing Best Face-to-Face and Online Classes: Instructor Characteristics

Instructor characteristic	Overall	Face-to-Face	Online	Difference
		Open-ended responses		
Caring	0.18	0.2	0.12	0.08*
Engaged	0.28	0.28	0.28	0
Enthusiastic	0.09	0.11	0.03	0.08*
Communicative	0.11	0.11	0.14	0.03
		Survey questions		
Availability	13.52	13.48	13.65	0.17
Communicates effectively	4.71	4.72	4.69	0.03

*$p < .05$

Engagement and communication—two behaviors that may be easier to convey electronically—were not significantly different. Additionally, and in the same vein, quantitative survey questions about the availability of the instructor and the instructor's communication were indistinguishable across course mediums. These findings provide mixed support for H2. It seems as though *some* instructor characteristics were more important for face-to-face classes, but not all.

We saw stronger support for H2 when it came to the reasons why a student selected a course as the best. Those comparisons are presented in Table 3, where we see that those who chose a face-to-face class as the best were both more likely to say the instructor was the most important factor in that selection and more likely to rank their relationship with the instructor and the instructor's attitude as important. Those students who selected an online class as the best, on the other hand, were significantly more likely to say that assignments were the most important factor, and they ranked course organization significantly higher than students who chose face-to-face classes.

Table 3

Difference of Means Tests Comparing Best Face-to-Face and Online Classes: Main Factor Influencing Selection

Factor	Overall	Face-to-Face	Online	Difference
Most important factor in selection				
Interest in the subject	0.16	0.15	0.19	0.04
Personal situation	0.02	0.02	0.05	0.03
Instructor	0.62	0.67	0.43	0.24*
Assignments	0.14	0.1	0.27	0.17*
Comparative rankings of influences on best class selection				
Instructor relationship	2.72	2.64	3.03	0.39*
Instructor attitude	1.94	1.83	2.34	0.51*
Instructor engagement	2.36	2.41	2.16	0.25
Course organization	2.97	3.1	2.45	0.65*
n	937	714	223	

*$p < .05$

In line with our theoretical expectations, these results indicate that instructors connected more often with students in face-to-face classes. Their students noticed that relationship, and the instructor's attitude influenced their evaluation of the course. In online classes, on the other hand, personal interactions are less common by definition. Assignments and course organization thus become more important and weigh more heavily as students evaluate the course.

How are the *worst* face-to-face and online classes similar and different? We conducted the same difference of means tests to compare the worst face-to-face and online classes, shown in Tables 4 and 5. In Table 4, we can again evaluate H2 as we compare the importance of the instructor in the worst face-to-face classes and the worst online classes.

Table 4

Difference of Means Tests Comparing Worst Face-to-Face and Online Classes: Instructor Characteristics

Characteristics	Overall	Face-to-Face	Online	Difference
Open-ended responses				
Caring	0.15	0.19	0.09	0.1*
Engaged	0.17	0.12	0.24	0.12*
Enthusiastic	0.05	0.07	0.01	0.06
Communication	0.18	0.18	0.17	0.01
Survey questions				
Instructor availability	8.81	8.816	8.818	0.002
Instructor communicates effectively	2.58	2.583	2.581	0.002

*$p < .05$

We see support for H2 once again as significantly more students in face-to-face classes mentioned instructor caring in their open-ended responses. Because we were talking about worst classes as opposed best classes, the word "caring" in an open-ended comment almost certainly carries a very different meaning. Thus, it appears the lack of a caring instructor contributes to worst class evaluations in face-to-face classes more than in online classes, just as the presence of a caring instructor contributes to best class evaluations in face-to-face classes more than in online classes. In both cases, the students noted caring (or lack of) more often when they had contact with instructors through face-to-face classes.

Thus, comparing Table 2 to Table 4 reveals an initial lack of support for Hypothesis 3 (H3). Instructors seemed to matter to students both when they were weighing the designation of a class as the best and when they were considering it to have been the worst.

Table 5 presents the factors that mattered most in student evaluations of the worst classes by modality. Students in the worst face-to-face classes were significantly more likely to say the instructor mattered the most in their evaluation of the course, whereas students in the worst online classes say assignments mattered most. Engagement is also significantly different across course delivery modes as shown in Table 5. Students in the worst online classes were more likely to mention instructor engagement (likely the lack of engagement) in their open-ended comments, which supports H2. We suspect that, just as students might be less likely to stay plugged into their online classes without the physical class meeting multiple times each week, instructors are likely to do the same. Importantly, students noticed when online instructors checked out. Positive engagement did not help in the best online classes any more than the best face-to-face classes, but a *lack* of instructor engagement hurt the worst online classes more than it hurt the worst face-to-face classes.

In terms of rankings, we saw again that instructor attitude mattered more in face-to-face classes—perhaps because attitude is less easily communicated electronically. When it comes to the worst classes, however, course organization was not significantly different across modes as it was for the best classes.

Table 5

Difference of Means Tests Comparing Worst Face-to-Face and Online Classes: Main Factor Influencing Selection

Factor	Overall	Face-to-Face	Online	Difference
Most important factor in selection				
Interest in the subject	0.06	0.04	0.07	0.03
Personal situation	0.03	0.02	0.04	0.02
Instructor	0.57	0.63	0.46	0.17*
Assignments	0.27	0.21	0.36	0.15*
Comparative rankings of influences on worst class selection				
Instructor relationship	2.78	2.75	2.84	0.09
Instructor attitude	2.49	2.39	2.65	0.26*
Instructor engagement	2.34	2.45	2.16	0.29*
Course organization	2.37	2.33	2.39	0.06
n	1.070	662	408	

*p < .05

We ran a series of logit models with the binary best class designation as the dependent variable and including a number of independent variables as specified in the Method section of this paper. The logit models evaluated the relative influence of these variables simultaneously to assess all three hypotheses, providing a more nuanced picture of the relationships among variables and allowing researchers to see the influence of each, even when a study population was not representative. By including the online course modality variable, we could test H1 (online courses were less likely to be considered "best" classes by students). By including instructor variables, we could test H3 (students who emphasize the instructor will be more likely to designate a course as the "best" class). We also ran separate models for online and face-to-face classes so we could evaluate H2 (importance of instructors in "best" online and face-to-face courses). The full results of all models are included in the Appendix.

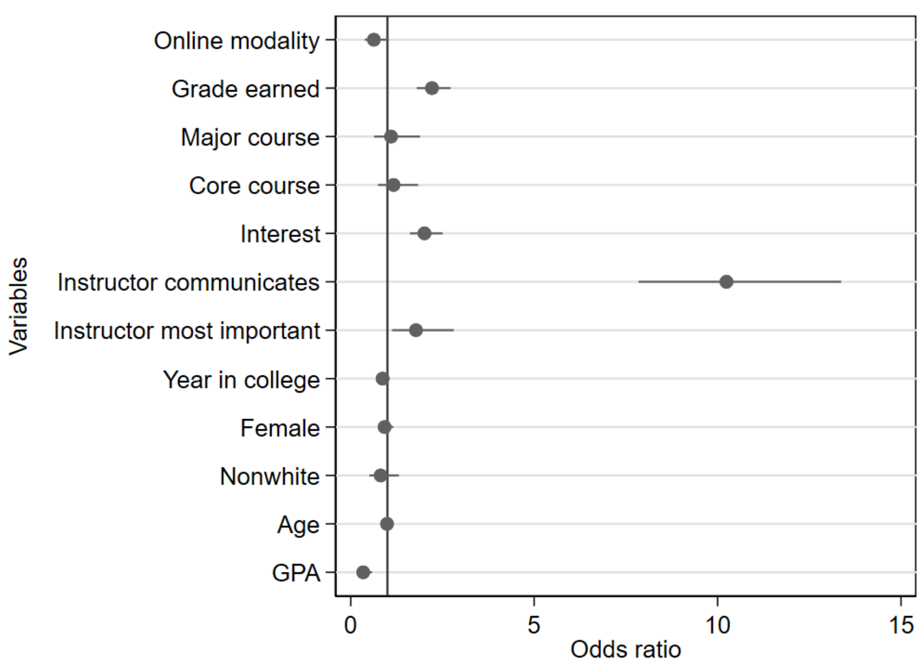
Five variables emerged as highly significant in determining whether a course was selected as the best course a student had taken at UA Little Rock, the odds ratios for which are presented in Figure 1. Odds ratios are a standardized measure of the impact of each variable in a logit model. First, the grade earned and interest in the subject were deemed significant in influencing whether a course would be selected as best. Students liked classes in which they were interested and achieved good grades. Additionally, students with high GPAs were less likely to designate a course as a best course. We can only speculate, but high-achieving students may have higher standards for teaching excellence.

Contrary to the expectations of H1, online courses were not less likely to be named by students as the best classes they had taken. Although fewer of the aggregate best classes were online classes, the statistical models take more factors into account and do not show that course modality was a significant factor. Online classes were not inherently worse than face-to-face classes for this sample.

The instructor as the most important factor is also a significant predictor of best class designation. As the odds ratios in Figure 1 indicate, far and away the most important variable in the model of best course selection was effective communication from the instructor. The strong impact of this variable was partially due to the question wording and the construction of the models. Instructor importance could have applied to either good or bad courses, but effective communication was likely to only be associated with good classes, so a stronger relationship in the model makes sense. This result also indicates how important effective communication is to students, which is a message reinforced by the qualitative data below. These findings support H3: instructors matter a great deal in best and worst classes.

Figure 1

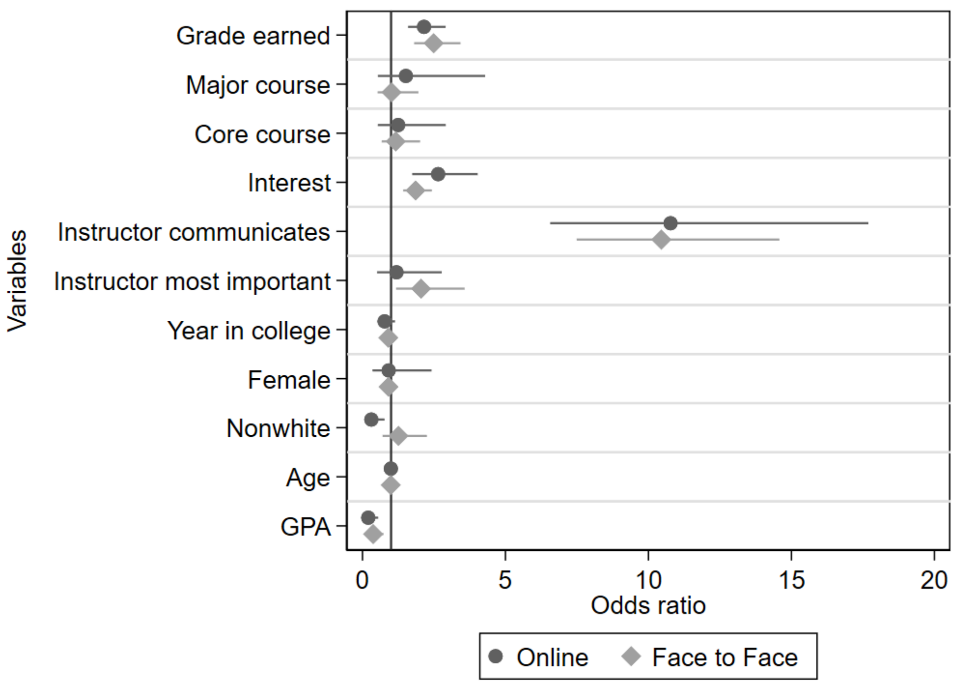
Odds Ratios of Best Class Logit Results



In order to directly compare those factors that influenced the selection of a class as the best online or face-to-face, we ran the same logit models for both modalities separately (full model results are available in the Appendix). The results are presented in Figure 2.

Figure 2

Best Class Logit Results, by Modality



In support of H2, the variable for the instructor as the most important factor was significant for the face-to-face model but not for the online model, indicating that instructors were more important for face-to-face classes. This finding reinforced the major difference we noted as key to lower retention rates in online classes—the distance between instructor and student created by the electronic barrier. A second, unanticipated difference was that non-white students were significantly less likely to designate an online class as their best classes, but ethnicity was not significant in the face-to-face model. Minority students, who comprise 45% of the student population at the UA Little Rock (University of Arkansas at Little Rock, 2019), may not be as well-served by online classes, a finding seen elsewhere in the literature (Jaggars, 2014).

Qualitative Data About Best and Worst Classes

We can better understand the student experience in both online and face-to-face classes by looking at the open-ended responses to the question "What makes this class the [best/worst] one you have taken at UA Little Rock?" Approximately 92% of survey respondents answered this open-ended question (n = 1,851), and we coded sentence fragments to capture each unique idea communicated about the class (n = 4,096).

Students emphasized the importance of different elements in online and face-to-face classes (summarized in Table 6).

Table 6

Prevalence of Open-Ended Comments Regarding What Makes a Class the Best, by Modality

Online		Face-to-Face	
Response	%	Response	%
The online modality was less distracting or better.	15	The class included interactive or project-based learning.	14
The instructor provided clear instructions and expectations.	14	The class included interesting discussions	11
The class included interactive or project-based learning	11	Instructor was engaged and enthusiastic.	11
The instructor was available.	11	The course provided real-world experience.	10
The instructor/class was organized.	11	The instructor was caring.	9
Instructor replied to inquiries promptly.	10	The instructor provided clear instructions and expectations.	9
The course provided real-world experience.	9	The instructor is knowledgeable.	8
The information was useful and/or interesting.	9		
The course included consistent deadlines.	8		

Note. the % indicates the percent of total student respondents completing the best survey (n=937).

Students found relevant, clearly communicated content important in both face-to-face and online courses. Students wanted information that was beneficial to their careers and lives, and faculty who explained it well and assessed it fairly. Regardless of modality, students found clear instructional communication and relevant and well-designed courses (aligned course outcomes, lectures, assignments, and tests) key to their satisfaction with courses. Students wanted faculty to explain materials and take time to talk them through course assignments. In the best face-to-face classes, students indicated that a variety of engaging, interactive assignments were an important feature (i.e., “project-based learning,” “in-class practice,” “hands-on assignments,” “guest speakers,” “field trips,” “labs,” and/or “writing assignments”).

Instructor and classroom organization was more important in online classes than face-to-face classes, as were instructors who responded in a timely manner, particularly to student email requests. The best online courses allowed students to work around their schedules and stayed on schedule consistently.

Instructor enthusiasm and caring were more important in face-to-face than online classes. In face-to-face classes, students described the instructors of the best classes using words such as “kind,” “caring,” “nice,” “friendly,” and “polite.” Students’ instructors in their best face-to-face classes were enthusiastic, dynamic, energetic, and passionate. Instructor attitude was not as important online as was attentiveness, timeliness, and clarity of communication. Students in the best online classes were more likely to describe their instructors as available rather than caring.

Sixty-two percent of students completing the worst class survey identified a face-to-face class as their worst class, and 38% identified an online class as their worst class. Instructor availability in online and face-to-face classes showed a much greater gap than any other area. Thirty-five percent of open-ended responses in the worst online classes and 10% of open-ended responses in the worst face-to-face classes mentioned instructor availability. Poor instructor responsiveness was the single most important factor for either a best or worst class. In the worst classes, students described faculty as unapproachable, unwilling to be questioned, absent, and unresponsive.

In many ways, the qualitative results of student-identified worst classes mirrored those of the student-identified best classes. Regardless of modality, students wanted classes to provide a worthwhile learning experience. Students expressed frustration with what they perceived as lack of instruction regarding unrelated content. Some students remarked that instructors in their worst classes expected them to already know content or assumed relevant content would be covered later in the program (see Table 7).

Table 7

Prevalence of Open-Ended Comments Regarding What Makes a Class the Worst, by Modality

Online		Face-to-Face	
Response	%	Response	%
The instructor was unavailable or unresponsive.	35	The instructor provided little instruction on assignments and activities.	14
The instructor was unclear about expectations and the purpose of assignments.	14	The class did not teach anything worthwhile and/or was a waste of time and money.	13
The class was too difficult and/or the workload was too demanding.	14	The instructor was belittling and/or talked down to students in the class.	13
The instructor graded unfairly or subjectively.	10	The instructor gave lectures that were boring and/or lectures were the primary instruction in the class.	13
The class did not teach anything worthwhile and/or was a waste of time and money.	9	The instructor was unavailable or unresponsive.	10

The class assignments and exams did not align or cover the same content as the instructional materials for the course.	8	The instructor was unfair or inflexible.	10
		The class assignments and exams did not align with or cover the same content as the instructional materials for the course.	9
		The instructor was unorganized.	8

Note. the % indicates the percent of total student respondents completing the worst survey (n=1070).

Poor course design was also a frequent concern of students regardless of modality. Students commented that worst classes included assignments and exams that did not align with course objectives. They did not feel adequately prepared for assessments and felt like the instructor was unfair or inflexible. In the worst classes, the grading systems did not make sense to the students, and the tests felt “impossible.”

The most striking qualitative answers for the worst classes reinforced quantitative survey responses. Students in the worst face-to-face classes indicated that their instructors would neither let students ask questions nor answer them. These instructors were unavailable, did not answer emails, and were “unresponsive” or “unapproachable.” In the worst online classes, students indicated that there was no instructor interaction; the instructor uploaded textbooks and tests, and then “disappeared.”

The negative personal interactions in the worst face-to-face classes came through in the open-ended comments as well, where students described the instructors as openly offensive, using terms such as “sarcastic,” “rude,” “belittling,” “defensive,” “bigoted,” and “racist.” Students claimed that bad instructors talked down to the class or were openly hostile. Open-ended responses told us that the instructors in these classes were “boring,” and lectures went “by the book.” There was little discussion, poor organization, and lectures, if any, were perfunctory.

Students in the worst online classes emphasized assignments and organization as important to their experiences in these classes. Students said the worst online classes had instructors who were unclear or confusing about expectations and assignments. Students in the worst online classes were also more likely to say that the class was difficult or that the workload was too hard. Assignments were seen as online busywork not associated to class hours.

Conclusion

Face-to-face students respond positively to instructors who demonstrate engagement and caring. This is much harder to do online, but research indicates that building rapport and relationships with students in online classes can improve their retention and success (Glader, 2013; Glazier, 2016, 2021). Instructors and instruction matter for both online and face-to-face classes, and instructors have an opportunity to make a positive impact on student retention and success by being available and communicating clearly with their students.

Instructors who teach the best online and face-to-face classes have many things in common. They are engaged and available. However, students more often note caring (or lack of) when they have personal contact with instructors through face-to-face classes. Both the statistically significant findings in our quantitative analyses and additional insights provided by the qualitative data indicate that instructors in both online and face-to-face classes can improve their courses by being available and supportive, and by communicating clearly with their students. In either modality, students wanted information beneficial to their careers and lives, and they wanted instructors to explain it well and assess it fairly.

There are some key points of difference across formats, which are instructive to note. Students in the worst face-to-face classes were more likely to say the instructors mattered the most in their evaluation of the course, whereas students in the worst online classes said assignments mattered the most. However, both the quantitative and qualitative data indicated that effective communication was key to the best courses. While student retention and success in any class is the result of a variety of factors, effective instructors and clearly delivered instruction matter a great deal to student success.

In line with our theoretical expectations regarding transactional distance, students connected more easily with instructors in face-to-face classes. In online classes, on the other hand, synchronous personal interactions are often limited, and assignments and course organization may become more important. In some ways, the instruction *is* the instructor in an online course, making clear and consistent course materials even more important. If online instructors are more purposeful in reaching out to and connecting with students, and if they pay particular attention to their communication with students, they may increase online student retention.

Further research should identify how instructors can close the transactional distance and build rapport in online classes, and how doing so relates to student retention. Our research here was limited in that it took place on a single campus. Future studies could examine other student populations, in addition to identifying whether institutions can train their online instructors in effective strategies to mitigate transactional distance and improve rapport (Bok, 2017; Lichoro, 2015).

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Appendix

Table A1

Survey Question Wording and Descriptive Statistics

Question wording	Coding	Descriptive statistics
Please rank the following four factors on their contribution to making this the [BEST/WORST] class.		
Your instructor’s relationship with you (for example: respect, understanding, annoyance)	Responses coded 1 to 4 with numbers closer to 1 indicating that the factor is ranked as more important.	Range: 0 to 4 *M*: 2.75 *SD*: 1.06 *N*: 1,615
Your instructor’s attitude about the course (for example: enthusiasm, positivity, the way teaching responsibilities were prioritized)	Responses coded 1 to 4 with numbers closer to 1 indicating that the factor is ranked as more important.	Range: 0 to 4 *M*: 2.23 *SD*: 1.08 *N*: 1,615
Your instructor’s engagement with you (for example: response time, feedback, participation in class)	Responses coded 1 to 4 with numbers closer to 1 indicating that the factor is ranked as more important.	Range: 0 to 4 *M*: 2.35 *SD*: 0.98 *N*: 1,615
Course organization (for example: syllabus, due dates, assignments)	Responses coded 1 to 4 with numbers closer to 1 indicating that the factor is ranked as more important.	Range: 0 to 4 *M*: 2.65 *SD*: 1.24 *N*: 1,615
Whenever you have an issue, how often is the instructor available to you? Questions asked for in-person, in video conference, on the phone, and through email availability.	Response options are *always*, *sometimes*, *rarely*, and *never*, with higher numbers indicating more availability. All 4 are summed into a single measure of availability.	Range: 4 to 16 *M*: 11.92 *SD*: 3.59 *N*: 339
To what extent does the instructor effectively communicate with you?	Response options from 1 to 5 with higher numbers indicating more effective communication.	Range: 1 to 5 *M*: 3.65 *SD*: 1.34 *N*: 1800
What reason contributed the MOST to this course being the [BEST/WORST] class you have taken at the University of Arkansas at Little Rock?		
My interest in the subject	Each option is treated as a dummy variable and coded 1 if it is selected and 0 if it is not.	Range: 0 to 1 *M*: 0.109 *SD*: 0.312 *N*: 2,007

The instructor	Each option is treated as a dummy variable and coded 1 if it is selected and 0 if it is not.	Range: 0 to 1 *M*: 0.593 *SD*: 0.491 *N*: 2,007
Assignments/readings/activities	Each option is treated as a dummy variable and coded 1 if it is selected and 0 if it is not.	Range: 0 to 1 *M*: 0.213 *SD*: 0.409 *N*: 2,007
My personal circumstances at the time I took the class	Each option is treated as a dummy variable and coded 1 if it is selected and 0 if it is not.	Range: 0 to 1 *M*: 0.032 *SD*: 0.177 *N*: 2007
GPA		Range: 1.3 to 4 *M*: 3.464 *SD*: 0.466 *N*: 1758
Year in college		First year: 190 Sophomore: 279 Junior: 425 Senior: 553 Graduate: 433
Year born		Range: 1920 to 2000 *M*: 1988 *SD*: 11.04 *N*: 1,762
Race/Ethnicity		White: 1,205 (63.6%) Black: 389 (20.5%) Hispanic or Latino/a: 100 (5.3%) Asian: 116 (6.1%) Native American or Pacific Islander: 19 (1%) Other: 64 (3.4%)
Gender		Female: 1,335 (70.1%) Male: 551 (28.9%) Other: 18 (0.09%)

Table A2

Logit Model of Best Class Designation

Variable	Coefficient	Odds Ratio
Online course	-0.462 (0.253)	
Grade earned	0.795*** (0.105)	2.214
Course is in major	-0.095 (0.276)	
Course is in the core	0.115 (0.112)	
Interest in course	0.698*** (0.112)	2.010
Instructor communicates effectively	2.326*** (0.136)	10.241
Instructor is the most important factor	0.575** (0.232)	1.778
Year in college	-0.141 (0.101)	
Female	-0.079 (0.115)	
Nonwhite	-0.203 (0.242)	
Age	-0.009 (0.011)	
GPA	-1.078*** (0.273)	0.339
Constant	-10.641 (0.81 0)	
N	1,403	
Pseudo *R*2	0.71	

Note. Standard errors are in parentheses.

*p < .05, **p < .01, ***p < .001

Table A3

Logit Models of Best Class Designation by Course Modality

Face-to-Face			Online		
Variable	Coefficient	Odds ratio	Variable	Coefficient	Odds ratio
Grade earned	0.991*** (0.163)	2.488	Grade earned	0.766*** (0.153)	2.152
Course is in major	0.016 (0.333)		Course is in major	0.417 (0.529)	
Course is in the core	0.151 (0.280)		Course is in the core	0.222 (0.432)	
Interest in course	0.619*** (0.136)	1.857	Interest in course	0.972*** (0.214)	2.645
Instructor communicates effectively	2.346*** (0.169)	10.449	Instructor communicates effectively	2.377*** (0.252)	10.774
Instructor is the most important factor	0.717** (0.283)	2.049	Instructor is the most important factor	0.173 (0.431)	
Year in college	-0.100 (0.122)		Year in college	-0.255 (0.196)	
Female	-0.093 (0.121)		Female	-0.086 (0.494)	
Nonwhite	-0.229 (0.297)		Nonwhite	-1.168* (0.464)	0.311
Age	-0.011 (0.014)		Age	-0.006 (0.018)	
GPA	-0.983***(0.344)	0.374	GPA	-1.059***(0.510)	0.202
Constant	-11.553 (1.422)		Constant	-9.904 (1.886)	
N	967		*N*	436	
Pseudo *R*2	0.711		Pseudo *R*2	0.706	

Note. standard errors are in parentheses.

*p < .05, **p < .01, ***p < .001.

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 22, Number 3

August – 2021

Video Lectures: An Analysis of Their Useful Life Span and Sustainable Production

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Abstract

The learning effectiveness of video lectures has been extensively studied by the scientific community, but research on their cost-effectiveness and sustainable production is still very scarce. To shed light on these aspects, this study has measured the useful life span and cost-effectiveness of a large catalog of video lectures produced for undergraduate courses at a Spanish university. A Kaplan–Meier survival analysis has been performed to identify factors linked to video longevity. The analysis accounted for variables such as the video production style (screencast, slideshow, chalk and talk, talking head, and on-location film) and others such as the instructional purpose and field of knowledge. The teachers involved in video production and integration have been surveyed to discover causes of video obsolescence. In addition, using life span and production cost data, the cost-effectiveness of each production style over time was estimated. The results suggest that production style affects video longevity, and in particular, dynamic visuals are more related to longer life spans compared with static contents. Screencast stands out as the most cost-effective production style, having the best ratio of life span to production effort. Some practical suggestions are provided for producing video lectures with higher longevity expectations.

Keywords: video lecture, sustainable education, higher education, useful life, cost-effectiveness

Introduction

Video is a resource that is increasingly used in higher education, both in online activities and as a complement to face-to-face instruction. Traditional expository instruction has been steadily leveraging on streamed video lectures and tutorials (Crook & Schofield, 2017), which have become a key resource in distance and distributed learning environments, as well as in hybrid modalities. The scientific community has paid much attention to research on how video can benefit learning within several contexts (Kay, 2012; Poquet et al., 2018). Nevertheless, research about the sustainable production and cost-effectiveness of instructional videos accounts for a relatively small number of contributions. The present observational study has the goal of contributing to this knowledge by assessing the useful life span of instructional videos used in higher education and identifying factors that are correlated to sustainability.

Production Costs and Video Presentation Format

Production of high-quality instructional videos may require considerable cost. Hollands and Tirthali (2014) estimate a range of USD$39,000–$325,000 for the overall production cost of a typical high-end massive open online course (MOOC), of which a large portion was taken up by video lecture production. In addition, video lecture recording and editing costs may be underbudgeted (Meinert et al., 2019). Expensive MOOC studio-recorded videos contrast with low-cost schemas (Furini et al., 2020) that deliver usable video lectures with a minimal infrastructure and production time. Efforts have been made to diminish the production cost of video lectures, for example, by repurposing preexisting video files (Nissenson & Shih, 2015) or promoting instructor self-production (Turro et al., 2010), which override the need for a costly specialized production team.

The presentation format of an educational video may have some influence in the learning process, both in the learning effectiveness and in the student's engagement (Guo et al., 2014; Ilioudi et al., 2013; Wilson et al., 2018). In addition, the cost of producing a video lecture may vary substantially depending on the chosen visualization format and the production setting. Therefore, in the design process of an educational video, it is crucial to select a set of presentation features that balances the production cost and the expected learning benefits.

Analyzing the cost-effectiveness of instructional video production has not received much direct attention by researchers. A large body of applied research is aimed at identifying features that improve the *learning effectiveness* of instructional videos (Clark & Mayer, 2016; Ibrahim et al., 2012; van der Meij & van der Meij, 2013). However, we found very few peer-reviewed studies about production factors linked to *cost-effectiveness* and *long-term reusability* (Henrich & Sieber, 2009; Hollands & Tirthali, 2014; Norman, 2017). In his review of the literature on the use of educational video in higher education, Winslett (2014) regrets the "lack of attention" (p. 500) that researchers had given to issues included cost, scalability, sustainability, and return on investment.

Useful Life Span and Sustainable Production

Beyond the concept of cost-effectiveness, *sustainable e-learning* is a term that covers multiple perspectives of sustainability in educational contexts (Alharthi et al., 2019). Sustainability in e-learning deals with the “continuous adaptation to change, without outrunning its resource base or receding in effectiveness” (Stepanyan et al., 2013, p. 95). It also pertains to resource management, in particular, with creating reusable learning materials (Liber, 2005). One indicator of resource sustainability is the *useful life span*: how long a learning object is effectively used since it is delivered. Factors linked to longer life spans should be considered when designing the production process of learning objects.

The life span of some learning media, such as printed books, has been measured (Renaud et al., 2015). Unfortunately, the obsolescence process of educational videos has not been studied in depth. The few peer-reviewed studies that have surveyed the actual use of video in academic settings (Han & Wong, 2009; Houston, 2000; Mardis, 2009; Santos Espino et al., 2020) do not collect the age or life span of the surveyed materials.

The video medium suffers from risks of obsolescence that differ from other media. Once a video clip has been edited, it is harder to modify than other instructional media such as PowerPoint files or Web pages are. Text and pictures are easier to modify than video. Minor changes can be straightforwardly applied to online texts without the final readers noticing; but amending an audio or video recording of a human speaker to introduce new content may be challenging. This means that the useful life span of video material is more threatened by partial obsolescence of contents than that of other media.

Given the growing importance of video lectures as a learning resource, it is critical to contribute knowledge about factors that help prevent video deterioration or increase their longevity.

The Prometeo Project

In this study, we assessed the production and use of a wide range of videos produced within the University of Las Palmas de Gran Canaria (ULPGC), a Spanish university. The Prometeo Project’s mission was to produce digital learning objects for the ULPGC for use as didactic material in its degree courses. The project was active from 2008 to 2012. During that time, over 500 learning objects were produced, most of them instructional video files. Prometeo’s videos relied on various presentation and production formats, each of which entailed different production costs. The outcomes of the Prometeo Project provide us with a considerable number of video clips and usage history to analyze.

Goals and Research Questions

The main goals of this study are to assess the useful life span of instructional videos and to identify factors linked to video longevity. These goals are deployed as a number of research questions that will be investigated within the context of the ULPGC’s Prometeo Project and its associated video lectures:

1. What is the useful life span of the instructional videos?

2. Are there significant differences in the useful life span between different production styles?

3. Are there other attributes in the instructional videos that influence their useful life span?

4. What causes can be attributed to the disuse of a video?

5. Which production styles show a better balance between life span and production cost?

For the purpose of this research, the useful life span of a video will be defined as the duration from the start of the course in which the video is first used to the end of the last course in which it was used, rounded up in years. If a video was produced but never deployed as a course material, its useful life span is considered zero.

Research Method

Overview

The useful life span of the examined video lectures has been estimated from direct surveys to those teaching teams involved in the production of the videos and in their subsequent integration into college courses. These teachers have informed us which videos have been in use and, in cases where they ceased to be used, what the causes were. This information has been crossed with quantitative data extracted from the video files so that we can estimate what attributes, such as production format, are most related to video longevity and cost-effectiveness.

To proceed with this method, the following procedure was followed.

1. Video Collection and Classification

First, all videos produced in the Prometeo Project have been collected and have been labeled with their main attributes, including production style, duration, course, knowledge field, and teachers involved in the production.

2. Production Cost Assessment

As a second step, a simple production cost model was estimated for the Prometeo Project videos. For this purpose, we interviewed the original production team to build a qualitative framework that attributes a cost function to each production style.

3. Teacher Surveys

Once all videos were classified, a series of semi-structured interviews were conducted with the teachers involved in the design, recording, and subsequent use of Prometeo Project videos. The goal of the interviews was to find out the time span of each video: whether they are still in use or, if not, when they ceased to be used and for what reasons. The interviews also tried to clarify the learning purpose that the videos were aimed at.

4. Integrated Data Set

The information retrieved from the teacher surveys was interpreted and coded, to be further combined with the data collected from the video inventory, to yield a complete relational data set of the learning items, their life spans, and their learning context.

5. Survival Analysis

The integrated data set allowed to carry out a survival analysis to identify factors that have significant influence on the useful life span of the instructional videos, with a particular focus on two attributes: the production style and the learning purpose.

6. Qualitative Analysis

The teacher surveys contain nonstructured comments that offer valuable insights about video obsolescence and preservation. As a final step of this study, we gathered and interpreted this information to complement the quantitative results.

Context: The Prometeo Project

For a better understanding of this study, we will describe in more detail some characteristics of the Prometeo Project that have shaped the type of instructional content that was developed.

Project Mission and Course Selection

The Prometeo Project was founded as an institutional project in the ULPGC with the goal to produce digital learning objects, most of them video lectures and tutorials, to support official degree courses. Videos were served in streaming via a server running an in-house learning management system (LMS).

Every year, the university called for a round to select a number of courses that would be supported by the production unit to generate content. Course participation had some requirements intended to maximize the institutional impact of the investment and that are relevant to this research:

- Teachers applied voluntarily to participate.
- Priority was given to basic and transversal subjects.
- In each yearly call, courses from all main knowledge fields were selected: arts and humanities, “hard” sciences, engineering, health sciences, and social sciences.

Four production rounds were issued from 2008 to 2011. The last videos were published in 2012. The Prometeo Project was abruptly dismantled at the beginning of 2012 amid the economic crisis that was hitting Spain. After the cancellation, the video infrastructure continued to operate without maintenance, though teachers kept using videos streamed from the server, or they otherwise downloaded the original videos to migrate them to other platforms, such as YouTube.

Video Production Styles

The Prometeo Project had a production unit in charge of video filming, editing, and publishing. Teachers were free to choose which presentation style would be used for their course videos, though the options were limited to a small number of formats.

The main production styles in Prometeo Project were the following:

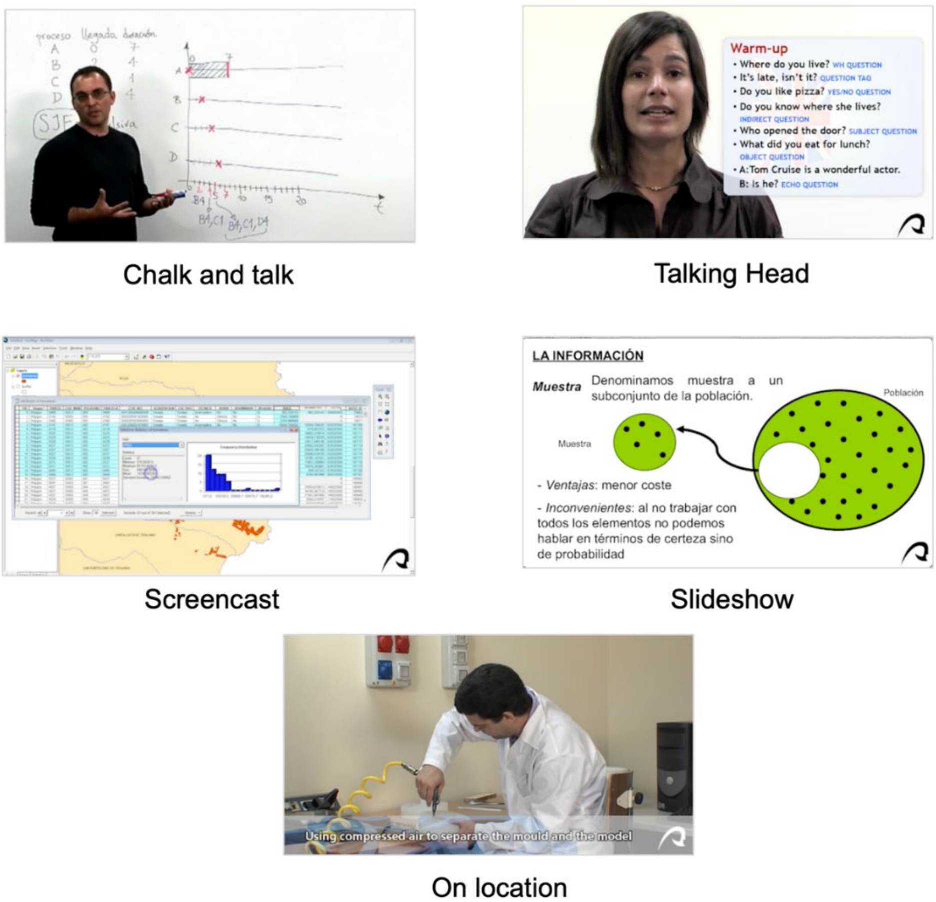
- Chalk and talk—An instructor gives a lecture in front of a large whiteboard in a studio setting. The whiteboard is used to write text, sketch schemes, or draw diagrams.
- Talking head—An instructor develops a lecture shot in frontal view. The speech is complemented with chroma-like overlaid text.
- Screencast—Many videos show recorded computer sessions with a voice-over—for example, solving mathematics exercises using a software tool or tutorials explaining how to use certain computer application.

