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Editorial – Volume 21, Issue 3

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In this issue of *IRRODL*, we have a robust variety of Research Articles, a substantial Literature Review, and two Notes From the Field. With the effects of the COVID-19 pandemic affecting education at all levels, the editors have experienced a pivot to seeking answers—*what are the best practices in distributed and open learning?* Researchers and reviewers in our field have experienced a surge in the need for their expertise; our journal has held a unique position of supporting research into online and blended learning and teaching since its inception.

The editors of IRRODL would like to acknowledge the many hours of commitment to the field that our contributors and readers have experienced since the spring of 2020. We commend your professionalism, dedication, and for the work you do in supporting this quick and fierce pivot to online education.

The first of our 15 research articles, "Learners' Perceptions of Online Exams: A Comparative Study in Turkey and Kyrgyzstan," examines online exams. **Adanır, İsmailova, Omuraliev,** and **Muhametjanova** studied university students' perceptions according to gender, and major and prior online course experience, in this mixed method study of a timely topic.

Student perceptions of service quality, e-service, and university image were studied by **Daud, Amin,** and **Karim.** "Antecedents of Student Loyalty in Open and Distance Learning Institutions: An Empirical Analysis" originates from the Open University of Malaysia.

"Does Delivery Model Matter? The Influence of Course Delivery Model on Teacher Candidates' Self-Efficacy Beliefs Towards Inclusive Practices" examines essential components of online education. The authors **Smothers, Colson,** and **Keown** applied a causal-comparative research design to examine the influences of face-to-face flipped or asynchronous online upon self-efficacy beliefs of inclusive learning and teaching.

Doo, Bonk, and **Heo** completed a meta-analysis regarding the significance of scaffolding in online higher education teaching practices. The results of this study, "A Meta-Analysis of Scaffolding Effects in Online Learning in Higher Education," will be of interest to instructional designers and the many educators who are now pivoting to online education.

MOOCs continue to be of interest to researchers and **Lee, Watson,** and **Watson** studied students' self-regulated learning strategies, self-efficacy, and task value on perceived effectiveness in the *Mountain 101 MOOC*. Read the study's results in "The Influence of Successful MOOC Learners' Self-Regulated Learning

Strategies, Self-Efficacy, and Task Value on Their Perceived Effectiveness of a Massive Open Online Course."

In the sixth research article, **Yang, Su**, and **Bradley** applied Rasch analysis for evaluation and validation of the Self-Directed Online Learning Scale (SDOLS). "Applying the Rasch Model to Evaluate the Self-Directed Online Learning Scale (SDOLS) for Graduate Students" contributes psychometric results toward increasing the reliability and validity of SDOLS.

"An Analysis of Course Characteristics, Learner Characteristics, and Certification Rates in MITx MOOCs" investigates the 122 Massachusetts Institute of Technology MOOCs and the interplay among course and learner characteristics as well as certification results. **Celik, Cagiltay,** and **Cagiltay** generated results that point to the importance of interactivity and course content design.

"Evaluation of Student Feedback Within a MOOC Using Sentiment Analysis and Target Groups" involved a dataset of over 25,000 online posts from an introductory computer programming MOOC. The researchers, **Lundqvist, Liyanagunawardena,** and **Starkey** applied automated sentiment analysis to assess student experience.

Shadiev, Wang, and **Huang** designed an intercultural VR learning activity to investigate university students from China and Uzbekistan as part of supporting intercultural competence. "Promoting Intercultural Competence in a Learning Activity Supported by Virtual Reality Technology" examines the role of advanced educational technology as part of emerging cross-cultural teaching practices.

Mobile technology continues to influence how people learn and teach. The article, "Research Trends in Mobile Learning" by **Yıldız, Yıldırım, Akça, Kök, Özer,** and **Karataş** provides the trends from 2016-2019 from 1023 articles–an excellent overview of topics and gaps in the literature for mobile researchers.

Zhang examines the role of emotions regarding the use of open educational resources. He examined students' reflections, group discussions, interviews, and field notes in his study, "Revisiting Textbook Adaption Through Open Educational Resources: An Inquiry into Students' Emotions."

"A Qualitative Inquiry of K–12 Teachers' Experience with Open Educational Practices: Perceived Benefits and Barriers of Implementing Open Educational Resources" marks the second OER research in this issue. **Tang** provides his interview results and thus contributes to the growing interest of OER for K-12 education.

"Profiles of Online Students and the Impact of Their University Experience" was a study conducted with students from a fully online institution, Universitat Oberta de Catalunya (UOC). This research by **Sánchez-Gelabert, Valente,** and **Duart** indicates that student profiles continue to reflect responsibilities outside of the university but younger students without significant work or family responsibilities are now being observed.

Dridi, Radhakrishnan, Moser-Mercer, and **DeBoer** examined the equity issues of education with their study, "Challenges of Blended Learning in Refugee Camps: When Internet Connectivity Fails, Human Connection Succeeds." This important research encountered connectivity issues and other barriers, yet the results point to the resiliency of students, educators and researchers.

Ouyang, Li, Sun, Jiao, and **Yao** provide the last research article for this issue. "Learners' Discussion Patterns, Perceptions, and Preferences in a Chinese Massive Open Online Course (MOOC)" applies a mixed method approach. The researchers examined how their pedagogical strategy, a learning analytic tool, and social learning interact as part of encouraging MOOC learner discussions.

The Literature Review examines MOOCs for the K-12 sector. **Koutsakas, Chorozidis, Karamatsouki,** and **Karagiannidis** fill a niche by locating and summarizing the extant literature of K-12 MOOCs since 2013. Educators and researchers of younger students alike will welcome "Research Trends in K–12 MOOCs: A Review of the Published Literature."

Completing this robust issue are two Notes From the Field. **Dennis** provides a theoretical discussion of connectivism and the role of language within its conceptualization. Hypertextuality and intertextuality are embedded within network learning and its roots in philosophy. "Languaging Network Learning: The Emergence of Connectivism in Architectonic Thought" contributes to the understanding of connectivism and its influence upon online education.

"Elements of Open Education: An Invitation to Future Research" will be of interest to new researchers and those who are shifting focus. Providing an historical overview of open education, the authors then move to their framework of macro, meso, and micro levels of research in open and distance learning. This cadre of authors include: **Zawacki-Richter, Conrad, Bozkurt, Aydin, Bedenlier, Jung, Stöter, Veletsianos, Blaschke, Bond, Broens, Bruhn, Dolch, Kalz, Kondakci, Marin, Mayrberger, Müskens, Naidu, Qayyum, Roberts, Sangrà, Loglo, Slagter van Tryon,** and **Xiao.**

Enjoy this issue.

Athabasca University

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Learners' Perceptions of Online Exams: A Comparative Study in Turkey and Kyrgyzstan

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Abstract

As online learning is becoming very popular in formal educational settings and in individual development, online exams are starting to be recognized as one of the more efficient assessment methods. Online exams are effective in either blended or traditional forms of learning, and, when appropriately used, bring benefits to both learners and the learning process. However, learners' perceptions of online exams in developing countries have not been widely studied despite the potential of such research for contributing to more effective use of online exams in these countries. Thus, this study served two purposes. First, it aimed to investigate students' perceptions of online exams at a state university in Turkey, and at a state university in Kyrgyzstan. Second, the study compared the results. Structured as a mixed study, the research was conducted during the 2018-2019 fall term. The participants were 370 undergraduate students taking first-year courses online. Quantitative data considered learners' perception scores gathered via a survey, whereas qualitative data considered learners' opinions in response to an open-ended question. According to the quantitative analysis, learners' perceptions differed according to gender, major, and prior online course experience variables. In addition, Turkish and Kyrgyz learners differed in that Turkish learners found online exams less stressful and more reliable and fairer than traditional paper-based exams when compared with their Kyrgyz counterparts. The qualitative analysis provided important results for future planning in both institutions.

Keywords: online exam, online learner, perception, comparative study, developing country

Introduction

As a form of assessment, evaluation, and feedback, online exams play an important role in online learning. Advances have led to the increasing use of information and communication technologies (ICT) to conduct online exams in universities worldwide. The Internet and ICT provide such useful solutions in the education field that online exams have even come to be understood as one method of course evaluation (Al-Mashaqbeh & Al Hamad, 2010). Online exams are effective for diagnostic, formative, and summative assessments and provide students with the opportunity of demonstrating performance (Laine, Sipilä, Anderson, & Sydänheimo, 2016).

While traditional exams, using paper and pens, result in a heavy burden for learners and instructors, online exams provide solutions for such issues (Sarrayrih & Ilyas, 2013). Instructors can save time in grading and mark compilation, resulting in lower administrative costs, while students can receive immediate and detailed feedback, take their exams at a time and in a place that works best for them (Angus & Watson, 2009), and access self-assessment opportunities (Sorensen, 2013). However, online exams present several challenges, including increased work in the preparation stage, the possibility of technical failures, security issues, and dealing with cheating (Alsadoon, 2017). The extra work refers to the additional time needed to create question banks for online exams. However, the reusability of questions in different exams turns this drawback into an advantage. As for the other challenges, researchers have been working for several years to find appropriate solutions.

As online exams become an important assessment method in online learning, it is essential to analyze learners' perceptions (Dermo, 2009). This is especially true in developing countries where universities have only recently initiated the use of online exams in courses with large numbers of students. Also, some institutions of the countries started to employ online exams countrywide. For instance, driving license, foreign language, certification, promotion, and recruitment exams have been conducted in online means (Adanır, Akmatbekova, & Muhametjanova, 2020). While some developed countries have had more experience and success related to the implementation of online exams, learners in developing countries face many challenges due to limited access to ICT, lack of experience in online education or having a lower computer literacy level. Therefore, it is necessary to measure the readiness of such learners to accept online methods in the assessment of knowledge. In addition, the investigation of learners' perceptions could reveal factors that would make online examinations more accurate and effective.

Although there have been studies that investigated learners' perceptions of online exams, there has not yet been such a study comparing the perceptions of learners from different countries. Building on the work of Liu, Liu, Lee, and Magjuka (2010) who suggested that cultural differences could affect perception, this study investigated and compared online exam perceptions of students in the state university in Turkey with students in the state university in the Kyrgyz Republic.

In both universities, distance education centres manage online learning courses and programs. In the state university of Turkey, the centre is AUDCE, while in Kyrgyzstan, it's named the KTMUDCE.

AUDCE was founded in 2002. Since 2015, AUDCE has been providing online exams for evaluation of practical tasks as well as midterm assessment of learners in the state university of Turkey. In Kyrgyz University, the KTMUDCE was started in 2013. However, Kyrgyz students currently do not take online exams other than in one compulsory informatics course, offered to first-year students of all bachelor's degree programs. Taking into account this difference, this study analyzed and compared students' perceptions of knowledge evaluation.

This paper first reviews the literature, and then describes the methodology for the study including the research design and questions. Next, the findings are presented and discussed. Finally, the paper concludes with recommendations for action and further study.

Literature Review

Improving learners' qualifications is highly important in the educational context. Such improvement can be supported by assessment, evaluation, and feedback activities (Yılmaz, 2016). Assessment, an essential component of education, has both summative and formative types. Summative assessment aims to gather, describe, and quantify information related to student performance, while formative assessment aims to improve teaching and learning (Baleni, 2015). Online learning can benefit greatly from various assessment methods since there is a lack of face-to-face contact between students and instructors that might otherwise provide useful information about course content and delivery (Timms, 2017). In addition, to promote successful online learning experiences, learners' progress should be monitored in order to provide appropriate feedback and grading of performance. The traditional assessment methods such as online exams involving multiple-choice or true-false types of questions are useful for acquiring basic information about learning in a given course. On the other hand, authentic assessment methods such as online discussions, assignments, projects, presentations, and journals are effective for a deeper assessment of learner performance (Gülbahar, 2017). Authentic assessment methods are generally appropriate for courses with a small number of students since they require additional time for grading.

Thanks to improvements in ICT, learners and instructors witnessed more applications of online courses and thus, online exams (Kirtman, 2009). Although there is no restriction on their use, online exams are especially appropriate for courses conducted online and having a high number of students. At the same time, online exams bring advantages such as test security, safe data storage, immediate exam results, cost-effectiveness, saving paper and time, and automated record-keeping for learners, instructors, and institutions (Ilgaz & Adanır, 2020).

One emergent area in the research is learner perception. Many studies have analyzed learners' online exam experiences and perceptions. Cabı (2016) investigated master's students' perceptions of various e-assessment methods. The results showed that students preferred e-exams because they offered immediate feedback, motivation for study, and self-assessment. Yet, students had concerns related to cheating possibilities, technical failures, and the limited number of sessions for online exams offered throughout the term. The work of Laine et al. (2016) found that students were satisfied with both the electronic versions of exams and the appropriateness of exam questions. Their only challenge related to mathematical problems and calculations, in which they indicated the difficulties entering mathematical calculations and unpleasant use of the calculator. Böhmer, Feldmann, and Ibsen (2018) investigated part-time engineering students' opinions about the e-exam system and found that they were generally satisfied since they could easily take e-exams and receive their grades quickly.

In considering the preconceptions of learners toward online exams, Hillier (2014) surveyed undergraduate students. According to the findings, learners generally had positive attitudes toward online exams. However, they indicated concerns that this approach would favour students from technology majors over those from other departments. The students surveyed felt that students in computer departments would more easily adapt to online exams since they had more typing experience. Other concerns included the risk of technical failure and the possibility of cheating. Research in the UAE by Elmehdi and Ibrahem (2019) showed that students felt positively about online exams due to facilitated logistics and improved learning. Moreover, researchers reported no difference in perception in terms of age and gender.

The literature review demonstrated that learners had generally positive attitudes toward online exams. However, differences according to demographic variables were less clear. In addition, the review revealed that the concerns of learners in developed countries were also being reported by learners in developing countries. In general, these concerns include the possibility of cheating, risk of technical failures, lack of exam time, and lack of quality of questions.

Although not usually available or widely used in developing countries, some researchers have proposed recent technologies to improve system infrastructure in order to eliminate problems and user concerns. For example, Bawarith, Basuhail, Fattouh, and Gamalel-Din (2017) implemented an e-exam management system, which aims to detect and prevent cheating in online exams with the help of a fingerprint reader authenticator and the use of an Eye Tribe tracker in exam sessions. As another example, Kolhar, Alameen, and Gharsseldien (2018) proposed an Online Lab Examination Management System (OLEMS) in order to prevent misconduct and to secure the process of lab examination.

Other researchers have offered more appropriate frameworks and control procedures. For example, D'Souza and Siegfeldt (2017) developed a conceptual framework to identify cheating in online and take-home exams. Cluskey, Ehlen, and Raiborn (2011) proposed Online Exam Control Procedures for the security of online exams. In the first procedure, they proposed exams be set at one time, with access to exam questions only through a specified browser to guarantee that learners would be locked into the exam page and prevented from exiting/returning, cutting/pasting or otherwise manipulating the system. Backman (2019) also recommended using software that prevents Internet access and preparing a question bank so that students were asked different questions. The same research (i.e., Backman, 2019) also proposed to ask more demanding questions, limiting time to answer them to prevent cheating.

Despite a wide variety of research, the review of literature revealed that there is not prior work comparing the perceptions of learners from different countries. This study therefore is the first that investigates undergraduate learners' perceptions in two developing countries (i.e., Turkey and Kyrgyzstan) and compares the results in order to identify similarities and differences in perceptions.

Methodology

Research Questions

Online exam perception can depend on many factors including students' educational backgrounds, computer literacy, and the ICT level of the country they live in. Research that probes these and other factors and analyzes the differences across countries could help shed light on measures that will support the more effective use of online exams. Thus, this study identified four research questions:

1. What are the perceptions of learners towards online exams at the state university of Turkey?

2. What are the perceptions of learners towards online exams at the state university of Kyrgyzstan?

3. Is there any difference between Turkish learners and Kyrgyz learners according to their perceptions of online exams?

4. What are the opinions of learners towards online exams?

Research Design and Participants

The study was conducted during the 2018-2019 fall term and structured as a mixed study. Quantitative data consider learners' perception scores gathered via the survey, whereas qualitative data consider learners' opinions towards online exams. The mixed study approach was found useful in the analysis of two different data types (i.e., quantitative and qualitative), and strengthened research results.

The participants of the study were undergraduate students from a state university in Turkey and a state university in Kyrgyzstan taking first-year compulsory courses online. They were selected since they are all in the same grade level, taking online compulsory courses, and having a similar level of online exam experience. While the learners in Turkey would have had experience with online midterm exams in their Foreign Language and Informatics courses, the learners in Kyrgyzstan would have had experience due to a compulsory Informatics course.

There were approximately 8,400 students in Turkey's university and 1,200 in Kyrgyzstan's, all at the first-year level. The link to the online questionnaire, created for the study, was e-mailed to them from both universities. In total, 370 students responded to the survey. The demographic characteristics of the participants are shown in Table 1.

Table 1

Analysis of Demographic Data of Participants

Demographic characteristic	Variables	Turkish		Kyrgyz	
		Frequency (*f*)	Percentage (%)	Frequency (*f*)	Percentage (%)
Gender	Female	108	58.4	111	60.0
	Male	77	41.6	74	40.0
Total		185	100	185	100
Age	17-25	171	92.4	184	99.5
	26-34	11	5.9	0	0
	35-43	1	0.5	1	0.5
	44 +	2	1.1	0	0
Total		185	100	185	100
Number of online courses taken before	0	82	44.3	22	11.9
	1	14	7.6	24	13.0
	2	39	21.1	40	21.6
	3	27	14.6	26	14.1
	4	9	4.9	22	11.9
	5	14	7.6	51	27.6
Total		185	100	185	100

In the scope of the survey, there were students representing six different faculties including Applied Science, Social Science, Education, Engineering, Medicine, and Religion. Learners' distribution by faculty is provided in Table 2.

The most notable difference in distribution by faculty was in the field of applied science: among participants from Turkey, 5.9% were in this faculty, while among Kyrgyz respondents, it was 28.6%. In addition, unlike the Turkish sample group, there were no students from the medicine and religion departments among the Kyrgyz participants.