- Slideshow—These videos use the same production technique as the screen casts, though the purpose was to record a PowerPoint-like presentation with a voice-over.
- On location—Some videos are demonstrations of real-life processes, filmed in specific locations such as college laboratories and industrial facilities.

Figure 1 depicts screenshots of each of these five production styles.

Figure 1

Screenshots of the Prometeo Project's Main Production Styles



Most videos used exclusively one production style, though some hybrid instances were released (e.g., a talking head segment followed by a screencast). A minor number of videos used other styles, such as interviews and podcasts.

Video Collection and Classification

Two main sources have been used to collect video data. First was a set of work scheduling sheets of the production unit, containing all the courses, teachers, and videos in production. Second, all published video files were retrieved from the project LMS server. These two sources were crossmatched to obtain an exhaustive inventory of analyzable videos, plus a list of participant teachers.

A direct examination of video files allowed us to code basic attributes, such as duration. The production style attribute was coded according to the standard styles used in the Prometeo Project. Videos that alternate between several production styles were labeled as *hybrid*. Moreover, each video was assigned to one *instructional purpose*, chosen from these four: a *lecture* is the formal exposition of a conceptual topic by an instructor; a *tutorial* is the explanation of a procedure by an instructor; a *worked example* is a particular type of tutorial, characterized by being a step-by-step resolution of a task or problem; a *demonstration* is the live recording of a functioning system or a real-life process.

Modeling Video Production Cost

The former team leader of the Prometeo Project production unit gave information about the production process, which was supplemented with the archived work schedule sheets. In general, a video segment followed a pipeline of preparation, recording, editing, postproduction/render, review, and publishing. This pipeline was usually executed in a single batch for a set of videos belonging to the same course.

The most resource-consuming stages of the pipeline were recording and editing, whose efforts were proportional to the final duration of the published video. In addition, recording and editing costs depended on the video production style (e.g., a screencast required much less editing time than a talking head video). Time required for artwork, postproduction, and rendering was similar for each video batch and negligible when compared with the other factors. With all these findings at hand, a simple linear model of production cost has been built for each production style.

Teacher Survey

The teachers who were in charge of the courses provided us with additional information related to the actual use of the videos. The script for the interviews consisted of a structured questionnaire plus a set of open items. The open items were intended to capture spontaneous information from the interviewees. The script covered four main topics: participation in the Prometeo Project, current status of the course or subject, current status of produced videos in teaching, and teaching staff's technical competence.

For each surveyed course, at least one participant was contacted. In some cases, joint interviews were held with several participants of the same course. In all cases, answers were recorded on a per-course basis. It is important to remark that staff stability was very high for most courses, so in general, the teachers in charge of the courses at the time of the interviews were the same as those who participated in the Prometeo Project.

Two modalities were used to administer the surveys: a synchronous interview (face-to-face or via telephone) or a written questionnaire submitted by e-mail, which was used in five cases. Surveys were conducted between June and October 2016. Responses were obtained for 37 courses out of 39 (95% turnout), which covered 375 videos out of 381 (98%). A total of 38 teachers participated in the surveys.

Integrated Data Set

Once all surveys were conducted, responses were interpreted and coded into a structured database for later analysis. The following quantitative data were retrieved: course attributes (field of knowledge, stability in curriculum), instructional purpose of videos, complementary or compulsory nature of videos, video life span (starting and ending years), and videos' current validity. In addition, some qualitative information was recorded: perceived causes of obsolescence or deterioration of videos, obstacles to integrate videos in teaching, and interventions taken by teaching staff to extend video useful life.

From the video inventory and teacher survey data, an integrated data set could be elaborated for most videos ($N = 381$), providing several attributes for each item: duration, production style, course knowledge field, instructional purpose, observed life span (start/end year), current status of validity/obsolescence, and the main cause of deterioration/obsolescence (if reported).

Life Span Analysis: Method

The video life span analysis was performed in two stages. First, a nonparametric estimation was made for different subsamples, each one based on a single video attribute. A survival analysis estimates the empiric functions of density, distribution, and hazard using the well-established method proposed by Kaplan and Meier (1958). The Kaplan–Meier estimator uses a single sample of data in a way similar to a life table. Instead of people who survive or die after a treatment, we deal with the life span of videos. At any given time (t), we can count the number of videos that are known to be “alive” (still in use) and then count how many “deaths” occur in the next time interval (D). The method proceeds in three phases: (a) estimation of a hazard function for the full sample, (b) graphical plots of the survival function (Kaplan–Meier curves), and (c) nonparametric tests of equality to identify predictors for the final model.

After performing the Kaplan–Meier analysis, video duration was estimated using parametric models, using the set of parameters provided by the first nonparametric analysis. All estimations were implemented with the statistical package Stata 15 (StataCorp, 2017).

Results and Discussion

Video Demographics

The resulting integrated data set comprised 381 videos, linked to a total of 39 courses. Table 1 shows the frequencies of the five most frequent production styles, along with the distribution of the instructional styles for every production style. Other styles include podcasts (audio plus noninstructional imagery; 5 videos), Khan Academy–style virtual whiteboards (2), and hybrid-style videos (5). Just over half of the courses (21) used a single production style in all their videos, while the remaining 18 courses used two or more styles.

Table 1

Video Catalog Demographics

			Instructional purpose (%)				
Production style	*N*	% of total	Lecture	Tutorial	Worked example	Demonstration	Other
Screencast	105	27.6	2.9	**61.9**	34.3	0.9	
Talking head	91	23.9	**91.2**	4.4			4.4
Chalk and talk	89	23.4	44.9	3.4	51.7		
Slideshow	54	14.2	**79.6**	5.6	14.8		
On location	30	7.9	6.7	3.3		**86.7**	3.3
Other/hybrid	12	3.1	50		8.3		41.7
All videos	381	100	46.4	19.9	23.9	7.1	2.3

**Note*. Numbers in bold indicate the most prevalent instructional purpose for each production style.

Production Cost Model

The Prometeo Project data evidenced that the production cost of a video clip is strongly linked to working time. Considering all the findings and production data, the production cost of a video clip was approximated to the following simple linear expression:

$$P = K + \alpha \cdot (R + E) \cdot T$$

where *P* is the production cost for the video, measured in working hours, *K* is a fixed cost, α is a constant term that denotes team size (α ≥ 1), *T* is the duration of the published video clip, *R* is the contribution of the recording phase, and *E* is the contribution of the editing phase. The terms *R* and *E* vary depending on the video production style. Table 2 shows the estimated values for *R* and *E* for each production style, as well as a measure of their relative production cost. The high cost of on-location videos is due to the requirement to move a film crew to an external facility, often for a full journey.

Table 2

Estimated Cost of Production Styles

Production style	*R*	*E*	Relative cost (*R* + *E*)
Screencast	4.1	0.5	4.6
Talking head	5.1	2.5	7.6
Chalk and talk	5.0	1.8	6.8
Slideshow	5.7	0.5	6.2
On location	15.0	2.5	17.5

Note. *R* = contribution of the recording phase; *E* = contribution of the editing phase.

Life Span Analysis: Results

From a total of 381 surveyed videos, 362 (95%) became available to students; 19 videos were discarded by teachers before there was any chance for them to be used. At the time of the survey, a total of 198 videos (52.8% of total) were still in active use. Table 3 summarizes the average life span, taking into account the main video attributes. The observed average life span for all the videos is 5.74 years, for a possible upper bound of 9 years. (Note: life spans of censored observations have been counted as the age of each video in the last surveyed year).

Table 3

Average Life Span and Censoring of Surveyed Videos

Category	Avg. life (years)	Censoring
Production styles		
Screencast	6.81	51.4
Talking head	4.59	34.5
Chalk and talk	6.09	67.4
Slideshow	4.35	40.7
On location	6.68	78.6
Other/hybrid	6.17	83.3
Instructional purposes		
Lecture	5.30	52.6
Tutorial	6.96	47.4
Worked example	5.14	48.4
Demonstration	6.68	80.0
Other	7.10	70.0
All videos	5.74	52.8

Note. Avg. life = average life span in years; Censoring = percentage of videos still in use at the end of the observation period.

Nonparametric Estimation

A hazard function has been estimated using actuarial calculation techniques. Table 4 shows the video survival data for each annual interval. For each interval, these data are represented: lower and upper bounds of interval (*Interval*), number of survivors at interval start (*Total*), number of discontinued videos (*Deaths*), and the number of censored observations (*Cens.*). Values q_i show the adjusted proportion of terminal events (i.e., the probability of an observation that enters the interval i to stop being used in that interval). This probability is adjusted for censoring so that each censored observation is weighted as half of one finalized observation. The *Surv.* column shows the estimation of the empirical survival function S_i at the end of each interval, calculated as $(1 - q_i)\, S_{i-1}$. Column f is a density function that shows the probability of video end of life in the interval, calculated as $(S_{i-1} - S_i)$ / *interval_width*. The last column, *Hazard*, is the estimation of the per-year probability of video end of life, assuming that the item has been in use until the interval start.

Table 4

Video Survival Rates

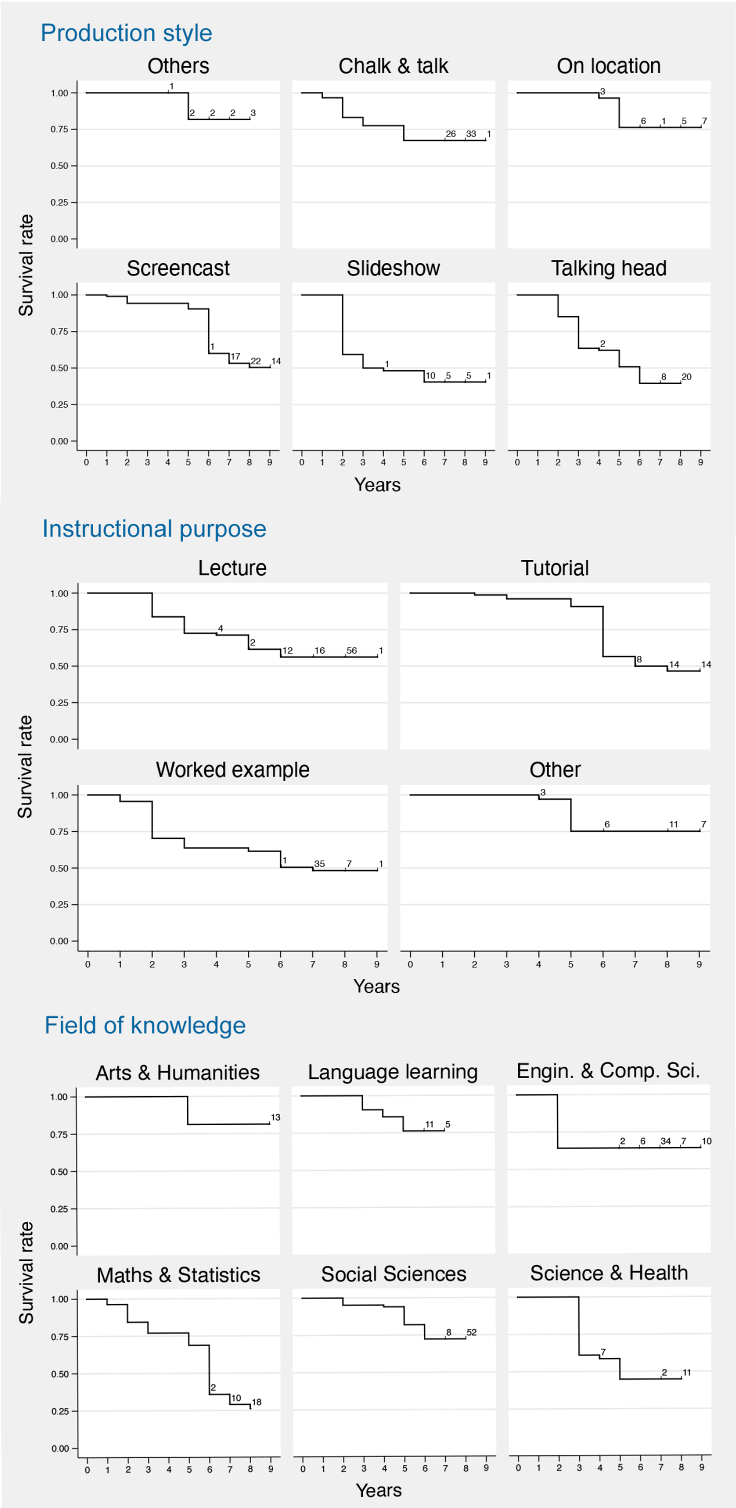
Interval		Total	Deaths	Cens.	*q*	Surv.	*f*	Hazard
0	1	362	0	0	.000	1.000	.000	.000
1	2	362	0	4	.000	1.000	.000	.000
2	3	358	0	50	.000	1.000	.000	.000
3	4	308	0	26	.000	1.000	.000	.000
4	5	282	7	3	.025	0.975	.025	.025
5	6	272	2	28	.008	0.968	.007	.007
6	7	242	19	44	.086	0.892	.076	.079
7	8	179	59	7	.336	0.598	.294	.330
8	9	113	88	2	.786	0.132	.466	.779
9	10	23	23	0	1.000	0.000	.132	1.000

Note. Interval = lower and upper bounds of interval; Total = number of survivors at interval start; Deaths = number of discontinued videos; Cens. = number of censored observations; q = the adjusted proportion of terminal events; Surv. = estimation of the empirical survival function S_i at the end of each interval, calculated as $(1 - q_i)\ S_{i-1}$; f = density function that shows the probability of video end of life in the interval, calculated as $(S_{i-1} - S_i)$ / *interval_width*; Hazard = estimation of the per-year probability of video end of life, assuming that the item has been in use until the interval start.

Graphs of survival functions were used to obtain direct insight of the survival trends. Figure 2 shows the charts for the attributes of most interest in this study (production style, instructional purpose, and field of knowledge). The numbers inside the graphics show the count of censored videos having each life span length. A direct observation of these charts reveals differences between video attributes as regards video survival rate. A further homogeneity analysis of strata would confirm the existence of significant differences. Two statistical tests were applied on each attribute: a homogeneity test of strata and an equality test for survival functions. We used Peto–Peto tests, trend tests, and log-rank tests, depending on the attribute type. The following attributes failed the tests and therefore were not included in the survival model: video clip duration, visibility of speaker in video, and two cases for the role played by videos in course material.

Figure 2

Kaplan–Meier Curves for Survival Estimates of Life Span (Three Attributes)



Parametric Estimation

The nonparametric analysis provided a set of attributes that will be used as parameters in the survival model. A goodness of fit analysis was made for three different specifications of the model: exponential parametric, Gompertz, and Weibull. All three models passed Chi-square tests for unobservable heterogeneity (p = .000). The best fit was the Weibull model, which obtained the largest value for log-likelihood (−153.61) and the lowest AIC (353.23).

Assuming a Weibull model, the full maximum likelihood estimates of the baseline hazard function report a statistically significant fit ($ln\ p$ = 1.11, p < .001) and a value of p > 1, which means that the odds of failure increase with time. In Weibull models, a positive coefficient indicates that the corresponding parameter increases the hazard rate of video discontinuation and thus decreases the video life span. The amount of this effect is calculated as $(exp(\beta) - 1) \cdot 100$, which is the increment in the probability of video discontinuation, expressed as a percentage. Table 5 shows the Weibull coefficients for all the parameters included in the model.

Table 5

Survival Model: Parameters and Weibull Coefficients

Variable	Weibull coefficient
Course field	
Arts and humanities	−3.060***
Social sciences	−2.900***
Language learning	−1.870*
Engineering and computer science	(ref)
Mathematics and statistics	0.716
Science and health	1.580*
Subject/syllabus stability over time	−0.585
Production style	
On location and other styles	(ref)
Screencast	0.362
Chalk and talk	0.426
Talking head	1.600**
Slideshow	1.960**
Production year	0.467*
Current validity of contents	−0.238
Instructional purpose	
Demonstration and others	(ref)
Lecture	1.670**
Tutorial	2.350***
Worked example	2.800***
Role in course material	
New and essential material	1.160**
Backup/alternative material	1.700**
Actual degree of use	
Not used	(ref)
Available for students but not actively used	−3.160***
Used in some teaching activities	−4.180***
Used in many teaching activities	−3.070***

Note. (ref) = reference value for variable group. * p < .01. ** p < .001. *** p < .0001.

Qualitative Analysis

The interviews yielded several qualitative findings about factors that have influenced the obsolescence or deterioration of the videos. In the following lists, we enumerate those factors that have been spontaneously expressed by the teachers and that were observed in more than one course (the number of courses is shown in parentheses).

Direct causes of obsolescence:

- Video lectures did not show benefits in students (8).
- Course/topic ceased to be offered (6).
- Videos showed a software tool that became obsolete (4).
- Teacher lost access to video material (3).
- Teacher was replaced by a new teaching team that discontinued the videos (2).

Obstacles and causes of video deterioration:

- Video length is too long—need to crop/split into shorter segments (8).
- The video instructor's face does not match current teacher's appearance (7).
- Changes are needed in overprint labels, opening titles, and so on to reflect organizational changes (5).
- Evolutive changes in displayed tools require updates in video content (4).
- Some video segments became irrelevant or inadequate and need removal (3).

Most observations from the above list are well known in the practice about educational video production. It can be noted that a few causes are of organizational nature, while others are related to the contents itself.

Aversion to Younger Self-Image or Inverse Dorian Gray Syndrome

An intriguing finding is that at least seven teachers expressed some kind of rejection or puzzlement when watching their own image, recorded on the video, looking younger than their current condition. This rejection was reported as an obstacle to video use. In two courses, it became a contributing factor to video discontinuation. This aversion to watching one's younger self resembles an inversion of the Dorian Gray syndrome (Brosig et al., 2001), characterized by a rejection of the subject's own aging process.

Discussion

The survival model data show that the most influential variable in a video's useful life is the course's knowledge field. The choice of production style and instructional purpose had a weaker but significant effect on video life span. The production year has a small effect on the survival rate, which probably relates to some quality loss in the videos produced during 2011, when financial stress on the project arose.

The survival analysis has not detected a relationship between video duration and useful life span, despite known evidence suggesting that short videos are more effective and engaging. Nevertheless, one of the most reported causes of obsolescence in the teacher survey is the partial deterioration due to the loss of validity of some piece of the video content. This points to the structural complexity, rather than the duration itself, as the factor that increases deterioration. In this study, we could not delve into this matter, which can be reanalyzed in further works.

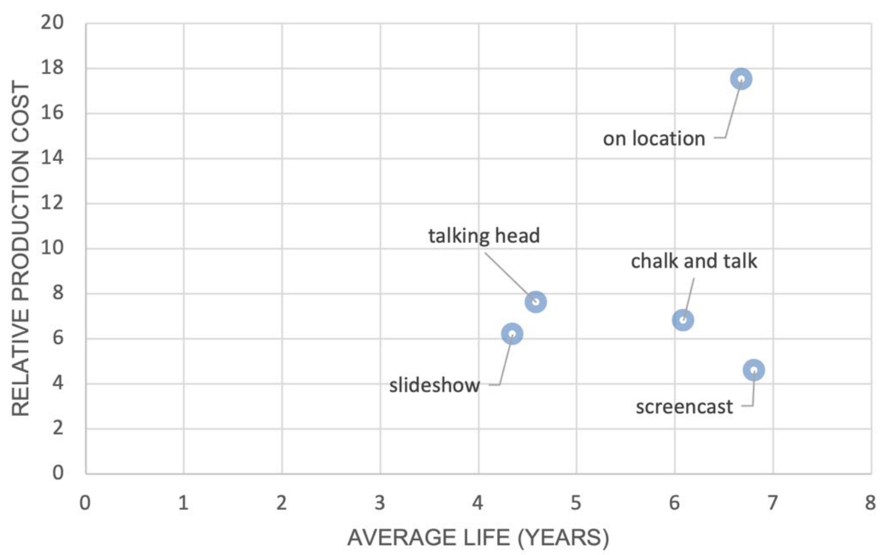
Another relevant finding is that the instructor's presence in the video frame does not show a significant effect on a video's useful life. Nevertheless, the abovementioned inverse Dorian Gray syndrome has been a cause of video discontinuation.

Influence of Production Style on Video Longevity

Figure 3 shows the relation between the average life span and the relative production cost for each main production style. For a better interpretation of the chart, it is important to recall that according to the survival model, the use of talking head and slideshow styles has a significant negative effect on video life span. Screencasts are observed to be very cost-effective, as they have a low production cost while enjoying the longest useful life. On-location videos somehow compensate for their huge production cost with a long, useful life span. On the other side, slideshows seem better for making cheap instructional content with an intended short period of use.

Figure 3

Average Life Span and Production Cost by Production Style



The comparison between chalk and talk and talking head videos deserves attention. Chalk and talk videos have a slightly lower production cost, but they enjoy a longer longevity than talking heads, even when other variables are factored out (see Table 5). Chalk and talk video longevity may be influenced by the way the content is presented: instructional content is smoothly handwritten by the instructor, in contrast with talking head videos, in which the content is displayed in discrete blocks, as in a conventional PowerPoint slideshow. Other studies have shown that handwriting is more engaging than static pictures and has some positive effect in learning, probably related to cueing effects (Fiorella &

Mayer, 2016; Guo et al., 2014; Türkay, 2016). It is possible that those positive qualities of chalk and talk videos have contributed to their relative longer life.

Suggestions for Increasing Useful Life Span

We believe that most video obsolescence factors identified in this study are addressable by proper managing of filmed footage in order to facilitate future editions. As other authors have pointed out, continuous updating of material is key for the maintainability of a teaching resource (Henrich & Sieber, 2009) and a way to make the video resources more reusable (Stepanyan et al., 2013), therefore ensuring longevity. This is in line with the findings reported in the qualitative study.

With this goal of maintainability in mind, our findings can derive some suggestions to prolong longevity so that the profitability of the production effort increases. Some of these suggestions have been acknowledged by the community or practice, such as the use of visual cues and the segmentation of content (Clark & Mayer, 2016; Ibrahim et al., 2012; van der Meij & van der Meij, 2013): this study provides additional support to their validity.

1. **Keep editable video sources.** The organization should keep an unedited copy of every video material that needs to be durable to ease future video re-editions. If preservation is a goal, high-quality audio and video are requirements. Common storage formats lose quality and degrade with successive editions, thereby risking video longevity. Therefore, we recommend preserving primary video files using quality-lossless formats.

2. **Avoid corporate branding in video sources.** Changes in branding are frequent maintenance tasks in multimedia learning objects (Young, 2008). For this reason, the preserved video sources should not contain corporate branding mixed in learning content. In the most manageable setting, branding items should be kept in separate segments (headers, credits, etc.).

3. **Keep single-topic video segments**. This research suggests that videos with a complex structure are more prone to become partially obsolete. If the video lecture is decomposed in independent segments, it will be easier to rebuild a usable video material out of the segments that remain valid. It is important to note that this suggestion should not always be implemented as the *delivery* of multiple video files. It has been observed that excessive file segmentation may hinder learning in people with higher levels of prior knowledge (Spanjers et al., 2011). To circumvent this risk, sometimes it will be better to merge the valid segments into a single video clip.

4. **Avoid excessive binding to video authors.** In the surveyed courses where the teaching team was replaced, videos were discontinued. In addition, the inverse Dorian Gray syndrome reported in this study is an indication that the product may become excessively tied to the video author shown on screen. This issue should be addressed if the institution intends to produce durable videos. Examples of policies are recording instructorless videos and decoupling the roles of writer and speaker (using actors instead of teachers).

5. **Use dynamic, cued action rather than static, un-cued pictures.** In this survey, chalk and talk videos have longer life spans than talking heads videos, and screencasts performed better than slideshows. These findings suggest that a fluid, dynamic presentation of contents, combined with cueing (instructor's gestures or computer pointer), helps make videos more effective and engaging, thus increasing their longevity prospects.

Conclusions

The present work has contributed to increasing our knowledge about the sustainability of digital resources for learning. To the best of our knowledge, this is the first study about the longevity of video lectures and one of the first about the cost-effectiveness of educational video lectures. Thanks to this work, the influence of some video features in the useful life span of videos have been assessed, and some practical suggestions have been elaborated regarding the design of video lectures and their preservation over time. These suggestions can be directly applied in open and distributed education designs to produce more cost-effective and durable video resources. In addition, open educational repositories can increase the reusability of their video content. The full nature of an open resource is its ability not only to be freely copied by anyone but also to be easily modified.

Limitations of the Study and Further Research

This study has some limitations that impact the strength and generalizability of its findings. First, it is a regional case study with a limited social and cultural scope. Second, the characteristics of the Prometeo Project imply that all courses were on basic subjects, and teaching teams were stable and motivated. In addition, due to the standardized production method, video clips were homogeneous in several basic properties, such as audiovisual quality, duration, and aesthetics. Finally, data about the useful life span of videos have been obtained only from teachers' perspectives. Other indicators of video service life, such as the number of visualizations over time, could not be measured because video server logs were not available and some teachers had moved their original videos to other repositories, such as YouTube. In further studies, video life span may be estimated using video-watching log data.

These limitations can be overcome by conducting similar studies in other sources, especially in video catalogs with a long history and a high diversity in their video and course characteristics. For those purposes, the method followed in this article is perfectly replicable in other environments, with minimal variations.

Final Words

We believe that it is necessary to seriously consider the assessment of educational videos' longevity and to incorporate more empirical findings on sustainable production, which will add evidence-based support to the existing preservation practices and would point toward novel production methods. We encourage other researchers to apply this kind of research in other video catalogs and organizations. Future findings about instructional video longevity will fruitfully complement the well-established research about the learning effectiveness of video-based learning and will help teachers and educational organizations produce more sustainable and reusable learning materials.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 22, Number 3

August – 2021

Facebook or LMS in Distance Education? Why University Students Prefer to Interact in Facebook Groups

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Abstract

This article describes an investigation into the level of satisfaction among students at Spain's National Distance Education University (UNED) regarding use of Facebook groups as an environment for learning. Based on a structural equation methodology, the research analyzed the most relevant personal and socio-educational factors that affect satisfaction. The sample consisted of 418 undergraduate and master's degree students at UNED's Faculty of Education; participants were consulted in three semesters between September 2019 and January 2021. The results showed that students who participated in Facebook study groups achieved better results than those who did not, and that they interacted more frequently in these groups than in UNED's official learning management system. The main latent variables that influenced satisfaction with Facebook study groups were the perception of efficacy they elicited as a complement to distance learning by enabling greater interaction with other students, and the feeling of course companionship they provided. The absence of teacher control also influenced student satisfaction, which allowed students to focus on learning and achieving better results in tests and exams.

Keywords: Facebook groups, distance education, learning management system, university, interaction

Introduction

The use of Facebook groups to support distance learning in higher education has been less researched than the use of this medium to complement different types of in-person tuition. Facebook is currently the most prominent social network, with an estimated 2.85 billion users, according to data for the first quarter of 2021 (Statista, 2021). University students continue to prefer Facebook to other social networks for academic work (Arteaga et al., 2014; Chiroma et al., 2016; Lambić, 2016). This study analyzed the level of satisfaction among distance learning students enrolled in Spain's National Distance Education University (UNED) regarding their use of Facebook study groups, free of teacher vigilance, as an educational resource in support of their learning process. The development of this study enabled us to discover the variables that had greatest influence on the adoption of Facebook groups as opposed to UNED's own learning management system (LMS), and to understand the implications for LMS design and teaching methodology in distance learning.

Facebook Groups for Learning

Virtual learning environments are an ideal context in which to examine how learning theories explain the effect of social factors on learning processes. Social cognitive theory (Bandura, 1999) has stated that people observe, imitate, and model the behaviour of others; social media, can foster the development of cognitive elements such as attention, memory, and motivation (Deaton, 2015). Furthermore, Siemens (2005) and Downes´ (2007) connectivism proposed a conceptual framework in which learning is greatly influenced by technology, socialization, and the connection of specialized nodes or information sources to support knowledge flow. According to social constructivism (Vygotsky, 1978) knowledge is the result of one's environment, dialogue, and interaction with others. Social constructivist applications in social media learning environments enable students to take an active role in knowledge creation, fostered by social media's participative nature (Churcher, 2014).

Most study of the educational use of Facebook has emerged in the last decade (Arteaga et al., 2014; Chiroma et al., 2016; Kitsantas et al., 2016; Lambić, 2016; Niu, 2019; Sharma et al., 2016). These studies showed that the main reasons for using Facebook as a learning tool were its ease of use and popularity as a social network familiar to nearly all students worldwide (Giannikas, 2020; Moghavvemi et al., 2017; Moorthy et al., 2019). The creation of Facebook groups or educational communities has allowed students at distance learning institutions to feel companionship throughout the tuition process, generating a feeling of belonging and a sense of identification with the coursework undertaken together (Callaghan & Fribbance, 2016; Sheeran & Cummings, 2018). Due to its familiar features, the use of Facebook groups avoids technological frustration related to other distance education environments (Manca & Ranieri, 2013).

Facebook has supported social presence that is valued positively by students in non-face-to-face education environments (Akcaoglu & Lee, 2018). It has exemplified how social presence can be improved by the characteristics of the communication medium (Stacey, 2001), making verbal and nonverbal communication possible, for example (Rice, 1993). Research has suggested social presence is an important factor for building educational communities as it is strongly connected to online interaction (Gunawardena, 1995; Gunawardena & Zittle, 1997; Tu & McIsaac, 2002), and potentially enables learning in online environments (Oztok & Brett, 2011). Social presence has been broadly defined (Feng at al., 2016; Sung & Mayer, 2012; von der Pütten et al., 2010) and in the context of this study, implies the degree to which a student feels connected with another student in an online learning community. Establishing social presence as a means for interaction has been associated with higher levels of cognitive analysis through active engagement (Stacey, 2001).

Various studies have shown that the use of Facebook groups engendered increased connections among students, and the interactions there, whether active or passive, were associated with a significantly greater commitment to the course compared to courses that did not establish an official Facebook study group (Chugh & Ruhi, 2018; Sheeran & Cummings, 2018). Such activity also strengthened commitment to content and learning among course colleagues, and in many cases, encouraged critical thinking, stricter monitoring, and questioning of the learning process. These groups provided an attractive, interactive, and motivating environment for the development of dialogue and bonds between colleagues and, if designed as such, among students and teachers, too (Al-Rahmi et al., 2015; Bahati, 2015; Davidovitch & Belichenko, 2018; Fiock, 2020; Moghavvemi et al., 2017). In this sense, Facebook's social function has been used for academic purposes such as promoting positive feedback by students (Arteaga et al., 2014; Davidovitch & Belichenko, 2018; Moghavvemi et al., 2017; Niu, 2019). That said, the use of Facebook groups in educational settings has appeared to be more effective when adopted alongside other applications or digital resources, or as a support to an LMS (Chiroma et al., 2016; Chugh & Ruhi, 2018 Kaya & Bicen, 2016). This is due to Facebook's organizational shortcomings, which have prevented its groups from becoming the one and only tool for managing learning in virtual environments (Barrot, 2016: Chen, 2018; Kalelioğlu, 2017; Niu, 2019).

According to Lambić (2016), interaction in informal groups was substantially greater than in groups with teacher involvement, as they tended to provide a space that students found less intimidating (Giannikas, 2020). Dalsgaard (2016) pointed out that the potential of Facebook groups as a learning tool unmediated by teachers was that they stimulate learning among equals through actions such as group discussion of concepts, or presentation and debate of results among students. Aaen and Daalsgard (2016) described Facebook study groups set up by students as a third space, a midway point between groups established by teachers and private groups outside the academic sphere. The Facebook learning environment, suited to autonomous tuition, has provided an experience for flexible in space and time that enabled the student to manage course material, communication, and involvement in collaborative work (Chiroma et al., 2016; Datu et al., 2018; Niu, 2019).

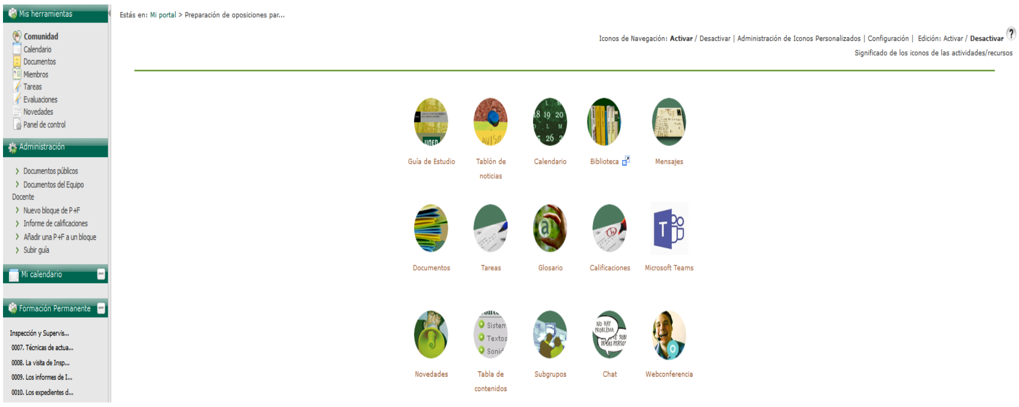
On the other hand, there is considerable scientific literature that has questioned the educational value of Facebook. Chen (2018) found no positive indicators for Facebook as a platform that foments the creation of learning communities, due to the lack of specific functions to enable participants to work on group projects. Others have recorded discourse on this social network that was "prosaic, mundane and occasionally anti-intellectual" (Selwyn, 2009, p. 170), which undermined its use as a tool to support learning and as a complement to assist students in formal study (Bahati, 2015). According to Bahati (2015) this medium was more closely related to the individual's sense of identity as a student, which added to the value of the student experience at university but diminished its value as an educational tool. Moorthy et al. (2019) described how only those students with a high level of self-sufficiency found Facebook study groups useful and accepted them as part of the academic context, although doubtful of their real educational value. In many cases, the educational and social value of belonging to these groups overlapped, with no clear perception of the academic usefulness of membership, which generated reluctance to join Facebook study groups (Manca & Grion, 2017). It has even been suggested that the usefulness of these groups in learning terms is marginal compared to their social potential (Hew, 2011). Other studies on use of Facebook for academic purposes have shown that, as with other simultaneous cognitive processes related to knowledge acquisition, the use of this social network can have a negative effect or yield poor results (Kirschner & Karpinski, 2010), with memory capacity and levels of concentration especially affected (Chiroma et al., 2016; Kaya & Bicen, 2016). These drawbacks have led some authors to produce guides on how to design well-structured activity plans that help differentiate Facebook use for social and educational purposes (Barrot, 2016; Junco 2015; Niu, 2019), and hence avoid the distractions associated with the former.

Research Context

Spain's National Distance Education University is the country's biggest university with 265,000 students; tuition is by way of a blended learning model delivered by the UNED learning management system known as aLF, as well as other resources. The LMS platform enables students to receive and send information, manage and share documents, create and participate in communities for specific courses, and develop projects online. aLF's main functions are to (a) manage work groups on demand, (b) share storage space, (c) organize content, (d) plan activities, (e) provide assessment and self-assessment, (f) offer an automatic notification service, (g) support questionnaire design, (h) publish news, and (i) provide a user-configured personal and public portal. In addition, aLF includes tools for communication and interaction to encourage collaboration and sharing of content between teachers and students by way of e-mail, internal messaging, forums, chat, a calendar, video-conferencing using Microsoft Teams, as well as notices and advice for students.

Figure 1

UNED's aLF: LMS Digital Environment



Note. Internal image of the aLF-Platform (UNED). (Source: Prof. Esteban Vázquez-Cano).

At the same time, UNED students have created Facebook groups to organize themselves and communicate with each other without teacher oversight. For example, at time of writing, the UNED pedagogy graduates Facebook group, the focus of this research, had around 5,000 members. In the 2019/2020 academic year, there were 2,973 students enrolled in the UNED degree course in pedagogy.

Figure 2

Facebook Group: UNED Pedagogy

Note. This is the Facebook group associated to the UNED University Degree in Pedagogy. (https://www.Facebook.com/groups/126570557394056)

This research was motivated by a concern expressed by various groups of UNED teachers regarding the decline in participation in the discussion forums established around official UNED courses. For example, student participation and interaction in the non-compulsory forums for three subjects in the pedagogy degree course and two in the official master courses has fallen by an average of 60% in the last five academic years.

This research was designed around three main objectives. First, are there significant differences in the end-of-course scores in the subjects taken by students who use Facebook groups and by those who do not? Second, do the students who use Facebook groups interact more with each other than those who use the LMS-aLF? Finally, we wished to design and assess a theoretical model using structural equations modelling.

Method

The research method applied in this study differed from the norm in two fundamental aspects. First, we adopted a methodological model formed of elements from three other models: the information success systems model (ISS), the technology acceptance model (TAM), and the unified theory of acceptance and use of technology (UTAUT). Second, the data for this work were gathered from a university that relies on distance learning, with models of interaction and collaboration mediated mainly by digital tools. We used EQS 6.4, structural equation modeling statistical software, to reveal the latent variables that can influence student satisfaction with Facebook study groups as a complement to the distance teaching-learning process.

The research hypotheses are illustrated in Figure 3.

Figure 3

Research Hypotheses

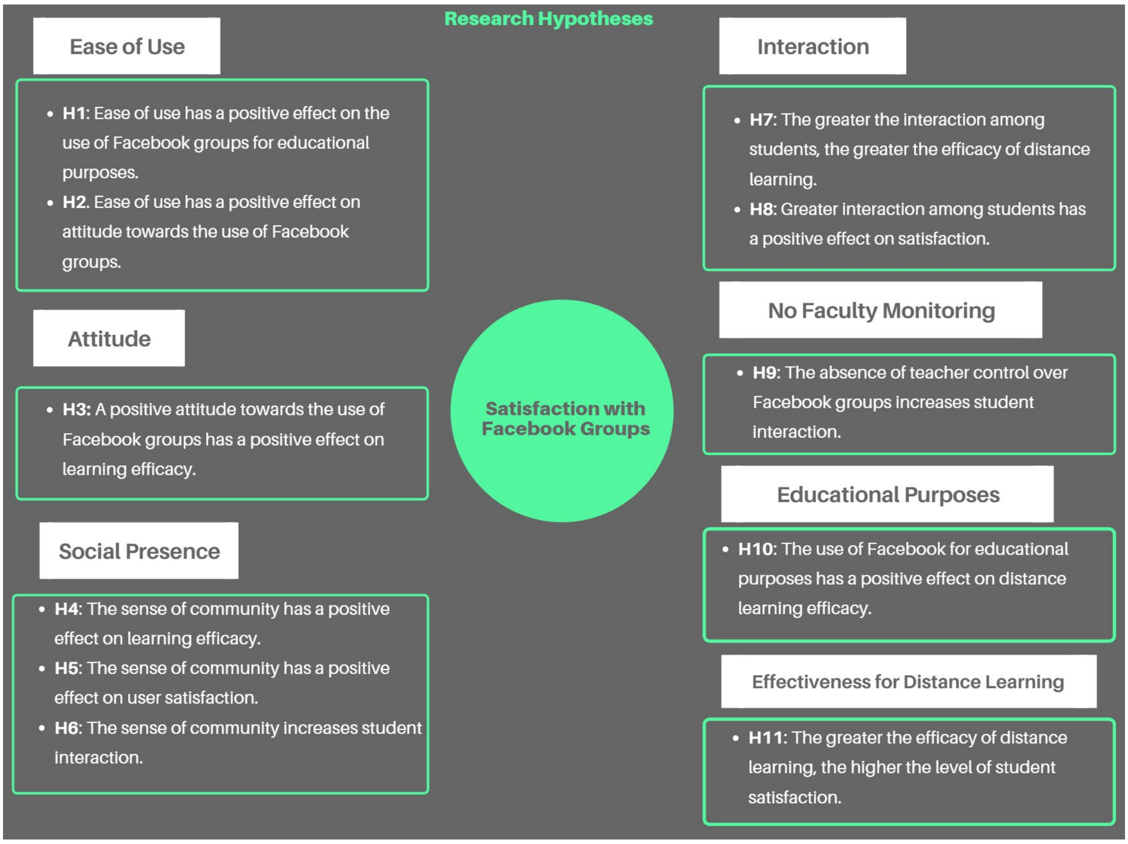
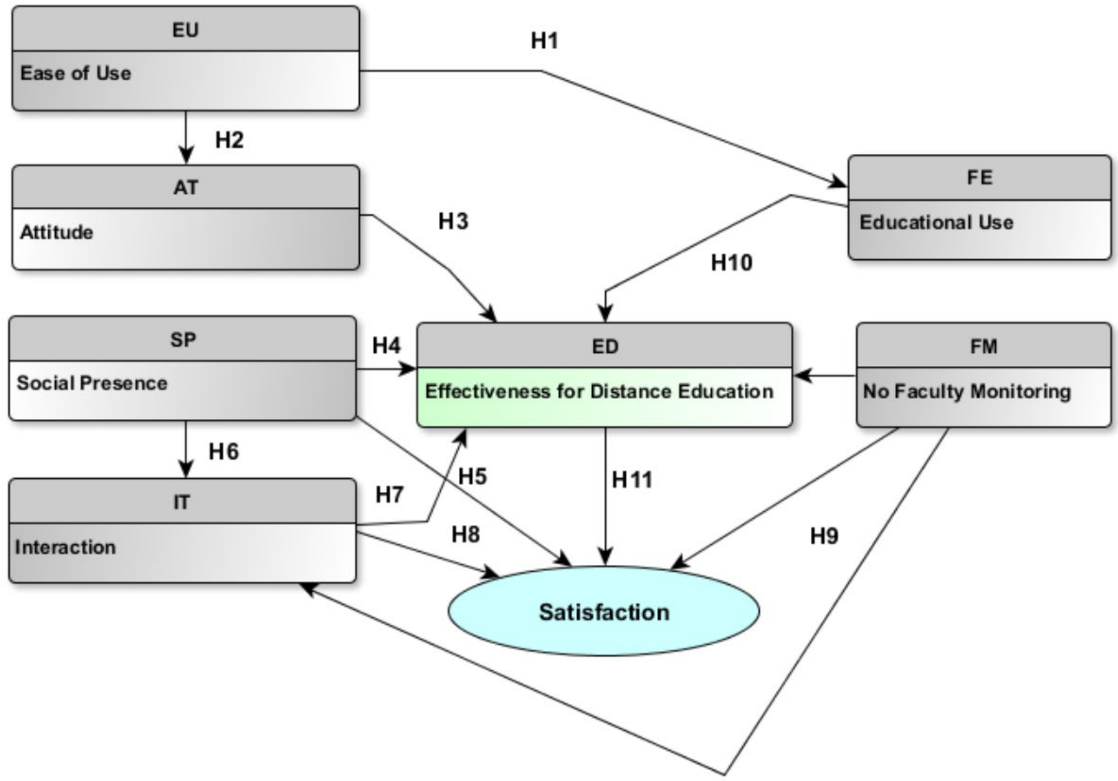


Figure 4 shows the proposed model that encompassed the relationships among the study's different variables and initial hypotheses.

Figure 4

Research Model and Hypothesized Relationships



Sample

The participant sample was obtained by cluster sampling students who use Facebook groups; the sample was formed of 418 students in UNED's pedagogy degree course, the Master in Innovation and Investigation, and the Master in Teacher Training. This constituted a representative sample (confidence level 0.95; z-score 1.96). The mean age of those interviewed was 32 (mean = 32.30; SD = 2.40).

Instrument and Variables

The study data were gathered between March 1, 2020 and December 20, 2020 using a validated questionnaire authorized by UNED's bioethics committee. Participants completed the questionnaire online once they provided their consent. The students who participated in the study voluntarily agreed that the researchers could check their final results on the academic platform (aLF) once the subject was finished. The questionnaire was distributed via UNED's virtual platform on aLF, and the participants were encouraged to pass it on to other Facebook study group members. The questionnaire contained 28 items among eight latent variables. The students responded to each item using a 1 to 5 scale, in which 1 corresponded to *totally disagree* and 5 to *totally agree*.

Figure 5 reflects the latent variables and items of the questionnaire. The first part of the questionnaire included sociodemographic items: age, sex, enrolled studies and subjects, and participation in UNED Facebook groups. The main constructs of the instruments were established according to seven latent variables, grouped among three macro-variables: (a) user's attitude (attitude and ease of use); (b) social perspective (social presence and interaction); and (c) educational impact (educational use, no faculty monitoring, and effectiveness for distance education). As illustrated in Figure 5, these three macro-variables have been previously identified and analysed in the scientific literature.

Table 1

Questionnaire: Latent Variables and Items

Variable	Items	Authors
Ease of Use	EU1: The ease of use of Facebook groups enables me to share resources and information on course subjects at UNED. EU2: The ease of use of Facebook groups enables me to access a range of resources that I need to study the subjects of my course at UNED. EU3: The ubiquitous and multiplatform access offered by Facebook enables me to be permanently connected.	[a] Abdalla (2007); DeLone & McLean (2003); Moorthy et al. (2019); Moghavvemi et al. (2017); Tarhini et al. (2017); Venkatesh & Bala (2008).
Attitude	AT1: I like to use Facebook groups to study. AT2: Facebook study groups provide me with considerable support in my course work. AT3: My opinion on the use of Facebook groups is positive.	[a] Henderson et al. (2016) Kirschner & Karpinski (2010); Wang et al. (2013).
Social presence	SP1: Facebook study groups enable me to interact with my course colleagues. SP2: With Facebook groups, I feel in close contact with my course colleagues. SP3: With Facebook groups, I feel that I am part of a learning community. SP4: With Facebook groups, I feel less alone.	[b] Aaen & Dalsgaard (2016); Akcaoglu & Lee (2018); Al-Rahmi et al. (2015); Aydin (2012); DeLone & McLean (2003); Ozkan & Koseler (2009). Wang et al. (2013).
Educational Use	FE1: Using Facebook groups enables me to share schemes, summaries, themes, and exams related to the courses I study at UNED. FE2: Using Facebook groups enables me to be informed of dates and organizational information related to my course work at UNED. FE3: Using Facebook groups is quicker and less complex than UNED's aLF platform. FE4: Using Facebook groups keeps me updated on issues related to my course work at UNED. FE5. The range of tools and options available to Facebook groups are useful to distance learning. FE6: I trust the academic information that appears in the Facebook groups.	[c] Arteaga et al. (2014); Aydin (2012); Cheung et al. (2010); Davidovitch & Belichenko (2018); Manca & Ranieri (2016); Mazman & Usluel (2010); Moghavvemi et al. (2017); Niu (2019); Tarhini et al. (2017).
Interaction	IT1: When I use the Facebook groups of my courses, I interact more in forums and chats than I do on the UNED aLF platform. IT2: Recognition and feedback by "likes" has increased my participation in Facebook groups. IT3: Facebook group resources (Messenger and Wall) make me interact more with other course colleagues than the resources available on aLF (forums and chat).	[b] Aydin (2012); Butler (2010); Chugh & Ruhi (2018); Davidovitch & Belichenko (2018); Dalsgaard (2016); Eom et al. (2006); Fiock (2020); Liaw (2008); Moghavvemi et al. (2017); Sheeran & Cummings (2018).
No faculty monitoring	FM1: The absence of teacher oversight in the Facebook groups means that I participate more. FM2. On the aLF platform, I do not post certain types of message because they can be seen by the teachers.	[c] Giannikas (2020); Hew (2011); Selim, (2007); Lambić (2016).

	FM3: I feel freer and less inhibited in Facebook groups than on UNED's aLF platform.	
Effectiveness for Distance Education	ED1: I believe that involvement in Facebook groups increases my learning efficacy. ED2: I believe that I am more productive when involved with Facebook groups. ED3: Participation in Facebook groups increases my motivation towards learning.	[c]Abdalla (2007); Barrot (2016); Bhuasiri et al. (2012); Callaghan & Fribbance (2016); Chen (2018); Chiroma et al. (2016); Chugh & Ruhi (2017); Kalelioğlu (2017); Kaya & Bicen (2016); Liaw (2008); Niu (2019); Sheeran & Cummings (2018).
Satisfaction	SA1: I am satisfied with the use of Facebook groups for educational purposes in the subjects I study at UNED. SA2: Facebook groups cover important aspects of learning in my course that are lacking in the aLF platform. SA3: Facebook groups satisfy my learning needs.	DeLone & McLean (2003); Lee (2010); Lee et al. (2009); Selim (2007).

Note: a) user's attitude b) social presence and interaction c) educational impact

Results

The results of this transversal study showed that the students who combined use of Facebook groups and LMS-aLF (n = 418) scored higher in their final course results (mean= 82.1/SE = 4.90) than those students who used only LMS-aLF (n = 217; mean= 78.8/SE = 3.30) with preliminary assessment of sample normality (Kolmogorov-Smirnov/GF sig. 234/aLF sig. 156) and compliance with the equality of variances criterion (Levene Test/sig. 567). Group comparison by the student's t test for independent samples was significant (sig. .000/t (45) = 12.45, p < .05). The effect magnitude was calculated, with a result that showed a medium-to-high influence of Facebook on LMS-aLF, with a value of r = .54).

Figure 5

Central and Non-Central Distribution and Effect Size d

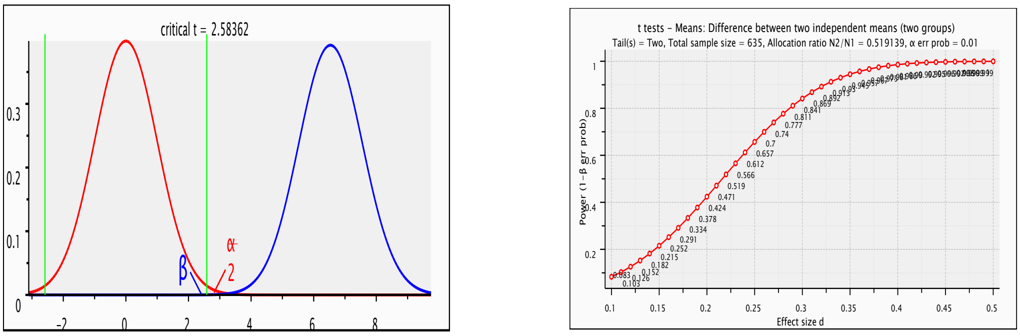


Table 2

Effect Size

Analysis	Post hoc: Compute achieved power	Results
Input	Tail(s)	Two
	Effect size *d*	0.5474088
	α err. prob.	0.01
	Sample size: Facebook group	418
	Sample size: LMS-aLF group	217
Output	Noncentrality parameter δ	6.5424878
	Critical *t*	2.5836185
	Df	633
Power (1 - β err. prob.)	0.9999608	

The 87% (n = 363) of students who used Facebook stated that they accessed Facebook groups more often and interacted there more frequently than they did LMS-aLF. A mean of 7.45 actions of access (S = 0.948 σ = 0.974) and 3.56 interactions (i.e., likes and messages) occurred per week in the Facebook groups (S = 0.831 σ = 0.690). Students who used LMS-aLF only, accessed it 3.12 times (S = 0.912 σ = 0,831) and 0.43 interactions (i.e., messaging in the forum, sending e-mails) per week (S = 0.898 σ = 0.806). Later, we analyzed and validated the scale used to measure the level of satisfaction of students who combined use of Facebook and LMS-aLF to develop their learning activity.

Analyzing the Validity and Reliability of the Scale

To begin, we performed a confirmatory factor analysis (CFA) to measure the model, using the robust maximum likelihood method (Bentler, 1995), with the EQS 6.4 statistical software. For a good fit, the loads average on each factor must be higher than 0.7 (Hair et al., 2006). The goodness-of-fit indices for the respecified measurement model are shown in Table 3.

Table 3

Standardized Estimations for Observable Indicators

Factor	λ	*t* Statistic	Chronbach's α	CRI	AVE
Ease of use			0.879	0.84	0.70
EU1	0.701	12.911			
EU2	0.698	11.193			
EU3	0.857	18.778			
Attitude			0.917	0.92	0.81
US1	0.903	18.765			
US2	0.963	19.001			
US3	0.831	18.323			
Social presence			0.901	0.90	0.71
SP1	0.815	18.045			
SP2	0.829	16.112			

SP3	0.850	17.143			
SP4	0.787	15.497			
Interaction			0.903	0.89	0.70
IT1	0.777	16.053			
IT2	0.885	17.567			
IT3	0.855	18.001			
No faculty monitoring			0.928	0.91	0.79
FM1	0.911	20.043			
FM2	0.932	21.112			
FM3	0.819	24.501			
Educational use			0.799	0.89	0.72
FE1	0.821	21.245			
FE2	0.802	22.322			
FE3	0.789	25.101			
FE4	0.811	19.108			
FE5	0.898	22.482			
FE6	0.815	23.432			
Effectiveness for distance education			0.952	0.94	0.84
ED1	0.895	22.098			
ED2	0.906	24.001			
ED3	0.948	25.019			
Satisfaction			0.879	0.91	0.83
SA1	0.803	19.987			
SA2	0.867	21.118			
SA3	0.851	20.231			

We calculated a number of goodness-of-fit indices: normed fit (NFI), non-normed fit (NNFI), comparative fit (CFI), and root mean square error of approximation (RMSEA). We obtained the following results: $\chi 2$ (105 df) = 3.445; NFI = 0.918; NNFI = 0.921; CFI = 0.927: RMSEA = 0.781. The model fit well for all the values. The internal consistency of the constructs was also good; all the Cronbach's α coefficient values exceeded 0.7 (Nunnally & Bernstein, 1994), and the composite reliability index (CRI) that represents the variance shared between the set of observed variables that measure a construct was above 0.6 in all cases (Bagozzi & Yi, 1988). The average variance extracted (AVE) that measures the relation to the total variance due to the factor's measurement error was calculated for the construct, and yielded AVE values that exceeded the minimum recommended 0.5 level (Fornell & Larcker, 1981). The estimated standard error of the coefficients was used to calculate the *t* statistic for the null hypothesis that the coefficients equal zero in the population; the *t* scores for the coefficients ranged from 11.193 and 25.101, thus the items were significantly related ($p < 0.01$) to their factors, which confirmed convergent validity and indicated that the various items were strongly correlated.

Discriminant validity was also calculated. First, according to confidence interval test criteria, none of the confidence intervals at 95% of the individual elements of the latent factors contained 1 (Anderson & Gerbing, 1988). Second, the AVE statistic for each pair of factors was greater than the squared correlation (Fornell & Larcker, 1981). Thus, both the convergent and discriminant validity of the questionnaire were confirmed (Table 4).

Table 4

Discriminant Validity of Measures

Variable	1	2	3	4	5	6	7	8
1. Use	**0.70**	[0.271; 0.556]	[0.120; 0.356]	[0.419; 0.616]	[0.460; 0.650]	[0.379; 0.678]	[0.478; 0.676]	[0.143; 0.341]
2. Attitude	0.129	**0.75**	[0.285; 0.491]	[0.501; 0.715]	[0.565; 0.710]	[0.442; 0.701]	[0.171; 0.303]	[0.234; 0.529]
3. Social	0.057	0.125	**0.73**	[0.231; 0.515]	[0.228; 0.502]	[0.574; 0.432]	[0.405; 0.757]	[0.395; 0.686]
4. Interaction	0.341	0.258	0.112	**0.81**	[0.767; 0.898]	[0.131; 0.276]	[0.481; 0.613]	[0.452; 0.701]
5. Monitoring	0.113	0.301	0.131	0.339	**0.78**	[0.298; 0.407]	[0.365; 0.690]	[0.529; 0.737]
6. Educational	0.211	0.254	0.221	0.139	0.154	**0.69**	0.587	[0.464; 0.612]
7. Effectiveness	0.055	0.211	0.331	0.311	0.312	0.135	**0.77**	[0.223; 0.510]
8. Satisfaction	0.151	0.173	0.241	0.371	0.201	0.181	0.119	**0.82**

Note. Diagonal of the matrix: extracted variance (in bold). Below the diagonal: estimated correlation of the squared factors. Above the diagonal: 95% confidence interval for the estimated correlation of the factors.

With the measurement model revised (confirmatory factor analysis), we analyzed the structural equations model with the theoretical causal relationships between the latent variables. The nomological validity of the theoretical model can be checked by the chi-square difference test, which compares the theoretical model to the revised measurement model. The theoretical model will have nomological validity if there are no significant differences between the fit of the measurement and theoretical models, given that the scales will have established predictive relationships of other variables which are so substantial that, being less, they equal the goodness-of-fit of the model (Anderson & Gerbing, 1988). Therefore, the chi-square of the revised measurement model is subtracted from the chi-square of the theoretical model to produce the difference in value: 3,445.05 – 3,469.23 = 24.18 (see Tables 3 and 4). The degrees of freedom for the test equal the difference between the degrees of freedom of both models, in this case 105 – 112 = 7. The chi-square critical value with seven degrees of freedom was 24.3213 ($p <$ 0.001). Thus, since 24.18 < 24.3213, we confirmed that the scales had nomological validity.

Analyzing the Structural Model

Table 5 presents the results of the hypotheses contrasted in the structural part of the model, namely the standardized coefficients and robust *t* statistics, to evaluate their significance.

Table 5

Hypotheses Contrasted

Hypotheses	Structural relationship	Std. coefficient	*t* Statistic
H1	Ease of use → Educational use	0.675	7.832**
H2	Ease of use → Attitude	0.612	6.978**
H3	Attitude → Effectiveness	0.698	7.110**
H4	Social presence → Effectiveness	0.121	1.106 ns
H5	Social presence → Satisfaction	0.775	12.003***
H6	Social presence → Interaction	0.801	11.786***
H7	Interaction → Effectiveness	0.712	11.112***
H8	Interaction → Satisfaction	0.675	7.456***
H9	Monitoring → Effectiveness	0.819	10.276***
H10	Educational use → Effectiveness	0.878	11.567***
H11	Effectiveness → Satisfaction	0.845	11.341***

To a greater extent, this model explains the variables of effectiveness (R^2 = 0.7792), social presence (R^2 = 0.610), interaction (R^2 = 0.823), monitoring (R^2 = 0.876), ease of use (R^2 = 0.561), attitude (R^2 = 0.370) and educational use (R^2 = 0.891). Based on the previous discussion, the model that was initially proposed is that which appears in Figure 6.

Figure 6

Structural Model

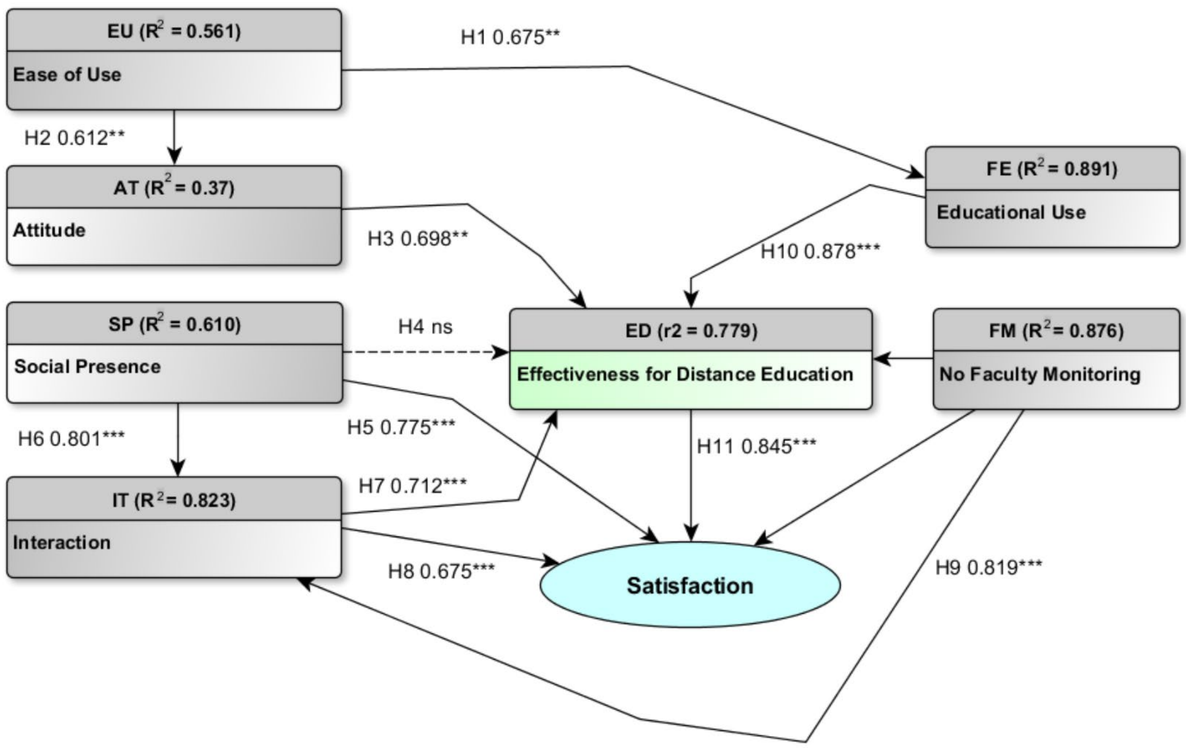


Table 6 presents the values of the structural model's fit indices. All the measurements fall within the limits established to confirm the data's goodness-of-fit.

Table 6

Fit Indices for the Structural Equations Model

Fit index	Recommended value	Actual
χ^2/df	<3 preferable <5	3.469
Goodness-of-fit index (GFI)	>0.80	0.815
Adjusted goodness-of-fit-index (AGFI)	>0.80	0.901
Comparative fit index (CFI)	>0.90	0.911
Root mean square error of approximation (RMSEA)	<0.08	0.902
Normed fit index (NFI)	>0.90	0.921
Non-normed fit index (NNFI)	>0.90	0.932
Parsimony normed fit index (PNFI)	>0.60	0.756

The results showed that ease of use had a positive influence on the use of Facebook groups for educational purposes ($\beta = 0.675$; $p < 0.01$) thus confirming hypothesis 1. The model also confirmed hypothesis 2 ($\beta = 0.612$; $p < 0.01$), which implied that the ease of use of Facebook groups bolstered students' attitudes towards using them. Positive attitudes towards use of Facebook groups had a positive effect on learning efficacy, thereby confirming hypothesis 3 ($\beta = 0.698$; $p < 0{,}01$). The hypotheses related to sense of community (H4; $\beta = 0.775$; $p < 0.01$) and social presence (H6; $\beta = 0.801$; $p < 0.01$) are confirmed, but not hypothesis 5 ($\beta = 0.121$; $p < 0.01$). Sense of community had a positive effect on user satisfaction and boosted interaction among students, which is one aspect of current didactics that the LMS does not seem to be achieving. On the other hand, the role of student interaction was confirmed in hypothesis 7 ($\beta = 0.712$; $p < 0.01$), so the greater the interaction among students, the greater the efficacy of distance learning, and hypothesis 8 ($\beta = 0.675$; $p < 0.01$), the greater the interaction among students, the more positive the effect on user satisfaction. Interaction was one of the main predictors of the efficacy of use of Facebook groups for distance learning, and interaction increases in Facebook groups when there is no teacher oversight (H9; $\beta = 0.819$; p < 0.01). The model confirmed hypothesis 10 ($\beta = 0.878$; $p < 0.01$) and demonstrated that use of Facebook groups for educational purposes increased perceived efficacy in distance education. Finally, hypothesis 11 showed that a higher level of distance learning efficacy increased student satisfaction at UNED ($\beta = 0.845$; p < 0.01). Satisfaction was confirmed mainly by the sense of community and the efficacy of distance learning achieved by membership in Facebook groups, which were more attractive due to their potential for interaction and lack of teacher control.

Discussion

The results showed that students viewed use of the Facebook groups in the distance learning university environment as an effective tool for learning; the learning efficacy achievable in online settings had a positive effect on user satisfaction, particularly in terms of productivity and motivation. According to the UNED students surveyed, the Facebook tool satisfied their learning needs and enabled them to access more relevant aspects of their courses than the official university platform (aLF) provided. The benefits of Facebook group use described here are in line with the findings of other studies (Akcaoglu & Lee, 2018; Arteaga et al., 2014; Davidovitch & Belichenko, 2018; Moghavvemi et al., 2017; Niu, 2019).

Effectiveness, therefore, was the most relevant variable in relation to satisfaction. This matched the conclusions of Davidovitch and Belichenko (2018) and Wang et al. (2013), who found that the feeling of satisfaction was the result of good academic performance incentivized by the positive effects on learning that emerged from use of this tool. According to the data, another relevant factor related to satisfaction was the sense of belonging to a community, which positively influenced the number of interactions. Besides enabling fluid interactions among course colleagues, Facebook group membership created a sense of closeness to others and offset the feelings of solitude associated with distance learning contexts. Forming educational communities was one of Facebook's pedagogical functions identified by Mazman and Usluel (2010), and in distance education settings, this created a sense of belonging and identity that allowed the student to feel accompanied during the learning process (Callaghan & Fribbance, 2016; Sheeran & Cummings, 2018).

Interaction was another component related to student satisfaction, with a correlation between levels of interaction and greater distance learning efficacy. Students used Facebook groups and its communication resources (Messenger and Wall) more frequently than they used the forums and chats on institutional platforms. Resources such as recognition and feedback represented by Facebook likes helped to boost participation (Wang et al., 2013). Interactivity defines Facebook as a tool of communication and, according to Chugh and Ruhi (2018), and Sheeran and Cummings (2018), it facilitated connectivity between student working groups and staff teams; even when interactions were passive, they still contributed to higher levels of course commitment.

The values of the total effects included educational use, which is perceived as the most important predictor of distance learning efficacy, followed by other indicators such as attitude and interaction. According to the students' responses, the Facebook study group enabled them to remain updated on course information and important dates in the academic calendar better than the UNED platform, even though there was no difference in the quality of information provided by both. This indicated that the information posted on Facebook was reliable. Facebook also helped students share course information such as schemes, summaries, and exams; this supported connectivist theory that knowledge is acquired through the constant input of new information in virtual spaces (Siemens, 2004). The dynamics already mentioned helped explain the purely educational use of Facebook, and according to the results, they were strongly linked to its efficacy in generating good academic results. The perception of the tool's use as a study support to achieve better educational outcomes, together with intentionality or attitude towards its use, matched the findings of a range of authors who have pointed to these indicators to justify the decision by students to use Facebook groups (Goh et al., 2019; Kalelioğlu, 2017; Kitsantas et al., 2016; Lambić, 2016; Sharma et al., 2016).

Ease of use was also perceived as a predictor of attitude towards use of Facebook groups, as well as the main predictor for perceived usefulness. Our results showed that this medium provided students with a ubiquitous and easily accessible environment. Facebook's multiplatform characteristics enabled students to share and obtain course resources and information, and always be connected. These findings coincided with those of various studies (Giannikas, 2020; Moorthy et al., 2019; Moghavvemi et al., 2017), that showed how students' familiarity with this tool derives from automated use, hence they found no technical barriers.

We also noted that absence of teacher control was the most important predictor of interaction, although sense of belonging to a community was also influential. The students stated that the number of interventions rose when there was no teacher oversight, alluding to a sense of freedom that allowed them to interact more frequently, which would not occur if an authority figure was present to engender feelings of inhibition. The fact that the number of interactions in groups was higher when a teacher did not intervene was detected in studies by Giannikas (2020) and Lambic (2016), who showed that lack of teacher oversight enabled the development of student scenarios that felt closer and less intimidating and led to a higher number of interventions. Lambic (2016) also indicated that interventions were motivated by the sense of community generated by the students, which was also noted by Aaen and Dalsgaard (2016). These researchers proposed a third space for communication represented by the absence of teachers, in which the student sets aside the role of student and individual to express themselves as a valuable member of a community.

The results allowed us to deduce that the use of Facebook in educational contexts was promoted by the affective and social factors that social presence represents, and, therefore, was not strictly linked to the cognitive processes of learning, but fostered them, instead. In the present study, motivation and productivity were connected with learning efficacy, supporting the application of social cognitive and social constructivism theories, respectively, to social media. The former has stated that motivation is one of the cognitive factors developed in this context (Deaton, 2015), and the latter has explained how learning is acquired by taking an active role in the knowledge-creation process thus increasing students' productivity (Churcher, 2014). According to the results of this study, university students preferred a like-for-like presence where their input was valued by a person with the same status, regardless of the personal or academic focus of the communication. Therefore, a most significant social presence for students has direct impact on learning outcomes. Research has not established a clear relationship between better learning outcomes and social presence, as most of the studies focus is on perceived learning (Oztok & Brett, 2011). This study, then, constitutes a significant step forward for research into social media-enhanced learning environments due to its confirmation of greater learning results through the use of non-controlled Facebook groups at the university level.

Conclusion

Facebook study groups that are not controlled by teachers can be an efficient, complementary educational tool to develop the teaching-learning process in distance learning. Students feel greater satisfaction when group involvement generates a sense of accompaniment that minimizes feelings of solitude, and a sense of participation in a learning community. Interaction was higher in Facebook groups than on the official LMS platform due to the former's ease of use and social penetration, as well as the sense of greater freedom these groups provide by not being controlled by teachers.

The main implication for practice is the need to rethink LMS design to enable learning communities to boost students' social presence and interaction, which in turn can activate methodologies for collaborative and cooperative work, among others. This is essential for developing university students' generic and specific competences in virtual environments. The current LMS design directs students to interact in spaces created for that purpose (e.g., forums, chats, Web conferencing). Many teachers use social networks in the methodological development of their subjects, but teacher control is always evident. For this reason, the LMS needs to provide spaces that are unregulated by teachers to encourage anonymous, informal interaction among students. Such spaces should enable students to create their own course communities using PLEs, MOOCs, and social networks (e.g., Facebook, Twitter, LinkedIn), which they can design and control themselves.

With on-site learning, students organize themselves around libraries, cafeterias, and the virtual and physical workspaces they already occupy. This leads to setting up Facebook and WhatsApp groups for organizing and sharing knowledge and information, disseminating study material, as well as for their downtime activities. This close interaction is absent in distance learning, where students can feel isolated and lack a sense of belonging to a learning community. Social networks such as Facebook are a response to this need for students to interact in anonymous, informal settings for a variety of academic and social activities. In distance learning, informal spaces can help students feel part of a community of classmates, diminishing their sense of isolation, binding them more closely to their coursework and companions, and stimulating informal work dynamics. These objectives can be achieved on social networks, though they can also take place within the interactive spaces provided by a higher education institution's own LMS, thereby democratizing knowledge and access to these informal learning spaces associated with formal education.

Finally, we conclude that students perceive Facebook groups with no teacher oversight as satisfactory for distance learning. Even so, integrating with the LMS or designing the LMS with an architecture and functionalities similar to Facebook groups will be conditioned by the main motivation of each student, namely learning versus getting good marks.

Acknowledgments

The study was funded by Universidad Nacional de Educación a Distancia (Vice-Rector's Office for Digitization and Innovation with the support of the University Institute of Distance Education [IUED]), Governing Council of July 2, 2019 / BICI 37/08/07/2019.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 22, Number 3

August – 2021

Knowledge Marketplaces: An Analysis of the Influence of Business Models on Instructors' Motivations and Strategies

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Abstract

Unlike MOOC platforms such as Coursera or edX, which typically partner with institutions of higher education, online knowledge marketplaces allow anyone to broadcast courses and charge for them. In this article, we investigate, through a mixed-method approach, the motivations and strategies of the instructors of Udemy and Skillshare. Semi-structured interviews and a quantitative analysis of the characteristics of Skillshare's courses, obtained using a Web scraper, suggest that while a significant proportion of the marketplace's instructors are outreach driven, the majority are income driven. They develop strategies to maximize their revenues, notably by adapting the characteristics of their courses, such as the number of videos, to the business model of the platform. Courses are shorter on Skillshare than on Udemy, where instructors' incomes are proportional to the number of registrations. We hypothesize that the latter platform's business model incentivizes instructors to create longer courses in order to attract wider audiences.

Keywords: marketplace, MOOC, instructor, content analysis

Introduction

Marketplaces, Business Models, and Instructors' Motivations

While massive open online courses (MOOCs; Daniel, 2012) have attracted considerable attention from media over the past decade (Pappano, 2012), less publicized platforms for teaching and learning, known as *knowledge marketplaces* (KMs), have been gaining momentum (Author, 2019). Represented by companies such as Udemy and Skillshare, KMs allow anyone to publish and monetize courses on various topics, ranging from data science to photography. One can find books on course design specifically written for these independent instructors (Mardan, 2018). However, despite the growing popularity of these platforms, there is, to our knowledge, hardly any research on the topic.

KMs are occasionally mentioned in MOOC literature (Tovar et al., 2013) and these marketplaces themselves sometimes use the term MOOC to describe their courses (Choy & Tay, 2016). MOOCs and KMs share similarities, in the sense that they rely primarily on videos and quizzes, even if more complex activities are common on both types of platforms (Udemy, 2019). However, in marketplaces, courses are produced by independent instructors, not necessarily affiliated with an educational institution, while experienced faculty members account for most of the instructors of MOOC platforms such as Coursera and edX (Evans & Myrick, 2015). Additionally, courses in KMs are usually not freely available, and these classes do not lead to a certificate or statement of accomplishment. In contrast, Coursera and edX usually offer free access to courses, at least for a short time, but charge for certificates (Coursera, 2015, 2016). Alternatively, they make available yearly subscriptions, using a model that dates back at least to the early 2000s, when the iconic online learning platform, Lynda.com, was launched. The statistics provided by the marketplaces themselves also highlight the differences with what is usually labeled as a MOOC platform.

For example, marketplaces offer more courses. While there were 2,700 courses on Coursera at the time of the analysis in early 2019, there were more than 100,000 courses on Udemy, 42,000 instructors, and 30 million users (Udemy, 2018). Business models (BM) also differ considerably (Table 1); while MOOCs rely mostly on certificates to generate revenue, marketplaces sell access to content. Udemy offers instructors the possibility to create free or paid courses, with prices ranging from $10 to $200, while the marketplace takes a commission. Learners usually pay for each class they want to access; it is a registration-based or pay-per-course BM. Conversely, Skillshare, another of the largest marketplaces, relies on subscriptions.

Table 1

Comparison of the Business Models of Udemy and Skillshare at the Time of Analysis

Characteristic	Udemy	Skillshare
How learners are charged	Pay-per-course	Monthly subscription
Price range	From $10 to $200 per course	$14 a month for the whole platform
Revenue model for instructors	Proportional to the number of registrations	Streaming-based (revenue is proportional to the number of videos viewed)

For $14 per month, as of 2019, learners on Skillshare were granted unlimited access to all courses, while instructors were paid according to the number of minutes of videos that users viewed; we will call this BM the *streaming model* (Skillshare, 2016). Both platforms authorized the creation of tuition-free classes, possibly as a means to drive more users to register. Finally, while course categories ranged from poetry to physics on MOOC platforms, KMs asked their instructors to label their courses based on a list of categories and subcategories. For instance, the typology of categories proposed by Skillshare includes business, technology, creativity, and lifestyle. KMs appear more openly mercantile than MOOC platforms, in the sense that they only promote topics likely to generate income for both the company and the instructors, whose motivations are the focus of the present article.