Table 2

Percentage of Students by Faculty

		Percentage (%)	
		Turkish	Kyrgyz
Faculty	Applied Science	5.9	28.6
	Social Science	25.4	29.7
	Education	14.1	11.4
	Engineering	31.4	30.3
	Medicine	15.7	0
	Religion	7.6	0
	Total	100	100

Data Collection Tool and Analysis

The study used a scale, based on the work of Hillier (2014), consisting of items and rankings. The scale covered eight major themes: (a) affective factors, (b) teaching and learning, (c) validity, (d) reliability, (e) practicality, (f) security, (g) production, and (h) adoption. The scale was designed to work with 5-point Likert-type responses, which included rankings ranging from *strongly disagree* to *strongly agree*. In this study, the production theme, focusing on essay questions and handwriting, was not included since it is not relevant to the format of online exams that use only multiple-choice questions. The resulting scale covered 15 items. Participants provided responses voluntarily, therefore, reliability analysis was performed based on 370 participants, and the resulting Cronbach Alpha value was estimated at 0.82. In addition to the survey questions, thoughts of learners were gathered through an open-ended question asking their opinions toward online exams.

To analyze quantitative data collected through the scale, appropriate statistical analyses (i.e., *t*-test and ANOVA test) were used. The responses of learners from the two universities were compared using the *t*-test. All tests were conducted using SPSS 20.0 software. For analysis of the open-ended question, however, the content analysis approach was employed. In total, 32 participants (i.e., 18 Turkish and 14 Kyrgyz) responded to the open-ended question. In this study, open coding as offered by Strauss and Corbin (1990) was used and an inter-coder agreement strategy was applied for reliability. The coefficient was 0.72, which is considered to be within an acceptable range as proposed by Krippendorff (2004).

Results and Discussion

Research Question 1: What are the Perceptions of Learners Towards Online Exams at the State University of Turkey?

Relationship between Turkish learners' gender and perceptions of online exams. An independent sample *t*-test was performed to examine whether there was a difference between male and female learners' perceptions toward online exams at the state university of Turkey. Results, provided in Table 3, show a statistically significant difference between male and female learners in terms of four of the 15 perceptions the respondents were asked to rank.

Table 3

Results of the Independent Samples T-test on Turkish Learners' Perception by Gender

	t	*df*	Sig. (2-tailed)	Mean difference
1. Using a computer for an exam is more stressful than a handwritten paper exam	-3.269	183	.001	-.662
9. Online exams favour some students more than others	2.144	183	.033	.374
14. It is easier to cheat in online exams than with paper-based exams	-2.470	183	.014	-.504
15. I want online exams to replace paper-based exams in the context of online courses	2.539	183	.012	.497

According to results, female learners tend to be more stressed than male learners (item 1), while more male learners would prefer that online exams replace paper-based exams in the context of online courses (item 15). Regarding the possibility of cheating on online exams, female learners expressed more concern than males (item 14). The high stress and cheating concerns of female learners may be related. However, more male learners perceived that online exams favoured some students over others.

Relationship between Turkish learners' academic major and perceptions of online exams. The relationship between learners' academic major and perceptions of online exams was analyzed. The ANOVA test revealed a statistically significant difference between learners' academic major and perceptions of online exams for three items as shown in Table 4.

Learners from the Applied Science and Engineering faculties perceived online exams as reliable and secure while learners from Social Science, Medicine, and Religion perceived them as less reliable than paper-based exams. Furthermore, Social Science, Medicine, and Religion faculty learners perceived that it is easier to cheat in online exams than with paper-based exams as compared with Engineering and Applied Science students.

Table 4

Results of the One-Way ANOVA Test on Turkish Learners' Perception by Academic Major

		Sum of squares	*df*	Mean square	*F*	Sig.
8. The technology used in online exams is unreliable	Between Groups[a]	17.733	5	3.547	2.340	.044
	Within Groups	271.326	179	1.516		
	Total	289.059	184			
13. Online exams are just as secure as paper-based exams	Between Groups	20.764	5	4.153	2.523	.031
	Within Groups	294.641	179	1.646		
	Total	315.405	184			
14. It is easier to cheat in online exams than with paper-based exams	Between Groups	39.293	5	7.859	4.473	.001
	Within Groups	314.469	179	1.757		
	Total	353.762	184			

Note. [a]Compared groups are: Applied Science, Engineering, Social Science, Medicine and Religion.

Relationship between the number of online courses taken and perceptions of online exams. Since experience can change an individual's perception, the impact of the number of online courses taken on the perception of online exams was analyzed. Regarding Turkish learners, no statistically significant difference was found between perceptions of online exams and the number of online courses taken. That is, prior experience had no effect on their perceptions of online exams.

Research Question 2: What are the Perceptions of Learners Towards Online Exams at the State University of Kyrgyzstan?

Relationship between Kyrgyz learners' gender and perceptions of online exams. An independent sample *t*-test was performed to see whether there was a difference between Kyrgyz male and female learners' perceptions toward online exams.

As shown in Table 5, the results of the *t*-test showed a statistically significant difference between male and female learners in two items. Female learners taking online exams felt more disadvantaged than male learners, with the mean difference being -.365 (item 2), while male learners perceived that it was easier to cheat in online exams than with paper-based exams, with a mean difference of .468 (item 14).

Table 5

Results of the Independent Samples T*-test on Kyrgyz Learners' Perception by Gender*

	t	*df*	Sig. (2-tailed)	Mean difference
2. I am at a disadvantage when undertaking online exams	-1.986	183	.049	-.365
14. It is easier to cheat in online exams than with paper-based exams	2.412	183	.017	.468

Relationship between Kyrgyz learners' academic major and perceptions of online exams. To determine the relationship between learners' academic major and perceptions of online exams, the ANOVA test was used. Results (Table 6) showed a statistically significant difference between learners' academic major and perception of online exams only for item 13. That is, learners from the Engineering faculty perceived online exams to be just as secure as paper-based exams while learners from the Education faculty perceived them as less secure than paper-based exams.

Table 6

Results of the One-Way ANOVA Test on Kyrgyz Learners' Perceptions by Academic Major

		Sum of squares	*df*	Mean square	*F*	Sig.
13. Online exams are just as secure as paper-based exams	Between Groups[a]	14.713	3	4.904	3.294	.022
	Within Groups	269.471	181	1.489		
	Total	284.184	184			

Note. [a]Compared groups are: Applied Science, Social Science, Education, Engineering.

Relationship between the number of online courses taken and perceptions of online exams. Results of the ANOVA test showed a statistically significant difference between the number of online courses taken and students' perceptions of online exams for items 4 and 6 (Table 7). That is, learners who had taken more than three courses thought that the potential for immediate feedback with an online exam would help improve their learning in comparison with those who took only one course. However, more experience resulted in a less positive estimation of suitability: more of the learners who took two courses thought that online exams were appropriate for their discipline/subject area than the learners who took five courses.

Table 7

Relationship between the Number of Online Course Taken and Perceptions of Online Exams

		Sum of squares	*df*	Mean square	*F*	Sig.
4. The potential for immediate feedback with an online exam could help improve my learning	Between Groups[a]	17.074	5	3.415	2.730	.021
	Within Groups	222.643	178	1.251		
	Total	239.717	183			
6. Online exams are appropriate for my discipline/subject area	Between Groups	21.285	5	4.257	2.619	.026
	Within Groups	289.318	178	1.625		
	Total	310.603	183			

Note. [a]Compared groups are: none, 1 course, 2 courses, 3 courses, 4 courses, 5 courses.

Research Question 3: Is There any Difference Between Turkish Learners and Kyrgyz Learners According to Their Perceptions of Online Exams?

An independent sample *t*-test was performed to see whether there was a difference between Turkish and Kyrgyz learners' perceptions toward online exams.

The results of the *t*-test showed a statistically significant difference between the perception of learners from Turkey and Kyrgyzstan in 12 of the 15 items (Table 8). Turkish learners appreciated the capabilities of online exams more than Kyrgyz learners did. Specifically, Turkish learners indicated that online exams are consistent with learning approaches, provide immediate feedback, are appropriate for demonstrating knowledge, and appropriate for the chosen major. Moreover, Turkish learners demonstrated more expectation towards the online exams in place of paper-based exams as they want online exams to replace paper-based exams in the context of online courses (item 15). On the other hand, they also stated concerns about technical problems, cheating possibilities, and the impracticality of using the campus computer lab to take exams.

Table 8

Results of the Independent Samples T-test on Learners' Perception by Country

	T	*df*	Sig. (2-tailed)	Mean difference
1. Using a computer for an exam is more stressful than a handwritten paper exam	1.276	368	.203	.1784
3. Online exams are consistent with contemporary learning approaches at university	-4.225	368	.000	-.5351
4. The potential for immediate feedback with an online exam could help improve my learning	-6.058	368	.000	-.7081
5. Online exams allow me to demonstrate my knowledge in more ways than paper-based exams	-4.953	368	.000	-.6162
6. Online exams are appropriate for my discipline/subject area	-4.871	368	.000	-.6541
7. Online exams need to include a variety of question types to test my knowledge fully	3.458	368	.001	.4324
8. The technology used in online exams is unreliable	3.835	368	.000	.4919
10. Paper-based exams are fairer than online exams	2.591	368	.010	.3568
11. Technical problems make doing exams via computer impractical	-5.988	368	.000	-.7189
12. Doing exams in the campus computer labs is impractical	-5.993	368	.000	-.7892
14. It is easier to cheat in online exams than with paper-based exams	-4.623	368	.000	-.6486
15. I want online exams to replace paper-based exams in the context of online courses	-3.416	368	.001	-.4703

According to results, Turkish learners agree more strongly with all stated items except items 1, 7, 8, and 10. The results related to item 1 demonstrated that a higher number of Kyrgyz learners found online exams to be more stressful than paper-based exams when compared to the number of Turkish learners who reported the same thing. The results related to item 7 showed that more Kyrgyz learners than Turkish learners perceived that the inclusion of various question types would test their knowledge more fully. Furthermore, Kyrgyz learners, when compared to Turkish learners, showed more apprehension as they specifically highlighted those items that typically raise anxiety levels: they thought that "technology used in online exams is unreliable" (item 8), and that "paper-based exams are fairer than online exams" (item 10). This might be explained by the fact that, in the Kyrgyz university, all exams are mostly paper-based and the General Course exams are all paper-based. The only experience of online exams is related to the compulsory Informatics course. This might explain Kyrgyz students' perceptions of online exams as unreliable, and not as fair as paper-based ones.

Research Question 4: What are the Opinions of Learners Towards Online Exams?

In the open-ended question part of the survey, the majority of Turkish participants indicated that online exams were effective and practical, and hence, they supported their continuation and even expansion. In Turkey, legal restrictions prevent the implementation of final exams in an online format; the presence of proctors is required. Thus, only midterm exams can be held online. Nevertheless, a transition to online final exams, in a format analogous to midterm exams, was supported by some participants. For instance, one Turkish learner indicated that:

> I found online courses beneficial and useful. In my opinion, both midterm and final exams of these courses should be conducted online in the schools and under the control of proctors. In this way, cheating issues can be eliminated.

Using the physical space of universities' computer laboratories for final exams could provide opportunities for carrying out such exams both online and under proctor control.

Cheating was a major concern of many participants. However, there was some misunderstanding about the meaning of cheating in the context of online exams. One participant stated, "The students have a helping attitude toward each other, and exam questions are generally solved by a group of learners." Another said, "I did not have previous knowledge about the cheating issue for online exams. Sorry since I solved the exam questions with my friends."

Although participants from Kyrgyzstan had little prior experience in taking online exams, they had several concerns which may have originated from existing problems. One concern was the existence of identical questions in exams across terms or even years. A Kyrgyz participant stated that, "Online exam questions are the same as the ones provided 3-4 years before." Participants said that some students memorized prior exam questions, forgetting the rest of the course content, leading to superficial learning. In order to prevent this and increase motivation, it is recommended that instructors give learners new and highly distinct questions in exams.

Another concern of learners from Kyrgyzstan was evaluation, due to the fact that online exams have only multiple-choice questions. For instance, one Kyrgyz participant stated that, "The technique of online exams is not appropriate since there are only multiple-choice questions, it is like a practice test." The inclusion of various types of questions adds to the effectiveness of exams, especially at the university level. To enhance the effectiveness of online exams and make the evaluations more useful to students, it is recommended that various types of questions, such as drag and drop, matching, and essay type questions, be considered for inclusion in online exams. In addition, in the final grading, along with online exams, it is recommended to also evaluate learners' participation work in other online activities, such as assignment uploads, and forum postings.

Conclusion

This study explored online exam perceptions of learners in two developing countries and additionally compared perceptions between those two countries. The participants were first-year undergraduate learners from Turkey and Kyrgyzstan. All were in their initial year, and therefore had no prior experience with online exams.

According to the results, online exam perceptions differed in terms of gender: Turkish female learners felt more stressed and Kyrgyz female learners thought they were disadvantaged as compared to males. The same results were observed in the work of Hillier (2014) in which female learners reported more stress and more concerns about technical problems during online exams. However, research conducted in the UAE by Elmehdi and Ibrahem (2019), found no difference in online exam perception in terms of gender. Therefore, further (qualitative) research to define the reasons for this difference in Turkish and Kyrgyz learners should be conducted.

In considering the academic background of students, the differences in perception of online exams that was noted between students from different disciplines was related to security and reliability. In both countries, Engineering learners considered online exams to be as secure as paper-based exams. On the other hand, Turkish learners from the Social Science, Medicine, and Religion departments, and Kyrgyz learners from the Education department perceived online exams to be less secure and reliable. An analysis of the open-ended questions suggests that this difference is due to students' level of computer literacy, which is related to how closely their field of study is connected to computer science. This result is in line with results obtained in a recent study on the perception of online education as a whole undertaken by Ilgaz and Adanır (2020). However, other studies, such as one carried out by Bandele, Oluwatayo, and Omodara in 2015, found that undergraduates' opinions of online exams did not differ in terms of their majors. The factors that result in online exam perception differences based on learners' fields of study could be a topic for future research.

Prior online learning experience also impacted online exam perceptions in different ways for Turkish and Kyrgyz participants. According to results, prior experience did not affect learners' perceptions of online exams in Turkey. On the other hand, Kyrgyz learners taking more than three online courses had positive attitudes toward online exams and reported their potential for improving learning through the provision of immediate feedback. This is similar to the findings of Sorensen (2013) who reported that students felt e-assessment provided immediate feedback and value to their learning, and hence believed it should be more accessible in the context of learning management systems.

Some Turkish students' perceptions toward online exams can be attributed to their concerns about implementation. A major issue was cheating. In a recent study by Cerimagic and Hasan (2019), it was observed that 81% of learners cheated or attempted to cheat during online exams. However, in the study by Case, King, and Case (2019) it was also observed that students' perceptions suggest it is becoming more difficult to cheat in online exams. This can be due to emergence of more appropriate frameworks and control procedures. For instance, novel technologies that provide online proctoring capabilities could eliminate cheating issues. The responses of participants were in line with the work of Atoum et al. (2017), who developed a multimedia analytics system that performs automatic online exam proctoring and detects cheating behaviours. In addition, Backman (2019) recommended steps that instructors could take to reduce the occurrences of cheating. These include the implementation of online exams in a physical room where all exam takers are present, inclusion of more demanding questions, allocation of less time for completing the exam, availability of software preventing Internet access, and selection of random questions.

Another concern of Turkish learners was the lack of time provided for some questions, especially those requiring paper-based calculations. This issue could be eliminated with the allocation of more time for answering such questions. In addition, online calculation tools, such as those as offered by Finnish Matriculation Examination Board (Ylioppilastutkintolautakunta, 2017), could be included in the online exam system. As for the time lost due to technical failures, Turkey's AUDCE offered a solution that could have application in other developing countries. While online exams are taking place, learners have access to an online chat tool that is integrated into the online exam system. When learners report technical failure, the support team from AUDCE examines log records and, where there has been such a failure, provides students with the opportunity to re-take the exam if necessary.

Kyrgyz learners reported concerns related to questions provided in the e-exam system. Their initial concern was the repetition of questions in exams from one term to the next. This situation pushes learners to memorize answers instead of deeply learning the course content. In this respect, it is recommended that universities vary questions more often for better assessment and increased student motivation. In addition, the use of open-ended questions in e-exams may result in a better assessment of students' knowledge. For instance, Benli and İsmailova (2018) proposed a method for the evaluation of exams with open-ended questions. However, the evaluation of such questions by instructors is time demanding, especially when it comes to large classes.

Finally, the results of this study showed countrywide differences in perception of online exams. There can be many reasons for such differences, including ICT infrastructure level, differences in education systems, and cultural differences in both learning and in certain demographic variables such as gender. Determining the reasons for these differences could be the focus of further study.

To conclude, online exams provide students with benefits such as time reduction in view of savings on transportation, ease of access, and the immediate announcement of exam results. However, the ICT environment is one of the major factors influencing students' perceptions. Adding courses that raise the computer literacy rate would increase the knowledge base of learners and thus, improve online exam perception. In addition, the development of system usage tutorials such as in the case of the distance education centre in Turkey could be helpful. Furthermore, in the initial weeks of each semester or before exam sessions, universities could inform learners about the use and security of online exams through guides or face-to-face sessions. Such steps could eliminate some concerns and result in better online exam experiences.

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Antecedents of Student Loyalty in Open and Distance Learning Institutions: An Empirical Analysis

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Abstract

The purpose of this research is to examine the relationship between factors leading to student loyalty in open and distance learning universities. Specifically, this research explores the relationship between perceived service quality, perceived e-service quality, and university image as mediators of student loyalty in Open University Malaysia (OUM). Data were collected from 16 OUM learning centres throughout Malaysia. A purposive stratified convenience sampling technique was applied and a sample size of 752 respondents was obtained. The data indicated that perceived service quality has a positive and significant relationship with both university image and student loyalty. Similarly, it was found that perceived e-service quality has a positive significant relationship with both university image and student loyalty. University image acted as a mediator both in the relationship between perceived service quality and student loyalty, and in the relationship between perceived e-service quality and student loyalty.

Keywords: perceived service quality, perceived e-service quality, university image, student loyalty

Introduction

Higher education in Malaysia has evolved and transformed tremendously. The changes and trends in Malaysian education have been caused by globalization, new approaches to teaching and learning, new governance models, and the emergence of a knowledge-based society. Globalization has been defined as the opening of local and nationalistic perspectives to the broader outlook of an interconnected and interdependent world with free transfer of capital, goods, and services across national frontiers (Grapragasem, Krishnan, & Mansor, 2014). The education sector is projected to play an important role in long-term investments that highly potential lead to higher productivity (Manohar, 2018). Positive attitudes toward lifelong learning have resulted in the rapid emergence of lifelong learning providers (Li, 2018). In Malaysia, there were only six universities providing lifelong education in 2006; as of 2019, there were twenty-one public universities that offered distance education programmes in different modes. This situation has created very intense competition among providers.