Conceptual Framework and Research Questions

Over the past four decades, a growing body of scientific literature on motivation has emerged. The Self-Determination Theory (SDT) (Deci & Ryan, 2000; Ryan & Deci, 2000, 2020) represents one of the most common theoretical frameworks in the field of education. While initially focused on learners' motivation, various authors have also applied the framework to teachers and instructors (Stupnisky et al., 2018).

The SDT has been used extensively to conceptualize the difference between intrinsic and extrinsic motivation and to distinguish different types of extrinsic motivations (Ryan & Deci, 2000). External motivation and intrinsic motivation represent both ends of the spectrum. In the former, external regulation or external rewards, such as money, regulate motivation, while in the latter, enjoyment and inherent satisfaction play this role. Identified and introjected regulation represent two types of extrinsic motivation where personal importance and ego involvement or internal rewards control behavior, respectively. For instance, for an instructor, being motivated by the idea of democratizing education and spreading one's knowledge arguably corresponds to an identified regulation, while public recognition would classify as an introjected motivation.

In research articles focused on MOOCs (Zhu et al., 2019), most instructors do not seem to be driven by external rewards, such as income, given the importance that motives such as the democratization of education appear to take in survey answers. It is unlikely to be the same for KMs, whose objectives are more openly mercantile. This thinking led us to formulate several questions. First, to what extent does the mercantile philosophy of knowledge marketplaces deter instructors who are not externally motivated from broadcasting classes on these platforms? It is likely that the importance that marketplaces give to monetization attracts individuals who are more income driven, or, in other words, externally motivated, than MOOC instructors. However, the existence of free courses on both KMs led us to propose a first hypothesis (H1): a significant nucleus of instructors teach on these platforms for the outreach they offer, rather than for the incomes they potentially create. Through the lens of the SDT, introjected or identified regulation plays a stronger role than external regulation for such instructors.

The difficulties associated with the use of large-scale surveys to poll course designers make it challenging to assess how well represented this category of individual is, but some other approaches can be followed. More specifically, we can scrape course characteristics such as tuition fees at the scale of the platform, and we can assume that the higher the proportion of instructors who provide free courses, or mostly free courses, the more corroborated H1 is. Nevertheless, if interviews provide clues that instructors tend to propose free classes mostly to promote chargeable classes, H1 could be partly invalidated.

Another question raised by KMs' strategies with regards to their BM is to what extent financial incentives shape the structure of their catalog. In other words, how does the BM influence the choices that instructors make in terms of course characteristics? The apparently longer duration of courses on Udemy led us to propose the following hypothesis (H2): income-driven instructors, where external regulation plays a strong role in their motivation, adapt the characteristics of their course (duration, media) to the BM of the platform in order to maximize their revenues. In a pay-per-course BM, increasing the amount of content available in a class could represent an attempt to give learners a stronger sense of return-on-investment. In a streaming-based BM, the instructors' economic interest is to decrease dropout, which is synonymous with revenue loss, by providing shorter classes. Therefore, if courses indeed last longer on Udemy than on Skillshare, and if some instructors admit that their content design strategy depends upon the BM, it would corroborate H2.

To test these hypotheses, we used a mixed methods research (Tashakkori & Teddlie, 1998; Creswell & Plano Clark, 2007). With the help of a Web scraper, we performed a quantitative analysis of the characteristics of twelve thousand courses from Skillshare, which we complemented with descriptive statistics originating from Udemy. We then conducted fourteen semi-structured interviews with instructors from both Skillshare and Udemy; we compared our results with the literature on the motivations of MOOC designers. After a short discussion on the definition of MOOCs, we provide, in the next paragraph, a brief overview of the research published on the topic.

Motivations of MOOC Designers: A Literature Review

At least two elements can explain the lack of consensus regarding the definition of a MOOC. First, as a buzzword that has attracted considerable attention, it was used to designate a variety of online courses and pedagogical resources and as a synonym for e-learning (Author, 2016). Second, on what most people refer to as MOOC platforms, e.g., Coursera or edX, characteristics and business models evolved quickly (Coursera, 2016), and differences between platforms became blurrier over time. In the literature, however, authors generally use the term MOOC to refer to courses broadcast on platforms such as Coursera, edX, or Futurelearn (Daniel, 2012). From 2016 onwards, certificates were usually charged for, but course content remained freely available (Coursera, 2015). In this article, we define a MOOC as an online course following a business model in which there is free content but a charge for certificates, regardless of the academic affiliation of course designers. According to this definition, a MOOC is typically designed by an institution of higher education, but even platforms like Coursera or edX have partnered with companies such as Microsoft or institutions such as the World Bank for course delivery.

MOOCs' instructors initially attracted little attention from the scientific community (Deng et al., 2017). In a review encompassing 183 studies, Veletsianos and Shepherdson (2016) found that less than 10% of studies focused on instructors and course characteristics. However, there are a few notable results found in both the grey and scientific literature. Interest in course instructors increased after the publication of a 2013 study in *The Chronicle of Higher Education* (Kolowich, 2013). This first work surveyed instructors, and results highlighted the existence of a mix of motivations: increasing their own visibility on the one hand, and altruistic motives such as providing free access to higher education on the other hand.

Haavind and Sistek-Chandler (2015) as well as Zheng et al. (2016) conducted interviews with, respectively, eight and 14 MOOC instructors and confirmed their interest in both global impact and name recognition. Evans and Myrick (2015) expanded on this work by surveying almost 200 respondents and following that up with semi-structured interviews. Their research showed that MOOC instructors were experienced faculty members with little prior online experience. Lowenthal et al. (2018) confirmed that beyond the global impact, instructors were not ignoring benefits for their careers, in terms of visibility or research opportunities. Through a mixed-method study featuring a survey sent to 143 MOOC designers, Zhu et al. (2019) also showed that building institutional reputation was a recurrent motivation for most instructors in their sample, even though it seemed less important than the possibility of reaching new students and increasing access to higher education. Finally, Doo et al. (2020) highlighted the importance that launching these online classes had, for teachers, in terms of professional development.

Most respondents enrolled in these investigations belonged to academia, which partly explains why MOOC instructors did not appear to be money-driven. Direct economic benefits were not often mentioned by instructors, although some respondents mentioned indirect financial benefits (marketing a book, etc.). Platforms such as Coursera or edX typically collect a significant part of the revenue stream, and what is left for the partnering institutions is not necessarily redistributed to instructors. Symbolic rewards, such as public recognition, seemed to be one of the most efficient incentives for these teachers, which, as we will see in the results, can also be the case for instructors broadcasting their courses on marketplaces.

Method

The characteristics of more than 12,000 of Skillshare's platform courses were extracted using a Web scraper. The results of the quantitative data analysis were compared to the outcomes of 14 semi-structured interviews conducted with instructors from both Udemy and Skillshare. We, therefore, followed a mixed-methods approach (Creswell & Plano Clark, 2007), with the intent to triangulate results from both the qualitative and the quantitative studies. This approach seems to have gained momentum in MOOC research over the 2010s (Zhu et al., 2020).

Semi-Structured Interviews

Construction of the Interview Canvas

From April to May 2019, 14 semi-structured interviews were conducted. The interviews lasted between 30 and 50 minutes, with a median duration of approximately 40 minutes. We based the interviews on a canvas, with necessary adaptations in both the order and the exact formulation of the question. The canvas was divided into three parts: background of the instructor (degree, etc.), motivations to design the course, and strategies. Questions in the strategy section touched upon the actions that instructors would take to widen their audience. More specifically, we asked them how they chose the topics they would teach, and how they would try to promote their courses. The goal of this qualitative analysis was neither to achieve representativity nor to explore the full range of instructors' motivations and strategies, but rather to provide insights into the results of the quantitative analysis of the catalogs of the marketplaces.

Selection of the Interviewees

Instructor contact information was obtained from the courses' landing pages. As the e-mail address was usually unavailable on the platform, addresses had to be searched and were found on instructors' personal Websites, blogs, or YouTube channels. For each topic, ten instructors were contacted, with a frequency of twenty e-mails per week over four weeks. A total of 80 interview requests were sent, with a response rate of 25%. The instructors were chosen to obtain the most diverse and complete sample possible in terms of gender, nationality, number of courses, topics of courses, and seniority on the platform. Only 14 instructors agreed to be interviewed. When quoting them in this article, we use the letter I for interviewee (I1 = Interviewee 1).

The survey population was predominantly male (12 men, 2 women) and originated mostly from France (6), followed by the United States (3), Canada (1), India (1), the Netherlands (1), Uruguay (1), and Brazil (1). The instructors were teaching on Udemy only (8), Skillshare only (2), or both (4). The instructors published courses in the following categories: technology (5), design (4), business (2), science (2), and lifestyle (1). The number of courses created by each instructor ranged from 1 to 210, with a median value of 6. Interviews were conducted using Skype or Zoom, recorded with the built-in recorder provided by these video conferencing tools, and fully transcribed afterwards.

Quantitative Analysis of Marketplaces' Catalogs

Scraping has been used successfully in the past to explore the characteristics of courses at the scale of the whole MOOC platform, such as FUN (Author, 2018). Our initial plan was to analyze course catalogs from both Udemy and Skillshare, but Udemy prevents Web scraping and explicitly prohibits it. While some data were manually collected on Udemy, we focused on Skillshare, using the Web scraper plugin Data Miner in the Google Chrome browser.

Manual Explanation of Descriptive Statistics from Udemy

Though Udemy does not allow Web scraping, it provides aggregated statistics on course length that allowed us to make a comparison with Skillshare. The number of hours of video available in each course was the only data we collected from the website. For a given topic (computer science, for example), classes were divided into four categories (less than 3 hours, between 3 and 7 hours, between 7 and 17 hours, and more than 17 hours). We compiled these data for all topics, which allowed us to compare the distribution of course duration between the two platforms. It is important to note that while data collection and aggregation were manual for this variable on Udemy, and automated on Skillshare, we collected the exact same data and used the same technique to plot the distribution of the variable, which enabled us to compare both KMs.

Using a Data Scraper on Skillshare's Catalog

The Data Miner plug-in allows extracting data from specific Web pages. We focused on the following variables: course name, course category and subcategory, instructor name (which was replaced, right after extraction, by an anonymous ID), number of students enrolled in the course, and course duration (in hours). We provide, in the following paragraph, a more detailed account of our approach, along with some basic descriptive statistics.

Data scraping could be performed on only a single page at a time, and it was not possible to display all Skillshare's courses on a single page. We, therefore, extracted the data from all the courses of a given sub-category, and then repeated the process on all the subcategories on the platform to have a complete overview of its offerings. There were 40 subcategories at the time of this study. For a given sub-category, it was possible to display a maximum of three hundred of the most popular courses (based on the number of enrollees) on a single page. Several sub-categories had fewer than three hundred courses. For the sub-categories that included more than 300 courses, it was observed that beyond the limit of three hundred (i.e., the 300th course listed), the remaining courses had only a few to zero participants. They were considered negligible in terms of platform activity since they were hardly visible to prospective learners. In the end, data for a total of 12,314 courses were obtained from a total of 28,000 courses listed on the platform. This database was cleaned and analyzed using the statistical software R version 3.2.

There were imbalances among categories in terms of registrations (Table 2). For instance, while courses from the technology category represented 18% of the courses analyzed, they accounted for less than 5% of enrollments. Courses in the creativity category were the most popular, with 62% of registrations on the platform. The number of courses in this category was slightly lower than in the business category: 29% vs. 31% of total offerings. Most instructors (58%) who produced more than one course specialized in a single category. However, more than a third (42%) produced courses in different categories. The diversity of topics is more striking when we look at subcategories: 72% of instructors designed courses that belonged to different subcategories.

Table 2

Characteristics of the Different Categories of Courses in Skillshare

Course category	% courses on the platform	*M* registrations	% registrations on the platform	*M* course length (min)
Business	31.00	488 (±2,208)	22.70	66 (±88)
Creativity	28.70	1,452 (±3,644)	62.50	64 (±78)
Lifestyle	22.40	296 (±1,022)	9.90	53 (±77)
Technology	17.80	181 (±755)	4.80	113 (±141)

Note. N = 12,314. The number in parentheses corresponds to standard deviations and not variances.

The differences between KMs and MOOC platforms appeared more clearly when we analyzed the number of registrations per course. On platforms such as edX or Coursera (Ho et al., 2014), MOOCs usually attract thousands or tens of thousands of enrollees; courses on marketplaces display much lower numbers. More than half of Skillshare's offerings could not be analyzed because there was not a single registration in those courses. Among the 12,314 courses that we studied, only a small proportion exhibited an audience size comparable to those found in the MOOC platforms. About 18% of courses had less than ten participants, while a third had between ten and a hundred participants, and another third had between a hundred and a thousand participants. The maximum number of enrollees was 60,007. In contrast, many MOOCs gather more than one hundred thousand registrants (Ho et al., 2014).

One benefit of Web scraping with regards to our research questions is the fact that it surveys the whole catalog of the platform, in contrast with online surveys that usually suffer from self-selection bias. We believe that this approach, applied successfully to analyze institutional strategies in terms of MOOC production (Author, 2019), also has the potential to provide insights into instructors' motivations and course design strategies.

Results

We first provide data supporting our hypothesis (H1) which states that, for a significant proportion of instructors, external regulation through external rewards such as incomes plays only a minor role. We notably use results from the analysis of Skillshare's catalog on free courses. In the second section, we focus on income-driven instructors and their strategies to maximize revenues. We show that, on average, courses are shorter on Skillshare than on Udemy. We suggest that it is a consequence of the differences in BM in which a pay-per-course model incentivizes instructors to create more content to attract additional learners.

Instructor Motivations

More than a third of the instructors declared that they were primarily motivated by outreach. However, most interviewees stated that their motivation was the revenue stream. We present excerpts from the interviews that show the importance of online teaching as a source of income in some cases. Finally, a significant portion of the courses were offered for free, which is, according to interviews, not necessarily a means to attract more learners.

Similarities Between Outreach-Driven Instructors and MOOC Designers

The revenue stream was perceived as a secondary motivation for five out of fourteen interviewees. Instructors who claimed they were not money-driven described the goals behind course design in a way similar to how MOOC designers have in the literature: outreach. The motives they listed typically corresponded to identified regulation, a subcategory of extrinsic motivation, i.e., widening access to knowledge and its potentially beneficial consequences in order to improve their learners' lives, etc. This position was exemplified by this faculty member, an assistant lecturer in an American university (I1):

> Some lecturers want to put a lot of courses on Udemy to make a living from them. But I have a living already, I have a job as a lecturer so this for me is something extra, nice, a way of spreading my expertise for people who are interested, not only students [in my university], but also a broader audience.

Unlike some instructors who taught themselves certain topics in order to be able to teach them, these instructors all focused on topics they already knew. A course designer who was also a scholar provided more details on this matter (I2):

> I started with my own expertise [...]. It was not the commercial idea of what do people need and I give it to them. No, it was the other way around, what can I do and how can I spread it.

Income-Driven Instructors

In contrast to the previous interviewees, most instructors openly admitted that they broadcast classes on the marketplaces to generate revenue. Some of them even made a living out of the income they get from the marketplace.

This was the case for this 19-year-old French developer, who had become a full-time instructor even though he struggled financially because he earned less than when he was freelancing (I3):

> Today it's my main revenue source, I spend between 6 and 10 hours per day to producing and handling my community. I set big goals, so I need to work hard to reach them. [...] I was expecting to live from it sooner or later, but it takes a lot of time and effort.

Some of the people that we interviewed had renounced an academic career to become a full-time instructor, such as this ex-assistant lecturer, who has a Ph.D. in psychology from a Canadian university (I4):

> Right after my Ph.D., I had children and wanted to work from home to be able to spend time with them. I did not want to spend three hours commuting to give a 1h30 class [...]. I wanted flexibility and independence. So I started to create content online.

One of the main challenges that we faced was to determine the relative proportion of outreach-driven vs. income-driven instructors. Given the impossibility of using surveys to address the challenge due to the low response rates, we tried to derive metrics from the scraped data that could provide insights. In the next section, we will discuss how these data showed that chargeable courses account for the majority of Skillshare's catalog, and what this might say about instructors' motivation.

Free Courses vs. Premium Courses in Skillshare's Catalog

We observed a dichotomy between individuals who proposed only free courses and represented 21% of Skillshare's instructors, and those who produced only premium courses – 71% of the 4,541 instructors were included in our study (Table 3). Launching more than one course represented a common behavior: 43.5% of instructors do so. Only 21% of Skillshare's offering is made up of courses designed by an instructor who created only one course, whether free or premium. A nucleus of instructors often designed several courses on the platform, with a mix of free and premium offerings. To sum up, we can observe, based on Table 3, that individuals that propose only paid courses represent the vast majority of instructors, and account for most of Skillshare offerings.

Table 3

Distribution of Instructors by Number of Paid and Free Courses They Produce

Instructor category (by type and number of courses offered)	% of instructors	% of Skillshare offerings*
Paid		
1	42.5	17.5
2+	28.7	46.7
Total	71.2	64.2
Free		
1	14.0	5.0
2+	7.3	14.0
Total	21.3	19.0
Combination of paid & free		
1 paid, 1 free	1.3	1.0
1 paid, 2+ free	1.2	0.7
2+ paid, 1 free	2.2	4.7
2+ paid, 2+ free	2.7	10.2
Total	7.4	16.6

Note. N = 4,541. *Proportion of the platform's total offerings designed by each category of instructor.

It is likely that instructors who propose only free courses are not money driven, with the possible exception of those who have not started posting their premium courses on Skillshare and have just posted free courses to establish a reputation, in order to subsequently market premium courses more effectively.

While the 21.3% of instructors who produce only free courses are most likely to be outreach driven, we believe that a significant proportion of instructors who create premium courses also belong to this category. They only charge for some courses in order to cover the costs of creating pedagogical resources. This hypothesis was corroborated by some of the interviews. Two instructors explained that charging a fee was to give a sense of quality to their content, or to cover basic costs for course creation, as detailed by this teacher (I1):

> I don't earn a lot [...], because most of my courses are free courses. So now I make them available for a little amount [of money], just to give some standards to them.

These findings suggest that it is not possible to categorize instructors as either money-driven or outreach-driven since many produce both free and chargeable courses. Skillshare's catalog analysis shows that they potentially represent a significant portion of instructors, even if money-driven instructors are likely to be dominant.

Adapting Design Strategies to the Platform Rules: The Example of Course Duration

Course duration represents a strategic characteristic with respect to two elements: resource development and income. The cost associated with course development is roughly proportional to the amount of content in an instructor's design. Regarding income, the explanation is more complex, and an instructor must dig into the relationship between dropout and course duration to assess the optimal course length. A common recommendation for online course designers is to decrease the duration of their courses in order to increase retention (Jordan, 2015). While dropouts do not threaten incomes for Udemy instructors, since revenues depend only upon the number of registrations, they do have an effect on instructors for Skillshare since they shifted to a streaming-based BM (Skillshare, 2016). We, therefore, hypothesized that strategies differed between marketplaces in terms of course duration. On Udemy, one way to increase the perceived value is to create long courses, as explained by an international student majoring in computer sciences (I3), who is both a student in a brick-and-mortar university, and an instructor on the marketplace:

> A course that will work is one that will last more than three, four hours or so. The ones that are really well promoted, at least by Udemy, and the ones people buy, are courses that last more than six, seven hours.

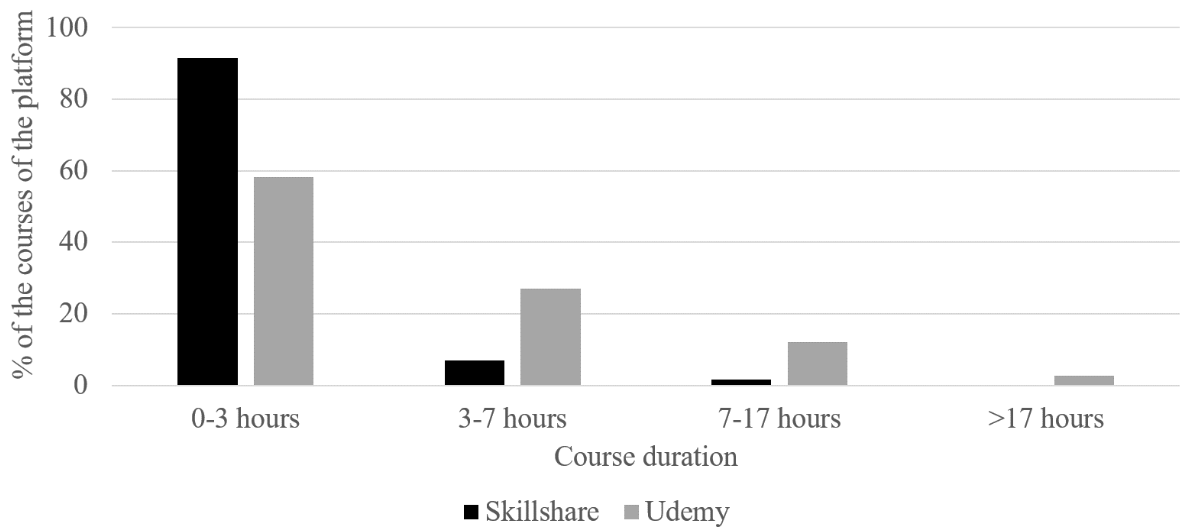
Since Udemy follows a registration-based BM, instructors are often advised by the marketplace's employees to provide more content to give the impression the course is worth paying for. In the same spirit, teachers are advised to set up high prices for registration, even if it means offering large discounts (often -90%) from time to time to fill up their class. On the contrary, since Skillshare's BM remunerates instructors according to the number of minutes of premium video watched by students, it may be considered a better strategy for designers to tackle dropout by creating shorter courses, even if it means launching more classes. They may believe that the longer the course, the more likely a learner is to dropout, which would be detrimental to their incomes. This hypothesis was supported by this American full-time instructor, active on both platforms (I5). He claimed that he published shorter courses on Skillshare than on Udemy.

> I had over 100 of them [courses on Skillshare] believe it or not, but many of those were very, very short; there were a lot of 20-30 minutes kind of basic ideas. [...] In reality, it was a thing I could've made into a 30 minutes YouTube video and I just broke it down into pieces and just made it more step-by-step than you would in a normal course. So that was kind of my angle with Skillshare because it was more about volume and just creating courses that at the time it seemed to be producing more revenue on that platform. Udemy had a much stricter process in terms of what you submit.

We tried to assess whether these differences in strategy actually affected course duration. Udemy's descriptive statistics enabled a comparison with Skillshare (Figure 1) and corroborated our hypothesis (H2). Udemy's classes were longer; the 0-3 hours category accounted for 93% of Skillshare's and 58% of Udemy's offerings, respectively. Courses that exceeded seven hours represented respectively 1.5% and 15% of the marketplaces' catalogs.

Figure 1

Course Duration in Skillshare and Udemy



Note. Skillshare *N* = 12,314. Udemy *N* = 106,192.

These descriptive statistics seem to indicate that BMs impact designers' strategies and affect course characteristics, with longer classes in registration-based BMs. In the following discussion, we dwell further on the evolution of BMs of distance education and compare their differential influences.

We begin with a brief synthesis of our results.

Discussion

Income- vs. Outreach-Driven Instructors

Interviews and analyses of catalogs seem to support both our working hypotheses. On the one hand, marketplaces' instructors appear to be more money-driven, and therefore, their motivation seems to be more externally regulated than is the case for MOOC designers. However, we identified a nucleus of outreach-driven instructors (H1), such as I1, who claimed that he was mostly motivated by the potential of expanding his audience. Moreover, the fact that he charged for some classes not only to generate revenues, but also to "give some standards" to them suggests that charging for courses does not necessarily mean that an individual is income-driven. The economic incentives that KMs such as Skillshare put in place do not seem to discourage all instructors from taking a non-lucrative approach to online teaching. Some still provide most, if not all their courses for free, to share their expertise on a given topic in the spirit of what has been done during the MOOC movement (Lowenthal et al., 2018). However, the choice of BM seems to influence income-driven instructors, who tailor their courses according to the BMs of the marketplaces (H2).

They likely prefer to design more material on a platform such as Udemy, with a registration-based BM, presumably in order to give the feeling that the content is worth paying for, as I3 pointed out when he claimed that a course "that will work" will last more than three or four hours on Udemy. The fact that courses are shorter on Skillshare could be a hint that the KM tried to create a situation in which retention was economically incentivized for the instructor.

Marketplaces' Business Models and Their Influence on Instructors' Strategies

Monthly subscription, which is Skillshare's model, represents a singular shift from the pay-per-course model that dominated the distance education market for decades. Instructors compete against one another for learners' attention, and the model drives them to develop strategies to retain their learners; we can hypothesize that it drives those whose motivation is not driven by introjected or identified regulation but by external rewards to increase the quality of their content, in addition to strategies such as decreasing the length of both the course and the pedagogical videos. Excerpts from interviews with I3 and I4 have shown that some instructors strongly rely on the revenues they generate from the KMs. Regardless of the proportion of their incomes that come from the platforms, it means they are incentivized to optimize the amount of content that they design and broadcast, and, more specifically, to increase the revenues they generate per hour of video they create. Authors have shown that retention, especially in MOOCs (Jordan, 2015), is negatively correlated with course length. Author (2019) observed, based on Class Central aggregator's data, that MOOCs had shortened over the year, possibly due to increasing awareness of this issue. This is consistent with what I5 said about his course broadcasting strategy on Skillshare. Producing more classes, but shorter ones, seemed "to be producing more revenue on that platform" because "it was more about volume."

While competition among instructors also exists in the case of Udemy's pay-per-course model, they compete for paying registrations, not for time-on-video. With this BM, dropout does not disadvantage course designers, since users do not get refunded when they abandon the course. Arguably, a drop in students even plays in their favour, since it decreases the time they must spend interacting with learners. Instructors who adopt the pay-per-course model face one of the everlasting contradictions of the online education economy: while both distance education practitioners and scholars have claimed for decades to be trying to tackle the issue (Woodley & Simpson, 2014), dropout decreases operating costs.

Limitations of This Study

In this article, we dwelled significantly upon instructors' motivations, but only through interviews or indirect measurements. A large-scale survey sent to instructors would be required to support further our hypotheses, similar to what was done by Zhu et al. (2019) or Lowenthal et al. (2018) to capture MOOC designers' motivations. It could have enabled us to get a more precise view of the relative importance of instructors' motivations. Ideally, the survey would be sent by the platform itself to get enough answers to limit biases associated with low response rates. The lack of data on video consumption is also one of the shortcomings of our study. This could notably help to support our claims on the trade-off between dropout and course duration, by enabling us to determine the relationship it has with dropout in the context of marketplaces.

Conclusion

A growing body of literature is emerging on how the COVID-19 situation pushed institutions to embrace remote teaching (Mishra et al., 2020). Such a move was required most often to comply with the restrictions imposed by public authorities. However, articles seem to have focused on higher education, and notably on how universities adopted online platforms and blended learning at a large scale (Peimani & Kamalipour, 2021). Yet, the challenges posed by the pandemic have possibly benefited knowledge marketplaces more than they have academia. It is likely that many learners who could not attend adult training sessions turned to such platforms to compensate. In further research, we suggest exploring how the lockdowns have impacted the number and profiles of both learners and instructors teaching on KMs. It would be especially interesting to investigate whether there was a surge of instructors who tried to compensate for a loss of revenues in face-to-face teaching by converting to online education and, more specifically, by broadcasting classes on knowledge marketplaces.

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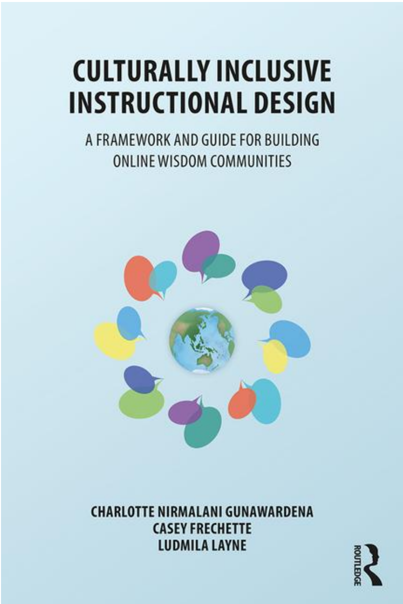
International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 22, Number 3

August – 2021

Book Review: Culturally Inclusive Instructional Design: A Framework and Guide to Building Online Wisdom Communities



Authors: Charlotte Gunawardena, Casey Frechette, and Ludmila Layne: (NY: Routledge, 2019, 286 pages) ISBN: 978-1-138-21786-7

Reviewed by: Gülten Kartal, PhD Student, *Anadolu University, Turkey*

Written by Charlotte Gunawardena, Casey Frechette, and Ludmila Layne, and contributed to by Damien M. Sanchez and Linda Barril, this book explores the WisCom instructional design model that aims to create and maintain a culturally inclusive wisdom community in online learning environments. The model mainly consists of seven components: wisdom community, communication, technology, distributed co-mentoring, learner support, the collaborative inquiry cycle, and transformative learning. The details of all the components related to the model, the learning theories that the model relies on, and other related issues such as the development, implementation, assessment, research, and evaluation processes, are discussed. Accordingly, the explanations are divided into four sections. In the first section, some theoretical foundations of the WisCom model and the culture and wisdom concepts of the model, are discussed comprehensively. In the second section, the WisCom model and its seven components are explained in detail. Comprehensive descriptions of the assessment and evaluation methods of the WisCom model are presented to the reader in the third section, including the presentation of a variety of methods, techniques, and research examples about learning in the wisdom community. The final section covers topics such as the needs analysis, learner assessment and evaluation, design and development to create online wisdom communities among cultures, and the development of this model.

Considering the 21st century skills required in the network society, the book offers a new instructional design model for learning in online environments where cultural diversity is an indispensable element. In this way, it is a flexible model that covers the current situation and meets future needs and therefore is able to meet and develop important features. At the same time, the model adds diversity to existing instructional design models as it can be applied not only in online environments but also in face-to-face learning environments. Besides this, it is evident that the model is open to further development by applying it in different cultures and environments. There are different books in the field of open and distributed learning that refer to cultural diversity in online learning environments; however, many of these books address points under different categories. In this book, the integrity of the chapters has been captured; messages and important issues are clearly expressed to explain the instructional design model. The book inspires new research on dimensions such as analysis and evaluation of the WisCom framework.

The 2017 Horizon Report emphasizes the importance of enhancing cultures of innovation, collaborative learning, and digital literacy (Adams Becker et al., 2017); and the 2018 Horizon Report, it highlights the importance of cross-institutional and cross-sectoral collaboration and authentic learning experiences (Adams Becker et al., 2018). Covering the pandemic and post-pandemic period, the 2020 and 2021 Horizon reports also draw attention to the consideration of diversity and support equity and inclusion in education due to the increase in the online globalization and student population (Brown et al., 2020; Pelletier et al., 2021). The components and perspectives of WisCom instructional design shaped 18 years ago (pp. xvi) covers the current and future issues in line with current reports, making this a forward-looking, comprehensive, and versatile perspective.

The organization of the book is very well-structured yet the chapter on regulation transformative learning (Chapter 10) could have been placed after the concepts of wisdom and wisdom communities that were elaborated on in Chapters 3 and 4. In addition, new tools and methods could have been developed to contribute to the WisCom framework, supported by a system for matching the mentors with mentees or co-mentors communities. As such, the learning outcomes of the course could be categorized before teaching and learning starts. The skill and competency level, according to the collaboration and knowledge level of each learner, could then be taken as data, which would show the learner's existing knowledge and situation. In other words, some learner's existing knowledge could be potential knowledge that another learner could reach at the end of learning. In this view, some learners that have collaboration skills and knowledge could be the best mentors for other learners. Accordingly, the best mentor-mentee or co-mentors matching system could be developed through the use of different algorithms. This might help to improve the transformative learning potential of the environment in the best way, because in the transformative learning environment, the learner has the potential knowledge and helps to improve existing knowledge of other learners. As well, it could help to determine the zone of proximal development of learners besides revealing the transformative learning needs assessment. In this way, the model contributes to the transformative learning needs assessment component of the WisCom Needs Assessment.

In summary, the WisCom model is a very important contribution to open and distributed learning. This book is a helpful guide and a fundamental reference that provides knowledge and new perspectives to researchers, instructional designers, specialists, and practitioners interested in the fields of distance education, learning, and culture.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 22, Number 3

August – 2021

Distance Learning in Museums: A Review of the Literature

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Abstract

Distance learning has become an important tool in many fields of education. Museums, like other educational institutions, have been offering distance learning programs to their audiences for more than 30 years. This scoping study examined the published literature related to distance learning programs in museums to inform future research in this field. Searches were conducted in three academic databases in addition to journal hand searches. This resulted in 954 unique citations associated with distance learning in museums. Of these, 17 articles met the criteria for inclusion in the study. Forwards and backwards searches resulted in the addition of two books. A search of the research hosted by the Center for Advancement of Informal Science Education resulted in one additional study for a total of 20 manuscripts. Upon analysis, four major themes were identified. These included benefits and barriers related to distance learning programs in museums, partnerships, and educators' changing roles as they relate to distance learning programs. Each of these themes is described and areas for future research are identified. Future work should move beyond the predominately evaluative case studies and pursue larger questions about how future research might support museums as they continue to design and implement online programming. This may include exploring best practices in museum-based distance learning and how to develop effective professional development opportunities for the educators engaged in these programs. Such research will enhance museum-based distance learning programs so that they can continue to support global learners.

Keywords: museums, online learning, distance learning, literature review

Introduction

Interest in distance learning programs has increased since the outbreak of COVID-19 and the global closure of schools (Butcher, 2020). There is a wide range of definitions for distance learning due to technology changes over time and differences in implementation (Moore et al., 2011). Distance learning is often used as a blanket term that includes "online learning, e-learning, technology mediated learning, online collaborative learning, virtual learning, web-based learning" and so on (Moore et al., 2011, p. 130). Even so, the many definitions agree that distance education occurs between at least two people at different times and/or places using a wide range of resources (Moore et al., 2011).

There have been many studies on the benefits and challenges of distance learning (e.g., Fadde & Vu, 2013; Kaplan & Haenlein, 2016; Nortvig et al., 2018; Pulham & Graham, 2018; Watts, 2016). One of the major strengths of distance learning is the increased access for audiences who may otherwise face barriers to education. However, there are challenges related to the lack of technology, increased workloads for the educator and learner, or even loss of instructional flexibility (Fadde & Vu, 2014). While much research has been carried out on distance learning at the university level (e.g., Nortvig et al., 2018; Singh & Hurley, 2017) and in K–12 settings (e.g., Moore-Adams et al., 2016; Pulham & Graham, 2018), there is still much to be learned about distance learning in museums.

In the United States, "museums spend more than $2 billion a year on education . . . [and] provide more than 18 million instructional hours for educational programs" (American Alliance of Museums, 2021, para. 5). While museums are important spaces for learning, there are still concerns about access. For adults who are interested in visiting museums but do not, access (e.g., cost, distance, accessibility) is one of the largest barriers (Dilenschneider, 2019). To reach broader audiences, some museums have begun offering distance learning programs. These programs allow museums to increase their reach through technology that is becoming more ubiquitous (Kraybill, 2015).

During the 2020 COVID-19 school closures, the United States suddenly transitioned from supporting nearly one million students enrolled in online learning to more than 55 million students (Butcher, 2020). Rather than creating new content, schools were encouraged to partner with organizations, such as museums, already offering online materials (Butcher, 2020). Since the outbreak of COVID-19, museums have increased their online offerings, however, many museum educators are not confident in their ability to produce high-quality online materials (Ennes, 2021). As more museums begin offering online programs, there is a need to examine the current research regarding distance learning in museums. This article provides an overview of the current literature surrounding distance learning in museums and areas in need of further research. This study was guided by the following research questions:

1. What is the current state of research regarding distance learning in museums?
2. What themes are apparent in the existing research on distance learning in museums?

The purpose of this study was to establish a foundation for future work examining distance learning in museums. For example, this review was used to inform a study of distance learning in museums before and after museum closures due to COVID-19 (See Ennes, 2021).

Methods

For this study, a distance learning program was defined as any museum program conducted by an educator via the Internet with audiences at offsite locations. This definition excluded virtual museums (Schweibenz, 2004) or virtual field trips that "are basically Websites that include text, audio, or video resources about specific topics" (Zanetis, 2010, p. 20). Additionally, digital games and educational apps designed by museums were not included in the search as they provide no engagement with an educator.

To better understand the current state of the research surrounding distance learning in museums, we conducted a scoping study (Arksey & O'Malley, 2005). Scoping reviews can "provide a snapshot of the field and a complete overview of what has been done . . . identify the conceptual boundaries of a field, the size of the pool of research, types of available evidence, and any research gaps" (Xiao & Watson, 2019, p. 99). Additionally, scoping reviews clarify definitions and map the major concepts surrounding a topic (Peters et al., 2015). Scoping reviews can be used to summarize and publish results of research, particularly for those who might not have the ability to review the literature themselves; they also identify gaps in the literature for future studies (Arksey & O'Malley, 2005).

Literature Search

This study began in September 2019 with a search of the following multidisciplinary electronic databases: Web of Science, EbscoHost, and Eric (ProQuest). Each of these databases has been empirically tested and identified as being appropriate for use as principal search systems when conducting literature reviews (Gusenbauer & Haddaway, 2020). Keywords were identified based on literature identified for a previous study (Ennes, 2015). The following keywords were used: museum, combined with one of distance learning, distance education, virtual field trip, or virtual fieldtrip. The variations on the term virtual field trip were included because some early articles referred to distance learning programs as virtual field trips (e.g., Bradford & Rice, 1996). However, any article that referred to a virtual field trip in the form of a static, self-directed online tour of a museum or other location was excluded (e.g., Kenna & Potter, 2018; Zanetis, 2010). This search led to an initial field of 220 papers with 13 duplicates for a total of 207 potential articles.

Following the database search, we conducted three journal hand searches (Alexander, 2020). First, we searched a major university's catalog of journal titles for any title that included the word museum. We identified a total of 10 journals to be hand searched. While it did not show up in the journal search, the *Journal of Museum Education* was added to this list for a total of 11 (Table 1). The journal hand search resulted in 54 potential articles with 10 repeated articles for a total of 44 new articles; 17 were kept for a full read based on the criteria outlined in Figure 1.

Table 1

Journals Included in Museum Journal Hand Search

Journal	Hits	Articles kept
Curator: The Museum Journal	13	4
International Journal of Cultural Studies	2	1
International Journal of the Inclusive Museums	0	0
Journal of Conservation and Museum Studies	0	0
Journal of Cultural Studies	0	0
Journal of Museum Education	31	12
Journal of Museum Studies	1	0
Museum International	6	0
Museum and Society	1	0
Museum Worlds: Advances in Research	0	0
Museums and Social Issues	0	0
Total	54	17

To broaden our search, we did a third search for additional journals that might publish articles on distance learning or museums. To do this, we searched the InCites Journal Citation Reports for journals related to education and educational research (n = 243); computer science, interdisciplinary applications (n = 106); social sciences, interdisciplinary (n = 104); and education, science disciplines (n = 41). Of these 494 potential journals, 22 were selected as relevant to the study (Table 2). From these 22 journals, 634 potential articles were assessed by reading their title to identify whether they were relevant to the study. Two of the articles were repeats from previous searches and none of the remaining papers were relevant to the study.

Table 2

Journals Included in InCites Journal Citation Hand Search

Journal	Hits	Articles kept
ACM Journal on Computing and Cultural Heritage	0	0
American Educational Research Journal	18	0
British Journal of Educational Technology	33	0
Educational Research Review	18	0
Educational Technology and Society	51	0
Educational Technology Research and Development	41	0
IEEE Transactions on Learning Technologies	45	0
International Journal of Computer-Supported Collaborative Learning	40	0
International Journal of Science and Mathematics Education	36	0
International Journal of Science Education	29	0
International Journal of Technology and Design Education	2	0
Journal of Research in Science Teaching	13	0

Journal of Science Education and Technology	55	0
Journal of the Learning Sciences	21	0
Learning Media and Technology	118	0
Research in Science and Technology Education	12	0
Research in Science Education	32	0
Review of Educational Research	18	0
Science and Education	2	0
Science Education	14	0
Social Science Computer Review	19	0
Studies in Science Education	28	2 repeats
Total	645	0

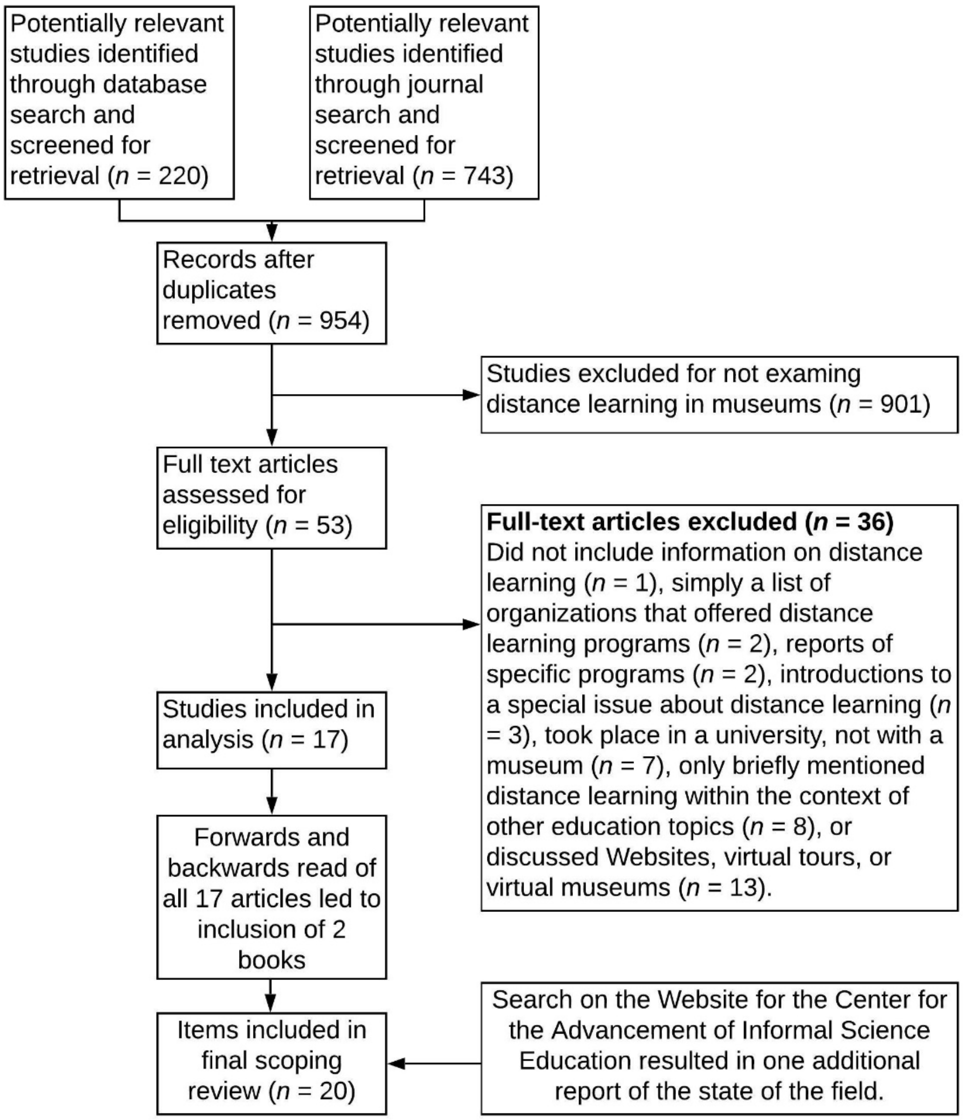
The first author read each of the paper titles as well as the abstracts of any that appeared to fit the study. A total of 53 articles were identified for a full article read based on their abstract. Both authors read all 53 articles and identified 17 articles for inclusion in the study (Table 3). Papers were excluded if they (a) did not include information on distance learning (*n* = 1); (b) were a list of organizations offering distance learning programs (*n* = 2); (c) were evaluation reports of a specific program (*n* = 2); (d) were introductions to a journal issue (*n* = 3); (e) did not include a museum (*n* = 7); (f) only briefly mentioned distance learning within the context of other education topics (*n* = 8); or (g) discussed Websites, virtual tours, or virtual museums (i.e., static, no interaction; *n* = 13). Figure 1 illustrates the search process based on the PRISMA statement (e.g., Page et al., 2021).

Following the first read for inclusion, a backwards and forwards search for each of the 17 articles was conducted in Google Scholar. This resulted in the identification of two books on distance learning written by Crow and Din (2009, 2011). The books should also be considered by others who want to learn more about a wider range of digital opportunities for museums.

Finally, a search was conducted in the research archives on the Website for the Center for the Advancement of Informal Science Education (CAISE). CAISE aims to advance the field of informal science education through infrastructure, resources, and building connections between stakeholders (CAISE, n.d.). The search for distance learning with research as a limiter identified 13 potential articles. Of these 13 results, only two were related to the subject. One was an evaluation report of teachers' perceptions of museum-based online learning programs and was not included. The other was an examination of the current trends in online learning in museums and was included (Hardee & Duffin, 2015) for a final total of 18 articles.

Figure 1

Article Selection Process



Analysis

Using an inductive approach (Thomas, 2006), the authors individually re-read and coded five of the articles (20.8%) to identify themes. The authors came together to discuss themes and develop a codebook. Once the codes were developed, the authors coded each of the articles. They then discussed each article until they came to a consensus about the codes. This resulted in four major themes found in the literature: benefits to using distance learning in museums, the changing roles of educators related to distance learning, partnerships in developing/implementing distance learning in museums, and barriers to distance learning in museums.

Table 3

Articles Included in Review

Citation	Type of study	Study focus	Methods	Important results	Themes
Barshinger & Ray (1998)	Experimental study*	K–12 school programs	Interpretive study using observations, field notes, pre- and post-interviews, post-visit interviews, researcher reflections	The new technology increased some novelty. It was effective at orienting them to the gallery. Teacher and students all thought the program was successful.	Benefits
Bell et al. (2016)	Case study	K–12 school programs in museums		Discussed the importance of institutional buy-in for university/museum partnerships.	Benefits Partnerships Barriers
Bowen (2017)	How-to			Discussed examples of ways museums use distance learning for conferences and school programs. Listed the technology they used.	Benefits Barriers
Bradford & Rice (1996)	Case study	K–12 school programs		Discussed barriers and benefits. Also claimed the program increased interest in visiting.	Benefits Changing roles Partnerships Barriers
Coquillon & Staples (2015)	Case study*	K–12 students out-of-school		Discussed the development of virtual student summit.	Benefits Partnerships Barriers
Crow & Din (2009)	Case study and guide			Discussed considerations for beginning digital learning opportunities in museums.	Benefits Changing roles Partnerships Barriers
Crow & Din (2010)	Case Study*			Discusses pros, cons, and considerations for developing distance learning programs in museums.	Benefits Changing Roles Partnerships Barriers
Crow & Din, (2011)	Case study and guide			Discussed barriers, challenges, and effective strategies for developing online learning.	Benefits Changing Roles Partnerships Barriers

Din (2015)	Theoretical			Described a range of distance learning programs in museums along with barriers, benefits, and practical considerations.	Benefits Changing Roles Barriers
Engelke (2015)	Case study*	K–12 students out-of-school		Discussed the development and refinement of a distance learning program where participants receive badges.	Benefits Barriers
Gaylord-Opalewski & O'Leary (2019)	Experimental study*	Museum educators	Focus group surveys and interviews	Offered definitions of distance learning along with best practices from those working in the field.	Benefits Changing Roles Barriers
Hardee & Duffin (2015)	Current trends report	Staff and leaders in museum-based distance learning	Interviews	Claimed museum-based distance learning is on a downward trend due to lack of museum capacity and school funding. However, there are many positive opportunities.	Benefits Barriers
Harrell & Kotecki (2015)	Case study	K–12 school programs	Summative evaluation utilizing surveys, interviews, observations, and artifacts	Fostering positive attitudes towards art and emotional connections were best achieved onsite. Knowledge and skills increased through student evaluation of their work. The online platform was not student-centered enough.	Benefits Partnerships Barriers
Hilton et al. (2019)	Experimental study*	Adult learners	Focus group discussions and surveys	When working with adult audiences, success depended on presentation style, content, entertainment value, and technology expertise of participants.	Benefits Partnerships Barriers
Kraybill & Din (2015)	Case study	K–12 school programs		Discussed the development and implementation of online courses in collaboration with a virtual public school.	Benefits Changing Roles Partnerships Barriers
Mazzola (2015)	Case study	Teacher professional development	Formative action research and a survey	Claimed museums should consider developing a MOOC to remain	Benefits Partnerships

				relevant. Shared best practices and lessons learned.	Barriers
Mitchell et al. (2019)	Case study	Museum educators	Self-analysis of the program model	The program did not replace onsite visits, rather it supplemented them. Participants still need interpretation of digital resources as they would on-site.	Benefits Changing Roles Partnerships
O'Leary (2011)	Case study			Discussed the changes in a distance learning program at a museum.	Benefits Changing Roles Barriers
Sanger et al. (2015)	Case study*	Teacher professional development	Written reflections	Discussed the development of sustainable partnerships between museums and schools.	Benefits Partnerships Barriers
Schmidt, (1997)	Case study	K–12 school programs		Discussed the development of an electronic field trip and how to improve on their model.	Benefits Barriers

Note: * Indicates studies with qualitative or quantitative data. For example, some case studies simply described how they designed their programs without any data to support their decision making or argument for a particular strategy.

Results

The manuscripts included in this scoping review are outlined in Table 3. The programs described in these studies predominately focused on K–12 school programs, K–12 students in out-of-school settings, teacher professional development, and adult learners (Table 3). The remaining articles did not discuss specific programs but rather, they evaluated the current state of the field (Hardee & Duffin, 2015) or were broader in scope (Bowen, 2017; Crow & Din, 2009, 2010, 2011; Din, 2015; Gaylord-Opalewski & O'Leary, 2019; O'Leary, 2011). Six studies included either qualitative and/or quantitative data in their results (Table 3). Three articles (Barshinger & Ray, 1998; Crow & Din, 2010; Harrell & Kotecki, 2015) and both books (Crow & Din, 2009, 2011) used constructivism as a theoretical framework to guide their study. In addition to constructivism, Crow and Din (2011) offered a range of alternative theories that might be considered when developing distance learning programs including media theory, cognitive theory, as well as situated and distributed cognition.

Definitions of Distance Learning

Throughout the literature, several different terms were used including virtual field trips (Bradford & Rice, 1996), electronic field trips (Schmidt, 1997), and interactive virtual learning (Gaylord-Opalewski & O'Leary, 2019; Mitchell et al., 2019). To better understand the terms used to describe distance learning programs in museums, Gaylord-Opalewski and O'Leary (2019) interviewed museum professionals who worked with these types of programs. As with other studies, the authors found a wide range of terms for distance learning, which was frequently "interchanged with Interactive Videoconferencing or Virtual Field Trips" (Gaylord-Opalewski & O'Leary, 2019, p. 232). These authors identified eight definitions related to distance learning in museums: (a) synchronous distance learning, (b) asynchronous distance learning, (c) interactive virtual learning, (d) virtual museum educator, (e) interactive virtual learning program, (f) point-to-point connections, (g) multi-point connections, and (h) streaming (Gaylord-Opalewski & O'Leary, 2019). Crow and Din (2009, 2011) also described various types of online learning museums could engage in such as blogs, Websites, and online courses.

Types of Technology

As the articles in this study spanned the period from 1996 to 2019, a wide range of technology was described. One example of early technology was the Integrated Services Digital Network (ISDN) which was popular in the mid-1990s, and which allowed for two-way video conferencing (Bradford & Rice, 1996; Gaylord-Opalewski & O'Leary, 2019; O'Leary, 2011). Two articles discussed the importance of buying specialized computers and webcams (e.g., Bowen, 2017; Bradford & Rice, 1996). Hardee and Duffin (2015) discussed the transition from expensive, specialized equipment towards the use of free technology, but they felt that the free software options were not sufficiently advanced. However, newer articles discussed the ease of using readily available and free or no-cost technology (e.g., Bowen, 2017; Hilton et al., 2019).

Video conferencing was described in 10 articles (Barshinger & Ray, 1998; Bell et al., 2016; Bradford & Rice, 1996; Coquillon & Staples, 2015, Crow & Din, 2010; Engelke, 2015; Hilton et al., 2019; Mitchell et al., 2019; O'Leary, 2011; Sanger et al., 2015). Online courses were described in six articles (Din, 2015; Engelke, 2015; Harrell & Kotecki, 2015; Kraybill & Din, 2015; Mazzola, 2015; Sanger et al., 2015). Two articles discussed the importance of using online chat technology (Coquillon & Staples, 2015; Mitchell et al., 2019). One article discussed use of a flipped classroom model before a museum visit (Harrell & Kotecki, 2015).

How to Develop a Distance Learning Program

In an attempt to help other museums begin new programs, Bowen (2017) wrote an article to help other planetariums through the process of developing "distance learning systems" (p. 86) within their domes. Bowen included the technology and other resources leveraged to develop the new programs. While not specifically a how-to article, Mitchell and colleagues (2019) included guiding questions a museum should ask before developing a distance learning program. The article recommended museums think critically about the resources they already have in place that they can use (e.g., content, experts, tools, educators) and how the technology may change their "institutional practices" (Mitchell et al., 2019, p. 248). Crow and Din (2009, 2011) also offered guiding questions institutions should consider when developing distance learning programs. In all, the books and articles agreed that, while an institution should think critically about its ability to offer distance learning programs, there are many benefits to doing so.

Themes

Benefits of Distance Learning

The most common benefit was that distance learning programs allowed the museums to increase their reach to new audiences as well as increase visitors' access to their collections (Barshinger & Ray, 1998; Bell et al., 2016; Bowen, 2017; Bradford & Rice, 1996; Coquillon & Staples, 2015; Crow & Din, 2009, 2010, 2011; Din, 2015; Engelke, 2015; Gaylord-Opalewski & O'Leary, 2019; Hardee & Duffin, 2015; Hilton et al., 2019; Mazzola, 2015; Mitchell et al., 2019; O'Leary, 2011; Schmidt, 1997). Distance learning programs increased a museum's outreach potential by breaking down geographic boundaries and allowing museums to reach visitors who might not otherwise have access (Gaylord-Opalewski & O'Leary, 2019).

Crow and Din (2010) suggested that online learning offered new ways to connect and communicate with people who might not be familiar with the museum, increasing the possibility for future interactions on a much larger scale. While there has been concern that distance learning programs may decrease audiences' interest in physically visiting, several studies reported the opposite to be true (e.g., Hardee & Duffin, 2015; Hilton et al., 2019; Mitchell et al., 2019; O'Leary, 2011; Schmidt, 1997).

Leveraging distance learning, museums also offered their visitors access to previously underutilized resources (Crow & Din, 2009, 2010; Din, 2015; Engelke, 2015; Hardee & Duffin, 2015; O'Leary, 2011). Through distance learning programs, museums enabled students to examine artifacts up close in ways that would otherwise not be possible (O'Leary, 2011). Additionally, distance learning programs allowed museums to use media and other technological resources that may not be appropriate in the physical museum (Din, 2015).

Several studies also discussed the opportunity to increase engagement with their visitors through distance learning programs (Bell et al., 2016; Bradford & Rice, 1996; Coquillon & Staples, 2015; Crow & Din, 2009, 2011; Din, 2015; Kraybill & Din, 2015; Mazzola, 2015; Sanger et al., 2015; Schmidt, 1997). Bell and colleagues (2016) discussed the opportunities museums have to engage their visitors in authentic science through distance learning programs. Additional studies discussed the ability to use live question and answer sessions to increase engagement with learners (Bradford & Rice, 1996; Coquillon & Staples, 2015). Additionally, distance learning increased engagement through enhanced experiences, increased spontaneity and responsiveness during synchronous programs, and increased reflection and depth of knowledge through asynchronous distance learning experiences (Crow & Din, 2009, 2011; Din, 2015). Distance learning programs also allowed educators to engage with their visitors much longer than with those who attended a one-time program on-site; online materials were much easier to keep current compared to printed materials (Crow & Din, 2009). In addition to engaging with museum educators, some types of distance learning programs offered participants the opportunity to engage with one another and build new connections (Coquillon & Staples, 2015; Crow & Din, 2009; Harrell & Kotecki, 2015). Through distance learning, museums found they were able to inspire their audiences to take action in their communities (Engelke, 2015) and build lifelong interests (Gaylord-Opalewski & O'Leary, 2019).

Implementing distance learning programs allowed museums to increase the types and amount of data they collect about their audiences (Crow & Din, 2009, 2010, 2011; Din, 2015; Gaylord-Opalewski & O'Leary, 2019; Hilton et al., 2019). Distance learning programs offered museums opportunities to gather real-time data about their participants, allowing them to pilot new programs and gain instant feedback to continually improve their programs (Crow & Din, 2010). Education staff were also able to document and archive participants' feedback and responses (Crow & Din, 2010; Din, 2015). Museums also used data for participatory development of programs by allowing participants to have a say in how programs evolved for greater buy-in (Crow & Din, 2009). Furthermore, museums were able to improve their reporting related to the number of people served in educational programs (Gaylord-Opalewski & O'Leary, 2019).

Educators' Changing Roles

Nine manuscripts discussed the changing roles of educators due to the introduction of distance learning programs in museums (Bradford & Rice, 1996; Crow & Din, 2009, 2010, 2011; Din, 2015; Gaylord-Opalewski & O'Leary, 2019; Kraybill & Din, 2015; Mitchell et al., 2019; O'Leary, 2011). The manuscripts in this set spanned 1996 to 2019, leading to a wide range of expected changes related to the implementation of distance learning programs. Early researchers questioned how already busy educators could include these new programs in their programming schedules (Bradford & Rice, 1996). Bradford and Rice (1996) suggested that distance learning programs be offered at odd hours, thus allowing educators to make better use of their time. However, the authors felt that developing these new, time-intensive programs would take away from educator's ability to prepare for onsite programming and that their education staff did not have the necessary training to develop these lessons (Bradford & Rice, 1996). Some authors discussed the importance of having educators specifically trained to facilitate online programs (Gaylord-Opalewski & O'Leary, 2019). However, other authors felt that museum educators were already well-positioned to transition to distance learning due to their experience "creating highly customized and interactive experiences with museum visitors and attending to their interests and needs" (Crow & Din, 2010, p. 162).

Engaging in distance learning "expands the role of the educator" beyond the traditional role of a museum educator (Mitchell et al., 2019, p. 242). Some articles examined how educator roles changed over time (O'Leary, 2011) or changed based on the type of online learning that was implemented (Din, 2015). While educators act as facilitators both during face-to-face and online presentations, the pedagogical strategies used in distance learning programs differ because the forms of interaction have been altered (Crow & Din, 2011).

When thinking about how to support these new types of programs, Kraybill and Din (2015) argued that educators need to start thinking "like entrepreneurs" (p. 172) to monetize their distance learning programs. Crow and Din (2011) described the qualities they believed online educators needed to possess to be effective. This included "creating a climate for learning . . . helping to establish social presence . . . encouraging active participation . . . [and] encouraging others to take leadership roles" (Crow & Din, 2011, p. 76-77). As distance learning becomes more common, educators have opportunities to collaborate with other staff members and negotiate roles and responsibilities in developing educational opportunities online (Crow & Din, 2009, 2010, 2011). In addition to collaborating with their colleagues, museums are taking advantage of partnerships with other organizations to support their distance learning programs.

Partnerships

The theme of partnerships was identified in 12 manuscripts (Bell et al., 2016; Bradford & Rice, 1996; Coquillon & Staples, 2015; Crow & Din, 2009, 2010, 2011; Harrell & Kotecki, 2015; Hilton et al., 2019; Kraybill & Din, 2015; Mazzola, 2015; Mitchell et al., 2019; Sanger et al., 2015). Some of the partnerships identified included (a) partnering with other museums (Coquillon & Staples, 2015); (b) museum-university partnerships (Bell et al., 2016; Mitchell et al., 2019); (c) partnerships with public schools (Harrell & Kotecki, 2015; Kraybill & Din, 2015; Mitchell et al., 2019; Sanger et al., 2015); and (d) partnerships with private companies (Bradford & Rice, 1996; Hilton et al., 2019; Mazzola, 2015). Kraybill and Din (2015) argued that "leveraging of strategic partnerships with public, private, and government organizations, combined with the tools of online learning … will increase a museum's capacity to reach more learners in more meaningful ways than physically visiting the museum could accomplish alone" (p. 172). Additionally, distance learning programs create collaborative teaching and learning environments, which can be mutually beneficial for all partners (Sanger et al., 2015).

Partnerships are beneficial for museums as collaborators may be able to offer access to technological resources or training to use new, and sometimes expensive, technologies (Crow & Din, 2010). Identifying internal and external partners can increase access to a wide range of resources (Crow & Din, 2009). Museums should identify (a) appropriate stakeholders within their museum and other organizations, (b) other individuals who may bring specific strengths and skills, (c) reasons why the collaborators might want to participate, and (d) barriers to collaboration (Crow & Din, 2011). "True collaboration requires a commitment to shared goals, a jointly developed structure and shared responsibilities, mutual authority and accountability for success, along with the sharing of resources, risks, and rewards" (Crow & Din, 2011, p. 55). For example, collaboration with a museum's internal information technology department can support Web design and content creation (Crow & Din, 2010), and working with the development office can lead to funding opportunities (Crow & Din, 2009).

Partnerships with Other Museums. While Crow and Din (2011) briefly describe the utility of partnering with other museums, Coquillon and Staples (2015) shared insight into their experience with museum partnerships. The authors discussed how the Smithsonian's National Museum of American History joined with their affiliate museum partners across the country to host a national student summit. Partner museums hosted regional summits where students could watch the program taking place in Washington D.C., participate in online forums, and engage in local programming. Another partnership included bringing in college students to act as moderators in the discussion forum. This partnership model allowed each museum to have a broader reach and access to resources they would not have otherwise; the partnership reached more than 30 states, several countries, and up to 10,000 viewers each year (Coquillon & Staples, 2015).

Partnerships with Universities. Partnerships between museums and universities allowed both to leverage the resources of the other (Bell et al., 2016). This type of partnership is frequently driven by increased interest in community science (also known as citizen science) and a desire for more university-based public outreach (Bell et al., 2016). Bell and colleagues (2016) discussed a partnership between the Center of Science and Industry (COSI) and The Ohio State University (OSU). Together they developed

> a center where research, science, and university outreach are embedded into the everyday public, student, and family experiences. Guided by formal institutional co-commitments at the highest level, university researchers, faculty, and students engage daily with the 600,000+ on-site guests to COSI and tens of thousands reached through interactive video conferencing. (Bell et al., 2016, p. 300).

Researchers and educators collaborated to design and deliver interactive virtual learning programs based on the research and exhibits taking place at OSU and COSI. This partnership increased the outreach for OSU, enhanced the authentic science taking place at COSI, and resulted in new staff positions shared between the two institutions.

Bell and colleagues (2016) discussed several points of consideration that are essential to the success of this type of partnership. First, there must be institutional buy-in from all levels and multiple points of contact between the two institutions. Decision making must be mutually beneficial. Both institutions must contribute to the investment of the partnership and have a public profile wherein both success and failures are shared between organizations. The personnel selected to engage with the public must be carefully selected from both institutions, and it is essential there are staff to manage administrative duties. Major challenges to this type of partnership included differences in organizational size/structure, institutions operating on different calendars, and leadership changes. Issues associated with leadership changes may be mitigated by a review of the goals and benefits of the partnership (Bell et al., 2016).

University-based museums are also well-positioned to create partnerships across their institution (Michell et al., 2019). When approached by a high school asking for online learning opportunities, the University of Pennsylvania Museum of Archaeology and Anthropology (Penn Museum) collaborated with faculty and graduate students to modify existing programs. The museum educators, faculty, and graduate students collaborated to design a new, multi-component program that leveraged the resources of both the university and museum. This partnership (a) resulted in an association with the high school, (b) created new interdepartmental relationships on campus, (c) addressed the lack of content experts within the museum, (d) increased educators' content knowledge, and (e) led to the use of high-quality pedagogy in the new online programs (Michell et al., 2019).

Partnerships with High Schools. Two articles discussed the benefits of partnerships with virtual high school providers (Harrell & Kotecki, 2015; Kraybill & Din, 2015). Both museums developed online courses to help support students who were required to take virtual classes to graduate. Harrell and Kotecki (2015) discussed the challenges of using an online learning management system to offer semester-long courses. Unfortunately, they found their platform did not meet their pedagogical needs, limiting the amount of self-directed learning that could take place due to a lack of flexibility in the course. Kraybill and Din (2015) partnered with an existing online course provider to increase their capacity through certified teachers working for the provider to teach the course. This strategy allowed the museum to scale up its capacity without straining its resources. The authors acknowledged that not all museums have the resources available to create this type of course in the first place but recommended partnering with outside organizations if interested in developing these kinds of programs (Kraybill & Din, 2015).

Partnerships to Support Teachers. In addition to serving students through online learning, museums support teachers as well. Sanger et al. (2015) discussed a partnership between the New York Institute of Technology and the Albany Institute of History and Art. The partnership received external funding to "increase the capacity of museum educators and teachers to develop successful partnerships and deliver new programs through the use of web-based technologies and share those lessons with the field as a model for future collaborations" (Sanger et al., 2015, p. 148). This article examined the influence of a professional development program where museum educators and formal educators came together to design and implement online programming. In this partnership, the New York Institute of Technology offered technical support while the Albany Institute of History and Art offered pedagogical support. While the partnerships required a large investment of educators' time, both the formal and museum educators gained a better understanding and respect for each other's roles and the challenges they face. The partnerships enabled the educators to learn more about the benefits of engaging in online learning with museums (Sanger et al., 2105).

Partnerships with Private Companies. Some museums have begun exploring online teacher professional development (Mazzola, 2015). Mazzola (2015) discussed the transition from small, online professional development experiences offered by individual museums to a large-scale massive open online course (MOOC) on Coursera. Through their work with Coursera, the museum was able to serve more than 50,000 teachers a year and transition their offerings from individual programs to a model where teachers could participate at any time. The benefits of using an existing platform included better data collection to refine programs, increased outreach and engagement, and encouragement for educators to revise their teaching styles. Online and in-person programs have different pedagogies, so the authors suggested museums should not expect to replicate their in-person programs online. Additionally, the authors recommended museums align their goals between online and in-person programs (Mazzola, 2015).

Beyond partnerships to serve teens and teachers, some museums developed partnerships to serve lifelong learners. Hilton et al. (2019) conducted a focus group study to identify the best way for museums to reach retirement communities. They suggested museums develop partnerships with committees of residents and so allow the audience to help direct the development of distance learning programs for their community. The findings also suggested interactive presentations are best for this audience, though museums need to consider their audio and visual media carefully. Educators should ensure all audio and visual components meet the needs of the senior audience (Hilton et al., 2019).

Early partnerships between museums and private companies came about due to emerging technologies. Bradford and Rice (1996) referenced the development of a partnership between an art museum and a communications company that was interested in researching video conferencing using ISDN. Scientists visited with the education staff to help develop custom software for the museum to use ISDN to videoconference with schools. This collaboration with a communications company helped the museum develop the capacity to videoconference and pilot their new program via a school partnership, and also gave the museum educators the flexibility to experiment and fail forward (Bradford & Rice, 1996). While partnerships bring many benefits, many of the articles reviewed also included barriers that prevent the development of museum-based distance learning programs.

Barriers to Museum-Based Distance Learning Programs

In the literature, technology was the most commonly described barrier (Bowen, 2017; Bradford & Rice, 1996; Coquillon & Staples, 2015; Crow & Din, 2009; Din, 2015; Hardee & Duffin, 2015; Harrell & Kotecki, 2015; Hilton et al., 2019; O'Leary, 2011; Sanger et al., 2015; Schmidt, 1997). For some museums, it was a lack of access to technology in the early days of distance learning (Bowen, 2017; Bradford & Rice, 1996; O'Leary, 2011; Schmidt, 1997). For other museums, the barriers came in the form of technology that did not function properly (Din, 2015; Hilton et al., 2019; O'Leary, 2011; Sanger et al., 2015). Hardee and Duffin (2015) discussed the high cost of maintaining expensive, specialty equipment. Additional museums struggled with systems that did not support the types of pedagogy the educators wanted their audiences to experience (Coquillon & Staples, 2015; Harrell & Kotecki, 2015). Following technology, the biggest barriers described were time, cost, and staffing concerns.

A total of 10 manuscripts outlined how the time needed to develop and implement distance learning programs was a major barrier (Bell et al., 2016; Bradford & Rice, 1996; Crow & Din, 2010, 2011; Engelke, 2015; Hardee & Duffin, 2015; Kraybill & Din, 2105; Mazzola, 2015; Sanger et al., 2015; Schmidt, 1997). Eight articles described the cost of implementing a distance learning program as prohibitive (Bradford & Rice, 1996; Crow & Din, 2010; Engelke, 2015; Gaylord-Opalewski & O'Leary, 2019; Kraybill & Din, 2105; O'Leary, 2011; Sanger et al., 2015; Schmidt, 1997). In addition to being expensive, some authors felt the return on investment for distance learning programs may be too small to justify them (Gaylord-Opalewski & O'Leary, 2019; Hardee & Duffin, 2015). Having insufficient staff to develop and run the programs was also seen as a barrier in nine articles (Bradford & Rice, 1996; Crow & Din, 2010; Gaylord-Opalewski & O'Leary, 2019; Hardee & Duffin, 2015; Hilton et al., 2019; Mazzola, 2015; Mitchell et al., 2019; O'Leary, 2011; Schmidt, 1997). In some cases, staff needed additional training to increase capacity (Crow & Din, 2010; Gaylord-Opalewski & O'Leary, 2019). In others, there was a lack of access to experts who could lead the program (Mitchell et al., 2019). It was even suggested that museums would need to hire a new type of employee who would be better suited to teaching in the online environment (Gaylord-Opalewski & O'Leary, 2019).

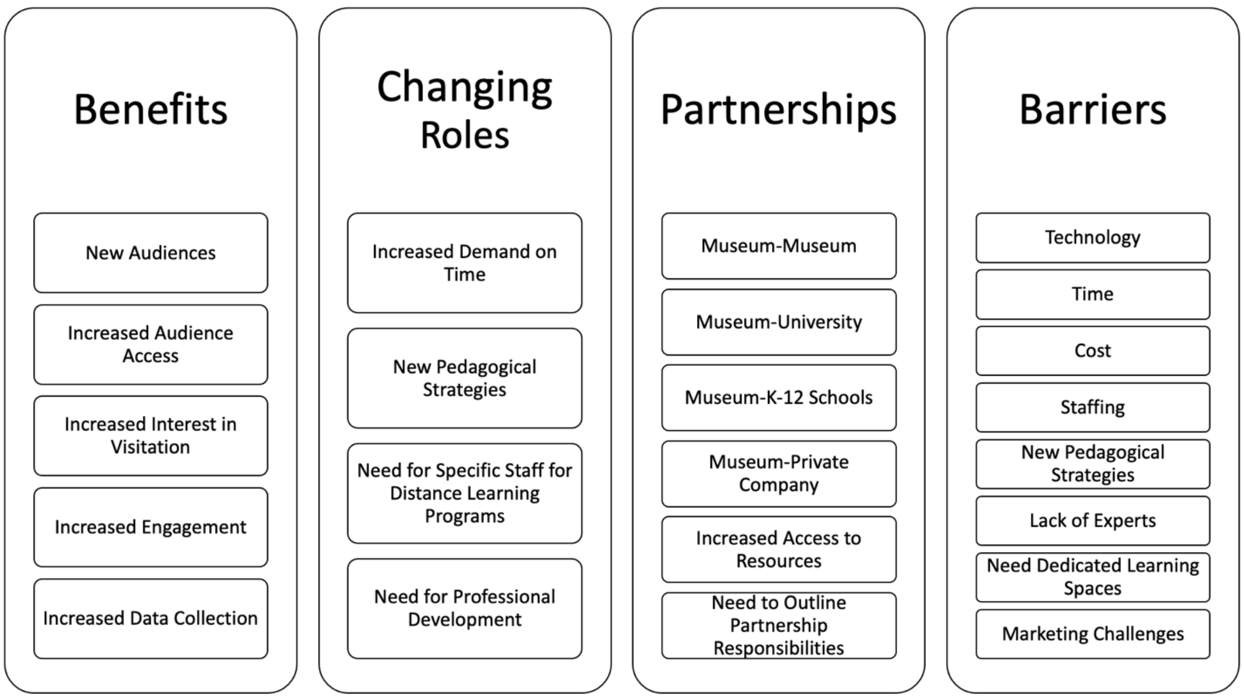
Other barriers included a need for dedicated distance learning spaces (Mitchell et al., 2019; O'Leary, 2011), specialized content for the programs (Crow & Din, 2010; Schmidt, 1997), and leadership issues (Bell et al., 2016; Din, 2015; Kraybill & Din, 2015; Mitchell et al., 2019). Din (2015) posited that there must be a "long-term institutional commitment to engage in online teaching and learning" (p. 108) to develop a sustainable distance learning program. Kraybill and Din (2015) suggested that external partnerships may help education staff attain "long-term institutional commitment" (p. 171) from their leadership. However, there are additional barriers when developing distance learning programs that rely on partners, as "lasting relationships must survive leadership changes in continually evolving organizations" (Bell et al., 2016, p. 303).

Hardee and Duffin (2015) also discussed barriers due to marketing. They reported that most marketing for museum-based distance learning programs was informal and struggled to reach the appropriate audiences. They also had concerns about the sustainability of the programs. The authors reported a declining trend in museum-based distance learning between 2010 to 2014 due to school budget cuts decreasing demand for programs, loss of staff due to museum budget cuts, and the cost of maintaining equipment (Hardee & Duffin, 2015).

While the number of museums offering distance learning is increasing (Ennes, 2021), each of the barriers described in this section brings specific challenges; museums must consider them all before choosing to develop new distance learning programs. Figure 2 summarizes the major concepts from each of the themes discussed in this section.

Figure 2

Summary of Themes Identified in the Literature



Discussion and Recommendations

Opportunities to engage learners online continue to increase and museum-based distance learning programs are positioned to contribute significantly (Hardee & Duffin, 2015). In this review, we sought to understand the current state of research on distance learning in museum settings. We found that the literature in this field is relatively nascent and offers a multitude of opportunities for future research.

The types of available technology have changed since these programs began, but technology is still seen as both a benefit and barrier to developing distance learning programs. We found that most museums created programs that focused on online courses and live programming, also referred to as videoconferencing. Other museums tried to leverage new technologies to develop creative new experiences such as a flipped museum (Harrell & Kotecki, 2015), television programming (Bell et al., 2016; Schmidt, 1997), and using digitized collections (Engelke, 2015).