Student loyalty is essential for educational providers to sustain or grow in the education business. Research on the antecedents of student loyalty in the education sector has concentrated more on service quality and, to the best of my knowledge, there has been no empirical research applying perceived e-service quality specifically in Malaysia. There is also a gap in the literature pertaining to the antecedents of student loyalty for part-time students whose classes are delivered in a blended mode of online and face-to-face teaching. This study is undertaken to address these gaps in the literature.

The intense competition as well as the challenges of delivering education to diverse learners in lifelong learning strengthen the need for research. A high attrition rate or lack of loyalty will lead to a reduction of financial revenue, extra costs of recruiting new students, and the loss of free advertising by word of mouth, particularly for educational institution providers adopting the online or blended learning approach. Therefore, student loyalty has become an important concern for lifelong learning providers (Li & Wong, 2019).

Literature Review

Theoretical Foundation of Student Loyalty

Studies have used the theory of reasoned action (TRA) as one of the bases of a research framework on brand loyalty and purchasing behaviour (Sulehri & Ahmed, 2017). According to the TRA, intentions have a direct effect on behaviour as an outcome of attitudes and subjective norms and are ideal for predicting consumer behaviour because of the voluntary nature of that behaviour (Shrum, Liu, Nespoli, & Lowrey, 2013). Predictions include consideration of current attitudes, subjective norms, and intentions to act. (Sheppard, Hartwick, & Warshaw, 1988).

The expectation disconfirmation theory (EDT) is rooted in the research of marketing and consumer behaviour (Oliver & DeSarbo, 1988). The usual approach to study satisfaction entails comparing initial expectations with observed performance. According to Oliver (1980), the EDT's satisfaction is a function of initial expectations and disconfirmation, and satisfaction is the main determinant of repurchase intentions (Oliver, Balakrishnan, & Barry, 1994). The EDT is used in various areas of study such as marketing and consumer behaviour (Kopalle & Lehmann, 2001), service quality (Kettinger & Lee, 2005), and human resources (Hom, Griffeth, Palich, & Bracker, 1999). The common theme of study in expectation disconfirmation is the satisfaction function of size and direction of disconfirmation: consumers are satisfied in terms of positive disconfirmation and are not satisfied in the case of negative disconfirmation.

Perceived Service Quality

Service quality literature focuses on the relationship between customers' expectations of service and perceptions of service quality (Grönroos, 1984). Grönroos (1984) explained that service quality is the result of customer evaluation of a course of action as that customer compares expected service with perceived service. For this reason, measuring service quality is important to business organizations and the instrument often used to measure service quality is the SERVQUAL or gap model (Parasuraman, Zeithaml, & Berry, 1985). Teeroovengadum, Kamalanabhan, and Keshwar (2016) proposed the Higher Education Service Quality scale (HESQUAL) in India and found that service quality is positively related to student satisfaction and loyalty. In addition, both Pedro, Mendes, and Lourenço (2018) and Wantara (2015) studied the determinants of student satisfaction using constructs of perceived service quality and found that perceived service quality is positively related to student satisfaction and student loyalty in the long run.

In this study, I conceptually define perceived service quality as the difference between the performance of service received with the actual expectation. Operationally, I define perceived service quality as the perception of customer experience, in all services provided by an organization, consisting of five dimensions: tangibility, reliability, responsiveness, assurance, and empathy. In line with previous studies and consolidating the idea that perceived service quality precedes student loyalty, this study considers perceived service quality as an antecedent to student loyalty that also has a positive relationship with student loyalty. Thus, the first hypothesis is as stated here:

H_1: There is a positive relationship between perceived service quality and student loyalty.

Perceived E-Service Quality

Studies on e-services have looked at various aspects of e-service quality. E-services provided by the university include various electronic services that require no face-to-face or physical interaction between learners and the university, such as electronic registration, electronic payment, electronic seminars or tutorials, and live forums with tutors (Nsamba, 2019). Yoo and Donthu (2001) developed SITEQUAL, a psychometric measure of service quality for online shopping websites. Barnes and Vidgen (2002) developed WebQual 4.0 to assess the service quality of online bookstores in the UK and found three dimensions and five sub-dimensions that are significant in measuring the e-service quality of websites. These were defined as follows:

- usability (sub-dimensions usability and design): appearance, ease of use, ease of navigation;
- information quality (sub-dimension information): accuracy, format, and relevancy of information; and
- service interaction quality (sub-dimensions trust and empathy): transaction/information security, product delivery, personalization, and communication with website.

Ataburo, Muntaka, and Quansah (2017) stated that e-services should be designed to support the interactive flow of information between the customer and service provider. They indicated that the nature of e-service is to provide the customer with great experience with respect to the interactive flow of information. They also found that perceived e-service quality was closely related to customer satisfaction and loyalty.

I conceptually define perceived e-service quality as the difference between the performance of electronic services received with the expectation as suggested by researchers such as Ali (2019) and Alzoubi, Abdo, Al-Gasaymeh, and Alzoubi (2019). Operationally, I define perceived e-service quality as the perception of customer experience of all e-services provided by an organization, consisting of ease of use, website design, e-responsiveness, customization, and website security. In concurrence with previous studies and the idea that perceived e-service quality precedes student loyalty, this study considers perceived e-service quality as an antecedent to student loyalty, and thus, the second hypothesis is stated here:

> H_2: There is a positive relationship between perceived e-service quality and student loyalty.

University Image

University image is considered one of the important constructs in determining student loyalty in universities (Eskildsen, Dahlgaard, & Norgaard, 1999). It can be defined as the belief held by internal members of an organization of how outsiders view their organization, which has direct influence on the identity of that organization (Lievens, Hoye, & Anseel, 2007). I define university image as a summary of the perceptions held by people outside the organization that determine the reputation of that organization. University image has primarily been used as a positioning instrument to influence a student's choice of a particular university (Alves & Raposo, 2010). Studies have found that a university's positive image and reputation strongly affected retention and loyalty (Helgesen & Nesset, 2007). Alves and Raposo (2010) stated that positive university image significantly influences student satisfaction with direct and indirect effects. Khairani and Razak (2013) also found that positive university image significantly influences student loyalty and suggested that if universities wish to compete through image, first they need to measure that image based on student perception. Operationally, I define university image as the positive impression that a person holds towards an institution. Five hypotheses concerning university image were developed and are as follows:

> H_3: There is a positive relationship between university image and student loyalty.
>
> H_4: There is a positive relationship between perceived service quality and university image.
>
> H_5: There is a positive relationship between perceived e-service quality and university image.
>
> H_6: University image mediates the relationship between perceived service quality and student loyalty.
>
> H_7: University image mediates the relationship between perceived e-service quality and student loyalty.

Research Framework

The research framework illustrated in Figure 1 was adapted from Hassan et al., (2019). Although there is no consensus about the most appropriate determinants of student loyalty, this research has suggested the determinants to be perceived service quality and perceived e-service quality as independent constructs. The university image is proposed as the mediating construct and student loyalty as the dependent construct. The TRA and EDT theories support this model.

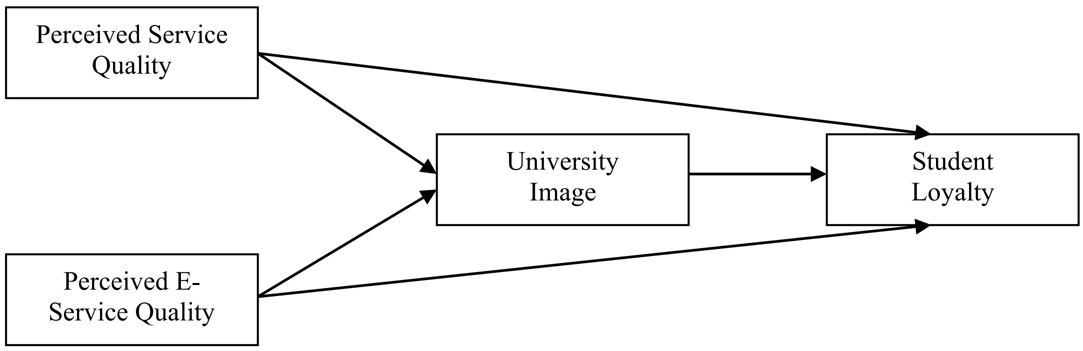

Figure 1. Theoretical framework. Adapted from "Mediating Effect of Corporate Image and Students' Satisfaction on the Relationship between Service Quality and Students Loyalty in TVET HLIs," by S. Hassan et al., 2019, *Asian Academy of Management Journal, 24*(Supp. 1), p. 97. Copyright 2019 by the Asian Academy of Management and Penerbit Universiti Sains Malaysia. Licenced under CC BY 4.0.

Methodology

Open University Malaysia has 16 learning centres throughout the country. The function of each learning centre is to execute and implement university academic activities such as tutorials, seminars, and quarterly colloquiums. Besides that, the learning centres also serve and carry out non-academic functions such as student affairs, student clubs, marketing, and promotional activities of the university.

This study, which adopted a cross-sectional survey approach, employed structured questionnaires for data collection. The questionnaires, which were distributed to all 16 Open University Malaysia OUM learning centres, were self-administered to give students privacy and time to answer the questions. The respondent in this study were the part-time students who are studying in a blended mode. Due to the nature of tutorial class scheduling and time constraints, most students had no time for interviews. A purposive stratified convenience sampling technique was applied. This technique reduced the random sampling error as it is internally homogeneous and results in smaller standard errors because the group is adequately represented when strata are combined. Another reason for using this sampling technique was to ensure that the samples accurately reflected the population based on criteria used for stratification. Samples of students were based on OUM's Management Information System. Such a sample is deemed appropriate and acceptable in the scale development process when given evidence of internal consistency of the scale (DeVellis, 2016). The questionnaire was further evaluated and reviewed by OUM academics and students for suitability, readability, and ambiguity for content validity. The original items were modified to suit the research context in the open and distance learning setting.

Items addressing each construct were adapted from previous studies. For example, items concerning perceived service quality were adapted from Parasuraman, Zeithaml, and Berry (1988). Items for perceived e-service quality were adapted from Parasuraman et al., (1988) and Ribbink, Riel, Liljander, and Streukens (2004). Items related to university image were adapted from Huang, Yen, Liu, and Huang (2014), Johnson, Gustafsson, Andreassen, Lervik, and Cha (2001), Lemmink, Schuijf, and Streukens, (2003), Richard and Zhang (2012), Riordan, Gatewood, and Bill (1997) and Parasuraman et al., (1988). Lastly, items for student loyalty were adapted from Chen and Lee (2008) and Hennig-Thurau, Langer, and Hansen (2001).

The first pilot test was conducted on 30 students, and the questionnaire was revised based on feedback. The second pilot test was conducted by distributing the questionnaire to 50 students before conducting the main survey.

Results

Data Screening

A total of 1,600 questionnaires were distributed and 1,035 questionnaires were returned, giving a response rate of 64.6 percent. The collected questionnaires were inspected for completeness, patterns of response, and inconsistencies of answers followed by a coding process. Out of 1,035 questionnaires returned, a total of 752 were deemed eligible and analysis was conducted using the software SPSS Statistics 23.0. Data were screened to impose minimum quality standards on raw data. In this process, initial checks, missing data controls, and checks on the normalization of data distribution were performed. Extreme values caused by errors in data entry were identified by generating frequency tables. By observing the range of values for each item, the researcher was able to ensure the values fell within the coded end points. Student demographic profiles are shown in Table 1.

Table 1

Student Demographic Profile

Demographic characteristic	*n*	%
Gender		
Male	247	32.85
Female	505	67.15
Race		
Malay	428	56.91
Chinese	153	20.35
Indian	111	14.76
Others	60	7.98
Age		
≤ 20	33	4.39

21 - 25	151	20.08
26 - 30	145	19.28
31 - 35	129	17.15
36 - 40	119	15.82
41 - 45	79	10.51
46 - 50	66	8.78
51 - 55	21	2.79
56 - 60	5	0.66
61 - 65	4	0.53
Highest education level before enrolling at OUM		
Lower than SPM	7	0.93
SPM or equivalent	188	25
STPM or equivalent	136	18.09
Diploma	289	38.43
Bachelor's degree	110	14.63
Master's degree	22	2.93
Programme pursued at OUM		
Diploma	80	10.64
Bachelor's degree	528	70.21
Master's degree	108	14.36
Doctorate	26	3.46
Post Graduate Diploma	10	1.33
Cluster		
Business and Management	237	31.52
Education and Applied Science	376	50
Social Applied Science	139	18.48

Note. OUM = Open University Malaysia; SPM = Sijil Pelajaran Malaysia; STPM = Sijil Tinggi Pelajaran Malaysia.

Descriptive Analysis

Perceived service quality was chosen as one of the first constructs in measuring student loyalty. These five dimensions of perceived service quality were measured:

- tangibility
- reliability
- responsiveness
- assurance, and
- empathy.

Tangibility is defined as the appearance of physical facilities, equipment, personnel, printed, and visual materials. Reliability is defined as the ability to perform promised service dependably and accurately. Responsiveness is defined as the willingness to help customers to provide prompt service. Assurance is defined as the knowledge and courtesy of staff and their ability to convey trust, confidence, and empathy is define as caring and individualized attention.

To gain a better understanding of participants' responses to these dimensions, I adapted several items for each dimension as follows:

- tangibility—4 items
- reliability—5 items
- responsiveness—4 items
- assurance—5 items, and
- empathy—4 items.

Items in this study are defined as the response items for the construct or a written set of questions to which the respondents record their answers, usually within defined alternatives. For example, in this study, items for reliability such as "When I have a problem, OUM shows keen and sincere interest in resolving it" and "OUM provides its service at the time it promised" were used. The standard deviation for all perceived service quality items ranged from 0.71 to 0.81. All perceived service quality item scores for skewness ranged from -0.58 to -0.07 and kurtosis scores ranged from 0.00 to 0.57. The results of the analysis indicated no violation of normality.

Perceived e-service quality was chosen as the second construct in measuring student loyalty. These five dimensions of perceived e-service quality were measured:

- ease of use
- website design
- responsiveness
- customization, and
- assurance.

Ease of use is defined as the functions that assist the help customers find what they need without difficulty, has good search functionality, and allows the customer to manoeuvre easily and quickly. Web design is defined as the benefit of online technologies in that the web site can be personalized to the user's needs. Responsiveness is defined as quick feedback on requests by the customer and when they suggest improvements. Customization is defined as the personalization on how much and how easily the site can be tailored to individual customers' preferences. Lastly, assurance is defined as the confidence the customer feels and is due to the reputation of the service provider and the products or services it offered, as well as clear and truthful information presented.

Similar to the previous construct, the dimensions were explored through participants' responses to a number of items assigned to each dimension. However, in this case, items were defined for only three of the dimensions:

- ease of use—4 items
- website design—4 items
- responsiveness—4 items
- customization—4 items, and
- assurance—3 items.

All perceived e-service quality item scores for skewness ranged from -0.59 to 0.03 and kurtosis scores ranged from -0.49 to 0.59. The results of the analysis indicated no violation of normality.

As discussed in the Research Framework section of this study and shown in Figure 1, university image was selected as the mediating construct. There were seven items used to measure the level of the university image. The standard deviation for all university image items ranged from 0.68 to 0.74. The entire university image item scores for skewness ranged from -0.26 to -0.05 and kurtosis scores ranged from -0.42 to 0.01. The results of the analysis indicated no violation of normality.

Similarly, as discussed in the Research Framework and shown in Figure 1, student loyalty functioned as the dependent construct in this study. There were twelve items used to measure student loyalty. The student loyalty item scores for skewness ranged from -0.53 to -0.04 and kurtosis scores ranged from -0.53 to 0.56. The results of the analysis indicated no violation of normality.

Assessment of the Measurement Model

In this study, Analysis of Moment Structures (AMOS) software was used for covariance-based structural equation models (CB-SEM). The theoretical framework were transfer into AMOS graphic to further analyze its psychometric properties such as measurement model and structural model. The measurement models of the latent constructs were validated using confirmatory factor analysis (Awang, Afthanorhan, & Mamat, 2015). The latent constructs with multiple indicators and the observed variables were predicted in a model concurrently and simultaneously, and the interrelationships among the constructs, indicators and the observed variables were analysed using AMOS. AMOS is able to test simultaneously the measurement model (the relationships between indicators or manifest constructs and their corresponding constructs) and the structural model (the relationships between constructs). The measurement model was independently assessed before continuing with the structural model. This involved assessing the unidimensionality of each construct to achieve an acceptable measurement model for each construct and assess the model fit (Anderson & Gerbing, 1988).

As depicted in Figure 2, the analysis of the full measurement model was conducted by correlating all variables involved in the structural model. All variables were assumed to be correlated. Following Byrne (2010), modification indices and standardized residuals were examined to evaluate any specification errors in the model to achieve the required unidimensionality of the constructs. Covariance lines were drawn linking the following error terms: (a) e43 and e45, (b) e54 and e56, (c) e14 and e15, (d) e1 and e5, and (e) e1 and e8.

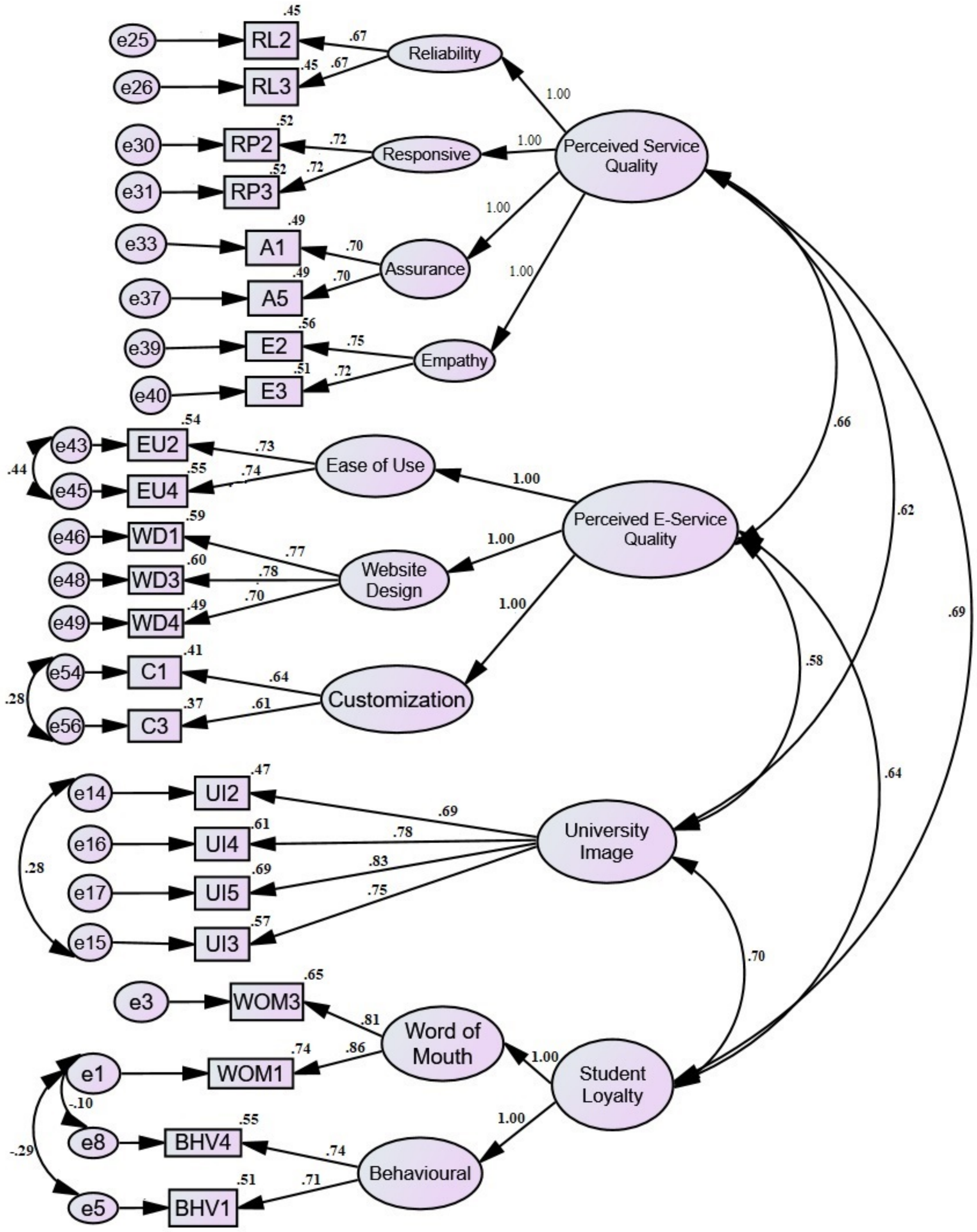

Figure 2. Assessment of full measurement model. RL = reliability; RP = responsiveness; A = assurance; E = empathy; EU = ease of use; WD = website design; C = customization; WOM = word of mouth; BHV = behavioural.

The results of goodness of fit indices indicate a well fit model with χ^2 / *df* = 3.506; Goodness of Fit index = 0.912; Adjusted Goodness of Fit index = 0.889; Tucker-Lewis index = 0.932; Comparative Fit index = 0.941; Normed Fit index = 0.920; Incremental Fit index = 0.941; and, RMSEA = 0.058. Based on the standardized regression weight, the standard loading ranged from 0.61 to 0.86 (see Figure 2). If the value obtained for AGFI is lower than the recommended threshold, i.e., the value does not exceed 0.9, it meets the requirement suggested by Baumgartner and Homburg (1996) and Doll, Xia, and Torkzadeh (1994). This was the case in this analysis. Thus, overall fit indicated no necessity to modify the relationships in the hypothesized model.

Discriminant validity occurs when unidimensionality is confirmed among the variables. The results of the individual CFA and full measurement model assessment indicated that all times were significant with standard factor loading ranging from 0.606 to 0.826. Based on the work on discriminant validity undertaken by Byrne (2010) and Awang, Afthanorhan, Mohamad, and Asri (2016), the square root of the average variance extracted (AVE) was calculated for each of the four constructs. Then, the AVE square roots were incorporated with the latent variables to determine how they were correlated with the independent variables as shown in Table 2. According to Awang, Afthanorhan, and Asri (2015), a correlation score lower than 0.85 is valid and indicates no redundancy. If the result is greater than 0.85, the researchers should delete either of the latent constructs since there would be an occurrence of construct redundancy. In this research, the requirement of discriminant validity was fulfilled, and, therefore, the measurement model was accepted as the structural model in the research.

Table 2

Results of Discriminant Validity Testing

Latent constructs	1	2	3	4
Perceived service quality	0.707			
Perceived e-service quality	0.656	0.711		
University image	0.625	0.577	0.763	
Student loyalty	0.685	0.639	0.703	0.783

Hair, Black, Babin, and Anderson (2010) stated that factor loading is important to establish convergent validity. Anderson and Gerbing (1988) explained that convergent validity is achieved when all indicators have significant factor loadings, reflecting the effectiveness of the indicators to measure the same construct. In applying the CFA, the critical ratio (CR) for factor loadings is normally used to assess convergent validity (Bryne, 2010). Table 3, which shows the test results, indicates convergent validity as demonstrated by all factor loadings. The CRs values as seen in the Table 3 such as RL3, RP3, A5, E3 and so on are greater than 1.96, showing the achievement of significance level. The parameters were statistically significant as they exceeded the ± 1.96 benchmark (Arbuckle & Wothke, 1999).

Table 3

Results of Convergent Validity Testing Based on Factor Loadings

			Beta estimate	Standard error	Critical ratio	*p* value
RL3	<---	RELIABILITY	0.669	0.057	16.730	***
RL2	<---	RELIABILITY	0.674			
RP2	<---	REPESPONSIVE	0.720			
RP3	<---	REPESPONSIVE	0.724	0.048	19.245	***
A5	<---	ASSURANCE	0.698	0.061	17.454	***
A1	<---	ASSURANCE	0.698			
E3	<---	EMPATHY	0.717	0.047	19.988	***
E2	<---	EMPATHY	0.749			
EU2	<---	EASE OF USE	0.735			
EU4	<---	EASE OF USE	0.739	0.037	26.158	***
C1	<---	CUSTOMIZATION	0.641	0.063	16.941	***
C3	<---	CUSTOMIZATION	0.608			
WD4	<---	WEBSITE DESIGN	0.698			
WD1	<---	WEBSITE DESIGN	0.766	0.059	19.074	***
WD3	<---	WEBSITE DESIGN	0.776	0.058	19.303	***
UI4	<---	UNIVERSITY IMAGE	0.778			
UI3	<---	UNIVERSITY IMAGE	0.754	0.048	20.287	***
UI5	<---	UNIVERSITY IMAGE	0.829	0.046	22.616	***
UI2	<---	UNIVERSITY IMAGE	0.685	0.049	17.914	***
BHV4	<---	BEHAVIOURAL	0.745	0.052	18.060	***
BHV1	<---	BEHAVIOURAL	0.713			
WOM1	<---	WORD OF MOUTH	0.859			
WOM3	<---	WORD OF MOUTH	0.807	0.040	23.424	***

Note. RL = reliability; RP = responsiveness; A = assurance; E = empathy; EU = ease of use; WD = website design; C = customization; WOM = word of mouth; BHV = behavioural.

In Table 3, each of the acronyms in Table 3 for example RL3 are define as Reliability 3, meaning, item 3 in Reliability dimension. EU2 are define as item 2 in Ease of Use dimension and WOM1 is define as item 1 in Word of Mouth dimension.

Analysis of a number of data, as shown in Table 4, reveal the reliability and construct validity of the measurement model. First, the CR values, all above 0.9, confirm that the threshold that determines unidimensionality of the constructs has been met.

Second, the AVE figures show convergence validity. According to Fornell and Larcker (1981), convergence validity can be measured using a percentage of the AVE. In this study, the AVE values for the constructs, ranging from 0.500 to 0.613, were all above Fornell and Larcker's 0.5 recommended threshold.

Third, Cronbach's α, ranging from 0.849 to 0.888, was well above the threshold level of 0.7. Furthermore, when Cronbach's α is combined with composite reliability, as is often done with structural equation models, together they can provide evidence of convergent validity (Kline, 2005). Hair et al., (2010) stated that a value greater than 0.7 suggests reliability and thus the results of this study indicate construct reliability and confirm again convergent validity.

Fourth, the maximum shared variance (MSV) and average shared variance (ASV) were determined in order to ensure that the theoretical research used for the measurement model was well defined. According to Hair et al., (2010), for a model to be valid, the MSV and ASV should be lower than 0.50. Based on the findings shown in Table 4, both the MSV and the ASV met this requirement.

Finally, Table 4 shows that convergent and discriminant validity exist for this measurement model as CR>AVE and AVE>0.50, while MSV<AVE and ASV<AVE respectively (Bagozzi & Yi, 1988; Fornell & Larcker, 1981; Gerbing & Anderson, 1988)

Table 4

Reliability and Construct Validity

Latent constructs	CR (>0.5)	AVE (>0.5)	Cronbach's α (>0.7)	MSV (<0.5)	ASV (<0.5)	Convergent validity	Discriminant validity
						CR>AVE, AVE>0.50	MSV<AVE, ASV<AVE
Perceived service quality	0.993	0.500	0.888	0.469	0.430	Yes	Yes
Perceived e-service quality	0.991	0.506	0.881	0.408	0.371	Yes	Yes
University image	0.985	0.583	0.856	0.494	0.406	Yes	Yes
Student loyalty	0.991	0.613	0.849	0.494	0.457	Yes	Yes

Note. CR = composite reliability; AVE = average variance extracted; MSV = maximum shared variance; ASV = average shared variance.

Assessment of the Structural Model

The structural equation modelling procedure was conducted using the maximum likelihood fitting process (Gerbing & Anderson, 1988). The hypothesized relationships of the structural model were tested based on goodness of fit indices. The results indicated that the hypothesized model had an adequate fit, where χ^2 / *df* = 4.268; Goodness of Fit index = 0.911; Adjusted Goodness of Fit index = 0.887; Tucker-Lewis index = 0.911; Comparative Fit index = 0.924; Normed Fit index = 0.904; Incremental Fit index = 0.924; and, RMSEA = 0.066. Figure 3 exhibits the structural model with standardized regression weights that indicate the significant relationships.

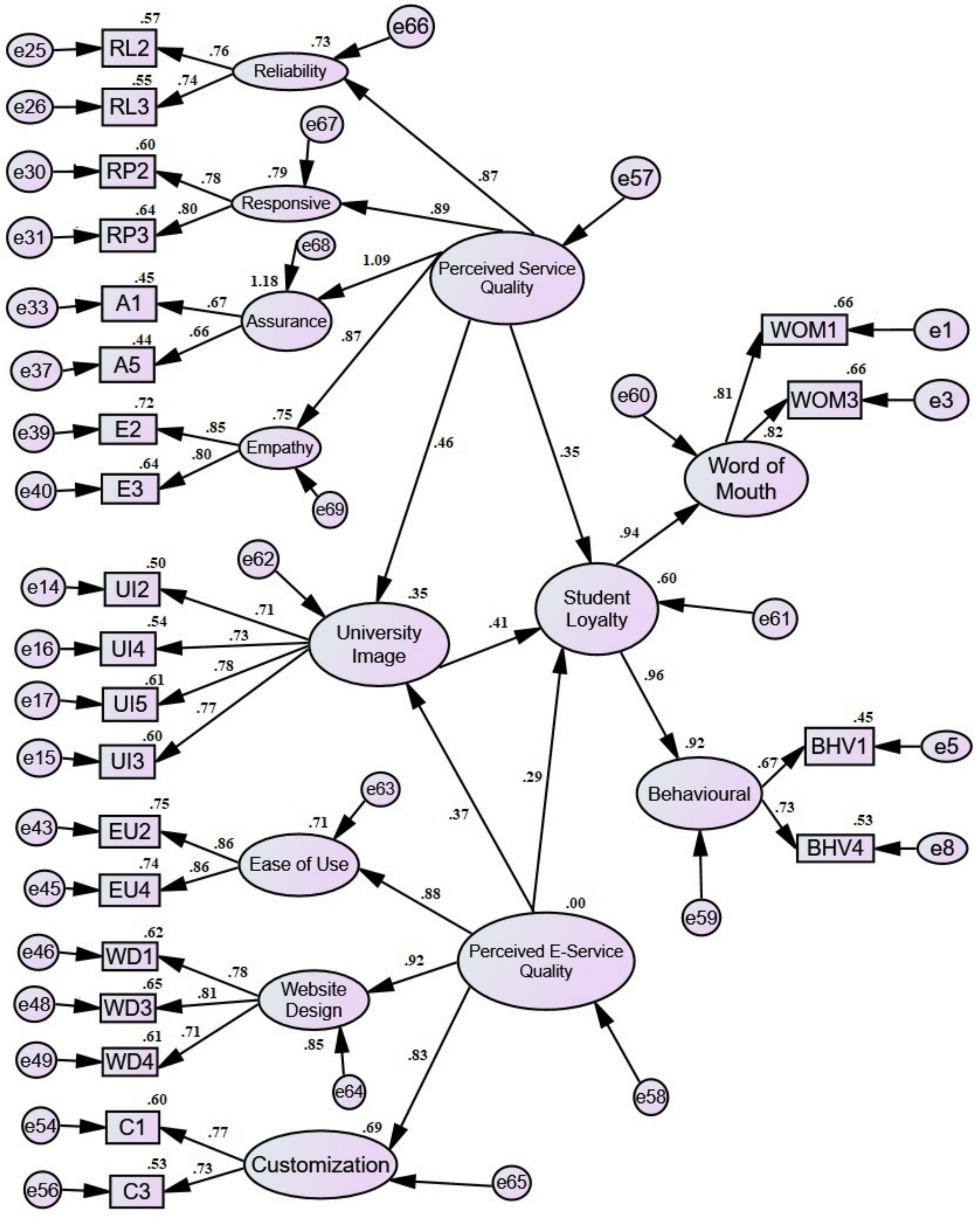

Figure 3. Structural model. RL = reliability; RP = responsiveness; A = assurance; E = empathy; EU = ease of use; WD = website design; C = customization; WOM = word of mouth; BHV = behavioural

The model in Figure 3 has 276 distinct sample moments. 60 parameters were freely estimated. Therefore, the hypothesised model was over-identified with 216 (276-60) degrees of freedom. Note that 216 is less than the sample moments of 276; according to Byrne (2010), an over-identified model is one in which the number of estimable parameters is less than the number of data points (i.e., variances and co-variances of the observed variables). This results in positive degrees of freedom that do not allow rejection of the model.

Table 5 presents a summary of the hypothesized relationships, standard errors of estimates, and *p*-values which were associated with the critical ratios. In this study, the hypotheses were accepted based on *p*-values <0.001 (considering 99.9% confidence interval) (Bagozzi & Yi, 1988).

Table 5

Test of Hypotheses

No.	Determinants & constructs	Expected direction	Beta estimate	*p* value	Result
		Direct relationship			
H_1	Perceived service quality & student loyalty	+ve	0.346	***	Supported***
H_2	Perceived e-service quality & student loyalty	+ve	0.294	***	Supported***
H_3	Student loyalty & university image	+ve	0.413	***	Supported***
H_4	University image & perceived service quality	+ve	0.458	***	Supported***
H_5	University image & perceived e-service quality	+ve	0.372	***	Supported***
		Indirect relationship			
H_6	University image mediates the relationship between perceived service equality & student loyalty				Partial mediation
H_7	University image mediates the relationship between perceived e-service equality & student loyalty				Partial mediation

Note. ***significant at *p*<0.001.

Discussion

The aim of this research was to examine the factors affecting student loyalty in the perspective of perceived service quality, perceived e-service quality, and university image in the context of open and distance learning. In Table 5, it is noted that all hypotheses were confirmed. The first objective of this study is to establish the relationship between perceived service quality and student loyalty, and it is found that the perceived service quality was positively and significantly associated with student loyalty. This finding indicated that a good and quality service delivered would bring benefits and advantage with the students in a long-term relationship and build up the student's loyalty from time-to-time. This finding is consistent with previous studies such as Siddiqi (2011) and Sultan and Wong (2012).

The second objective of this study is to establish the relationship between perceived e-services quality and student loyalty, and the results of the analysis shown that perceived e-service quality has a positive influence on student loyalty. It means that the implementation of effective and efficient activities of perceived e-service quality will increase the level of student loyalty. It is no doubt that the implementation of e-service quality would bring many benefits to the university as it makes the service delivered much faster, more convenient, and more reliable to the students. This finding is in line with Ribbink et al. (2004) and Wantara (2015).

The third objective of this study is to establish the relationship between university image and student loyalty, and it is found that the university image had a positive influence on the student loyalty. This finding indicated that ability to perform activities that projected a good image of the university will lead to higher level of student loyalty and bring confidence to the students that they are in the right path, enrolled in the right institutions and eventually gaining their devotion on long term basis. This finding is in line with past studies such as Bloemer and Ruyter (1998) and Nguyen and Leblanc (2001).

The fourth objective of this study is to establish the relationship between perceived service quality and university image. It is found that the university image had a positive influence on the student loyalty and this finding indicated that the university's ability to perform activities that demonstrated good service quality will influence and lead to a better positive image of the university. A reliable, guarantee and fast service would influence the customers to have higher expectation towards the institution to provide a better and quality service from other educational institutions. This finding is consistent with past studies such as Nguyen and Leblanc (2001) and Helgesen and Nesset (2007).

The fifth objective of this study is to establish the relationship between perceived e-service quality and university image. It is found that the perceived e-service quality had a positive influence on the university image and this shows that the e-service provided in terms of ease of use of the institutions online platform, customization, and good website design would provide a faster and better e-service for the university customer. The usage of digital platform in providing service for the customer is a must in the current business practice including higher education institutions as it is much more convenient and faster, but most importantly, it will save cost and time for the institution's customer. This finding is in line with similar studies (Alves & Raposo, 2010; Khairani & Razak, 2013).

The sixth objective of this study is to establish the mediation effect of the university image between the relationships of perceived service quality and student loyalty. From the finding, it is confirmed that the university image has a partial mediating effect on the relationship between perceived service quality and student loyalty. This finding is important as past literatures only support the significant direct effect between perceived service quality and student's loyalty but the significance of indirect effect of university image remains unexplored. This study provides the empirical evidence that shows the significance of indirect effect of the university image and highlighted the importance of the inclusion of university image as part of the university's competitive business strategy in gaining student support and loyalty (Khairani & Razak, 2013). The effect of university image should not be ignored by the university and it can be an advantage for the university to capitalize the undeniable positive effect in the current competitive business environment.

Finally, the seventh objective of this study is to establish the mediation effect of university image between the relationship of perceived e-service quality and student loyalty. It is found that university image has a partial mediating effect. Past literatures only show the significant direct effect between perceived e-service quality and students' loyalty but the significance of indirect effect of university image is often neglected. This study provides the empirical evidence of the significance of indirect effect of university image and the importance of this effect should not be ignored by the university. Beyond any doubt that e-service would benefit both the service provider and their customer in the current digital era, e-service is meant to increase the effectiveness of the university and eliminate unnecessary cost in serving their students. The significance of university image would indirectly enhance the student loyalty as they perceived that the university provides a quality e-service that would benefit them in the future.