Many of the articles in this review were case studies that examined individual programs; less than half of the articles offered qualitative or quantitative data. The lack of data in these articles makes it difficult to compare studies. In future, researchers should consider opportunities to collect more quantitative data with larger population sizes in addition to case studies and interviews.

In addition to limited data, many of the studies lacked a theoretical framework; peer-reviewed journals often see this as a failing (Lederman & Lederman, 2015). Only three papers grounded their studies in a theoretical framework (Barshinger & Ray,1998; Crow & Din, 2010; Harrell & Kotecki, 2015), and all three focused on constructivist approaches. Crow and Din (2010) argued that educators in museums have long "advocated a constructivist, learner-centric approach by creating highly customized and interactive experiences with museum visitors and attending to their interests and needs" (p. 162). Additionally, Crow and Din (2011) discussed alternative theoretical frameworks researchers should consider. Identifying appropriate theoretical frameworks for future research on distance learning in museums will be important as the field moves forward.

The overall themes that arose from the literature examined the benefits and barriers of engaging in distance learning, the ways museum educators' roles are changing in response to developing distance learning, and the importance of leveraging partnerships for successful programs. Overwhelmingly, the literature revealed the perception that distance learning programs allowed museums to increase their reach and offer access to learners of all ages and abilities.

Based on the results of this review, museums are clearly aware of the benefits of engaging in distance learning but also face distinct barriers to implementing such programs. The barriers expressed in this study (i.e., technology issues, cost, time, staffing issues, and institutional support) were all identified as barriers in a recent study of current practices in museum-based online learning (Ennes, 2021). The theme of partnerships emerged as a tactic to offset many of the barriers identified in this study. Partnerships allowed museums to reduce costs (Crow & Din, 2010), add to their expertise (Bell et al., 2016), and increase staff capacity (Kraybill & Din, 2015; Mazzola, 2015). The school closures caused by COVID-19 led to an increase in partnerships between schools and museums (Ennes, 2021). As evidenced by the educational offerings offered by museums during closures due to COVID-19, online learning and partnerships will continue to become more important (Butcher, 2020).

While partnerships were seen as a viable avenue for developing and implementing online programs in museums, they involved significant time commitments from all partners (Sanger et al., 2105). Building relationships across organizations improved learning outcomes and outreach strategies, and helped to identify common goals between organizations (Asera et al., 2017). While there is no one best way to build partnerships, effective strategies require support from both institutions' leadership (e.g., Asera et al., 2017; Bell et al., 2016). Specific elements of a partnership that can lead to success include (a) establishing clear goals, (b) defining how the partnership works to support both organizations and their learners, (c) developing a clear understanding of change processes, (d) committing to the long-term relationship building of various stakeholders, and (e) using data to inform decision making (Asera et al., 2017).

In addition to the use of partnerships to overcome barriers, increased professional development will be necessary to support the creation of high-quality online programs as more institutions transition to online learning (Ennes, 2021; Gaylord-Opalewski & O'Leary, 2019). Most museum educators have extensive content knowledge but typically less preparation in pedagogy (Bevan & Xanthoudaki, 2008). As teaching online requires specific pedagogical strategies, professional development should be a major focus for museums offering distance learning programs (Mohr & Shelton, 2017).

Museums have been offering online programs for almost three decades, however, the research in this area is more limited than, for example, studies examining online learning in formal settings. Current research regarding online learning in K–12 and higher education has focused on (a) challenges (e.g., Boelens et al 2017; Rasheed et al., 2020); (b) adult learning theories and online learning (e.g., Arghode et al., 2017): (c) relationships and learning communities (e.g., Emde et al., 2020; Jan et al., 2018); (d) using analytics to improve online learning (e.g., Herodotou et al., 2020; Rajabalee et al., 2019) and (e) the digital divide-particularly during COVID-19 (e.g., Esteban-Navarro et al., 2020; Lai & Widmar, 2020). Recently, there have been calls to develop a field-wide agenda for research in formal online learning (Zawacki-Richter & Anderson, 2014). Current research in online learning for K–12 and higher education has been developing frameworks for best practices and professional development (Adelstein & Barbour, 2017; Mohr & Shelton, 2017) and can act as a guide as the field of museum-based online learning research moves forward.

The museum education research community has the opportunity to collaborate with museum practitioners in the development of a field-wide research agenda and future studies. As evidenced by their biographies, 68% of the authors cited in this review were museum professionals rather than researchers, demonstrating that practitioners are already leading research in this field. "Engaging museum educators in reflecting on their practice and doing research on their own experience in collaboration with researchers seems to have strong potential as a powerful method toward changing practice" (Piqueras & Achiam, 2019, p. 391). Therefore, these research-practitioner collaborations can act as a model for future studies that can lead to highly qualified educators and robust museum-based online learning opportunities.

Limitations

As with any study, this review had limitations. While we tried to be comprehensive, it is possible we missed theses, conference proceedings, or other gray literature that were not accessible through our searches. Our choice of search terms could have been limiting as well if authors chose different terms to describe their programs. Additionally, we limited our search to English which may have excluded some sources of information. However, we feel this review will serve to move the research of distance learning in museums forward.

Future Research

As the research in this field is still emerging, there are abundant opportunities for future studies. Several articles included suggestions for future research questions. Bradford and Rice (1996) recommended that future research examine (a) how widely distance learning can be used, (b) the range of intended audiences, (c) whether distance learning programs can pay for themselves, (d) how many programs can be offered based on limited resources and staff capacity, and (e) whether is it worth the time and resources to develop these programs if they come at the cost of on-site programs. Hardee and Duffin (2015) described the need for research to examine ways to differentiate online programs, determine the types of online programming museums should be developing, and identify avenues to better market programs to diverse audiences. Harrell and Kotecki (2015) identified the need for additional research on the "significance of blended learning approaches in the field" (p. 129).

We recommend future research aim to move beyond solely evaluative studies and begin to explore fieldwide studies of museum-based distance learning. Future studies should begin to ask larger research questions about the affordances offered by museum-based online learning, appropriate pedagogies for distance learning in museums, and best practices for the development and implementation of these programs.

Conclusion

This scoping review offers a foundational perspective of the current research of distance learning in museums. As museums play an important role in learning (National Research Council, 2009) it is vital we understand how museums are using digital programming to increase their program offerings. In this study, we have detailed the benefits and barriers to developing new programs. We have also discussed the importance of developing partnerships and being cognizant of the changing role of the educators involved in these programs. This review also offers opportunities for researchers to think about the type of work that needs to be done to advance this field.

Researchers in the fields of museum education and distance learning should consider opportunities to support museums as they continue to develop new online programs. This may include exploring alternative pedagogical strategies that are effective for the various types of online programs museums are offering (e.g., MOOCs, programs for adults, virtual tours). Additionally, research on establishing partnerships for museum-based distance learning programming will be beneficial for museums hoping to develop new programming in the future. Specifically, researchers should consider how to establish research-practice partnerships with museums as much of this work is currently being led by museum professionals. However, one of the most vital areas of research will be in developing professional development opportunities to support the educators engaged in museum-based distance learning programs (Ennes, 2021). The opportunity to develop the skills and strategies needed to effectively design and facilitate these programs is necessary to help support museum educators as they design new programs. High-quality professional development will increase the self-efficacy of museum educators and encourage them to design and facilitate online programs that use research-based best practices (Ennes et al., 2020). Since museum-based distance learning programs will continue to grow in importance as the world adapts to COVID-19, establishing a robust research agenda to examine these programs will benefit learners worldwide.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 22, Number 3

August – 2021

New Challenge for Initial Training of Mathematics Teachers: The Planning Phase of Mathematics Distance Learning

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Abstract

The scientific literature identifies five challenges related to training teachers: the basics of the constructivist approach, the problematization of mathematical knowledge to be taught, the promotion of interdisciplinarity, the use of digital pedagogical resources in planning teaching, and new skills to be developed due to the arrival of artificial intelligence. Considering the COVID-19 pandemic, it is appropriate to consider a sixth challenge, notably, training teachers capable of delivering mathematical distance learning courses focused on students' conceptual understanding. It therefore is necessary to link the stakes of initial training with that of distance learning, which can enhance conceptual understanding. Linking the need to construct knowledge among students with technological tools used for distance learning allows new challenges faced in the planning of mathematics teaching to be highlighted. These new challenges give rise to the anticipation genesis that helps in situating the planning of mathematics teaching between three variables: artifact variables, arrangement variables, and variables related to the nature of the data to be used. These variables are a major asset for the training of the preservice mathematics teacher. Their study in this article allows us to recognize that the choice of technological tools to be used in mathematics distance learning depends greatly on the conceptual analysis of the mathematical knowledge to be taught. This study shows that it is important to rethink and question distance learning for each mathematical concept.

Keywords: distance learning, planning, preservice teachers, conceptual understanding, mathematics

Introduction

The COVID-19 pandemic has had a significant impact on education in most countries around the world. Governments have temporarily closed all schools. According to UNESCO, the closure affects more than 91.5% of the world's student population and 63 million teachers, a figure that might increase before the end of the crisis. On March 20, 2020, UNESCO organized a first webinar with government officials and education experts from 50 countries to encourage school continuity and learning in particular. This illustrates the importance of "adopting a community-wide approach and strengthening partnerships to ensure inclusive distance learning" (UNESCO, 2020a). Distance learning is a teaching/learning system in which the teacher and students are separated geographically (Rogers, 2009). On March 27, 2020, a second webinar gathering 159 participants from 33 countries from all regions of the world was organized by UNESCO. The latter focused on teacher training and support and highlighted that the suddenness of school closures took most teachers around the world by surprise (UNESCO, 2020b).

The states of the world have used various strategies depending on their different resources. In Quebec, the response was diversified. First came government measures, such as creating a national learning platform (L'École Ouverte: https://www.ecoleouverte.ca/fr/?) for students, parents, and teachers; proposing weekly educational kits in schools; and partnering with local television stations to promote TV learning and partnerships with educational content providers, some of which have focused on distance learning. In addition, we have observed the purchase of computer and technological tools necessary to allow all students in Quebec to easily continue learning at home. Then we have measures taken by school centres such as synchronous or asynchronous distance learning. Schools have not only respected the measures proposed by the government, but they have also used and continue to use creativity in order to continue distance learning and to make the necessary changes to diversify human and material resources. For example, several virtual schools have been created and are recruiting new pedagogical advisers to support in-service teachers. Finally, we have nonprofit organizations and private companies tutoring or designing educational content that offer contents to students and synchronous distance learning environments.

Parents, students, and teachers are thus called upon to adapt to distance learning. They should therefore consider a new way of learning, teaching, and collaborating during the confinement period. This raises several questions. Have teachers been trained to deal with such situations that require them to teach remotely? We observed that the Ministry of Education and Higher Education of Quebec, in partnership with TÉLUQ University, has equipped teachers from elementary school to university with global practices of distance learning through an asynchronous firmware: J'enseigne à distance (https://www.teluq.ca/site/etudes/clom/enseigne-a-distance.php). In addition, RECIT's national services enrich the provision of in-service teacher training by offering webinars in the form of distance learning focusing on disciplines.[i] However, although there is a strong demand for teachers who require coaching and support on distance learning, RECIT's national services can only accommodate a limited number of teachers in their training. Thus, the government of Quebec has increased the number of RECIT educational advisers so that they can accompany many in-service teachers on the pedagogical strategies and the use of the tools for distance learning. However, analyzing the different educational resources available to support teachers allows us to notice that very few of them deal with distance teaching in a disciplinary way. In addition, the strong demand for in-service training on pedagogy and didactics of distance learning raises questions about mathematics teachers' initial training: how does teachers' initial training prepare preservice teachers for planning mathematics distance learning?

To answer this question, it is essential to analyze previous studies on teaching and learning mathematical concepts at a distance. However, several of these studies have been interested in the use of tools, environments, and online platforms for teaching and assessing mathematics (Cho & Heron, 2015; Farrús & Costa-jussà, 2013; Ku et al., 2011; Lee, 2014;), but few studies have been interested in distance teaching of mathematics, focused on the construction of knowledge in students (Francis & Jacobsen, 2013). In this work, we will define, in an innovative way, the parameters that operationalize the planning of mathematics distance learning anchored in the construction of knowledge in students. Our research objective is therefore to define a theoretical framework to fuel teachers' initial training in the planning of mathematics distance learning.

Research Question

Our research question concerns the training of teachers so that they are able to provide distance learning by relying on, among other things, creativity, collaboration, and the development of conceptual understanding among students. As part of this work, we will answer the following question: How does initial training prepare preservice teachers for planning distance learning focused on developing students' conceptual understanding? Our analysis will be carried out mainly through examining scientific research on mathematics distance learning over the past 20 years. This will also help to define more precisely the new challenges related to the initial training of mathematics teachers.

Mathematics Distance Learning

The mathematics distance teaching and learning process should not be viewed in the same way as that of other disciplines. The type of support required for the mathematics teaching and learning process goes far beyond staying in contact with mathematics. It must above all consider the development of students' conceptual understanding. Indeed, it is important not to confuse transposed distance learning in emergency situations with teaching that is truly planned to be delivered from a distance (Hodges et al., 2020). During the COVID-19 pandemic, we observed in most countries that applied confinement measures how schools concerned with student learning improvised several strategies enabling students to continue practising mathematics—for example, sending homework assignments through e-mail, as well as asynchronous and synchronous courses. Although these learning continuity strategies that were improvised according to diverse educational resources available are highly appreciated, it appears that secondary education teachers were not prepared to face such a crisis. This means to encourage their students' knowledge building through distance learning. This shows the need to anticipate these problems at the level of initial training. During initial training, these anticipations require multiple "moments and places of 'discussion' about different knowledges enriching the teaching practice" (Malo, 2000, p. 233). Thus, three phases are considered from these discussions surrounding the initial training of mathematics teachers: the distance learning planning phase, the distance learning phase, and the distance assessment phase. In this work, we will focus on the planning phase of mathematics distance learning.

Why Planning for Preservice Teachers?

In their planning, secondary preservice teachers may find it difficult to establish coherence between the skills to build in students and the questions to ask in anticipation activities (Diallo, 2005). In particular, they have difficulty transferring the didactic knowledge they have learned to adapt their planning to the students' level and to transform mathematical knowledge into an object of teaching by establishing links between concepts (Morin, 2008). They also have difficulty reflecting on teaching objectives such as formulating learning objectives, developing assessment approaches, and adapting their teaching to students' needs (Clerc & Martin, 2011; Cohan & Honigsfeld, 2006; Nongni, 2020). In terms of resource evaluation, some preservice teachers appear to have difficulty assessing the relevance of the digital resources they use to enrich their teaching planning (Dumouchel & Karsenti, 2013).

Several factors in teachers' initial training influence these difficulties, including links between practical and theoretical training, the place given to analyzing mathematical concepts, and the analysis of digital technology specificities in the development of conceptual understanding, notably for face-to-face training and distance learning. These difficulties point to the need to study the planning of mathematics distance learning. Indeed, when planning mathematics distance learning, the constraints of conceptual understanding must be considered by promoting the development of mathematical thinking and reasoning among students. It is important for preservice teachers to be aware that distance learning is intended to contribute to the construction of knowledge in students. The teachers must therefore see the relevance of developing an overview of the goals and issues involved in planning mathematics distance learning.

Planning Distance Learning: Analysis of Mathematics Distance Learning Variables

The anticipation phase in the distance learning of a mathematical concept takes place before students encounter the teaching subject. It must account for previous learning sequences and constraints of available resources that can support the teaching and that can be involved in students' learning process. This anticipation phase helps in providing adaptations that will enable effective control of the work environment (Cabon et al., 2014). The anticipation phase is characterized by thinking and decision-making approaches regarding the teaching to be provided and the learning, whereby the teacher has a great responsibility as far as improvisation and adaptation are concerned (Tochon, 2013). Moreover, Bergeron (2016) and Legendre (2005) define *planning* as an anticipation process made up of course preparation operations that take into account teachers' creativity, unpredictable elements, students' learning needs, resources required for teaching, and the analysis of teaching situations. Thus, subject to a variety of educational resources, activities experienced by preservice teachers relate directly to anticipation activities, and the educational resource they design becomes their planning (Nongni, 2020). It is therefore appropriate to define the requirements related to anticipation activities during initial training, especially when preservice teachers use various educational resources to develop planning.

In this perspective, Rabardel (1995) studies the artifact–instrument dialectic by supporting the thesis that analyzing an artifact's conceptual properties is necessary to achieve teaching goals. An *artifact* is a resource capable of interfering with or "nurturing" teaching practice (Adler, 2010). Indeed, the analysis of the conceptual properties of an artifact leads to the elaboration of use patterns, a concept borrowed from Vergnaud (1994). Vergnaud (1994) calls a *use pattern* a structured organization of a subject's action. Use patterns allow one to carry out a task and to anticipate and plan one's activity (Vergnaud, 1990). Thus, the artifact and use patterns constitute a mixed entity, allowing for the emergence of what Rabardel (1999) calls an instrument: instrumental genesis. Considering the diversity of the resources, Gueudet and Trouche (2008) extend Rabardel's (1995) instrumental approach by recognizing the importance of documentary work in planning mathematics teaching. Gueudet and Trouche (2008) extend the artifact–instrument dialectic from the instrumental approach to the resource–document dialectic. For them, a document is made up of two components: recombined resources plus use patterns. We consider resources, including digital and non-digital (software, applications, books, course materials, interactions, etc.), in a broad sense (Adler, 2000). The process of transforming a resource into a document is the documentary genesis (Gueudet & Trouche, 2008). This new dialectic makes it possible to manipulate didactic knowledge and knowledge related to the activity and professional development of preservice teachers. However, the documentary genesis does not consider the epistemological stance adopted by future teachers when they operationalize their anticipation activity. Indeed, a change in stance is necessary to offer distance learning that contributes to developing learners' skills (CSE, 2020). It becomes important to define a genesis that considers changing stances during anticipation activities when planning mathematics distance learning.

Anticipation activities range between the search for digital educational resources and the design of planning (Nongni, 2020). They are operationalized through artifact variables, arrangement variables, and variables related to the nature of the data to be used (Nongni, 2020). These are variables brought about when preparing for mathematics distance learning. Artifact variables make up a scenario system associated with the research, collection, evaluation, design, revision, and analysis of resources involved in teaching practice (Gueudet & Trouche, 2010). Arrangement variables make up a system of educational operating scenarios connected with the knowledge to build using artifacts (Trouche, 2007). They consist of patterns of use and their functioning, their evolution by accommodation or assimilation, and their joint evolution with the mathematical knowledge to teach. Variables related to the nature of the data to be used reflect all parameters that affect the data to promote students' knowledge building when teaching, such as didactic variables, data from reality, and data collected by students. *Didactic variables* are parameters that can be modified by the teacher. Their modifications (even limited) are likely to influence students' problem-solving process (Brousseau, 1998).

In addition to the previously defined variables, it is important to consider epistemological stances adopted by preservice teachers during anticipation activities (DeBlois, 2012; DeBlois & Squalli, 2002) when planning distance learning. In fact, Nongni (2020) has noted that the epistemological stance adopted by preservice teachers has an impact on their anticipation activities. Nongni (2020) also noticed that anticipation activities lead trainees to reconsider their knowledge, teaching, and learning problems in a dynamic perspective. So mathematical and technological skills, teaching conceptions, and their development vary from one stance to another, particularly between the stances of the former student, the university student, and the teacher. Conceptions about teaching correspond to "personal approaches to mathematics teaching. This includes mental images representing typical learning and teaching activities as well as the underlying principles" (Gattuso, 1993, p. 220). The former student's stance helps in maintaining conceptions about mathematics and its learning (DeBlois & Squalli, 2002). Conceptions about mathematics "bring together all personal beliefs about what mathematics is and what it means to do mathematics" (Gattuso, 1993, p. 219). The former student's stance includes teaching problems for which answers are available, learning of mathematics through memorization, and fear or resistance when it comes to dealing with teaching approaches (DeBlois, 2012; DeBlois & Squalli, 2002; Nongni, 2020). This stance also includes personal beliefs about mathematics distance learning. The university student's stance highlights difficulties that can transform the teaching project by distancing the former student from their experiences (DeBlois & Squalli, 2002). It is characterized by the knowledge acquired while training, such as practices discussed during university didactic courses and didactic knowledge offered to preservice teachers (Savard, 2014). This didactic knowledge considers the analysis of tasks and educational material that can promote conceptual understanding when teaching mathematics remotely. The teacher's stance is observed when the concerns of preservice teachers are focused on student learning (Deblois, 2012; DeBlois & Squalli, 2002; Ndolly, 2012). The stances previously explained justify and define the support needed by preservice teachers in anticipation activities in mathematics distance teaching. As a matter of fact, The preservice teachers need to think more deeply about how distance learning resources should be used to encourage student motivation, to represent, design, and explore mathematical ideas to help students build mathematical concepts.

Mathematics teachers' initial training should include anticipations that could allow transitions from one epistemological stance to another, especially to encourage the emergence of the teacher's stance. This transition requires considering variables that may contribute to students' knowledge construction during distance learning, notably artifact variables, arrangement variables, and variables related to the nature of the data. This genesis, which values, among others, the emergence of the teacher's stance among preservice teachers through these three variables is called *anticipation genesis*.

Artifact Variables in Mathematics Distance Learning

Artifact variables of anticipation genesis for distance learning are operationalized by the choice and analysis of resources to be used, the combination of resources, the canvas for the combination of several resources, the appropriation of teaching–learning environments, the analysis of content to be taught according to selected teaching–learning environments, the design of teaching materials, the design of both formative and summative assessments, and the continuous evaluation and revision of teaching–learning environments (Nongni, 2020). We have observed that not only are artifact variables limited to the choice or recension of technological tools for synchronous or asynchronous mathematics teaching, but these effects also take account of the analysis and revision of technological tools based on the teaching content and the students' familiarity with the learning environment. This operationalization of artifact variables for distance learning promotes the emergence of the teacher's stance among mathematics preservice teachers, mainly by considering teaching–learning problems in a more dynamic perspective.

In fact, choosing distance learning tools first requires a conceptual analysis of the concepts to teach. The nature of the mathematical task to be taught therefore influences the technology to be used (Francis & Jacobsen, 2013). In an online synchronous learning community involving 13 Canadian mathematics teaching professionals exploring how to teach better, Francis and Jacobsen (2013) observe that mathematical tasks that require a minimum of symbolic writing appear to work better in online learning environments. It is therefore important, in distance learning planning, to anticipate the challenges linked to technological tools by diagnosing opportunities provided such as possible interactions with learners and with mathematics (Francis & Jacobsen, 2013). A distance learning environment should have flexibility in terms of face-to-face teaching, especially in communicating, manipulating, using, and visualizing mathematical symbols or representations. However, it is through analyzing the concept being taught that we determine, inter alia, technological tools that could be used for distance learning and the way in which pedagogical design employing these technological tools is carried out. This is how we move towards distance learning focused on conceptual understanding. On the contrary, if the technological tool is chosen before the conceptual analysis, teaching could be limited to putting students in contact with mathematics. We then differentiate between learning mathematics remotely and putting in contact with mathematics.

The appropriation of teaching and learning environments by preservice teachers is an effect of artifact variables, which could contribute to the emergence of the teacher's stance among them. In effect, students appear more motivated when the teacher has better mastery over the technological tool used (Lee, 2014). This motivation is related to the support provided by teachers in order to develop in online learners, along with mathematics teaching, the skills needed to use the selected technology (Ku et al., 2011; Nuangchalerm et al., 2011). To increase students' motivation and evolution in a distance mathematics course, it is important to provide guidance that allows them to adapt to all technological tools used in the course (Cho & Heron, 2015). The design of support tools in online tutorials will benefit students, even in learning sequences explaining how to use technological sequences that will be employed in the mathematics course. All these aspects can be discussed during the first class session and, if need arises, continuously during other teaching sequences. The goal is to reduce students' emotional frustrations by enabling them to focus on the mathematical learning content instead of the technological tools for distance learning (Cho & Heron, 2015).

In addition to the support related to technological tools, teachers' availability also constitutes a major factor for mathematics distance learning (Lee, 2014; Russell et al., 2009). According to these authors, distance learning in mathematics should rely on tools and strategies that would maintain interactions between the teacher and the students on a regular basis. Lee (2014) cites, inter alia, online forums, live chats, webinars, and virtual meeting times where students ask questions to improve their understanding of the course concepts. These tools might be used to encourage communication, which is essential in affecting artifact variables for mathematics teaching–learning. In fact, the communication "in math education is critically important since it promotes students' reasoning and proof abilities along with their collaborative skills as they share their own mathematical ideas and listen to their peers" perspectives" (Lee, 2014, p. 126). Therefore, by creating a virtual communication community, students can share their modification, emotions, and learning strategies, and they can also regulate their learning (Cho & Heron, 2015). The teacher will have relevant elements to link distance learning to students' needs.

The appropriation of several assessment environments, an effect of the artifact variables, would allow the teacher to interact with students, monitor their learning process, motivate them, and communicate with them as needed. Actually, "assessment in education is the process of obtaining, organizing and presenting information about what and how the student is learning. Assessment uses several techniques during the teaching–learning process, and it is especially useful when evaluating open-answer questions since they allow teachers to better understand the assimilation of the student in the subject" (Farrús & Costa-jussà, 2013, p. 240). Many assessment tools are available in learning environments and choosing one tool or another must depend on several parameters. After all, assessment tools to be used in distance learning in mathematics are determined through prior analysis of the assessment sequences and students' anxiety levels. The analysis of assessment sequences is carried out during anticipation activities and helps to identify mathematical and technological tools needed to define how information about the quality of students' learning process are obtained, presented, and organized. Meanwhile, analyzing students' anxiety levels helps in choosing assessments that will lead to lower levels of anxiety (Hewson, 2012). The assessment tools selected should facilitate the use and manipulation of mathematical symbols and representations. They must allow the teacher to observe and analyze students' reasoning. In an online learning environment, assessment tools should also enable students to self-assess at any time and to receive immediate feedback (Farrús & Costa-jussà, 2013). These tools should enable the teacher to target assessment questions that appear most difficult for the students.

This will allow the teacher to personally intervene when students face difficulties, notably those observed in their assessments.

Unlike Brown et al. (1999), we observed that online assessment does not reduce the teachers' work. The evaluation of mathematics teaching cannot be limited to the automation of assessment tasks; it goes far beyond that. As a matter of fact, summative assessment cannot be limited to multiple-choice questions; nor can formative assessment. The purpose of assessment in mathematics is to observe the development of students' conceptual understanding. Assessment through multiple-choice questions does not allow one to observe how students build their knowledge. In distance synchronous or asynchronous learning in mathematics, assessment is a key element in observing students' learning difficulties and misunderstandings. The assessment therefore allows the teacher's involvement in the students' learning process by situating the teacher on the concepts on which it will be necessary to dwell again. It is essential for preservice teachers' initial training to be based on assessment techniques and tools that can be used to observe students' reasoning.

In short, the nature of mathematical knowledge greatly determines the technological tools to use for distance learning. Artifact variables serve to interpret how to choose, use, evaluate, and revise technological tools for mathematics distance learning. They are focused on the use, manipulation, and presentation of mathematical symbols or figures based on the mathematical knowledge to build. These variables must be discussed during initial training as the appropriation process of knowledge about the use of technological tools for the distance learning of curricular content. These best effects are therefore related to curricular content, the development of conceptual understanding, and students' motivation. Artifact variables are thus greatly influenced by arrangement variables.

Arrangement Variables in Mathematics Distance Learning

Arrangement variables of the anticipation genesis for distance learning is a scenario system of didactic exploitation that is operationalized through the following: (a) the analysis of students' possible errors and their didactic or epistemological origin; (b) the adaptation of curricular content; (c) the way concepts are explained (the meaning given to concepts or to their formulas, different representations of concepts); (d) the interpretation of concepts; (e) the problems related to providing context; (f) the way tasks, definitions, and characteristics are presented; (g) the way teaching is introduced; and (h) the organization of the education period (Nongni, 2020). These eight characteristics of arrangement variables influence the technological tools to use for asynchronous or synchronous mathematics teaching. During anticipation activities for distance learning of a mathematical concept, teachers must first define the orientations of the concepts to teach based on each of the eight operationalization characteristics of arrangement variables. It is following the analysis of the eight characteristics based on the concept to teach that the teacher will identify technological tools that will better link to the teaching needs of the concept concerned. This phase of linking technological tools depending on the concept to be remotely taught helps in observing that anticipation activities of distance learning in mathematics require extra work that is not needed in face-to-face teaching. Thus, the initial training of mathematics preservice teachers might account for this extra work. In fact, linking student needs for knowledge construction with technological tools to be used in distance learning will encourage the emergence of the teacher's stance among preservice teachers, mainly by situating teaching–learning problems from a more constructive perspective of mathematical knowledge.

The selection of task types is a component of arrangement variables to consider when teaching mathematics remotely. In effect, routine problems and problems centred on calculation procedures seem to disengage students during a remote mathematics course, particularly in a synchronous mode (Francis & Jacobsen, 2013). Thus, in anticipatory activities for teaching mathematics in a synchronous mode, the above-mentioned tasks must occupy little space. They might be used for students' homework. Activities selected during teaching anticipations could enhance the development of students' conceptual understanding. For instance, a multifaceted presentation of mathematical concepts, discovery-centred tasks, tasks focused on collaborative problem-solving, and active learning–oriented tasks would promote a more engaged mathematical space (Francis & Jacobsen, 2013).

Moreover, motivation and self-efficacy greatly influence student engagement (Cho & Heron, 2016). To promote student engagement, it appears necessary to identify the tasks that interest students. Adapting tasks according to the students' interests is an effect of the arrangement variables. In fact, taking into account students' interests during anticipation activities enhances the choice of the learning context. However, mathematics teacher training, in relation to the context, remains a major challenge (Balhan et al., 2019; Ben-Zvi & Makar, 2016; Djeumeni, 2015; Proulx & Bednarz, 2010). For example, research conducted with 12 Cameroonian preservice teachers reveals that preservice teachers' problems with tasks that might interest students are focused on their experiences as a former student, their personal experiences, and their beliefs (Nongni, 2020). This seems to keep preservice teachers away from the teacher's stance, where surveys of students are encouraged to determine their interests. The teacher's stance also enhances the environmental context of technological tools so that preservice teachers continuously adapt to individual differences between students. It equally takes into account interdisciplinary challenges that interest students. Note also that difficulties faced by preservice teachers in regard to students' interests are equally influenced by their teaching difficulties (Nongni, 2020). This result enriches that of Queiroz et al. (2017), who conducted interviews with preservice teachers regarding their knowledge of, background in, and experience with statistics. They then observed the predominance of their previous and personal experiences on their point of views about contexts and tasks. We can therefore confirm the hypothesis left open by Queiroz et al. (2017): that former students' experiences and trainees' personal experiences would have implications in their anticipation activities when planning teaching. In the context of distance learning, challenges related to recognizing tasks that lead to student engagement become more important in influencing the different arrangement variables. Initial training could prepare preservice teachers to efficiently work on student engagement. It should allow preservice teachers to move from their conception of contextualization that remains focused on the stance of former students to a conception of contextualization oriented towards the stance of the teacher. Preservice teachers must in fact be flexible to understand their students' contextual needs in order to anticipate solutions that could be useful for students' learning (Chinnappan, 2006).

Arrangement variables in mathematics distance learning help the preservice teachers and the teachers to observe deeply how technological resources can influence teaching a mathematical concept. Consequently, the selection of technological tools for distance teaching and learning and of the components of artifact variables can influence the implementation of arrangement variables. The technological tools employed have an impact on the components of arrangement variables such as the recognition of tasks that interest students, the multifaceted presentation of concepts, the anticipation of tasks facilitating the introduction of the teaching, the anticipation of definitions, and data interpretation (Nongni, 2020). Furthermore, arrangement variables can also influence and initiate the use of didactic variables, variability, and dispersed data, all of which are related to the nature of the data. In fact, Nongni (2020) has observed in 12 Cameroonian preservice teachers who plan to teach statistics that their anticipated tasks highlight changes of modality values to enable studying these concepts from several angles. These tasks are characterized by, inter alia, discrete and continuous data, problem situations of addition and multiplication of modalities by the same number, and situations of using data from the students' social reality. This is how arrangement variables implementing concepts from various angles lead to the use of variables related to the nature of the data.

Variables Related to the Nature of the Data to Use in Distance Learning

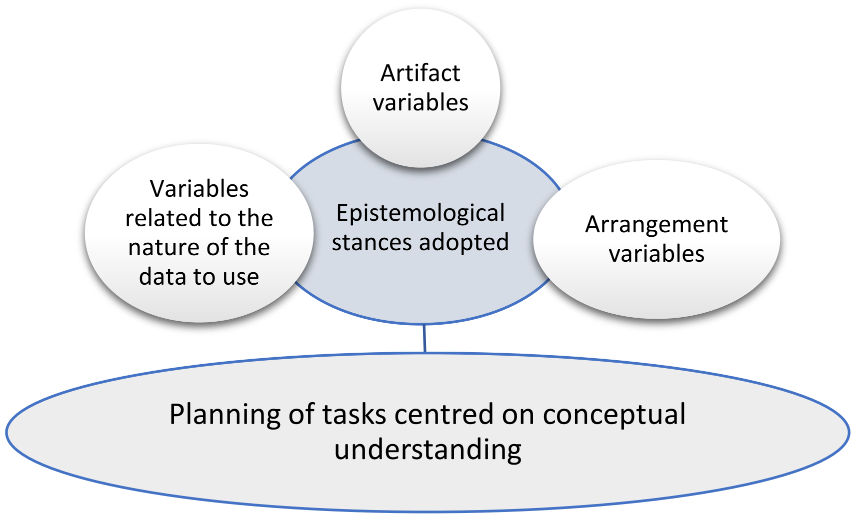
Variables related to the nature of the data of the anticipation genesis for distance learning concern data used to enhance students' conceptual understanding. They are operationalized in anticipation activities through the following: (a) the use of didactic variables; (b) the use of real-life data; (c) the collection of data by students; (d) the gathering of the data; (e) the use of various data (dispersed, undispersed, continuous, discrete, etc.); and (f) variability of the data (Nongni, 2020). Employing these variables encourages the implementation of arrangement variables that serve to anticipate tasks, by presenting the concepts to be taught in several facets (Nongni, 2020). During anticipation activities of mathematics distance learning, the valorization of the variables' components linked to the nature of the data assist in orientating planning towards students' knowledge construction. They will thus allow students to adapt and regulate their knowledge. In the context of distance learning, however, manipulating variables related to the nature of the data is not obvious. Indeed, it seems more difficult for the teacher to observe in a real way how students perform the learning tasks. Therefore, the data to be used should be diverse and clearly identified in the tasks. Furthermore, continuous and frequent formative assessments constitute a key element to regulate students' knowledge based on variables related to the data's nature.

Conclusion

We have analyzed how mathematics teachers' initial training could prepare them to anticipate the challenges if distance learning. In this vein, the anticipation genesis of planning mathematics distance learning has been defined (see Figure 1).

Figure 2

Schematic Representation of the Anticipation Genesis in the Planning of Teaching



This approach, called anticipatory genesis, extends the documentary genesis of Gueudet and Trouche (2008). It is also part of the documentational approach to didactics perspective (Drijvers et al., 2019) and the design linking the stances that teachers can adopt with learning materials (Leroyer, 2018a, 2018b), in particular, at the level of initial training for mathematics distance learning. The innovation of this approach is that it makes defining how to plan the teaching of mathematical distance learning possible, in particular, by highlighting the interplay between the planning variables and the epistemological postures adopted by preservice teachers. This approach sheds light on the role of planning in mathematics distance learning, differentiating between staying in contact with mathematics remotely and mathematics distance learning. It is easy to stay in contact with mathematics remotely. Besides, many solutions and tools exist to give students the opportunity to stay connected to mathematics. Mathematics distance learning goes beyond contact with mathematics, it focuses on the students' development of conceptual, cognitive, and meta-cognitive understandings. It is thanks to the conceptual analysis of the knowledge to teach, of students' difficulties and knowledge, and of teaching–learning pedagogical resources that we can determine the technological tools to be used in distance learning. Thus, linking technological tools depending on the concept to be remotely taught helps in observing that mathematics distance learning requires an extra work that is not needed in face-to-face teaching. So, to better prepare primary or secondary preservice teachers to teach mathematics remotely, initial training should enable them to move towards the teacher's stance by enhancing students' understanding and interpretation.

It seems necessary to multiply, during the preservice training programs, the moments of discussion on the different knowledge feeding the practices of mathematics distance learning. Indeed, given that preservice teachers show resistance to less familiar practices (Clift & Brady, 2005), it is interesting to develop courses that are fully and essentially grounded in mathematics distance learning and that allow for in-depth exploration of mathematical concepts: this is the new challenge of preservice training programs. These courses should focus on didactic knowledge regarding the teaching of mathematical concepts at a distance. They will therefore complement educational technology courses and courses focused on planning that currently exist in preservice training programs and are very general in nature. Indeed, since the emergence of the teacher's stance among preservice teachers is reciprocally influenced by the components of artifact variables, arrangement variables, and variables related to the nature of the data, it seems important to study how to teach each mathematical concept at a distance. This does not mean putting face-to-face courses online but rather highlighting the development of conceptual understanding during distance learning. Although this research is limited to the analysis of several scientific studies, the underlying theoretical framework allows us to conclude that teaching each mathematical concept should be rethought and questioned in the context of distance learning.