Therefore, by referring back the findings of this study, it is highly potential that the research model contributes to overall service quality of the university. Although this study focuses on the students as the respondent, future research is highly recommended to take survey or opinion of the university staff, parents, and others for a more holistic approach to improve further the university service quality initiative. The focus of this study is not merely concentrated on the part-time students but the students who are working adults that may demonstrate dissimilar behaviour compared to other full-time or part-time students. The research model paved the way and it is highly potential to expand the existing literature in service quality or e-service quality in open and distance learning context.

Conclusion

The research provides useful information to academics, practitioners, and policy makers by showing that service quality is strongly correlated to student loyalty and university image. Various strategies could be implemented to improve service quality. For example, it is recommended that feedback from employees on the reasons for low scores in service delivery be collected and then analysed. Furthermore, it is recommended that service quality be regularly monitored. In addition, training in service delivery is suggested to improve quality. In another perspective, this study opens the way for the university to become more customer oriented rather than product centric or mass product customization.

The university should enhance their current business strategy planning based on the findings of this study and maximize the value created by each student by satisfying their needs. Attaining student loyalty is the main objective of this study as it provides a vital non-financial metric for the university such as student satisfaction, student lifetime value, and student equity.

This research has also shown that a positive university image will likely result in greater student loyalty. When students are proud of their university, they are more likely to convey a positive message when discussing their experiences with other people. Several initiatives that could be undertaken by a university to improve its image include maintaining strong academic and student profiles, using success stories in promotion activities, distributing awards, sustaining good infrastructure and positive ambiance, and associating with like-minded partners, including government agencies such as the Ministry of Higher Education, Malaysia Qualification Agency (MQA), and others higher education institutions that provide open and distance learning mode in the country or in the South East Asia region.

The findings of this study could be used by the administration of open and distance learning universities for further business improvement such as business differentiation strategy to differentiate them from other competitors. Differentiation has now become more difficult and more important for universities as currently many higher education institutions offer the same service and similar academic courses. Moreover, student's loyalty is the key to long term profitability and plays an important role in increasing revenues, and thus service quality is linked to business profits.

The research model is applicable to others public or private agency including higher education institutions who are interested in testing or further expanding the research model with their own discretion. A comparison studies in the country or in the region is also recommended as it might reveal more interesting findings. Future research can use scales to test other theoretical propositions such as satisfaction, retentions, and attritions, which illustrate how the behaviour of consumers or other areas is influenced by the perceived service quality and perceived e-service quality.

This study has reviewed and verified the dimensions of perceived service quality, perceived e-service quality, and university image and student loyalty with quantitative techniques. This was done in the context of OUM students and it would be desirable if any comparison studies can be conducted between part-time students (i.e., working adult and full-time student). It is also suggested that a comparison study to be conducted between public universities and private universities. Another limitation is that this study was cross-sectional so there was no causal relationship that can be claimed, only the association that shows the relationship between the various contributions rendered by the perceived service qualities constructs.

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Does Delivery Model Matter? The Influence of Course Delivery Model on Teacher Candidates' Self-Efficacy Beliefs Towards Inclusive Practices

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Abstract

A causal-comparative research design was used to examine the influence of course delivery (face-to-face flipped or asynchronous online) on participants' self-efficacy beliefs toward teaching in an inclusive classroom. The following research questions were used to guide the study: (a) Is there a relationship between completing an introduction of exceptionalities course and participants' self-efficacy toward teaching an inclusive classroom? (b) Is there a relationship between completing an introduction of exceptionalities course in an asynchronous online or face-to-face flipped format on participants' self-efficacy beliefs toward teaching in an inclusive classroom? The purpose of this study was to explore if there is a relationship between self-efficacy belief development and course delivery models. The results indicated a significant difference in self-efficacy beliefs towards teaching in an inclusive classroom after completing an introduction of exceptionalities course. However, there was no significant difference in the participants' efficacy based on the course delivery model (face-to-face flipped or asynchronous online). Implications and suggestions for future research are discussed.

Keywords: distance education, self-efficacy, teacher education, inclusion

Introduction

A climbing trend in higher education is to offer courses in a variety of delivery formats. In fall 2016, 31.6% of all higher education students in the United States were taking at least one distance education course compared to 26% the previous year. This was the 14th straight year that distance education enrollment experienced an increase (Allen & Seaman, 2017). An implication of this pedagogical movement is that individual program areas are experimenting with distance and hybrid courses in order to meet the demand.

The central tenet of teacher preparation programs is to prepare high-quality special education and general education teachers. Historically, the pathway to becoming a K–12 teacher included enrolling in a college or university for several years while taking a variety of on-campus coursework and engaging in practicum experiences in the local school system. However, institutions are offering more online coursework, and many teacher preparation programs are following suit. This trend in higher education may impact both students who choose to pursue a teaching degree and teacher preparation programs since it deviates from more traditional models.

Considering the trend of growth in distance education, there is a need for teacher preparation programs to ensure that their varied delivery models are indeed effectively equipping their teacher candidates to teach in a variety of educational settings, including inclusive environments. Additionally, the American Association of Colleges for Teacher Education (2013) suggests that teacher preparation programs examine the impact course delivery methods have on teacher beliefs. In response to this need, the present study reviewed the literature involving distance education in higher education, distance education in teacher education, and the development of teacher candidates' self-efficacy beliefs.

The purpose of this study was to explore whether there was a relationship between self-efficacy belief development and course delivery models. The study is guided by the following research questions: (a) Is there a relationship between completing an introduction of exceptionalities course and participants' self-efficacy toward teaching in an inclusive classroom? (b) Is there a relationship between completing an introduction of exceptionalities course in an asynchronous online or face-to-face flipped format on participants' self-efficacy beliefs toward teaching in an inclusive classroom?

Review of the Literature

Distance Education

According to a report on distance education in the United States, distance education enrollments have continued to increase and are growing faster than they have for the past several years (Seaman, Allen, & Seaman, 2018). This enrollment trend is especially important information since overall enrollments in higher education have been on a decline since 2012. Between fall 2015 and fall 2016, the number of students taking at least one distance education course grew by 5.6% (6,359,121), which equals 31.6% of all students. Additionally, 14.9% of students were taking only online courses, and 16.7% were taking a combination of distance and on-campus courses. The number of students not taking any online courses dropped by 6.4% (1,173,805) from 2012 to 2016. During the same time, the number of students not taking distance courses at all declined by 11.2% (1,737,955). As a result of this trend, higher education is implementing various online delivery models across all disciplines.

Delivery models. As distance learning in the United States has become more widespread, universities are offering a wider variety of options in terms of delivery (Severino & DeCarlo, 2017). There are fully online, hybrid, flipped, and face-to-face course options. Fully online models can either be synchronous (i.e., have a regularly scheduled online meeting time) or asynchronous (i.e., self-paced and independent, with instruction delivered in a way that does not require scheduled meeting times). Additionally, some universities merge the asynchronous and synchronous models. Hybrid courses utilize some face-to-face time on campus in addition to asynchronous online learning. A flipped course design commonly reverses the content instruction from the classroom to online. The content is often delivered through online lectures and learning activities, which students complete outside of the scheduled class time. The face-to-face instructional time is spent discussing and applying the concepts learned. Finally, the most traditional model delivers instruction through face-to-face courses delivered on campus, with all of the content taught and applied in the classroom. Couse delivery models involving distance are summarized in Table 1. The face-to-face description is original; all others are from the Commonwealth of Learning (COL; 2015).

Table 1

Descriptions of Distance Learning Delivery Options

Type of course delivery	Description
Fully online (asynchronous)	"learning online at different time and/or place using an online learning platform. Example of asynchronous learning is use of discussion forums and email for learning" (p. 2).
Hybrid, blended	"a teaching and learning approach that demonstrates a blend of different methods, technologies, and resources to improve student learning. Some examples of blended learning are flipped classroom, online interaction followed by face-to-face teaching, online learning supplemented by face-to-face practical" (p. 2).
Face-to-face, flipped	"a form of blended learning where learners read or watch online lecture materials at home, before participating in interaction in a classroom environment" (p. 2).
Mobile learning	"defined as the provision of education and training using mobile devices such as Personal Digital Assistants (PDAs), tablets, smartphones and mobile phones. While learning is not mobile, it is about teaching and learning through use of mobile devices, anywhere, anytime" (p. 3).
Face-to-face	traditional classroom setting where the teacher and students are not separated by physical space or time

Faculty perceptions. There are also significant and salient challenges represented in the literature. University faculty and staff reported that they have ongoing concerns about the workload associated with teaching online (Bollinger & Wasilik, 2009; Wingo, Ivankova, & Moss, 2017); generally faculty would not recommend teaching in an online context to others (Ulmer, Watson, & Derby, 2007), and they struggle with maintaining student engagement within the course (McQuiggan, 2007). Ultimately, many faculty indicated that they miss the engagement and face-to-face interaction with their students that comes with teaching on-campus courses (McQuiggan, 2007).

Student perceptions. The literature varied on the degree of satisfaction and perceptions students have when comparing online to face-to-face courses. Some online students report that they feel a lack of engagement and confess to being minimally involved in the course and with their peers (Dobozy, 2009). Young and Duncan (2014) conducted a study that examined student ratings on 172 online courses and 470 face-to-face courses and found that face-to-face courses were rated significantly higher than online courses in the categories of communication, faculty to student interaction, grading, instructional methods, and course outcomes. Interestingly, the participants showed that student effort was significantly higher for online courses. Overall, students were more satisfied, as measured by student course evaluations or ratings, with face-to-face courses. Other similar studies found parallel results regarding student satisfaction scores between online versus face-to-face courses (Mentzer, Cryan, & Teclehaimanot, 2007; Summers, Waigandt, & Whittaker, 2005). However, there are studies that directly contradict these findings, and they found that students are equally satisfied taking online and face-to-face courses (Horspool & Lange, 2012; O'Neal, Jones, Miller, Campbell, & Pierce, 2007). An additional and significant challenge to the online education trend is that online students have lower graduation rates than face-to-face students (Grau-Valldosera & Minguillon, 2014; Legon & Garrett, 2018).

The benefits of online education options for higher education institutions and their students are documented in extant literature. Online education has been found to promote accessibility to educational opportunities for non-traditional students and those who live in remote regions (Chau, 2010; Robina & Anderson, 2010). Also, students often report valuing the flexibility of online courses so they can pursue their academic career while holding jobs and maintaining personal obligations (Chau, 2010; O'Brien, Hartshorne, Beattie, & Jordan, 2012; Vernon-Dotson, Floyd, Dukes, & Darling, 2014). Studies have found that some online learning models are student-centered (Gilboy, Heinrichs, & Pazzaglia, 2015), increase student engagement (Anderson, 2008; Herrington & Herrington, 2006), and assist in the development of students' technological skills which can be applied in their workplace (Chau, 2010). Another well-established finding is that students can and do learn successfully from coursework in online formats (Means, Toyama, Murphy, Bakia, & Jones, 2009; Rowley & O'Dea, 2014). Cross (1981) posited that adult learners experience three primary types of barriers (situational, institutional, and dispositional) which can block their path to pursue a degree. Online learning has the capacity to remove barriers, particularly for adult learners.

Employer perceptions. Perhaps due to the many challenges facing online education, employers have indicated that they do not perceive online education as credible, or would prefer to hire an applicant who has a degree from a traditional four-year institution (Gaytan, 2009; Grossman & Johnson, 2016; Roberto & Johnson, 2019). Similarly, school administrators who did not have personal experience with online education were also more hesitant to hire teachers whose coursework was primarily taken online (Fogle & Elliott, 2013; Linardopoulos, 2012).

Establishing the Need for Distance Education in Teacher Education

Teacher shortage. The trend towards online teaching and learning in higher education shows no signs of diminishing, therefore, it is imperative to examine the literature on distance education in teacher education. According to Naranjo (2018), the field of teacher education faces two primary and pressing challenges that necessitate the need for teacher preparation programs to innovate by (a) equipping a sufficient number of qualified special education teachers to keep pace with the market demand, and (b) equipping general education teachers to teach students with disabilities in inclusive classrooms. The teacher shortage in the United States is a salient reason why teacher preparation programs are seeking innovative methods to attract future candidates. The teacher shortage has hit especially hard in the areas of special education, science, technology, engineering, and mathematics (Cowan, Goldhaber, Hayes, & Theobald, 2016; Naranjo, 2018). Specifically, the shortage is predominantly in urban and rural locations (Cowan et al., 2016; Milner & Lomotey, 2013). Given the critical need to prepare effective special education teachers, teacher preparation programs are working to increase enrollment while maintaining high-quality programs by offering courses in a variety of delivery models (Caywood & Duckett, 2003; Gillett, Cole, Kingsbury, & Zidon, 2007; Wake & Bunn, 2015). While offering a variety of delivery options may be an effective and innovative way to attract more candidates to the field of education, there are concerns whether online teaching and learning provides the same high-quality learning experiences necessary to successfully prepare teachers as traditional face-to-face courses can (Downing & Dyment, 2013; Fogle & Elliott, 2013; Severino & DeCarlo, 2017).

Most of the literature relating to teacher education and program delivery has focused on student and teacher satisfaction, advantages and disadvantages of the logistical delivery, and descriptions of programs that were developed (Downing & Dyment; 2013; Smith & Kennedy, 2014; Vernon-Dotson et al., 2014). According to Gillett et al., (2007), teacher candidates continue to request online course delivery options because they value the convenience, have potential to individualize and personalize their learning experiences, and can receive prompt feedback. Vernon-Dotson et al. (2014) reviewed the literature regarding course delivery methods related to preparing special education teachers and found 17 studies that were qualitatively analyzed for themes. Their analysis led to the emergence of five major themes: (a) established need (e.g., teacher shortage, recruitment and retention, geographic outreach); (b) effectiveness (e.g., technology, student perceptions, instructor insights); (c) logistics (e.g., time, comfort, flexibility); (d) instructional methods (e.g., interactions, feedback, participation); and (e) critical factors (e.g., instructor quality, evaluation, population). While the need for the purpose behind the studies is clear, what is also needed is to explore the effectiveness of the online delivery model.

Effectiveness in teacher education courses. A study by O'Neal et al. (2007) examined the effectiveness of online learning compared to on-campus instruction by using student achievement and satisfaction data, but found no significant difference in achievement or satisfaction whether the course was offered online or face-to-face. Similarly, Caywood and Duckett (2003) studied the impact an online or face-to-face course on behavior management had on graduate students' academic performance and management skills. They also found no significant difference between the two groups. Dell (2012) conducted a longitudinal study in which she examined the competency level of an online elementary education cohort (n = 67) compared to traditional face-to-face program completers (n = 86) and found that the online cohort demonstrated the same level of competencies as those in the face-to-face program. Another study

(McDonnell et al., 2010) that explored the influence of online and face-to-face coursework on teacher candidates' acquisition of content and their ability to apply the newly learned skills and knowledge in the classroom, found no significant difference between the groups. Vernon-Dotson et al.'s (2014) review of the literature regarding effectiveness between distance and face-to-face courses stated that "no clear differences were noted between studies comparing traditional education to distance education" (p. 41). They went on to affirm that when looking at course delivery, participants did not perform differently, and the degree of satisfaction was virtually the same. According to their work, distance and face-to-face courses were equally effective. The same finding was affirmed in a review of the literature done by Smith and Kennedy (2014).

Scheetz and Gunter (2004) noted that positive outcomes could be attributed to teacher candidates' ability to choose their delivery model based on their learning style and needs. Vernon-Dotson et al. (2014) specified that other critical factors were represented within the literature, but did not directly address the following factors: (a) quality of the instructor, (b) need for a standardized evaluation of online education, and (c) skill sets needed by the diverse populations that were served.

Self-Efficacy

The present study was based on Albert Bandura's (1977) social cognitive theory, which includes the construct of self-efficacy. Self-efficacy is an individual's belief in their ability to perform behaviors that are necessary to complete a specific task (Bandura, 1977). This theory asserts that people learn through observing others complete a task, and behavior is influenced by personal, behavioral, and environmental factors. Self-efficacy beliefs have been strongly linked to teacher performance, and prior research has shown that self-efficacy beliefs are associated with teacher effectiveness, positive student outcomes, and positive attitudes towards teaching in an inclusive setting (Avramidis, Bayliss, & Burden, 2000; Bakar, Mohamed, & Zakaria, 2012; Sharma, Loreman, & Forlin; 2011). These beliefs have also been found to be a strong indicator of teacher candidates' success in their future teaching careers (Chesnut & Burley, 2015). Self-efficacy beliefs are task-specific and begin to develop early on in teacher candidates' preparation (Tschannen-Moran, Hoy, & Hoy, 1998). Since these beliefs are task-specific, it is important that studies are built around specific skills (e.g., inclusive teaching, teaching reading, behavior management).

There has been very little research published on the nature of distance learning and self-efficacy belief development among teacher candidates. Additionally, virtually no research has been conducted on the relationship between course delivery models and teacher candidates' self-efficacy beliefs towards teaching in an inclusive classroom. One of the only studies (Severino & DeCarlo, 2017) linking teacher candidates' efficacy beliefs and distance education involved a course where candidates tutored struggling readers in a field experience in which they were either enrolled in a flipped or a fully online course. Their study explored how the course delivery model influenced the participants' self-efficacy beliefs and their understanding of the structure of the English language. Using the Teacher Efficacy scale (TES; Hoy & Woolfolk, 1993), they found that there was no statistically significant difference between the participants regarding overall TES scores. However, participants in the face-to-face sections of the course showed a significant change between the pre- and post-test scores regarding personal efficacy, which is a subscale of the TES.

Significance of the Study

Several studies have suggested that foundational content such as that covered in an introductory course is often the first taken within teacher preparation programs. If these courses are offered in a quality online format, then they have the potential to increase access to critical and valuable content that will meet the scheduling and access needs of a broad range of teacher candidates (Hughes & Hagie, 2005; Naranjo, 2018). According to Vernon-Dotson et al., (2014), there is limited research and a need for more attention to be given to how teachers are prepared for special education contexts regarding course delivery formats. There is even less research specific to how course delivery impacts teacher candidates' self-efficacy beliefs towards teaching in an inclusive classroom. Therefore, it is important for teacher preparation programs to evaluate the impact various course delivery models have on the development of teacher candidates' self-efficacy beliefs (Vernon-Dotson et al., 2014). This study seeks to determine if course delivery (face-to-face flipped or asynchronous online) impacts participants' self-efficacy beliefs towards teaching in an inclusive classroom.

Method

A causal-comparative research design was used to examine the influence of course delivery (face-to-face flipped or asynchronous online) on participants' self-efficacy beliefs toward teaching in an inclusive classroom. The following research questions were used to guide the study: (a) Is there a relationship between completing an introduction of exceptionalities course and participants' self-efficacy toward teaching an inclusive classroom? (b) Is there a relationship between completing an introduction of exceptionalities course in an asynchronous online or face-to-face flipped format on participants' self-efficacy beliefs toward teaching in an inclusive classroom?

Participants

The participants in this study were undergraduate students who enrolled in an introduction of exceptionalities course at a mid-size university located in the Midwest US. The participants self-selected into the course delivery model they preferred. Most of the participants were not admitted into the teacher preparation program but were pursuing the academic path to gain admittance to teacher education. The demographics of the participants are represented in Table 2.

Table 2

Participant Demographics (N = 100)

Description	Frequency	Percentage
Gender		
Male	16	16%
Female	83	83%
Other	1	1%
Age		
17–19 years	72	72%
20–22 years	21	21%
23–25 years	3	3%
25–30 years	4	4%
30 years and up	0	0%
Major area		
Early childhood education	6	6%
Elementary education	34	34%
Secondary education (minor)	27	27%
Special education	11	11%
Elementary/early childhood (dual)	4	4%
Elementary/special education (dual)	11	11%
Other	6	6%
Non-licensure	1	1%
Class standing		
Freshmen	51	51%
Sophomore	32	32%
Junior	10	10%
Senior	6	6%
Data missing	1	1%
GPA		
4.0–3.5	46	46%
3.4–3.0	29	29%
2.9–2.5	22	22%
below 2.5	3	3%

Courses

There were five sections of the course; two were taught in a face-to-face flipped model and the other three were taught asynchronously online. All sections were taught by two adjunct instructors, one of them being the researcher for this study. Each section was built from a master course to ensure uniformity of content, assignments, and assessments. The course incorporated lectures and activities, including topics pertaining to special education such as (a) history, (b) legislation, (c) collaboration, (d) identification, (e) evaluation, (f) educational programming, (g) continuum of placements, (h) related services, and (i) a variety of disabilities categories. The key differences between the two delivery formats were that participants in the flipped classroom met twice a week to engage in discussions, apply what they had learned, and participate in group projects. Participants in the asynchronous online sections held online discussions with their peers and completed all their assignments individually.

Instrumentation and Data Collection

Data were collected using a pre-existing and validated self-report survey called the Teacher Efficacy for Inclusive Practices (TEIP) scale (Sharma et al., 2011) and a 13-item demographic questionnaire. Data collection occurred at the beginning and end of the course, but since one of the course instructors was also the researcher, the analysis did not begin until the course was finished and final grades were posted. The study received institutional review board approval before data collection began.

The TEIP is made up of 18 items about the participants' perception of their ability to effectively perform inclusive teaching practices. All 18 statements were assessed through a 6-point Likert item scale consisting of *strongly disagree*, *disagree*, *disagree somewhat*, *agree somewhat*, *agree*, and *strongly agree*. The highest possible score on the scale was 108, which indicates a very high sense of self-efficacy toward teaching in an inclusive classroom, and the lowest possible score was 18, which indicates a very low sense of self-efficacy toward the specific task. The TEIP scale is made up of three subscales that each have six items. The three subscales are (a) efficacy to use inclusive instruction (EII); (b) efficacy in collaboration (EC); and (c) efficacy in managing behavior (EMB). The three subscales are valuable because they provide a more detailed understanding of specific tasks in which participants feel efficacious, or the lack thereof, in performing.

Table 3

Teacher Efficacy for Inclusive Practices (TEIP) Scale Questions

TEIP questions
1. I can make my expectations clear about student behavior.
2. I am able to calm a student who is noisy or disruptive.
3. I can make parents feel comfortable about coming to school.
4. I can assist families in helping their children do well in school.
5. I can accurately gauge student comprehension of what I have taught.
6. I can provide appropriate challenges for very capable students.

7. I am confident in my ability to prevent disruptive behavior in the classroom before it occurs.
8. I can control disruptive behavior in the classroom.
9. I am confident in my ability to get parents involved in school activities of their children with disabilities.
10. I am confident in designing learning tasks so that the individual needs of students with disabilities are accommodated.
11. I am able to get children to follow classroom rules.
12. I can collaborate with other professionals (e.g., teachers, related service providers) in designing educational plans for students with disabilities.
13. I am able to work jointly with other professionals and staff (e.g., teacher assistants, other teachers) to teach students with disabilities in the classroom.
14. I am confident in my ability to get students to work together in pairs or small groups.
15. I can use a variety of assessment strategies (e.g., portfolio assessment, modified tests, performance-based assessment, etc.).
16. I am confident in informing others who know little about laws and policies relating to the inclusion of students with disabilities.
17. I am confident when dealing with students who are physically aggressive.
18. I am able to provide an alternate explanation or example when students are confused.

Sharma et al. (2011) reported that the content validity of TEIP was confirmed by six other faculty members, excluding the developers, who were identified as authorities in educational psychology and inclusive education. Additionally, the instrument was used in follow up studies results indicate that the TEIP scale is valid and reliable (Malinen, Savolainen, & Xu, 2012; Savolainen, Engelbrecht, Nel, & Malinen, 2012).

Results

A paired samples *t* test was conducted to analyze the data for research question one: Is there a relationship between completing an introduction of exceptionalities course and participants' self-efficacy toward teaching an inclusive classroom? The results indicated that the mean for the pre-TEIP survey (M = 78.11, SD = 13.82) was significantly lower than the mean of the post-TEIP survey (M = 91.30, SD = 9.80); $t(98)$ = 4.52, $p < .05$. The standard effect size index, Cohen's d, was 1.10, which indicated a considerable and consistent difference on the 6-point Likert ratings on the pre- and post-TEIP survey. The 95% confidence interval for the mean difference between the two surveys was -15.96 to -10.42. Therefore, the participants reported a higher sense of efficacy after completing an introduction of exceptionalities course.

An independent-samples *t* test was used to analyze the data for research question two: Is there a relationship between completing an introduction of exceptionalities course in an asynchronous online or face-to-face flipped format on participants' self-efficacy beliefs toward teaching in an inclusive classroom?

The results in Table 3 show that participants' sense of self-efficacy did not significantly differ between delivery models (face-to-face flipped, n = 48 and asynchronous online, n = 52).

Table 4

Mean Differences in Efficacy for Preservice Teachers on TEIP Depending on Delivery Format

Survey instrument	Asynchronous online		Face-to-face flipped		Cohen's *d*	
	M	*SD*	*M*	*SD*	*T*	*d*
TEIP	91.04	8.26	91.58	11.31	.08	.78

Note. $^*p < .05$.

Discussion and Conclusions

Prior literature in the domain of teacher education and delivery models has primarily explored the outcomes of satisfaction, logistical delivery, and program descriptions. Therefore, there is little to no prior literature that has explicitly explored the influence of the delivery model on teacher candidates' self-efficacy beliefs toward teaching in an inclusive classroom. Since the literature is scant, it is difficult to compare differing constructs (e.g., self-efficacy beliefs to the level of course satisfaction). However, the results of this study support the findings of Severino and DeCarlo's (2017) study in that overall self-efficacy scores did not significantly change between pre- and post-test after participating in coursework.

Limitations of the Study

Data collection occurred during a single semester, so only one set of participant responses was analyzed; therefore, a richer understanding of the results and implications could be gained if data collection occurred longitudinally. In addition, the results may not be generalizable to other institutions that greatly vary in terms of demographics. Additionally, responses to the survey were self-reported; such responses may provide opportunity for some participants to answer how they believe they should or to answer carelessly (Northrup, 1997).

Data were collected from five sections of the same course that were taught by two different instructors. While the sections were built from a master course in order to maintain uniformity, variances between the instructors' teaching styles, personality, and content delivery could have played a role in belief development. It is challenging to account for how qualitative differences in the instructors influenced the participants' perceptions and experience of each course and its content.

Implications for Teacher Education

Since completing an introduction of exceptionalities course was shown to significantly and positively influence participants' self-efficacy beliefs toward teaching in an inclusive classroom, it is recommended that teacher preparation programs be mindful of the value and necessity of similar courses in their curriculum. Offering such courses is particularly important for candidates who are early in their preparation because Bandura (1977) posited that self-efficacy beliefs are often difficult to change once they have been established. Since the participants in this study were early in their teacher preparation coursework, their beliefs were likely just beginning to form and were highly malleable. Considering the strong, positive change in self-efficacy scores, it is recommended that teacher preparation programs continue to offer introductory coursework early in the preparation process so beliefs can continue to develop. Petty, Good, and Putnam (2016) posited that the first step in addressing issues within teacher preparation is to ensure that teacher candidates receive substantive courses in special education, and special attention should be paid to the content of foundational courses.

The primary goal of the study was to determine if efficacy beliefs towards the specific task were influenced based on the course delivery (asynchronous online or face-to-face flipped). Since there was no significant difference between the two delivery methods, it is recommended that teacher preparation programs consider how to meet the needs of current and future teacher candidates as represented within the extant literature. It has been suggested that how foundational courses are delivered is as important as the content of the courses (Petty et al., 2016). Making these courses available to teacher candidates in a variety of formats has the potential to meet the scheduling and accessibility needs of a diverse group of teacher candidates (Petty et al., 2016). Additionally, teacher preparation programs are more likely to make a positive impact on the national teacher shortage if they are willing to fulfill the needs of the future workforce by providing course delivery options that are convenient, and allow candidates to personalize their learning and receive prompt feedback (Gillett et al., 2007; Hughes & Hagie, 2005).

In consideration of the delivery format, alternative pedagogical strategies should be employed as the complexity of the course curriculum evolves. One of the primary tenets of self-efficacy is that it is developed through observation of someone modeling the task (Bandura, 1977). Dyment, Downing, and Budd (2013) asserted that two major concerns facing online education within teacher education are the challenges of modeling effective teaching strategies and the difficulty in an online setting for instructors to be explicit with candidates about pedagogical choices while teaching. These are salient concerns that have the potential to directly impact candidates' self-efficacy to instructional tasks. However, it is recommended that instructors who teach methods courses in an online format should not strive to duplicate what is occurring in a face-to-face setting; rather, they should find alternative ways to achieve the same outcomes. This will likely mean using alternative pedagogical strategies and employing a variety of techniques that support the learning goals. There are indicators from other studies that with more experience teaching online, it is possible to achieve effective results (Fish & Gill, 2009; Robina & Anderson, 2010).

Suggestions for Future Research

There continues to be a pressing need for more research exploring the impact of course delivery models on teacher candidates' beliefs towards inclusion and teaching. The future research suggestions include exploring the relationship between varying outcomes, demographic trends between candidates who select certain delivery models, and the outcomes of varying levels of courses.

First, since the prior literature has frequently explored factors such as degree of satisfaction and achievement between delivery models, it would be helpful to have a better understanding of whether there is a relationship between student satisfaction with the course and self-efficacy, or student achievement and self-efficacy. Being able to determine the relationship between varying factors and self-efficacy could provide teacher preparation programs and teacher education with more information about programmatic or instructional choices. Since instructional methods used in distance education vary greatly, developing a more comprehensive understanding of the interaction between variables could have a significant impact on student learning outcomes, and allow teacher educators to identify and implement best practices specifically for distance education (Vernon-Dotson et al., 2014).

Another future research need is for studies to explore the demographics of teacher candidates who self-select into specific course delivery models. It is likely that candidates have specific learning preferences, dispositions, or circumstances that encourage them to choose between face-to-face or online courses. As commonly noted, distance education is a convenient option for non-traditional students because it allows them to pursue their education with flexibility, which is critical if they are balancing coursework and a complex schedule. One study noted that traditional undergraduate students felt that online course work was difficult and time-consuming, while non-traditional students indicated that they felt more comfortable in that educational setting (O'Brien et al., 2012). Understanding the demographic trends of students who opt-in for specific delivery models would enable educators to better meet students' needs.

The final future research suggestion is to explore the influence a delivery model has on varying types of courses (e.g., introductory, theory, methods, practicum) in relation to self-efficacy development. In a review of literature on course delivery methods for preparing special education teachers, the researchers found that the vast majority of distance education courses were introductory courses (Vernon-Dotson et al., 2014). Since teacher preparation programs are increasingly using distance education as a tool to recruit greater numbers and more diverse candidates, it is important that the implications of this strategy are more fully understood. This need is particularly important since self-efficacy is heavily influenced by modeling. Additionally, as Bore (2008) cautioned, "it is critical however, that teacher preparation programs do not sacrifice the quality of their course content for the sake of convenience" (p. 8). Since distance education is a growing trend in higher education, is it imperative that teacher education departments continue research that will explore the influence of course delivery on teacher candidates and their preparation.

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A Meta-Analysis of Scaffolding Effects in Online Learning in Higher Education

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Abstract

The significance of scaffolding in education has received considerable attention. Many studies have examined the effects of scaffolding with diverse groups of participants, purposes, learning outcomes, and learning environments. The purpose of this research was to conduct a meta-analysis of the effects of scaffolding on learning outcomes in an online learning environment in higher education. This meta-analysis included studies with 64 effect sizes from 18 journal articles published in English, in eight countries, from 2010 to 2019. The meta-analysis revealed that scaffolding in an online learning environment has a large and statistically significant effect on learning outcomes. The meta-cognitive domain yielded a larger effect size than did the affective and cognitive domains. In terms of types of scaffolding activities, meta-cognitive scaffolding outnumbered other types of scaffolding. Computers as a scaffolding source in an online learning environment were also more prevalent than were human instructors. In addition, scholars in the United States have produced a large portion of the scaffolding research. Finally, the academic area of language and literature has adopted scaffolding most widely. Given that effective scaffolding can improve the quality of learning in an online environment, the current research is expected to contribute to online learning outcomes and learning experiences.

Keywords: scaffolding, online learning, higher education, meta-analysis, effect size

Introduction

Online learning has become prevalent in higher education with increasing numbers of students taking online courses (Seaman, Allen, & Seaman, 2018). Despite the rapid growth of online learning, approximately 23% of students were concerned about the "quality of instruction and academic support" for online courses in higher education (BestColleges, 2019, p. 9). A MOOC instructor survey (Doo, Tang, Bonk, & Zhu, 2020) indicated the significance of appropriate academic support and the need to implement effective instructional strategies, such as scaffolding, to enhance the quality of learning in an online learning environment.

Wood, Bruner, and Ross (1976) defined scaffolding as a "process that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts" (p. 90). The first author's favorite metaphor for scaffolding is that of teaching a child how to ride a bike. At first, when a learner starts pedalling, an assistant needs to hold onto the bike seat firmly because the child may lose control. Next, while the learner is learning how to balance on the bike, the assistant needs to alternate between holding on to and releasing the bike seat as learning progresses. Finally, once the learner has a sense of balance, the assistant should let go of the bike, a step known as fading. This process is similar to teaching using small steps, called scaffolding.

Scaffolding has received considerable attention as an effective instructional strategy because it helps students engage in learning and enhances learning outcomes (Belland, Walker, Kim, & Lefler, 2017). Due to increasing interest in scaffolding as an instructional strategy, many scholars have researched this process; however, the research findings, to date, have been inconsistent and even conflicting. For example, Gašević, Adesope, Joksimović, and Kovanović (2015) found that conceptual scaffolding has positive effects in asynchronous online discussions, whereas Barzilai and Blau (2014) reported that conceptual scaffolding had little or no significant effect on learning. One way to synthesize these inconsistent research findings is to conduct a meta-analysis of the literature. Glass (1976) first introduced this approach and defined it as "the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings" (p. 3). The purpose of a meta-analysis is to combine data from several individual studies to summarize or identify the common effects and to assess the dispersion among the findings (Borenstein, Hedges, Higgins, & Rothstein, 2009; Glass, 1976).

Numerous scholarly studies have investigated the effects of scaffolding on learning outcomes including meta-analysis studies to examine the effects of scaffolding (e.g., Belland et al., 2017; Kim, Belland, & Walker, 2018). However, previous studies have only focused on a particular subject matter (i.e., STEM) or specific scaffolding sources, such as computer-based scaffolding. In addition, few studies have examined the influence of scaffolding on undergraduate and graduate students (i.e., higher education) in online learning environments. According to Brown et al. (2020), recent trends in higher education include (a) increased student diversity, (b) alternative pathways to education, and (c) the sustainable growth of online education. These three trends are not mutually exclusive; rather, they are interconnected. As student populations become more diverse and require alternative ways to learn, there is an increasing need for online learning in higher education. Despite the proliferation of online learning in higher education and the significance of scaffolding on learning, there is a lack of scaffolding research exclusively focused on higher education contexts. In response, this study examined the effects of scaffolding on learning outcomes in online courses in higher education by conducting a meta-analysis of the existing research.

Literature Review

Definition and Characteristics of Scaffolding

Based on the definition of scaffolding by Wood et al. (1976), the three distinctive features of scaffolding include (a) contingency, (b) intersubjectivity, and (c) transfer of responsibility (Belland, 2017; Pea, 2004). Contingency refers to the need for an ongoing assessment of students' abilities with specific tasks so the teacher can provide scaffolding activities. It also requires instructors to provide scaffolding activities at appropriate times. Belland (2014) viewed these scaffolding activities as providing temporary support for learners.

Intersubjectivity often refers to a temporary shared collective understanding or common framework among learners or problem-solving participants. As teams or groups of learners find common ground (Rogoff, 1995) or experience episodes of shared thoughts (Levine & Moreland, 1991), they can more easily exchange their evolving ideas, build or augment new knowledge, and negotiate meaning (Bonk & Cunningham, 1998). Explicit displays of shared knowledge such as that found in discussion forms, wikis, social media, and collaborative technologies should foster participant intersubjectivity and perspective taking (Bonk & Cunningham, 1998). Teams and groups of learners with enhanced levels of intersubjectivity should be able to identify solutions to problems for successful learning. Finally, transfer of responsibility means that scaffolding must encourage learners to take responsibility for or ownership of learning from those who provide scaffolding (i.e., instructors or peers). To satisfy the purpose of scaffolding, learners should eventually be able to perform tasks independently. Thus, transfer of responsibility emphasizes the importance of reducing scaffolding activities (i.e., withdrawing support) over time.