To specifically support the theoretical framework developed in this article, it is essential for future research to collect and analyze data on the distance learning of each mathematics concept. This will allow us to see how the variables discussed are specifically presented and how they could be enhanced in order for each concept to be taught.

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[i] RECIT (http://recit.qc.ca/) is a network that focuses on the development of students' competences through the integration of information and communication technologies. RECIT fulfils this mandate primarily by providing training, support, and guidance for Quebec's teaching staff while developing a culture of networking and sharing. It is a structure that brings together more than 200 school counsellors throughout Quebec.

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 22, Number 3

August – 2021

A Meta-Analysis on the Effects of Synchronous Online Learning on Cognitive and Affective Educational Outcomes

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Abstract

Synchronous online learning (SOL) provides an opportunity for instructors to connect in real-time with their students though separated by geographical distance. This meta-analysis examines the overall effect of SOL on cognitive and affective educational outcomes, while using asynchronous online learning or face-to-face learning as control groups. The effects are also examined for several moderating methodological, pedagogical, and demographical factors. Following a systematic identification and screening procedure, we identified 19 publications with 27 independent effect sizes published between 2000 and 2019. Overall, there was a statistically significant small effect in favor of synchronous online learning versus asynchronous online learning for cognitive outcomes. However, the other models were not statistically significant in this meta-analysis. The effect size data were normally distributed and significantly moderated by course duration, instructional method, student equivalence, learner level, and discipline. Implications for educational practice and research are included.

Keywords: synchronous, online learning, meta-analysis, face-to-face, asynchronous, affective, cognitive, outcome

Introduction

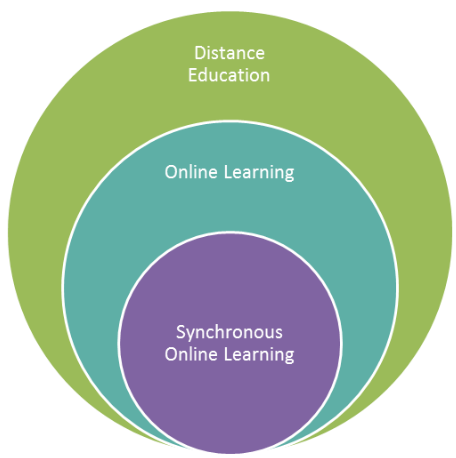
With the increase in the number of online courses (Seaman et al., 2018), research on online learning has grown (Martin et al., 2020). Primary research has made way for systematic reviews and meta-analyses conducted on various online learning models. While there are several meta-analyses of online learning, most focus on asynchronous online learning. There is still a need for a meta-analysis to examine the effects of synchronous online learning (SOL).

Synchronous Online Learning

SOL occurs when students and the instructor are together in "real time" but not at the "same place." SOL is a specific type of online learning gaining importance due to the convenience it offers to both students and instructors while enhancing interactivity. Instructors and students are realizing the necessity of immediate interaction in their online experience, which is often referred to as "same time, some place learning." Adding synchronous components to online courses can enrich meaningful interaction between student-instructor and student-student (Martin et al., 2012). As shown in Figure 1, SOL is considered a subset of online learning, and online learning a subset of distance education.

Figure 1

Synchronous Online Learning Conceptual Diagram



Synchronous online environments allow students and instructors to communicate using audio, video, text chat, interactive whiteboard, application sharing, instant polling, etc. as if face-to-face in a classroom. Participants can talk, view each other through a webcam, use emoticons, and work together in breakout rooms. Zoom, Blackboard Collaborate, Elluminate, Adobe Connect, and Webex are some of the synchronous online technologies prevalent in higher education. Synchronous technologies can be incorporated into online courses for community-building or social learning and are better suited to discussing less complex issues, getting acquainted, or planning tasks (Hrastinski, 2008). Synchronous online technologies are less flexible in terms of time, but can be accessed from anywhere. They render immediate feedback and allow multi-modality communication (Martin & Parker, 2014).

Fostering and sustaining different types of interactions among participants is particularly important in online learning environments since interaction plays a key role in influencing, if not determining, the quality and success of online education (Zimmerman, 2012). Given that online learners are much more likely both to feel isolated and alienated and to decide to drop out due to physical distance from peers and instructors, keeping online students interacting and engaging with others is also a significant factor in retention, which is known to be still lower in online education than in traditional face-to-face classrooms in higher education (Boston et al., 2010). In SOL, interaction is usually achieved through audio and/or video conferencing sessions, with synchronous chat features where each participant has a chance to receive and respond to messages or inputs in real-time, whereas asynchronous interaction is usually fostered and maintained via discussion boards where participants have time to reflect on the course content and their peers' ideas since they are not supposed to work at the same time and there is no pressure to respond immediately (Banna et al., 2015; Bernard et al., 2009; Giesbers et al., 2014; Revere & Kovach, 2011). Interactions in the synchronous mode of online communication are usually found to be more useful and effective in fostering social-emotional relations, sense of community and belongingness, learner engagement, and immediate feedback and information exchanges among participants (Chou, 2002; Giesbers et al., 2014; Mabrito, 2006), and these interactions take place learner to learner, learner to instructor, and learner to content (Moore, 1993).

Comparisons of Synchronous Online Learning

A number of empirical studies have compared SOL with the asynchronous online and face-to-face modes of learning, and a variety of significant findings have been reported in terms of specific learning outcomes, such as online interactions, sense of cooperation, sense of belonging, student emotions, cognitive presence, and critical and reflective thinking skills. We review these findings in the following sections.

Synchronous Versus Asynchronous Online Learning

Online learner interaction is one of those variables or outcomes empirically investigated when comparing synchronous and asynchronous learning environments. For example, using a content analysis method, Chou (2002) examined and compared online learners' interaction transcripts from synchronous and asynchronous discussions. In synchronous discussions, learners engaged in more social-emotional exchanges, using more two-way communication, whereas the interactions in asynchronous modes of learning were much more focused on the learning tasks, using primarily one-way communication with less interactive exchanges (Chou, 2002). Using a case study research design, Mabrito (2006) similarly explored differences in the patterns and nature of learner interactions between synchronous and asynchronous modes of communication by analyzing online learners' transcripts of discussions.

More recently, Peterson et al. (2018) found that asynchronous online cooperation yielded less sense of belonging and more negative emotions among learners, while the synchronous mode of communication positively influenced student sense of belonging, emotions, and cooperation in online groups. In a similar study, Molnar and Kearney (2017), as a result of their analysis of asynchronous and synchronous modes of online discussion, concluded that although both modes contributed to students' cognitive presence, students participating in synchronous Web discussions engaged in more cognitive presence than their peers in the asynchronous discussions. These studies clearly indicate that the synchronous mode of online communication can also positively influence cognitive processes and skills of online learners.

Synchronous Online Versus Face-to-Face Learning

Several studies have also empirically compared SOL with traditional face-to-face learning in terms of outcomes. Kunin et al. (2014) compared postgraduate dental residents' perceptions regarding the perceived effectiveness of synchronous and asynchronous modes of online learning to traditional face-to-face learning and found that participants perceived the face-to-face mode as being most conducive to their ability to learn, while also favoring the asynchronous over the synchronous mode after experiencing both. On the other hand, Garratt (2014) investigated whether a synchronous mode of instruction could be used effectively to teach a set of psychomotor skills to a cohort of paramedic students in comparison to face-to-face instruction of the same skills. Garratt (2014) found no significant difference in the skills performance results of the two groups, indicating that the synchronous mode of learning could be as effective as traditional face-to-face instruction to teach even complex psychomotor skills, although it should be noted that the very limited sample size was a serious limitation to the study. Haney et al. (2012) used synchronous and face-to-face modes of instruction to teach wound closure skills to two groups of paramedics. On tests of both knowledge and skills, the students who received the same instruction through videoconferencing performed at least as well as those who received traditional face-to-face instruction, while traditional face-to-face instruction was still perceived to be the more effective method of teaching (Haney et al., 2012).

In support of the equal or almost equal effectiveness of the synchronous mode of online learning in comparison to face-to-face learning, Siler and Vanlehn (2009) found that synchronous one-to-one tutoring worked at least as effectively as face-to-face tutoring in terms of students' gains in learning physics and several motivational outcomes, although the face-to-face tutoring was found to be more time-efficient and conducive to emotional exchanges, while also allowing more interaction. More recently, Francescucci and Rohani (2019) compared synchronous and face-to-face learning in terms of exam grades and perceived student engagement and found that students who received the synchronous online version of an introductory marketing course academically performed as successfully as their peers who took the face-to-face version of the same course. These studies cumulatively indicate that although the traditional face-to-face mode of learning is, as expected, perceived to be a more effective method of learning and instruction overall, the synchronous or asynchronous mode of online learning has the potential to help achieve desirable outcomes as effectively and successfully as conventional modes of learning and instruction.

Meta-Analysis on Synchronous Distance Education

Reviews of research have been conducted on distance education and exclusively on online learning. There have been a number of meta-analyses on distance education, specifically comparing face-to-face to online learning (Allen, 2004; Cook et al., 2008; Jahng et al., 2007; Shachar & Neumann, 2010; Todd et al., 2017; Zhao et al., 2005). However, we did not find a meta-analysis specifically examining SOL, comparing it to asynchronous online learning or to face-to-face learning, though we found a few studies examining SOL as a moderator variable (Bernard et al., 2004; Means et al., 2013; Williams, 2006). In the Bernard et al. (2004) review that examined 232 studies, synchronous and asynchronous were examined as a moderator variable. They found asynchronous distance education to have a small significant positive effect ($g+$ = 0.05) on student achievement, and synchronous distance education to have a small significant negative effect ($g+$ = -0.10). However, in this case, the studies were focused on all aspects of distance education and not specifically on online learning. Means et al. (2013) examined synchronicity as a moderator variable and found that it was not a significant moderator of online learning effectiveness. Williams (2006) examined

25 studies in allied health sciences and found that synchronous learning had a 0.24 average weighted effect size while asynchronous learning had a negative effect size of -0.06. There have been mixed findings when examining synchronous learning as a moderator. Also, when referring to synchronous learning, these studies did not specifically focus on SOL but on all synchronous distance education.

There is one systematic review on SOL in which Martin et al. (2017) reviewed 157 articles published from 1995 to 2014. The majority of the studies were conducted in the United States and in higher education. English/Foreign Language and Education were the top two content areas. Qualitative research methods were used in 57% of the studies and perception/attitude were examined in 61%. While questionnaires were used in 61% of the studies reviewed, 50% of the studies also used session transcripts to collect data. While this study provides a descriptive analysis of data on studies using SOL, it does not compare SOL to other delivery methods.

Purpose of the Study

While there are a few meta-analyses focusing on the broader comparison of online learning versus face-to-face or blended learning, there is a gap in the research comparing SOL with either face-to-face or asynchronous online learning. There is only one systematic review conducted on SOL (Martin et al., 2017) and a few moderator analyses on synchronous distance education (Bernard et al., 2004, Means et al., 2013; Williams, 2006). However, there is no meta-analysis focusing on SOL, though it is a critical aspect of online learning.

A meta-analysis can advance the field of SOL by providing information to contextualize what we know about online learning and technology and how it is applied (Oliver, 2014). Systematic reviews help develop a common understanding among researchers about the state of their field and improve future research to close gaps and eliminate inconsistencies. We hope to provide a quantitative synthesis of research literature on SOL from 2000 to 2019 and examine SOL's effectiveness in achieving educational outcomes.

Research Questions

1. What are the publication patterns of synchronous online learning research in this meta-analysis? (years of publication, number of articles published, and journals that publish synchronous learning research)

2. What effects does synchronous online learning have on educational outcomes compared to asynchronous online learning and face-to-face classroom in terms of cognitive (e.g., student achievement), and affective (e.g., satisfaction) educational outcomes?

3. To what extent do *pedagogical variables* (course duration and type of instructional method) moderate the influence of synchronous online learning?

4. To what extent do *methodological, demographic*, and *publication variables* (student equivalence, learner level, discipline, country, and publication source) moderate the influence of synchronous online learning?

Method

This study followed the meta-analysis process as described by Wilson (2014). There were five steps:

1. Identify the right question.
2. Determine eligibility criteria.
3. Conduct a literature search and review.
4. Calculate effect size.
5. Analyze the data.

Data Sources and Search Strategies

Researchers have used different terminologies to describe SOL. It is referred to as synchronous virtual classrooms (Martin & Parker, 2014), Web conferencing, e-conferencing, or virtual conferencing (Rockinson-Szapkiw & Walker, 2009), and also commonly known as a webinar. In this study, we used seven terms to identify research on SOL. The search keywords were “Synchronous and Online Learning”, “Web conferenc*”, “Virtual Classroom”, “Synchronous and Elearning”, “Econferenc*”, “Virtual conferenc*”, and “Webinar”.

To ensure we identified relevant literature, we did a broad search of journal articles and doctoral dissertations published between 2000 and 2019. We chose the year 2000 as the starting point as this is when synchronous online tools became popular in online courses. An electronic search was conducted in six databases, which included Academic Search Complete, Communication & Mass Media Complete, Education Research Complete, ERIC, Library, Information Science & Technology Abstracts with Full Text, and PsycINFO.

Working Definition, Inclusion, and Exclusion Criteria

To determine which articles to include in our study, we used the definition from Martin et al. (2017) which states that in SOL there is: (a) a permanent separation (of place) of the learner and instructor during planned learning events where (b) instruction occurred in real-time such that (c) students were able to communicate with other students and the instructor through text, audio, and/or video-based communication of two-way media. We then arrived at several criteria for inclusion/exclusion which are shown in Table 1.

Table 1

Inclusion/Exclusion Criteria

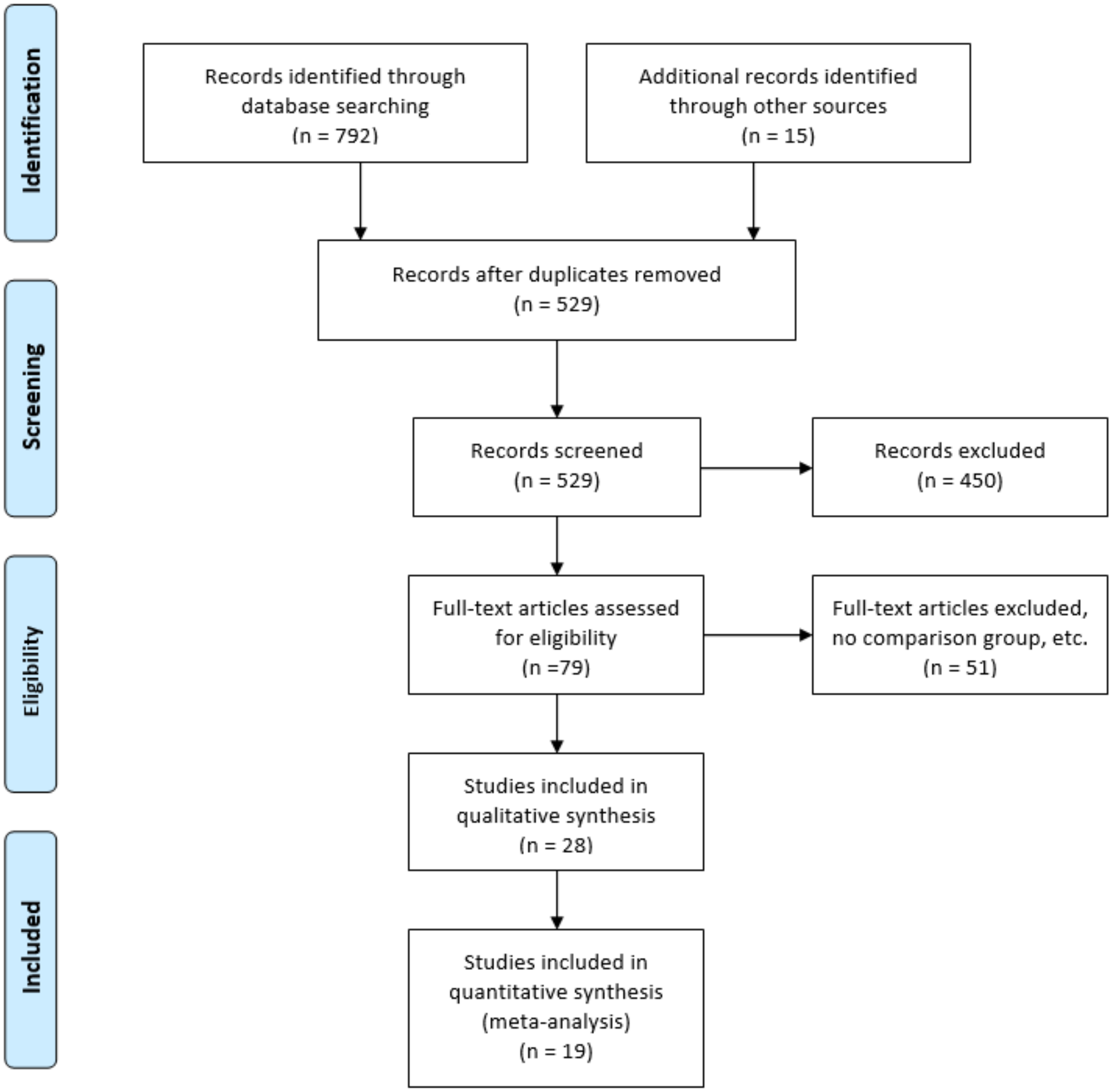
Criteria	Inclusion	Exclusion
Technology	Any use of synchronous online technology	Other technology that is not synchronous online
Publication date	2000 to 2019	Prior to 1999 and after 2019
Publication type	Scholarly articles of original research from peer reviewed journals and dissertations	Book chapters, technical reports, or proceedings
Language	Publication was written in English	Languages other than English
Research design	Experimental or quasi-experimental design and between subjects' design comparing synchronous online with asynchronous or synchronous online with face-to-face	Non-experimental designs or within-subject design
Results of research	Adequate data for calculating effect sizes	Not enough statistics provided
Educational outcomes	Clear educational outcomes (cognitive and affective)	No clear educational outcomes

Identification and Screening Process

We used the PRISMA flow model (Figure 2) to guide the process of identification, screening, eligibility, and inclusion of studies. The PRISMA guidelines were proposed by the Ottawa Methods Centre for reporting items for systematic reviews and meta-analyses (Moher et al., 2009). Our initial search identified n = 807 manuscripts, which was reduced to n = 529 after removing duplicate entries. To ensure consistent screening procedures, we hosted a discussion session with two team members and screened a random sample of five manuscripts for calibration purposes. After screening the titles and abstracts, full-text screening was conducted in two rounds with n = 28 manuscripts. After systematically applying our inclusion and exclusion criteria, n = 19 manuscripts qualified for final inclusion in the study. They were subjected to our coding and data extraction procedures.

Figure 2

PRISMA Flowchart for SOL Review



Study Coding and Data Extraction

The research team developed and used a Google form to code the variables described in Table 2. The form was divided into six sections to include (a) study identification, (b) outcome features, (c) methodological features, (d) pedagogical features, (e) synchronous technology features and (f) demographics. The initial coding was performed by two team members who met frequently with other team members to discuss coding related questions. The two team members coded the same five articles initially with inter-rater agreement of 88.46%.

Table 2

Description of the Coded Elements for Each Research Study

Element	Description
Article information	Full reference including author(s), year of publication, article title, journal name, and type of publication (journal article, dissertation, or other).
Outcome features	Coded as *cognitive*, *affective*, and *behavioral*. Cognitive outcomes included measures such as learning, achievement, critical thinking skills, comprehension, and similar outcomes. The affective outcomes included learner satisfaction, emotions, attitudes, motivation, and related measures. Behavioral focused on interactions.
Outcome measures	Outcome measures were coded for each type of outcome variable. Options on the cognitive outcome measures included standardized test, researcher-made test, teacher-made test, teacher/researcher-made test, and unknown.
Control conditions and type	Number of control conditions were coded. This included one control with one synch, one control with more than one synch, one synch and more than one control, and more than one synch and more than one control. The control type was also coded to be either asynchronous or face-to-face.
Course duration and synchronous session duration	The different options for course duration included: less than 15 weeks, 15 weeks, more than 15 weeks, and unknown. Synchronous session duration included: less than 30 minutes, 30 minutes to 2 hours, more than 2 hours, and unknown.
Instructor and student equivalence	Instructor equivalence was coded as; same instructor, different instructor, and unknown, while student equivalence was coded as random assignment, non-random assignment with statistical control, non-random assignment without statistical control, and unknown.
Time and material equivalence	Time equivalence was coded as yes, no and unknown, and material equivalence was coded as same curriculum materials, different curriculum materials, and unknown.
Interaction features	Learner-learner, learner-instructor, and learner-content interactions were coded as opportunity to interact, no opportunity to interact, and unknown.
Instructional teaching method	This was coded as lecture, interactive lesson, unknown, and other.
Synchronous technology	Synchronous technology type along with different synchronous feature used were coded.
Demographics	Types of synchronous learners (K-12, undergraduate, graduate, military, industry/business, professionals), discipline, gender and age of participants, and country were coded.
Effect sizes	Statistical information (M, SD, n) to calculate effect sizes.

Dependent and Moderating Variables

Cognitive and affective educational outcomes were the dependent variables used in this study. Cognitive outcomes include measures such as learning, achievement, critical thinking skills, comprehension, and similar outcomes. The affective outcomes included learner satisfaction, emotions, attitudes, motivation, and related measures. Though it was our intention to also code for behavioral educational outcomes, only two studies reported on behavioral outcome and hence this was not part of this meta-analysis.

Several variables important in SOL were coded and examined as moderators. Though we coded for a number of variables, there was not sufficient information to examine all as moderators. Thus, only seven were chosen: two pedagogical (course duration and type of instructional method), one methodological (student equivalence), three demographic (learner level, discipline, country), and one publication type variable (publication source).

Moderators included: (a) course duration (i.e., less than one semester or one semester and more); (b) type of instructional method (i.e., lecture or interactive lesson); (c) student equivalence (i.e., non-random assignment or random assignment); (d) learner level (i.e., undergraduate or graduate/professional); (e) discipline (i.e., education or others); (f) country (i.e., United States of America or others); and (g) publication source (i.e., journal article or dissertation).

Effect Size Calculation and Data Analysis

Data were analyzed using the computer software Comprehensive Meta-Analysis, version 3 (CMA 3.0; Borenstein et al., 2014). Effect size used in the current meta-analysis was Hedges' g. First, standardized mean difference (Cohen's d) was calculated by dividing the raw mean difference between the synchronous treatment condition and the control condition (asynchronous or face-to-face condition) by the pooled standard deviation of the two conditions using the following formula. Notations were borrowed from Borenstein et al. (2009).

$$d = \frac{\bar{X}_1 - \bar{X}_2}{S_{within}} \tag{1}$$

$$S_{within} = \sqrt{\frac{(n_1-1)*S_1^2+(n_2-1)*S_2^2}{n_1+n_2-2}} \tag{2}$$

Then d was transformed into Hedges's g for bias correction using the following formula (Borenstein et al., 2009).

$$g = (1-\frac{3}{4*df-1})*d \tag{3}$$

We have three types of effect size statistics. Most studies reported statistics of means, standard deviations, and sample sizes for the synchronous treatment condition and the control condition (i.e., asynchronous or face-to-face). One study reported raw mean difference and significance of difference (i.e., Cleveland-Innes & Ally, 2004) and one study reported Cohen's d (i.e., Francescucci & Rohani, 2019). The original data had 86 cases of effect size statistics in the 19 primary studies. Before conducting the meta-analysis, we had to deal with statistics that may have yielded dependent effect sizes within studies. For example, Peterson et al. (2018) reported multiple effect size statistics calculated from different affective measures. Ignoring the dependence issue would pose threats to validity of meta-analytic results because it may result in a spuriously smaller standard error of the summary effect size and a higher risk of committing type I error (Ahn et al., 2012). Literature suggested procedures in handling the dependence such as averaging or weighted averaging method (Borenstein et al., 2009) or robust variance estimation (RVE) (Hedges et al., 2010). Although RVE performs better than the averaging procedure in estimating unbiased standard error (Moeyaert et al., 2017), it requires a large sample (i.e., number of primary studies) for accuracy (Tanner-Smith & Tipton, 2014). Therefore, we used the weight averaging procedure to deal with the dependence issue. This resulted in 27 effect sizes in the 19 primary studies after we averaged effect size statistics of the same measure type (i.e., affective or cognitive) for each control group (i.e., asynchronous or face-to-face) within studies.

We employed a random-effects model for several reasons. First, the fixed-effect model assumes that all studies share one common effect size in the population (Borenstein et al., 2009), which can only make conditional inferences to the studies included in a meta-analysis (Field, 2001). Second, we hypothesized that the true effects were heterogeneous and the proposed moderators may explain the heterogeneity. Therefore, employing the random-effect model and assuming that the true effect sizes vary across studies was more appropriate and plausible. There were four conditions in the current meta-analysis:

a) synchronous treatment condition vs. asynchronous condition with cognitive outcomes,

b) synchronous treatment condition vs. asynchronous condition with affective outcomes,

c) synchronous treatment condition vs. face-to-face condition with cognitive outcomes, and

d) synchronous treatment condition vs. face-to-face condition with affective outcomes.

First, we estimated the overall effect size for each condition. Overall averaged effect size, standard error, confidence intervals, Z and its related p-value, and heterogeneity statistics (Q and its p-value, T^2, and I^2) were computed. Overall average effect size provides an estimate of the effects of SOL on educational outcomes. Its standard error and confidence intervals provide evidence of the estimation accuracy. The Z and its p-value show whether the effect size estimate is statistically significant. Heterogeneity statistics provide evidence of the variation of the true effect sizes across studies. We also conducted moderator analyses on the four conditions to determine if the heterogeneity (if any) in effect sizes could be accounted for by pedagogical, methodological, demographical, and publication variables. All the moderators are categorical variables, and analyses were conducted with the mixed effects analysis (MEA) as implemented in the CMA 3.0.

Finally, it was important to address the issue of publication bias which is when the published research is not representative of the population of work in the domain. In this meta-analysis, both journal articles and dissertations were included, which means some grey literature was accounted for, but there was still the risk of publication bias. Several strategies were used to determine publication bias. Funnel plots showing the relationship between standard errors or studies included and effect sizes (Borenstein, 2009) illustrate the spread of the studies. In addition, classic fail-safe N (Rosenthal, 1979), to represent the number of missing studies to bring the *p*-value to a non-significant level, was included. Finally, we used Orwin's fail-safe N (Orwin, 1983), which assists in computing the number of missing studies needed to bring the summary effect to a level below the specified value other than zero.

Results

Publication Patterns

Table 3 shows the publication details of the 19 journal articles and dissertations included in this study. The studies were published in a wide array of journals in several different disciplines, and dissertations were completed at institutions of higher education across the United States. Among the studies, three were published in each of 2008, 2010, and 2014, while there were two in each of 2012, 2015, 2016, and 2018, and one study in 2004 and 2006.

Table 3

Journal Articles and Dissertation Details

Journal articles (n = 12)	Dissertations (n = 7)
Australian Journal of Teacher Education	Northcentral University
Journal on Excellence in College Teaching	The Ohio State University
Implementation Science	Capella University (3)
Canadian Journal of University Continuing Education	The Texas Woman's University
Journal of Marketing Education	Texas A & M University
Online Learning Journal	
The Modern Language Journal	
International Journal of Distance Education Technologies	
Journal of Applied Business and Economics	
The Online Journal of Distance Education and e-Learning	
American Journal of Pharmaceutical Education	
Decision Sciences Journal of Innovative Education	

Characteristics of the Primary Studies

Descriptive information about the 19 primary studies is presented in Table 4. The final sample consisted of k = 27 independent effect sizes (across the four models) and N = 4,409 participants. A total of n = 1,114 students received SOL and the number of students who received asynchronous online learning and face-to-face learning were n = 1,079 and n = 2,216, respectively. Approximately half the studies were conducted with undergraduate students (n = 10, 52.6%), and the rest were conducted with graduates or professionals (n = 9, 47.4%). With respect to disciplines, the most frequently studied was education (n = 5, 26.3%), followed by business (n = 4, 21.1%) and medicine or nursing (n = 3, 15.8%). A majority of the studies were conducted in the United States (78.9%), and four others were conducted in Australia (i.e., Dyment & Downing, 2018), Canada (i.e., Cleveland-Innes & Ally, 2004), Japan (i.e., Shintani & Aubrey, 2016), and China (Taiwan) (i.e., Chen & Shaw, 2006). There were 12 journal articles (63.2%) and seven dissertations (36.8%).

Table 4

Descriptive Data for the Primary Studies

Authors	Publication source	Outcome	Control type	Course duration – 15 weeks	Student equivalence	Type of instructional method	Learner level	Discipline	Country/ Region
Buxton (2014)	Journal	Affective	Asynch	Less	Non-random	Lecture	Professional	Histology	USA
Chen & Shaw (2006)	Journal	Cognitive/ Affective	Asynch/F2F	Less	Random	Lecture	Undergraduate	Computer science	Taiwan
Cleveland-Innes & Ally (2004)	Journal	Affective	Asynch	Unknown	Random	Interactive lesson	Professional	Business	Canada
Dyment & Downing (2018)	Journal	Affective	Asynch/F2F	Less	Non-random	Interactive lesson	Graduate	Education	Australia
Francescucci & Rohani (2019)	Journal	Cognitive/ Affective	Asynch/F2F	More	Random	Interactive lesson	Undergraduate	Business	USA
Gable (2012)	Dissertation	Affective	Asynch	Less	Non-random	Interactive lesson	Graduate	Education	USA
Gilkey et al. (2014)	Journal	Affective	F2F	More	Random	Interactive lesson	Professional	Medicine	USA
Kizzier (2010)	Journal	Affective	Asynch/F2F	Unknown	Unknown	Interactive lesson	Undergraduate	Business	USA
Kyger (2008)	Dissertation	Affective	Asynch	Less	Unknown	Interactive lesson	Undergraduate	Computer science	USA
Leiss (2010)	Dissertation	Affective	Asynch	Less	Non-random	Interactive lesson	Undergraduate	Health	USA
Moallem (2015)	Journal	Cognitive/ Affective	Asynch	Equal	Non-random	Interactive lesson	Graduate	Education	USA
Nelson (2010)	Dissertation	Cognitive	F2F	Equal	Random	Lecture	Undergraduate	Medicine	USA
Peterson et al. (2018)	Journal	Affective	Asynch	Equal	Random	Unknown	Undergraduate	Education	USA
Rowe (2019)	Dissertation	Cognitive	Asynch/F2F	More	Non-random	Lecture	Graduate	Math	USA
Scharf (2015)	Dissertation	Cognitive	Asynch/F2F	More	Non-random	Lecture	Graduate	Others	USA
Shintani & Aubrey (2016)	Journal	Cognitive	Asynch	Less	Random	Interactive lesson	Undergraduate	Science	Japan
Spalla (2012)	Dissertation	Affective	F2F	Equal	Random	Interactive lesson	Undergraduate	Medicine	USA
Stover & Miura (2015)	Journal	Affective	Asynch	Less	Non-random	Interactive lesson	Graduate	Education	USA
Strang (2012)	Journal	Cognitive	Asynch	Less	Non-random	Interactive lesson	Undergraduate	Business	USA

Note. Asynch = asynchronous; F2F = face-to-face.

Overall Effect Sizes

Meta-analyses assume normal distribution of observed effect sizes for accurate estimation (Borenstein et al., 2009). The distribution of Hedges's g is plotted in Figure 3, which suggests that effect sizes were approximately normally distributed. Given the within-study dependent effect sizes, we conducted meta-analyses of the four conditions separately (i.e., synchronous vs. asynchronous with cognitive outcomes, synchronous vs. asynchronous with affective outcomes, synchronous vs. face-to-face with cognitive outcomes, synchronous vs. face-to-face with affective outcomes). The overall effect size statistics for each of the four conditions is presented in Table 5. The effect size was statistically significant in only one model (synchronous vs. asynchronous with cognitive outcomes), and it did not overlap zero in the confidence interval.

Figure 3

Histogram of Effect Size Estimates

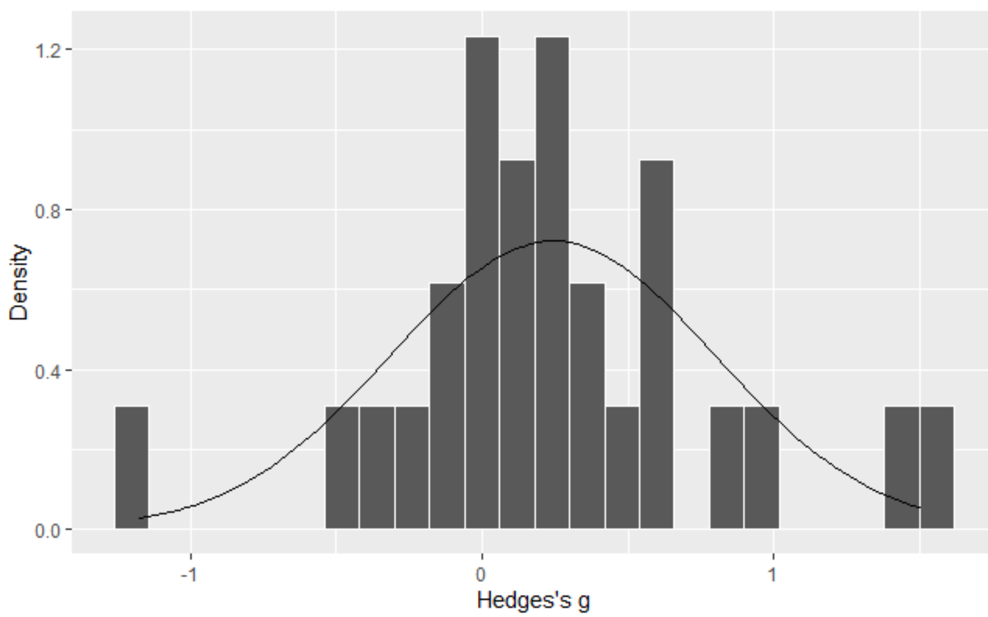


Table 5

Overall Effect Size Estimates for the Four Conditions

	Effect size and 95% CI							Heterogeneity	
	N	*k*	*g*	*SE*	95% CI	*Z*	*p*	Q-value	*df*
Synch vs. Asynch - Cognitive	1260	7	0.367	0.159	[0.055, 0.679]	2.308	.021	28.630***	6
Synch vs. Asynch - Affective	862	11	0.320	0.164	[-0.001, 0.641]	1.953	.051	50.193***	10
Synch vs. F2F - Cognitive	1833	4	-0.198	0.281	[-0.749, 0.352]	-0.706	.480	29.824***	3
Synch vs. F2f - Affective	1080	5	0.195	0.038	[-0.195, 0.568]	0.957	.338	22.520***	4

Note. N = the number of participants; k = the number of studies; CI = confidence interval; synch = synchronous; asynch = asynchronous; F2F = face-to-face. $p^{***} < .001$.

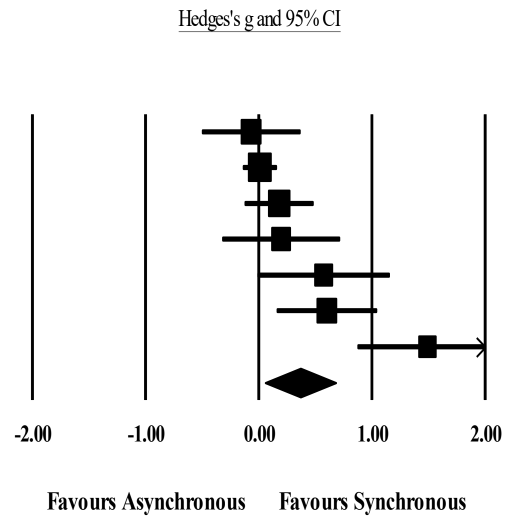
Synchronous vs. Asynchronous With Cognitive Outcomes

Seven studies comparing SOL with asynchronous online learning in terms of cognitive outcomes are shown in Figure 4. The last line indicates the statistics for the summary effect. The results of the weighted average applying a random model revealed a statistically significant effect size (g = 0.37, p = .02), with a 95% confidence interval of 0.055 to 0.679, indicating that SOL significantly and positively impacted students' cognitive outcomes. The significant Q-value suggests that the true effect sizes were heterogeneous across studies (Q-value = 28.63, p < .001) with 79% of the observed variance reflecting true heterogeneity (I^2 = 79.04).

Figure 4

Forest Plot of Cognitive Outcomes (Synchronous vs. Asynchronous)

Study name	Comparison	Outcome	Statistics for each study						
			Hedges's g	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Scharf (2015)	Asynchronous	Cognitive	-0.066	0.221	0.049	-0.500	0.367	-0.300	0.764
Francescucci & Rohani (2019)	Asynchronous	Cognitive	0.010	0.076	0.006	-0.139	0.158	0.127	0.899
Rowe (2019)	Asynchronous	Cognitive	0.181	0.155	0.024	-0.122	0.484	1.169	0.242
Chen & Shaw (2006)	Asynchronous	Cognitive	0.198	0.265	0.070	-0.321	0.717	0.748	0.455
Shintani & Aubrey (2016)	Asynchronous	Cognitive	0.573	0.297	0.088	-0.009	1.156	1.931	0.054
Strang (2012)	Asynchronous	Cognitive	0.602	0.225	0.051	0.160	1.043	2.670	0.008
Moallem (2015)	Asynchronous	Cognitive	1.490	0.315	0.099	0.873	2.107	4.734	0.000
			0.367	0.159	0.025	0.055	0.679	2.308	0.021



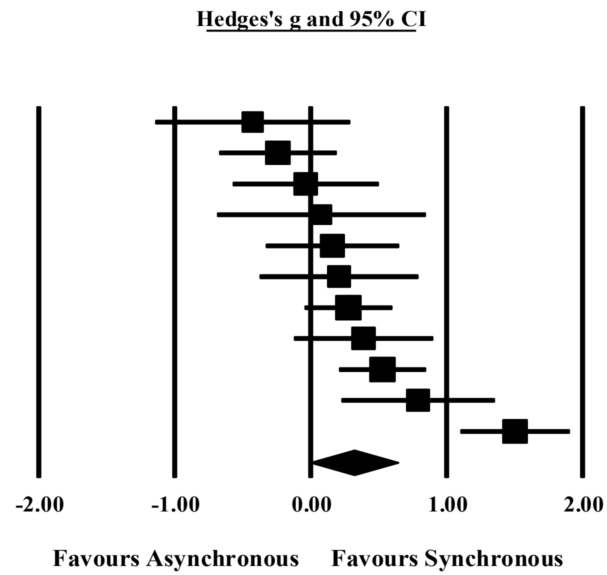
Synchronous vs. Asynchronous with Affective Outcomes

The eleven studies that compared SOL to asynchronous online learning with affective outcomes are shown in Figure 5. The results of the weighted average applying a random model revealed that SOL did not have a statistically significant effect on affective outcomes (g = 0.32, p = .051), with a 95% confidence interval of -0.001 to 0.641. The Q-value of homogeneity was statistically significant, indicating the true effect sizes varied across studies (Q-value = 50.19, p < .001) and a majority of variation of the observed effect sizes was due to between-studies variation (I^2 = 80.08).

Figure 5

Forest Plot of Affective Outcomes (Synchronous vs. Asynchronous)

Study name	Comparison	Outcome	Statistics for each study						
			Hedges's g	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Leiss (2010)	Asynchronous	Affective	-0.426	0.366	0.134	-1.143	0.290	-1.166	0.244
Buxton (2014)	Asynchronous	Affective	-0.241	0.220	0.048	-0.671	0.190	-1.096	0.273
Peterson et al. (2018)	Asynchronous	Affective	-0.036	0.273	0.075	-0.571	0.500	-0.131	0.895
Moallem (2015)	Asynchronous	Affective	0.079	0.391	0.153	-0.687	0.846	0.203	0.839
Chen & Shaw (2006)	Asynchronous	Affective	0.161	0.249	0.062	-0.328	0.649	0.645	0.519
Cleveland-Innes & Ally (2004)	Asynchronous	Affective	0.209	0.297	0.088	-0.373	0.792	0.704	0.481
Kizzier (2010)	Asynchronous	Affective	0.278	0.164	0.027	-0.043	0.599	1.697	0.090
Kyger (2008)	Asynchronous	Affective	0.389	0.260	0.068	-0.121	0.900	1.496	0.135
Gable (2012)	Asynchronous	Affective	0.529	0.162	0.026	0.211	0.847	3.261	0.001
Dyment & Downing (2018)	Asynchronous	Affective	0.791	0.287	0.082	0.228	1.353	2.754	0.006
Stover & Miura (2015)	Asynchronous	Affective	1.504	0.205	0.042	1.102	1.906	7.337	0.000
			0.320	0.164	0.027	-0.001	0.641	1.953	0.051



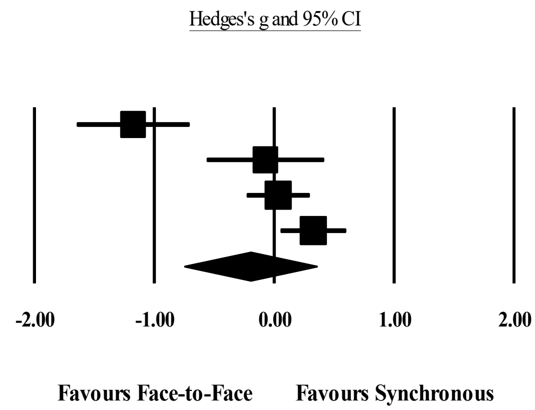
Synchronous vs. Face-to-Face with Cognitive Outcomes

Four studies comparing SOL with face-to-face learning in terms of cognitive outcomes are shown in Figure 6. Results revealed a statistically insignificant negative effect size (g = -0.20, 95% CI [-0.749, 0.352], p = .48), indicating that SOL did not statistically significantly improve students' cognitive outcomes compared with traditional face-to-face learning. The Q-value was statistically significant, indicating that the true effect sizes varied across studies (Q-value = 29.82, p < .001) and a substantial observed variation was real (I^2 = 89.94).

Figure 6

Forest Plot of Cognitive Outcomes (Synchronous vs. Face-to-Face)

Study name	Comparison	Outcome	Statistics for each study						
			Hedges's g	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Scharf (2015)	F2F	Cognitive	-1.176	0.239	0.057	-1.645	-0.708	-4.920	0.000
Chen & Shaw (2006)	F2F	Cognitive	-0.073	0.249	0.062	-0.561	0.415	-0.292	0.770
Nelson (2010)	F2F	Cognitive	0.033	0.133	0.018	-0.228	0.294	0.251	0.802
Rowe (2019)	F2F	Cognitive	0.326	0.139	0.019	0.054	0.598	2.352	0.019
			-0.198	0.281	0.079	-0.749	0.352	-0.706	0.480



Synchronous vs. Face-to-Face with Affective Outcomes

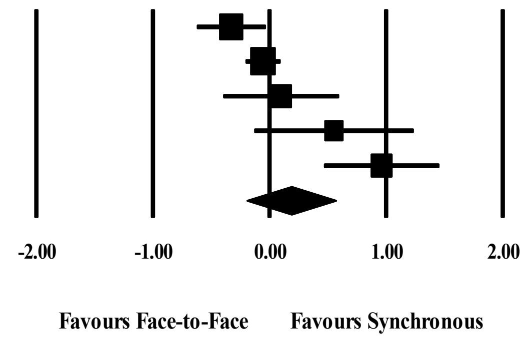
A final subset included five studies comparing SOL with face-to-face learning in affective outcomes and is illustrated in Figure 7. Results revealed a statistically insignificant and small effect size (g = 0.20, 95% CI [-0.195, 0.568], p = .34), indicating that SOL did not significantly improve students' affective outcomes compared with the face-to-face learning mode. Heterogeneity statistics suggested that the true effect sizes varied across studies (Q = 22.52, p < .001) and a large proportion of the observed variance was between-study variation (I^2 = 82.24).

Figure 7

Forest Plot of Affective Outcomes (Synchronous vs. Face-to-Face)

Study name	Comparison	Outcome	Hedges's g	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
			Statistics for each study						
Kizzier (2010)	F2F	Affective	-0.327	0.150	0.023	-0.621	-0.032	-2.175	0.030
Francescucci & Rohani (2019)	F2F	Affective	-0.055	0.076	0.006	-0.204	0.094	-0.724	0.469
Gilkey et al. (2014)	F2F	Affective	0.100	0.253	0.064	-0.396	0.596	0.394	0.693
Spalla (2012)	F2F	Affective	0.553	0.348	0.121	-0.129	1.235	1.590	0.112
Dyment & Downing (2018)	F2F	Affective	0.962	0.252	0.063	0.469	1.455	3.822	0.000
			0.186	0.195	0.038	-0.195	0.568	0.957	0.338

Hedges's g and 95% CI



Analysis of Moderator Variables

Since effect sizes were found to be heterogeneous across studies, moderator analyses were conducted to examine what factors may account for the heterogeneity of each condition. Seven moderating variables were chosen, falling into four categories: pedagogical, methodological, demographic, and publication variables. The results from the moderator analyses can be found in the Appendix in Tables A through D.

Effect Sizes of Pedagogical Moderator Variables

Type of instructional method and course duration were examined as potential pedagogical variables moderating effect size estimates.

Instructional Method. For the condition of synchronous vs. asynchronous with cognitive outcomes, the type of instructional method did not moderate effect size estimates. Although studies employing interactive lessons had a significant effect size estimate (g = 0.626, p = .048) and studies employing lectures resulted in an insignificant effect size (g = 0.118, p = .302), there was no statistically significant difference between the two conditions (Q-value = 0.115, p = .735). The results of moderator analyses for the condition of synchronous vs. asynchronous with cognitive and affective outcomes are presented in Table A and Table B. We found a moderating effect of the type of instructional method on effect size results. Interactive lessons had an effect size estimate statistically significantly larger than lectures (Q-value = 10.756, p = .001) and unknown condition (Q-value = 4.045, p = .044). Results of pedagogical moderator analyses for the condition of synchronous vs. face-to-face with cognitive outcomes and affective outcomes are presented in Table C and Table D, respectively. Since all studies employed lectures (k = 4) for the condition of synchronous vs. face-to-face with cognitive outcomes and all studies employed interactive lessons (k = 5) for the condition of synchronous vs. face-to-face with affective outcomes, the type of instructional method could not be examined as a moderator.

Course Duration. Comparing synchronous vs. asynchronous with cognitive outcomes, course duration tended to moderate effect size results. Studies with a course duration less than one semester yielded statistically significantly larger effect sizes than those with a course duration of one semester or longer (Q-value = 5.364, p = .021). In the condition of synchronous vs. asynchronous with affective outcomes, although effect sizes were all insignificant across the three conditions of course duration, there were statistically significant differences between the duration of less than one semester and that of one semester or longer, with the former yielding a statistically significantly larger effect size than the latter (Q-value = 4.191, p = .041). However, course duration did not moderate effect size under the condition of synchronous vs. face-to-face with cognitive outcomes (Q-value = 0.050, p < .824). On the condition of synchronous vs. face-to-face with affective outcomes, it was found that effect sizes varied as a function of course duration with shorter duration (i.e., less than one semester) having larger effect size estimates than the duration of one semester or longer (Q-value = 14.019, p < .001).

Effect Sizes of Methodological Moderator Variables

Student Equivalence. Student equivalence was examined as a potential methodological variable moderating the effect size estimates. This variable indicates whether studies employed random or non-random assignment to distribute students to the treatment and control condition. There were three studies employing random assignment and four studies employing non-random assignment when comparing the synchronous with the asynchronous condition in cognitive outcomes. Although both conditions yielded insignificant effect size estimates, non-random assignment had a statistically significantly larger effect size than random assignment (Q-value = 5.837, p < .016). On the condition of synchronous vs. asynchronous with affective outcomes, most studies employed non-random assignment (k = 6). Results revealed that student equivalence has moderating effects on effect sizes, with studies employing non-random assignment producing effect sizes statistically significantly larger than those employing random assignment (Q-value = 5.291, p = .021). Half the studies employed the random assignment (k = 2) when the control type was face-to-face and the outcomes were cognitive variables. Student equivalence did not moderate the effect size estimates (Q-value = 0.136, p < .713). In the condition of synchronous vs. face-to-face with affective outcomes, there were three studies employing random assignment and only one study employing non-random assignment. An additional study did not report information on student assignment. Results revealed that student equivalence moderated the effect size estimates, with studies employing non-random assignment having statistically significantly larger effect size than studies in the other two categories, studies employing random assignment (Q-value = 14.019, p < .001) and the study without information (Q-value = 19.331, p < .001).

Effect Sizes of Demographic and Publication Source Moderator Variables

Learner level, discipline, and country were examined as potential demographic variables to moderate effect sizes. We also hypothesized that effect sizes would vary as a function of publication source since studies with significant results or larger effect sizes tend to be published (Rothstein et al., 2005).

Learner Level. Results revealed that learner level did not moderate effect size in the two conditions with cognitive outcomes. However, effect sizes varied as a function of learner levels when outcomes were affective. Although none of the effect sizes was significant, the effect size for graduate/professional was statistically significantly larger than the undergraduate comparison for both conditions (Q-value = 7.732, p = .005 for asynchronous, and Q-value = 10.570, p = .001 for face-to-face).

Discipline. On the condition of synchronous versus asynchronous with cognitive outcomes, results revealed that effect sizes varied as a function of discipline, with the discipline of education having a statistically significantly larger effect size estimate than other disciplines (Q-value = 18.738, $p < .001$). There were also statistically significant differences in effect size estimates across disciplines on the condition of synchronous vs. asynchronous with affective outcomes, with the discipline of education again having a statistically significantly larger effect size estimate than other disciplines (Q-value = 16.773, $p < .001$). Likewise, on the condition of synchronous vs. face-to-face with affective outcomes, the discipline of education had a statistically significantly larger effect size estimate than other disciplines (Q-value = 15.904, $p < .001$). However, discipline did not moderate the effect size results on the condition of synchronous vs. face-to-face with cognitive outcomes.

Country. There were more studies conducted in the United States than in other countries. We failed to consistently find a moderating effect of country on effect size estimates across the four conditions, indicating that effect sizes of studies conducted in the United States were not statistically significantly different from those conducted in other countries.

Publication Source. We found that publication source was not a significant moderator of effect sizes either, suggesting that there was no statistical difference between effect size estimates obtained from journal articles and those obtained from dissertations.

Publication Bias

Publication bias occurs when the studies included in a systematic review are not representative of all studies in a population (Rothstein et al., 2005). We took the following steps to address publication bias:

1. Visual inspection of funnel plots.
2. Calculation of the classic fail-safe *N*.
3. Calculation of Orwin's fail-safe *N* at 0.01 trivial level.

The funnel plots are shown in Figures 9 through 12.

The funnel plots show the effect size (i.e., Hedges's *g*) on the x-axis and standard error on the y-axis to assess the likelihood of the presence of publication bias. The lack of a symmetrical distribution of effect sizes around the mean suggests the presence of publication bias in all four models, with a few notable outliers (Borenstein et al., 2009). The classic fail-safe *N* and Orwin's fail-safe *N* are shown in Table 6 for each condition. Using the classic fail-safe *N* larger than $5k + 10$ (Rosenthal, 1995) as a criterion, we expected publication bias to be a problem in all four models. All these criteria show evidence that our study was subject to the problem of publication bias, and thus, additional studies could substantially change the results of our models.

Table 6

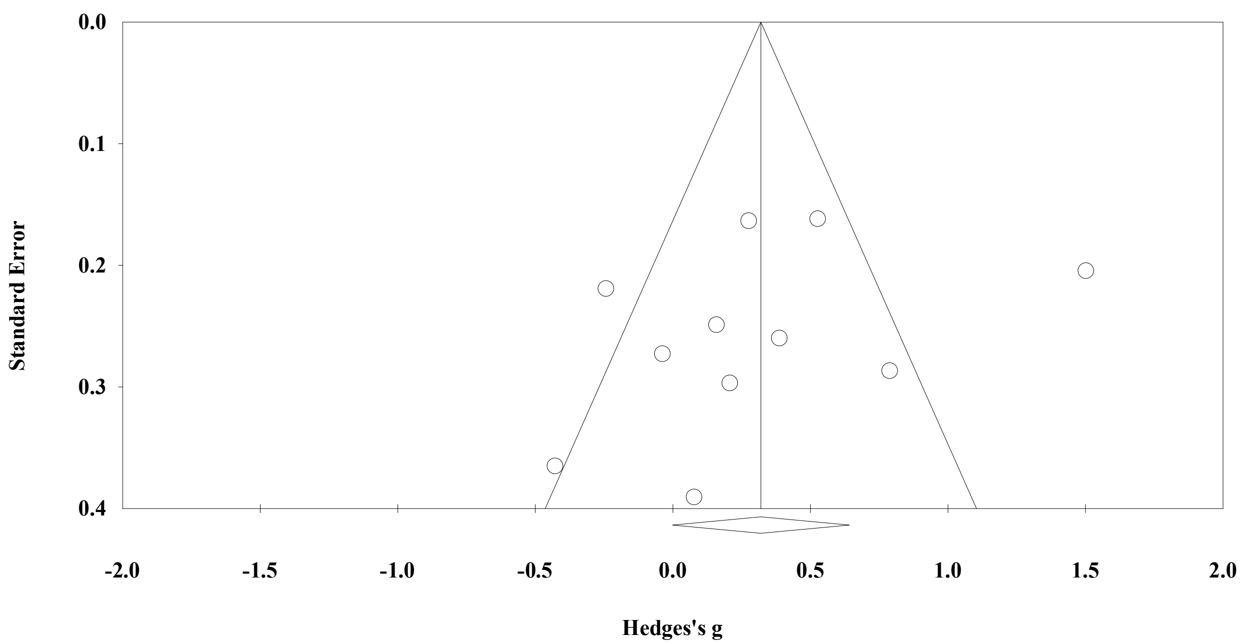
Classic Fail-Safe N and Orwin's Fail-Safe N for Each Model

Model condition	Classic fail-safe N	Orwin's fail-safe N
Synch vs. Asynch – Cognitive	25	99
Synch vs. Asynch – Affective	54	424
Synch vs. F2F – Cognitive	0	1
Synch vs. F2F – Affective	0	4

Note. synch = synchronous; asynch = asynchronous; F2F = face-to-face.

Figure 9

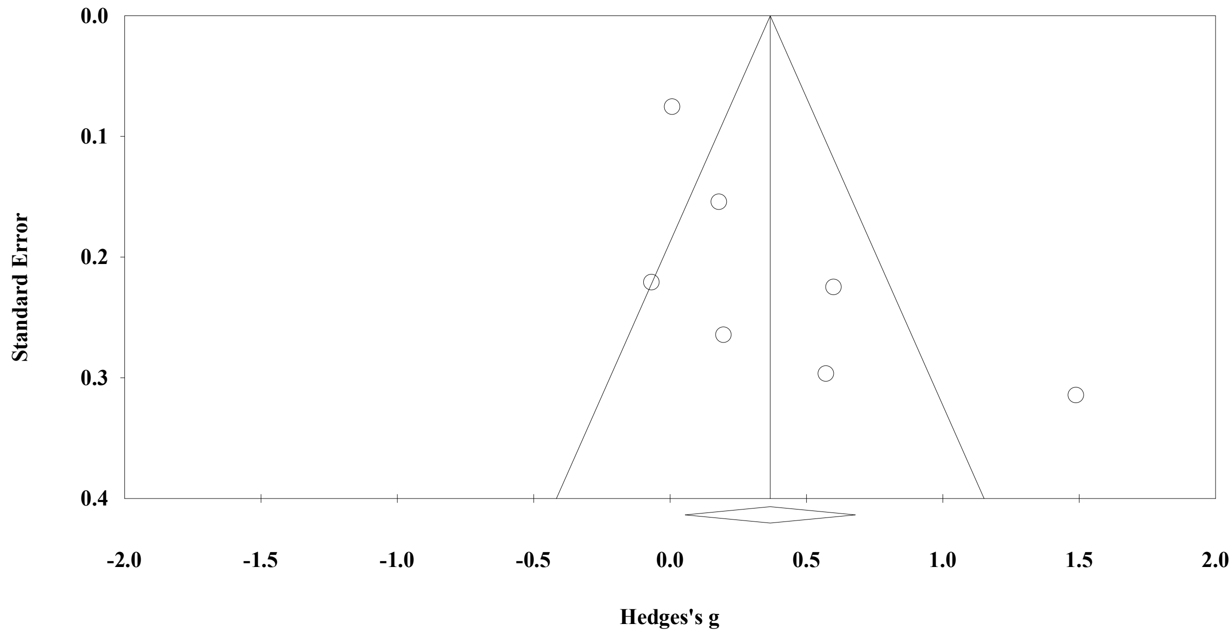
Funnel Plot for the Random Effect Model (Asynchronous vs. Synchronous) for the Affective Domain



Note. k = 11; The diamond represents the average effect size (Hedges's g).

Figure 10

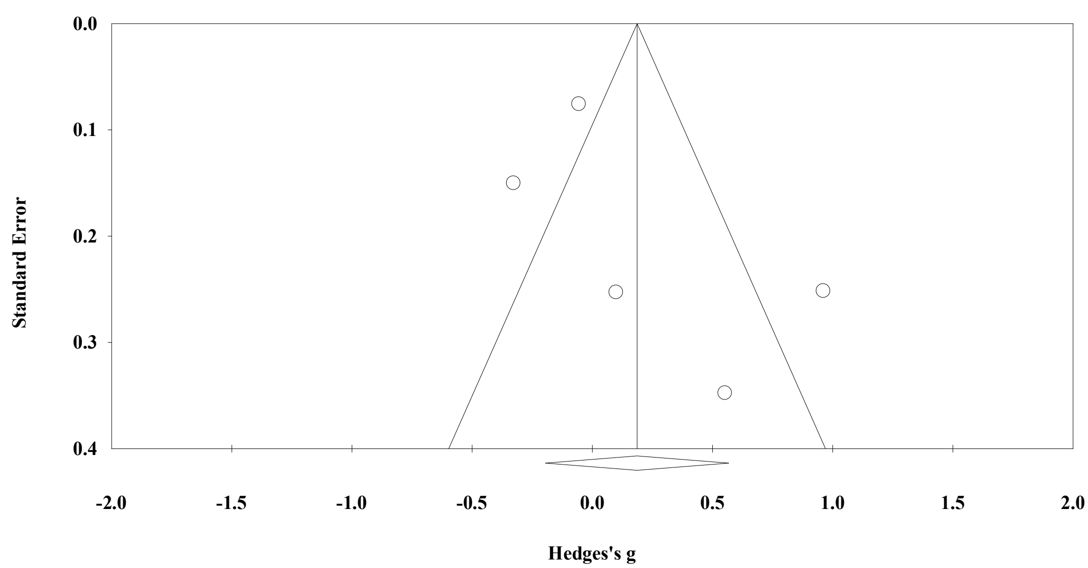
Funnel Plot for the Random Effect Model (Asynchronous vs. Synchronous) for the Cognitive Domain



Note. k = 7; The diamond represents the average effect size (Hedges's g).

Figure 11

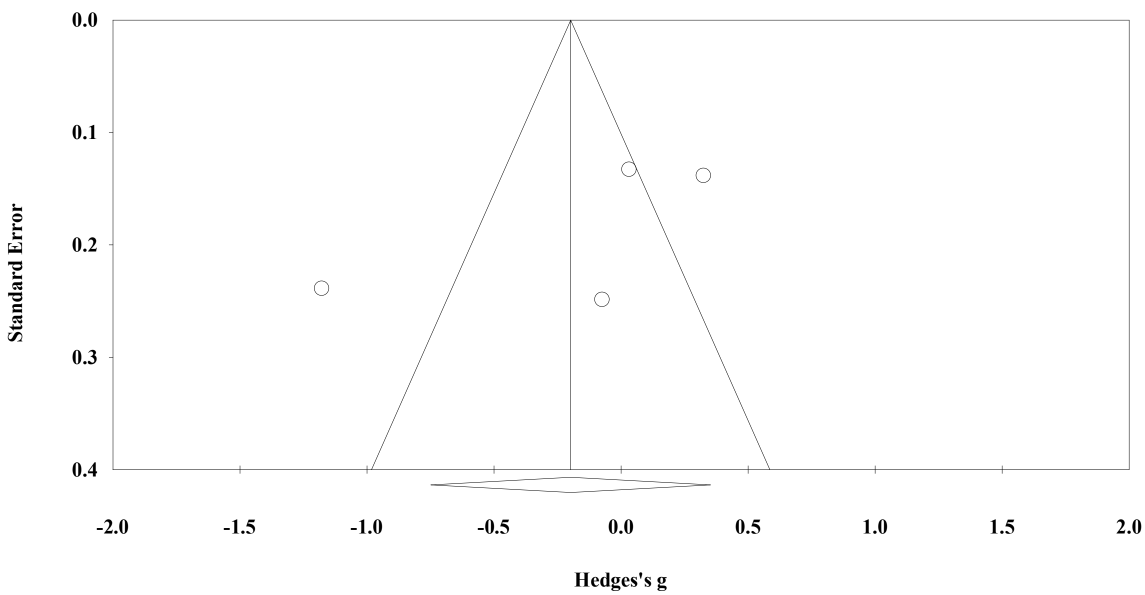
Funnel Plot for the Random Effect Model (Face-to-face vs. Synchronous) for the Affective Domain



Note. k = 5; The diamond represents the average effect size (Hedges's g).

Figure 12

Funnel Plot for the Random Effect Model (Face-to-face vs. Synchronous) for the Cognitive Domain



Note. k = 4; The diamond represents the average effect size (Hedges's g).

Discussion

Limitations and Delimitations

Prior to discussing our results, we present our delimitations and limitations so readers can interpret the findings in light of these considerations. While we planned to examine three learning outcomes, there were not sufficient studies focusing on behavioral outcomes and, hence, that outcome was not examined. Also, among the studies examined, the numbers were still small because we did four model comparisons and did not combine the control group of face-to-face and asynchronous since each of these has different characteristics and shares the same samples (e.g., independence of observation). While some meta-analyses report combined effects for affective and cognitive outcomes, we believe these two constructs are too different to report in a single model. When we framed the study, we coded for several variables; however, we realized that authors did not report several of the details in their methods. While we desired to examine types of interaction, we found this was not reported in most studies. The findings of the moderator analysis should be taken with caution since the number of studies, especially when comparing synchronous online to face-to-face, were very few. Also notable, we averaged effect size by combining multiple effect sizes, which ignores any subject variability. We opted to do this as correlations are not usually reported, and we assumed a correlation value of 1.0. Finally, the common problem of publication bias was detected in all four models, and thus, additional studies could produce much different results.

Effects of Synchronous Online Learning

Among the four models examined, the meta-analysis found significant differences between synchronous and asynchronous online learning to positively impact students' cognitive outcomes. The effect size was small (g = 0.37) under a random effects model. This summary effect supports primary research on SOL that found synchronous interactions to be focusing on discussing the learning tasks (Chou, 2002) and reaching the highest phase of cognitive presence more frequently than in asynchronous interactions (Molnar & Kearney, 2017). However, given the small number of studies and the presence of publication bias, this is a tentative finding. The other three models did not show a significant difference between the groups either for cognitive or affective outcomes, with the confidence intervals overlapping zero.

Instructional Method

Two types of instructional methods were examined as moderator variables. When SOL used interactive lessons instead of lecturing, it had significantly positive medium effect on students' affective outcomes when compared to asynchronous online learning. This shows that students might not be as engaged when a synchronous online lesson is not interactive and when an instructor chooses to lecture instead. Students scheduling time to participate in synchronous sessions would prefer to have an interactive session (Martin et al., 2012) rather than listen to a lecture which could have been recorded and delivered asynchronously.

Course Duration

Course duration was coded to be less than a typical 15-week semester or more than a semester. It was found that when the course was less than a semester, synchronous to asynchronous learning for cognitive and affective outcomes were positively significant. In addition, SOL was positively significant when compared to face-to-face courses for affective outcomes. This signifies that when class duration is longer than a 15-week semester, synchronous online learning is not as effective for both cognitive and affective outcomes.

Random Assignment

When non-random assignment was used instead of random assignment, there were significantly positive effects for synchronous compared to asynchronous online learning for both cognitive and affective outcomes. In addition, SOL was positively significant when compared to face-to-face courses for affective outcomes. This could have resulted from learners being self-selected into a delivery method of their preference rather than being randomly assigned.

Learner Level

Learner level moderated the effect of SOL on affective outcomes when compared with asynchronous or face-to-face learning. The effect is significantly larger for graduate students and professionals than for undergraduates. This signifies that for graduate and professional students' affective outcomes, SOL may be a more effective delivery method.

Discipline

Among education students, in contrast to other disciplines, there was a significantly positive effect size when comparing synchronous and asynchronous for both affective and cognitive outcomes, and when comparing synchronous to face-to-face for affective outcomes.

Publication Source and Country

There were no differences between the groups based on country or publication source. As a reminder, most studies were published in the United States, and additionally, most studies were published as journal articles.

Overall, the findings of this study are different from those in the work of Bernard et al. (2004) who found that synchronous distance education had a negative effect and Means et al. (2013) who did not find synchronicity as a significant moderator. From the early days of online learning and when synchronous distance education included other forms of synchronicity, this study found one model where synchronous online learning had a small significant effect compared to the asynchronous online condition. This is similar to Williams (2006), who found a positive effective size when examining synchronous distance education with asynchronous online learning.

Implications and Future Directions

SOL had a significant moderate effect over asynchronous online learning for cognitive outcomes. This shows that including synchronous sessions in online courses is important. In addition, it was found that interactive lessons had significantly higher effect than lectures. This finding has implications for centers for teaching and learning, and for faculty developers who provide training on the use of synchronous tools and offer workshops. Workshops focusing on synchronous online technology should emphasize designing interactive lessons so that students get the greatest benefit. For campuses without synchronous online tools, this study has implications for administrators to purchase and include a synchronous online tool in the learning management system. Also, for instructors who are teaching online or considering online teaching, this suggests that including synchronous online meetings in their courses would be helpful.

There were only 19 studies that we were able to identify and use in this meta-analysis. There is a need for more high-quality studies on this topic. Since the number of studies were few, the moderator analysis resulted in few cell sizes. There is also a need for more studies to focus on behavioral outcomes in addition to cognitive and affective outcomes. Also, another challenge we encountered during coding was insufficient information reported in the methodology to describe synchronous online sessions. It is important for authors to give as much detail as possible about both the pedagogy and methodology. For example, we were unable to identify the various synchronous functionalities used in the intervention or, if all types of interaction occurred, learner-learner, learner-instructor, and learner-content. We acknowledge this might be due to journal word count limits, but the important consideration is that pedagogical and methodological dimensions are equally relevant to report in a manuscript.

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Appendix

Table A

Moderator Analyses (Synchronous vs. Asynchronous Cognitive Outcomes)

Effect	Effect size and 95% confidence interval							Heterogeneity		
	N	*k*	*g*	*SE*	95% CI	*Z*	*p*	Q-value	*df*	*p*
Overall	1260	7	0.367	0.159	[0.055, 0.679]	2.308	.021	28.630	6	<.001
Course duration										
Less than one semester	193	3	0.468	0.149	[0.176, 0.759]	3.147	.002			
One semester and longer	1067	4	0.323	0.225	[-0.118, 0.765]	1.435	.151			
Total between								5.364	1	.021
Instructional method										
Interactive lesson	876	4	0.626	0.317	[0.006, 1.247]	1.978	.048			
Lecture	384	3	0.118	0.114	[-0.106, 0.342]	1.032	.302			
Total between								0.115	1	.735
Student equivalent										
Random assignment	810	3	0.163	0.156	[-0.143, 0.469]	1.043	.297			
Non-random assignment	450	4	0.509	0.278	[-0.035, 1.053]	1.835	.067			
Total between								5.837	1	.016
Learner level										
Undergraduate	891	4	0.295	0.175	[-0.049, 0.638]	1.682	.093			
Graduate/Professional	369	3	0.494	0.381	[-0.254, 1.241]	1.294	.196			
Total between								1.950	1	.163
Discipline										
Education	51	1	1.490	0.315	[0.873, 2.107]	4.734	< .001			
Other disciplines	1209	6	0.189	0.105	[-0.017, 0.396]	1.799	.072			
Total between								18.738	1	< .001
Country										
USA	1148	5	0.375	0.200	[-0.016 0.766]	1.878	.060			
Other countries	112	2	0.364	0.198	[-0.023, 0.752]	1.843	.065			
Total between								1.273	1	.259

Publication source										
Journal article	942	5	0.533	0.249	[0.045, 1.021]	2.136	.032			
Dissertation	318	2	0.100	0.127	[-0.149, 0.348]	0.786	.432			
Total between								0.211	1	.646

Table B

Moderator Analyses (Synchronous vs. Asynchronous with Affective Outcomes)

Effect	Effect size and 95% confidence interval							Heterogeneity		
	N	*k*	*g*	*SE*	95% CI	*Z*	*p*	Q-value	*df*	*p*
Overall	862	11	0.320	0.164	[-0.001, 0.641]	1.953	.051	50.193	10	<.001
Course duration										
Less than one semester	587	7	0.408	0.245	[-0.071, 0.887]	1.668	.095			
One semester and longer	77	2	0.002	0.224	[-0.437, 0.441]	0.009	.993			
Unknown	198	2	0.262	0.143	[-0.019, 0.543]	1.826	.068			
Total between								5.224	2	.073
Instructional method										
Interactive lesson	662	8	0.460	0.193	[0.082, 0.839]	2.382	.017			
Lecture	148	2	-0.057	0.200	[-0.449, 0.335]	-0.287	.774			
Unknown	52	1	-0.036	0.273	[-0.571, 0.500]	-0.131	.895			
Total between								13.348	2	.001
Student equivalent										
Random assignment	162	3	0.110	0.157	[-0.197, 0.416]	0.700	.484			
Non-random assignment	487	6	0.532	0.096	[0.344, 0.720]	5.547	< .001			
Unknown	213	2	0.310	0.139	[0.038, 0.581]	2.233	.131			
Total between								5.733	2	.057
Learner Level										
Undergraduate	360	5	0.161	0.113	[-0.060, 0.382]	1.431	.152			
Graduate/Professional	502	6	0.496	0.273	[-0.039, 1.030]	1.818	.069			
Total between								7.732	1	.005
Discipline										
Education	539	5	0.604	0.282	[0.051, 1.156]	2.141	.032			
Other disciplines	323	6	0.104	0.119	[-0.129, 0.336]	0.875	.382			
Total between								16.773	1	< .001
Country										
USA	701	7	0.285	0.260	[-0.225, 0.795]	1.096	.273			
Other countries	161	4	0.328	0.122	[0.089, 0.567]	1.691	.007			

Total between								0.520	1	.471
Publication source										
Journal article	595	8	0.354	0.219	[-0.075, 0.783]	1.616	.106			
Dissertation	267	3	0.250	0.247	[-0.234, 0.734]	1.031	.311			
Total between								0.015	1	.904

Table C

Moderator Analyses (Synchronous vs. Face-to-Face Cognitive Outcomes)

Effect	Effect size and 95% confidence interval							Heterogeneity		
	N	*k*	*g*	*SE*	95% CI	*Z*	*p*	Q-value	*df*	*p*
Overall	1833	4	-0.198	0.281	[-0.749, 0.352]	-0.706	.480	29.824	3	<.001
Course duration										
Less than one semester	56	1	-0.073	0.249	[-0.561, 0.415]	-0.292	.770			
One semester and longer	1777	3	-0.244	0.362	[-0.953, 0.465]	-0.674	.501			
Total between								0.050	1	.824
Instructional method										
Lecture	1833	4	-0.198	0.281	[-0.749, 0.352]	-0.706	.480			
Total between								0	0	1
Student equivalent										
Non-random assignment	1553	2	-0.412	0.751	[-1.885, 1.060]	-0.549	.583			
Random assignment	280	2	0.010	0.117	[-0.220, 0.240]	0.083	.934			
Total between								0.136	1	.713
Learner level										
Undergraduate	280	2	0.010	0.118	[-0.221, 0.241]	0.085	.993			
Graduate/Professional	1553	2	-0.418	0.757	[-1.901, 1.066]	-0.552	.581			
Total between								0.125	1	.723
Discipline										
Other disciplines	1833	4	-0.201	0.282	[-0.754, 0.353]	-0.711	.477			
Total between								0	0	1
Country										
USA	1777	3	-0.247	0.363	[-0.959, 0.465]	-0.679	.497			
Other countries	56	1	-0.074	0.252	[-0.568, 0.420]	-0.292	.770			
Total between								0.052	1	.819
Publication source										
Journal article	56	1	-0.074	0.252	[-0.568, 0.420]	-0.292	.770			
Dissertation	1777	3	-0.247	0.363	[-0.959, 0.465]	-0.679	.497			
Total between								0.052	1	.819

Table D

Moderator Analyses (Synchronous vs. Face-to-Face Affective Outcomes)

Effect	Effect size and 95% confidence interval							Heterogeneity		
	N	*k*	*g*	*SE*	95% CI	*Z*	*p*	Q-value	*df*	*p*
Overall	1080	5	0.195	0.038	[-0.195, 0.568]	0.957	.338	22.520	4	<.001
Course duration										
Less than one semester	74	1	0.962	0.252	[0.469, 1.455]	3.822	< .001			
One semester and longer	792	3	0.065	0.143	[-0.216, 0.345]	0.451	.652			
Unknown	151	1	-0.327	0.150	[-0.621, -0.032]	-2.175	.030			
Total between								3.149	2	.207
Instructional method										
Interactive lesson	1080	5	0.186	0.195	[-0.195, 0.568]	0.957	.338			
Total between								0	0	1
Student equivalent										
Non-random assignment	74	1	0.962	0.252	[0.469, 1.455]	3.822	< .001			
Random assignment	792	3	0.065	0.143	[-0.216, 0.345]	0.451	.652			
Unknown	214	1	-0.327	0.150	[-0.621, -0.032]	-2.175	.030			
Total between								3.149	2	.207
Learner level										
Undergraduate	945	3	-0.061	0.162	[-0.378, 0.257]	-0.375	.708			
Graduate/Professional	135	2	0.531	0.431	[-0.314, 1.376]	1.232	.218			
Total between								10.570	1	.001
Discipline										
Education	74	1	0.962	0.252	[0.469, 1.455]	3.822	< .001			
Other disciplines	1006	4	0.044	0.017	[-0.297, 0.209]	-0.338	.735			
Total between								15.904	1	< .001
Country										
USA	1006	3	0.065	0.143	[-0.216, 0.345]	0.451	.652			
Other countries	74	2	0.302	0.644	[-0.961, 1.565]	0.468	.639			
Total between								0.039	1	.843
Publication source										

Journal article	1047	4	0.125	0.210	[-0.288, 0.537]	0.592	.554			
Dissertation	33	1	0.553	0.247	[-0.129, 1.235]	1.590	.112			
Total between								2.712	1	.100