Critical questions to ask when designing scaffolding activities as an instructional strategy include "what to scaffold, when to scaffold, how to scaffold and when to fade scaffolding" (Lajoie, 2005, p. 542). In terms of what to scaffold, Hannafin, Land, and Oliver (1999) divided the types of scaffolding into four categories: (a) conceptual scaffolding helps learner identify essential themes and related knowledge; (b) meta-cognitive scaffolding helps learners monitor and reflect on the learning process; (c) strategic scaffolding provides alternative ways to work on a task; and (d) procedural scaffolding helps learners use resources and tools for learning, such as providing an orientation to system functions and features. The reported effect sizes of the four types of scaffolding have varied widely. Kim et al. (2018) found small-to-moderate effect sizes for meta-cognitive (g = 0.384) and strategic scaffolding (g = 0.345) on students' learning outcomes in science, technology, engineering, and math (STEM) learning. However, unlike meta-cognitive and strategic scaffolding, the effect size of conceptual scaffolding (g = 0.126) was small. They explained that the different effect sizes of the three types of scaffolding may result from greater requirements, in problem solving, for meta-cognitive and strategic types of scaffolding than for conceptual scaffolding. These results imply that instructors need to consider the influential factors affecting learning outcomes when providing scaffolding activities, such as the types of learning and characteristics of learners.

The type of scaffolding also depends on who provides scaffolding (e.g., instructors, tutors, or peers) and the technology used, such as intelligent tutoring systems including computers or artificial intelligence (Belland, 2014; Kim & Hannafin, 2011). In the past, teachers and tutors have been the primary designers of scaffolding activities, but technologies such as computers have recently grown in popularity as alternative sources to assist with learning (Devolder, van Braak, & Tondeur, 2012). Recent emerging technologies, such as artificial intelligence and learning analytics using big data, have made a quantum leap in computer-based scaffolding. Jill Watson, the world's first artificially intelligent (AI) teaching assistant developed at Georgia Tech University, is a cutting-edge example of computer-based scaffolding (Maderer, 2017). Jill Watson was a popular teaching assistant because of her kind and prompt replies to students' inquiries throughout the semester. At the end of the semester, students were surprised to learn that she was a chatbot invented by their instructor Professor Goel (McFarland, 2016). Like Jill Watson, AI-based teaching assistants are expected to be more widely adopted in higher education to facilitate learning as an alternative to human instructors or teaching assistants (Maderer, 2017).

By considering the core characteristics of scaffolding (i.e., learning diagnosis, fading, and contingent supports to learners) educators come to understand when to scaffold and when to fade scaffolding. In principle, all scaffolds are gradually removed depending on the learners' level of development. Diagnoses such as dynamic assessment and monitoring learners' understanding while conducting tasks or solving problems can capture relevant data (Lajoie, 2005), and provide basic information to determine the needs for the scaffolding. However, dynamic assessment of learning processes and the consequences of faded scaffolding has not been explored sufficiently in the context of online learning; so far, research has indicated mixed effects on learning outcomes (Ge, Law, & Huang, 2012). For example, Wu and Pedersen (2011) found that students who received faded computer-based procedural scaffolds did not perform well in science inquires. Belland, Walker, Olsen, and Leary (2015) reported larger effects of scaffolding with no fading.

Scaffolding strategies have been more rigorously designed and implemented in the cognitive learning domain than in other domains, and many researchers have reported on its learning effectiveness (Proske, Narciss, & McNamara, 2012; van Merriënboer & Kirschner, 2012). In particular, Belland et al. (2017) analyzed 144 experimental studies examining the effects of computer-based scaffolding on STEM learners' cognitive learning and reported a small-to-moderate effect size (g = 0.46). Although the effect size was shown to be just small to moderate, the effects of scaffolding on cognitive learning were statistically significant.

Scaffolding in Online Learning

It is predicted that online learning will continue to rapidly increase in higher education in the coming decade (Blumenstyk, 2018), particularly because online learning environments typically provide access to learning resources, tools, and communication media wherever students live and travel. Importantly, providing a sufficient infrastructure that enables easy and convenient access to these tools for learning across a university or institution can promote flexible and self-directed learning. For example, the rapid growth of MOOCs has accelerated the growth of online learning options and educational opportunities to satisfy learners' motivation and needs (Milligan & Littlejohn, 2017). Students have been provided more learning opportunities without restrictions, thanks to technology advancements. However, recent surveys and research findings have identified concerns about online learners including low learning engagement and low-quality instruction (Doo et al., 2020). To enhance online learning outcomes, learners need appropriate instructional support such as timely and appropriate scaffolding that encourages learners to construct their own knowledge in the online learning environment (Oliver & Herrington, 2003) which, in turn, makes learning more meaningful and engaging.

Several recent studies have explored the effects of scaffolding in online learning in different countries. Ak (2016) examined the effects of computer-based scaffolding in problem-based online asynchronous discussions in Turkey. The findings indicated that students in scaffolding groups were qualitatively and quantitatively more productive in message posting and in communication than the non-scaffolding group. Ak's study also reported that simple types of scaffolding, such as message labels and sentence openers in asynchronous discussions, facilitated students' task-related interaction. Ak concluded that technology-based scaffolding in a problem-based online asynchronous discussion enhances students' task orientation and facilitates task-related learning activities.

More recently, Kim and Lim (2019) compared the effects of supportive (i.e., conceptual) and reflective (i.e., meta-cognitive) scaffolding on problem-solving performance and learning outcomes in online ill-structured problem solving in Korea. The results indicated that the reflective scaffolding group outperformed the supportive scaffolding group in problem-solving performance and learning outcomes. The authors also found that there was a significant interaction between the type of scaffolding employed and the meta-cognitive effects in an online learning environment.

Yilmaz and Yilmaz (2019) also examined the effects of meta-cognitive support using a pedagogical agent on task and group awareness in computer-supported collaborative learning. Their findings indicated that meta-cognitive support using a pedagogic agent positively influenced the learners' motivation, meta-cognitive awareness, and group processing. Given the pervasive and ubiquitous global influence of online learning today across every educational sector in every region of the world (Bonk, 2009), it is necessary to examine the effects of scaffolding as an instructional strategy to enhance learning outcomes in online learning.

The current research aimed to synthesize the effects of scaffolding strategies on learning in online learning in higher education using a meta-analysis approach. The specific research questions explored here are as follows:

1. What is the effect of scaffolding on learning outcomes in an online learning environment?
2. To what extent do the effects of scaffolding influence learning outcomes based on the scaffolding purposes and sources?

Method

Borenstein et al. (2009) explained that the primary purpose of conducting a meta-analysis is "to synthesize evidence on the effects of intervention or to support evidence-based policy or practice" (p. xxiii). The strength of a meta-analysis is the generalizability of the topics and themes of interest as a result of synthesizing the findings across numerous research studies.

Search Process

To conduct this meta-analysis, we selected studies that explored the effects of scaffolding on learning in an online learning environment in higher education. To address our two primary research questions, we established inclusion criteria for the literature search to identify eligible studies. The inclusion criteria reflected the overriding purpose of the research and associated research questions (Lipsey & Wilson, 2001). We set the inclusion criteria in terms of the main theme and outcome variables of the research, publication period, publication language, and eligibility of the meta-analysis (Berkeljon & Baldwin, 2009).The specific inclusion criteria for the studies were as follows: (a) examined the effects of scaffolding; (b) written in English; (c) published since the start of 2010; (d) confined to an online learning environment; (e) implemented in a higher education setting; (f) employed rigorous research designs; (g) focused on undergraduate or graduate students in higher education; (h) measured learning outcomes quantitatively with test results, student self-reports, activities, or observation; and (i) included sufficient information for effect-size calculations (e.g., means, standard deviations, F values, t-test results, or correlations).

The literature search was conducted using a combination of a computer-based database search and manual search of major relevant journals. The following scholarly electronic databases specializing in the education field were searched using keywords: Academic Search Complete, Education Source (EBSCOhost), ERIC (ProQuest), PsycINFO, JSTOR (ProQuest Dissertation & Theses), and Google Scholar. In addition, we conducted a manual literature search of top-tier journals for studies on online learning and distance education, educational technology, educational psychology, and higher education to reduce the possibility of missing eligible studies in the database search. A combination of the following keywords was used to search the various sources: (a) scaffolding; (b) scaffolds or prompt; (c) online learning or distance education; (d) undergraduates, graduates, or higher education; and (e) learning outcomes or learning achievement. We limited the literature search to the years 2010 through 2019 to reflect more contemporary research trends on scaffolding and online learning. The literature search yielded 64 eligible examples of effect size studies from 18 relevant articles published between 2010 and 2019. The search and exclusion process is illustrated in Figure 1.

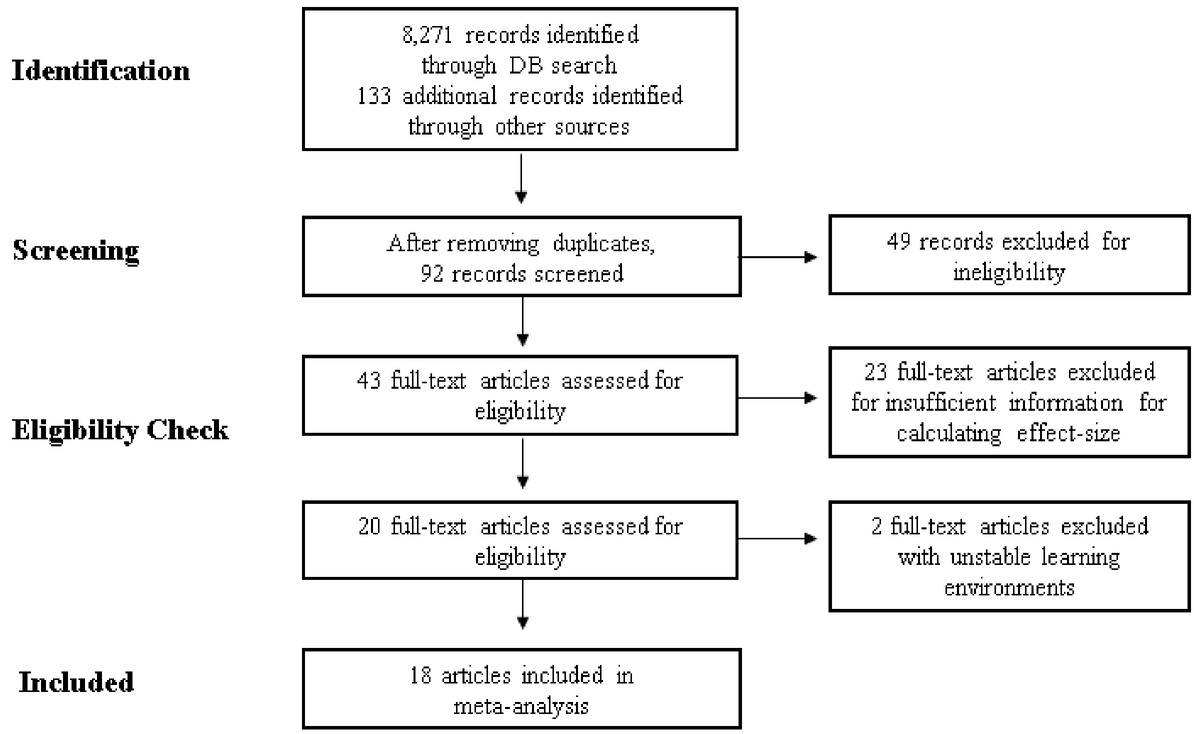

Figure 1. Search and exclusion process.

Coding Scheme

From the 18 articles, we extracted information on four types of variables: (a) independent, (b) moderating, (c) dependent, and (d) other variables (see Table 1).

Table 1

Coding Information for Meta-Analysis

Type of variable	Variable category	Sub-Category coding
Independent variable	Scaffolding	Control group or treatment group
Moderating variables	Scaffolding purposes	Conceptual, meta-cognitive, strategic, or procedural
	Scaffolding sources	Computers, instructors, or peers
Dependent variable	Learning outcomes	Effect sizes (sample size, mean, correlation, p-value, and F- or t-values) Types of learning outcomes (cognitive, meta-cognitive, or affective)
Other variables	Publication	Title, author, year, and name of journal
	Research design	Experimental, quasi-experimental, pre-experimental, or non-experimental
	Learning disciplines	Language and literature, science, education, communication, computing, and others

Each category of variable was coded using sub-categories (Table 1). First, the learning outcomes variable was coded using the three types of learning outcomes, namely cognitive, meta-cognitive, or affective (van de Pol, Volman, & Beishuizen, 2010). The cognitive domain of learning includes context knowledge and the development of intellectual skills (Anderson & Krathwohl, 2000). The meta-cognitive domain of learning refers to knowledge about one's own cognitive processes of monitoring and controlling thoughts (Flavell, 1979; Gagné, Briggs, & Wager,1988). The meta-cognitive domain includes self-regulation, referring to "a learner's cognitive, behavioral, and emotional mechanisms for sustaining goal-directed behavior" (Richey, 2013, p. 278). Finally, the affective domain of learning refers to students' feelings or psychological states during the learning process, such as emotions, motivations, values, satisfaction, and attitudes (Anderson & Krathwohl, 2000).

The scaffolding purposes in this research were coded following the four types of scaffolding outlined by Hannafin et al. (1999), namely (a) conceptual scaffolding, (b) meta-cognitive scaffolding, (c) strategic scaffolding, and (d) procedural scaffolding. If there were more than two scaffolding purposes (e.g., meta-cognitive and procedural scaffolding) in one study, rather than count both purposes, the more frequently used purpose was coded. We classified the research designs of the studies into four groups: (a) experimental design (e.g., pre-test/post-test control group design or post-test-only control group); (b) quasi-experimental research design (e.g., multiple time-series design, non-equivalent control group design); (c) pre-experimental (e.g., one-group pre-test/post-test design); and (d) non-experimental design or correlational studies (Campbell & Stanley, 1963).

Publication data. The 64 effect size studies came from 18 peer-reviewed scholarly articles published in English; the predominant number of studies were published in 2014 (25.0%) and 2010 (15.6%). From 2010 to 2019, scholarly articles that met our inclusion criteria were published annually except in 2011 (see Table 2).

Table 2

Number of Effect Size Studies and Associated Journals

Journal name	# of studies (% of total)
Instructional Science	11 (17.2%)
Interdisciplinary Journal of Problem-Based Learning	10 (15.6%)
Computers & Education	9 (141.1%)
Educational Technology Research and Development	6 (9.4%)
Journal of Adolescent & Adult Literacy	5 (7.8%)
Journal of Research in Reading	5 (7.8%)
Educational Technology & Society	4 (6.3%)
Internet & Higher Education	4 (6.3%)
Journal of College Science Teaching	3 (4.7%)
British Journal of Educational Technology	2 (3.1%)
Journal of Moral Education	2 (3.1%)
Journal of Online Learning and Teaching	2 (3.1%)
Australasian Journal of Educational Technology	1 (1.6%)

Studies using an experimental design (67.2%) far outnumbered those using a quasi-experimental design (26.6%). The types of research design included randomized post-test control group design (54.7%), pre-test and post-test design (25.0%), and repeated measure design (3.1%).

Participants and settings. Overall, the sample studies involved 4,852 participants with 71.82 participants ranging from 31 to 158. The ages of the participants ranged from 18 to 33.2 years with a mean age of 21.57 (*SD*: 3.45). Highlighting the popularity of scaffolding research around the world, the sample studies were conducted in eight different countries, including the US (42.2%), Canada (14.1%), Turkey (12.5%), Taiwan (10.9%), Germany (7.8%), Greece (6.25%), the Netherlands (3.13%), and South Korea (3.13%). The studies were set in a diverse range of disciplines across several learning domains, including language and literature (e.g., vocabulary, writing, language; 25.0%), science (e.g., physics, biology, energy; 17.2%), education (e.g., instructional design, educational psychology; 18.8%), clinical communications (15.6%), computing (12.5%), health and medical (7.8%), and economics (3.1%).

Scaffolding. In terms of scaffolding purposes, meta-cognitive scaffolding (60.9%) was the primary reason for providing scaffolding, followed by procedural scaffolding (23.5%), conceptual scaffolding (7.8%), and strategic scaffolding (7.8%). As a scaffolding source, computers or embedded systems (68.8%), outnumbered instructors (23.4%), and peers (7.8%). The range of scaffolding periods also varied widely in these studies from 80 minutes to 10 weeks. Some studies in the sample came from independent courses, contributing to the individual differences in the periods. Learning outcomes were classified into three domains: affective domain (14.1%), cognitive domain (64.0%), and meta-cognitive domain (21.9%). Notably, more than 60% of these studies measured cognitive learning outcomes.

Once the coding scheme was confirmed by all the authors of this research, only the first author did the actual coding. To compensate for the weakness of a single coder, coding was completed twice with a time lapse interval (i.e., five months) to ensure coding reliability. In the second round of coding, four wrongly coded items were found and corrected.

We followed the random effects model because a fixed effect model has two key assumptions and associated limitations (Borenstein et al., 2009). First, the purpose of using a fixed-effects model is to calculate the effect size of the given samples, so it does not generalize to multiple populations. Second, a fixed-effects model assumes that the true effect size of each sample is the same if it is error-free. Given the limitations of these assumptions, the random effects model was better suited for this research since the sample studies were not identical in the number of participants and their mean ages; academic disciplines, countries, and research design varied as well.

As a result, to calculate the effect sizes, we used Hedges's *g*, an estimator of the effect size (Hedges & Oklin, 1985). The standardized mean difference among the groups, Cohen's *d*, was obtained to determine the outcome measures in each study. We converted the effect size estimates in Cohen's *d* to Hedges's *g* to minimize potential bias in the effect size (Hedges & Olkin, 1985). To estimate the potential influence of publication bias on the results, a funnel plot was created, as shown in Figure 2 (Harbord, Egger, & Sterne, 2006). The funnel plot for the effects of scaffolding on learning outcomes showed that more samples had large effect sizes, but the plot was moderately symmetrical, indicating that the research findings were not greatly influenced by publication bias. All analyses were conducted using Comprehensive Meta-Analysis 3.0 for Windows (Borenstein et al., 2009).

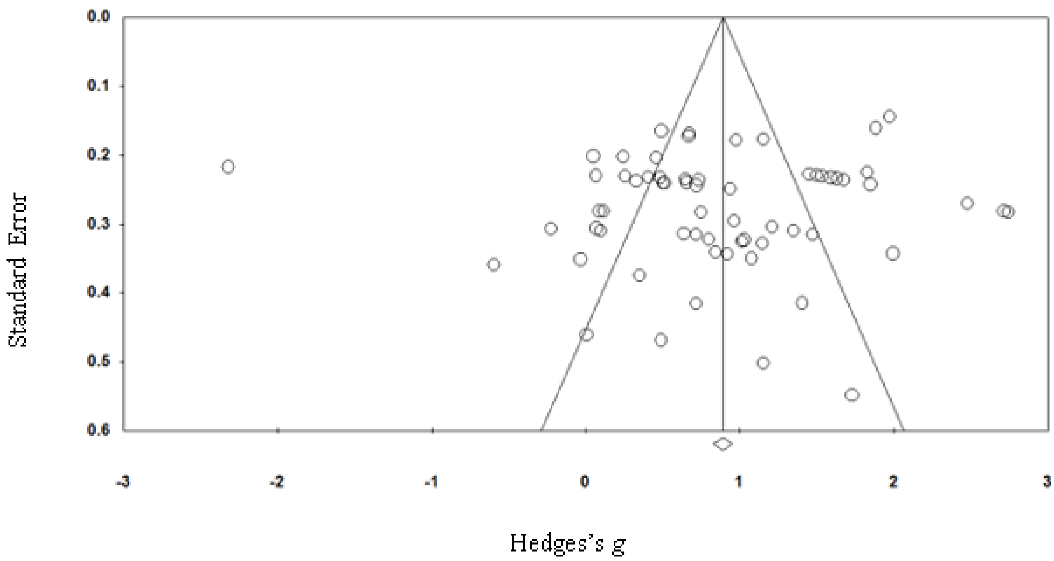

Figure 2. Funnel plot for the effects of scaffolding on learning outcomes.

Results

Overall Effect Size of Scaffolding

Using the random-effects model, among the 64 studies in the sample, the overall effect size for the effects of scaffolding on learning outcomes was calculated, g = .866 (95% CI: [.660, 1.072], p < .001, N = 64). This indicates a large effect size based on Cohen's (1988) criteria in which .2 is a small effect size, .5 is a medium effect size, and larger than .8 is a large effect size.

The overall effect size of the effects of scaffolding on learning outcomes, which is greater than 0 at a statistically significant level, z = 8.242, p < .001, indicates that scaffolding produced better learning outcomes than those without scaffolding. The heterogeneity test results (Q = 699.991, I^2 = 91.0%, p < .001) showed a considerable difference between effect size estimates in the meta-analysis, which validated our decision to use the random-effects model (Borenstein et al., 2009; Higgins & Green, 2008) in which I^2 index below 25% is small, 50% is moderate, and beyond 75% is a large amount of heterogeneity. Thus, it was necessary to conduct a sub-group analysis to systematically examine the effects of scaffolding on learning outcomes.

Sub-Group Analysis

To estimate the overall effects of scaffolding on different types of learning outcomes, we calculated the effect sizes for each learning outcome using a sub-group analysis with the random-effects model: meta-cognitive, cognitive, and affective. The effects of scaffolding on the meta-cognitive domain (g = 1.600) were larger than the affective learning outcomes (g = 0.672) and cognitive learning outcomes (g = 0.652) ($Q(df$ = 2)= 16.493, p < .001). See Table 3 for the summary of results.

Table 3

Effects of Scaffolding by Learning Outcome

Type of outcome	*k*	*n*	ES(*g*)	*SE*	95% CI	*z*	*p*
Affective	9	975	.672	.258	[.166, 1.179]	2.601	.009
Cognitive	41	2693	.652	.121	[.415, .890]	5.37	.000
Meta-Cognitive	14	1184	1.600	.042	[1.198, 2.001]	7.87	.000

Note. *k* (number of effect sizes); *n* (number of cumulative participants); ES (effect sizes, Hedges's *g* value); *SE* (standard error), 95% CI (95% confidence interval); *z* (Fisher's *z* transformation results); *p* (significance level).

We analyzed the effects of scaffolding on learning outcomes for different purposes (i.e., meta-cognitive, procedural, conceptual, and strategic). Meta-cognitive scaffolding (g = 1.104) and conceptual scaffolding (g = 0.964) had stronger effects on learning outcomes than did procedural scaffolding (g = 0.393) and strategic scaffolding (g = .440). According to the Q-test results, the differences of effect sizes among scaffolding purposes were statistically significant ($Q(3)$ = 11.584, p < .05; see Table 4).

Table 4

Effect Sizes and Confidence Interval for Scaffolding Purposes

Purpose	*k*	*n*	ES(*g*)	*SE*	95% CI	*z*	*p*
Meta-Cognitive	39	2788	1.104	.122	[.864, 1.344]	9.108	.000
Procedural	15	884	.393	.190	[.021, .766]	2.069	.039
Conceptual	5	338	.964	.345	[.287, 1.640]	2.792	.005
Strategic	5	210	.440	.344	[-.235, 1.115]	1.277	.202

To examine the effects of scaffolding sources on learning outcomes, we calculated the effect sizes of scaffolding from computers, instructors, and peer students. The effect sizes of scaffolding from peers was larger (g = 1.813) than from instructors (g = .837) and from computers (g = .764). In addition, we found that each scaffolding source had a statistically different effect ($Q(2) = 7.979$, $p < .05$; see Table 5).

Table 5

Effect Sizes of Scaffolding Sources on Learning Outcomes

Source	*k*	*n*	ES(*g*)	*SE*	95% CI	*z*	*p*
Computers	44	3063	.764	.121	[.526, 1.01]	6.304	.000
Instructors	15	677	.837	.206	[.433, 1.242]	4.223	.000
Peers	5	480	1.813	.352	[1.124, 2.503]	5.152	.000

Other Variables

As Table 6 shows, we also examined the effects of other variables on learning outcomes, including research design, country where the study took place, and learning discipline. In terms of research design, the studies using an experimental design (g = 1.045) yielded stronger effects than those with a quasi-experimental (g = 0.422) or non-experimental design (g = 0.702) ($Q(2) = 7.057$, $p < .05$). The 64 studies were published in eight countries; however, about 42% of the samples were published in the US, while some countries had only a small number of studies published (e.g., 3.13% in both South Korea and the Netherlands). Thus, we combined seven countries into a non-US category for comparison. The effect size of the scaffolding studies published in the US (g = 1.162) was statistically larger than those published outside the US (g = 0.641) ($z_{Diff} = 2.515$, p < .05).

The effect sizes of learning disciplines were also compared, which revealed that scaffolding in communications-related courses (g = 1.905) had a large effect size, followed by scaffolding in computing courses (g = 1.135) and those in the field of education (g = 0.846). The results showed a statistically significant difference in effect sizes among learning disciplines ($Q(5) = 32.995$, $p < .001$).

Table 6

Effect Sizes of Learning Outcomes: Research Design, Location, and Learning Discipline

Variable	*k*	*n*	ES(*g*)	*SE*	95% CI	*z*	*p*
Research design							
Experimental	43	3511	1.045	.123	[.804, 1.286]	8.492	.000
Quasi-Experimental	17	709	.422	.023	[.023, .820]	2.072	.000
Non-Experimental	4	632	.702	.390	[-.062, 1.467]	1.800	.072
Location							
US	27	2341	1.162	.156	[.856, 1.468]	7.443	.000
Non-US	37	2511	.641	.136	[.374, .908]	4.711	.000
Learning discipline							
Language and literature	16	950	.478	.184	[.118, .838]	2.605	.009
Science	11	919	.485	.208	[.076, .893]	2.326	.020
Education	12	1150	.846	.200	[.454, 1.238]	4.229	.000
Communications	10	960	1.905	.220	[1.475, 2.336]	8.672	.000
Computing	8	488	1.135	.256	[.634, 1.635]	4.440	.000
Other	7	385	.516	.269	[-.011, 1.043]	1.918	.000

Discussion

Since Wood et al. (1976) first defined scaffolding as support from experts enabling learners to accomplish what is beyond their current ability, scaffolding has been widely implemented as an effective instructional strategy (Balland, 2017; Kim & Hannafin, 2011). This current research was a meta-analysis of the effects of scaffolding in online learning in higher education in terms of learning outcomes. The results indicated that scaffolding in an online learning environment has a large and statistically significant effect on learning outcomes, confirmed the effectiveness of scaffolding as an instructional strategy, and supported previous meta-analysis studies on scaffolding. It is also notable that the current research yielded a large effect size (g = 0.866) compared to previous meta-analyses. For example, in their meta-analysis, Belland et al. (2017) reported a medium effect size of computer-based scaffolding in STEM education (g = 0.46). Steenbergen-Hu and Cooper (2014) also reported a moderate effect size of scaffolding of intelligent tutoring systems (g = 0.32 to .037) for college students. Kim et al. (2018) conducted a Bayesian meta-analysis to examine the effects of computer-based scaffolding in problem-based learning for STEM and reported a small-to-moderate effect size (g = 0.385).

The reason for the large effect size of our research may be explained by the population's characteristics. For instance, a key inclusion criterion was that the study be conducted in higher education. Belland et al. (2017) compared the effect size of scaffolding on cognitive learning outcomes of diverse participants who ranged from primary schoolers to adult learners and reported similar research findings to this current study. Interestingly, they reported that the effect sizes for scaffolded instruction with graduate students and adult learners were greater than those with young learner populations, lending credence to our findings regarding scaffolded learning in higher education. Belland et al. (2017) also mentioned that "scaffolding's strongest effects are in populations the furthest from the target learner population in the original scaffolding definition" (pp. 331–332), in which expert assistants enable children to extend their problem solving or strategic performance beyond what they could accomplish independently (Wood et al., 1976).

Other good examples of the influence of age groups are that of Steenbergen-Hu and Cooper's (2013, 2014) two meta-analyses for different age groups. They investigated the effects of intelligent tutoring systems (ITS) for K–12 students' mathematical learning in 2013 and the effects for college students in 2014. They found the overall effect size of ITS for K–12 students' mathematical learning ranged from 0.1 to 0.9, whereas the effect size for college students was moderate (i.e., g = .32 to .37). They attributed the different effect sizes to (a) the types of intervention and methodologies; (b) the degree of intervention implementation (i.e., laboratory environments vs. real environments); and (c) learners' age or educational level. They explained that

> it is likely that ITS may function better for more mature students who have sufficient prior knowledge, self-regulation skills, learning motivation, and experiences with computers than for younger students who may still need to develop the above characteristics and need more human inputs to learn. (Steenbergen-Hu & Cooper, 2014, p. 342)

The large effect size in our research may be related to the research designs of individual scaffolding studies. More studies used experimental designs (k = 43, g = 1.045) than quasi-experimental designs (k = 17, g = 0.422) or non-experimental designs (k = 4, g = 0.702). Steenbergen-Hu and Cooper (2014) also explained that educational interventions in laboratory environments usually produce larger effects than those in real environments. By including substantially more experimental design studies in our meta-analysis, this research could attain high internal validity and a large effect size.

In terms of the types of learning outcomes, few studies in our sample (9 out of 64) examined an affective domain. Affective domains include important learning outcomes, such as learning satisfaction and learning engagement. Given that satisfaction and engagement are strong predictors of students' learning achievements (Coates, 2005; Kuh, 2003), more scaffolding opportunities should be provided to students within affective learning domains. The meta-cognitive domain yielded a larger effect size than did the affective and cognitive domains. Since students in higher education settings are likely engaged in more activities requiring higher-order thinking skills and self-regulation compared to K–12 students, scaffolded instruction is expected to play an important role in the meta-cognitive learning domain.

The findings in this research also indicated that peers are a strong source of scaffolding; however, this finding should be interpreted with caution because of the small number of studies focusing on peers (g = 1.813, k = 5). The findings also indicated that the effects of scaffolding by instructors (g = 0.837) were larger than the effects obtained by computers (g = 0.764). More studies in this analysis used computers (k = 44) as a scaffolding source in an online learning environment than human instructors (k = 15).

This result is promising because scaffolding by computer is expected to improve the quality of online learning. For example, MOOCs, which typically have large class sizes with heterogenous participants compared to traditional classrooms, are expanding rapidly (Shah, 2019). Doo et al., (2020) revealed that key frustrations commonly found among MOOC instructors were a lack of interaction with students and difficulty providing feedback in a timely manner. If the effects of scaffolding by computers in an online learning environment are equivalent to human instructors, more social interaction and scaffolding leading to learning outcomes will be available to online learners. AI-based scaffolding opportunities are expected to be extensively implemented in higher education in the near future, given the considerable progress in research on artificial intelligence and learning analytics (e.g., Adams Becker et al., 2018; Metz & Satariano, 2018).

Another key finding is that scaffolding studies have more often employed experimental designs compared to quasi-experimental designs. Experimental designs have also shown large effect sizes (g = 1.045) compared to quasi-experimental designs and non-experimental designs with their small-to-moderate effect sizes (g = 0.396 to 0.702). The strength of an experimental design is in obtaining high internal validity (Vogt, 1999), which involves measuring the effects of scaffolding as a treatment by controlling extraneous variables.

Among the eight countries included in this analysis, the US has been the most productive in terms of the quantity of scaffolding research in online learning environments (42.19%). Studies in the US also had larger sample sizes and larger effect sizes compared to the non-US studies. Future qualitative and quantitative studies might examine the differences in scaffolding implementation by country from both instructor and student perspectives.

Among learning disciplines, scaffolding has been the most widely adopted in the language and literature academic area. However, the effect sizes in this area were small to moderate. By comparison, the effects of scaffolding in computing, communications, and education were larger than in language and literature. Further investigation is needed into how scaffolding is implemented in each learning discipline in online learning environments in higher education, and to explore the development of guidelines for effective scaffolding strategies and features in different disciplines.

Given the importance of scaffolded support in online learning environments displayed across the studies reviewed in this meta-analysis, combined with the proliferation of the forms and types technological supports, it is now time to carry out more fine-tuned and pointed research on this topic. Researchers need to begin to explore issues that yield more practical and strategic results for instructors and instructional designers such as the timing of scaffolding, including decisions related to the fading and elimination of that scaffolding altogether.

Limitations and Future Directions

It is important to explain the limitations of this meta-analysis study for future researchers. A limited number of studies were included in this meta-analysis due to the fact that only quantitative studies with sufficient information to calculate the effect sizes were eligible. Setting the literature search to the years 2010 through 2019 to reflect more contemporary research trends on scaffolding and online learning also limited the pool of relevant studies. In addition, many studies from the search process were eliminated because they did not meet our inclusion criteria. In terms of publication bias, more studies with large effect sizes were included in the meta-analysis. Because of the difficulties in searching for eligible studies, missing studies that could have corrected the asymmetry of the funnel plot likely were not included. Further limiting the generalizability of our finding, our search was limited to scholarly works published in English.

To strengthen the external validity and obtain more robust research findings, we recommend that future research include scaffolding studies published in local languages. Additional exploration could further identify specific instructional approaches that have been effective in online environments. Given the millions of learners who are enrolled in online learning in the US alone, the impact of such investigations would be substantial (Seaman et al., 2018). Another limitation of this research is that coding was completed by a single coder. Therefore, inter-coder reliability analyses were not possible. This limitation remains despite efforts to overcome this weakness by coding that data twice with a time lapse interval. Future researchers could use multiple coders to estimate inter-coder reliability.

Conclusion

Given that online learning has become a common and acceptable learning environment over the past two decades (Bonk, 2009), the significance of the quality of online learning cannot be overemphasized. In particular, scaffolding can improve the quality of learning, including learning outcomes. This research confirmed the large effects of scaffolding on learning outcomes in an online learning, higher education environment. By providing additional analyses of scaffolded instruction research in the discussion, this research has implications for online instructors, online learners, and administrators in higher education who manage online learning programs and degree options.

Vygotsky (1978) emphasized the importance of social interaction and critical support for learning. From this perspective, scaffolding is expected to substantially improve online learners' outcomes and learning experiences (Bonk & Cunningham, 1998). Clearly, this research provides significant support for this hypothesis. The variety of studies included in this review indicate that educators are commonly embedding scaffolded support for learners across a wide spectrum of age groups and content areas. This meta-analysis adds to the support for these practices. Simply put, scaffolded instruction is beneficial, and the benefits seem to increase as learners age.

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*Note: References marked with an asterisk (*) indicate studies included in the meta-analysis.

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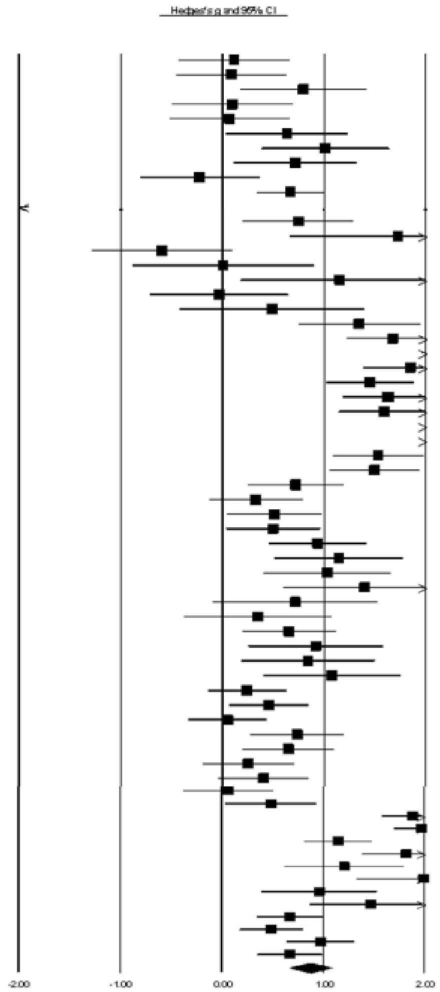
Appendix A

Forest Plot for Meta-Analysis

Study name	Subgroup within study	learning outcomes	Hedges's g	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
1_An (2014)	metacognitive	metacognitive	0.116	0.281	0.079	-0.435	0.668	0.413	0.680
2_An (2014)	metacognitive	metacognitive	0.088	0.281	0.079	-0.463	0.640	0.314	0.753
3_Ak (2016)	metacognitive	cognitive	0.797	0.322	0.104	0.165	1.429	2.471	0.013
4_Ak (2016)	metacognitive	cognitive	0.098	0.310	0.096	-0.510	0.706	0.315	0.753
5_Proske (2012)	strategic	cognitive	0.070	0.306	0.094	-0.530	0.670	0.229	0.819
6_Proske (2012)	strategic	cognitive	0.636	0.314	0.098	0.021	1.251	2.028	0.040
7_Proske (2012)	strategic	cognitive	1.013	0.325	0.106	0.376	1.651	3.116	0.002
8_Proske (2012)	strategic	cognitive	0.717	0.316	0.100	0.098	1.336	2.270	0.023
9_Proske (2012)	strategic	cognitive	-0.223	0.307	0.094	-0.824	0.379	-0.725	0.468
10_Rienties (2012)	procedural	cognitive	0.669	0.173	0.030	0.330	1.008	3.873	0.000
11_Rienties (2012)	procedural	cognitive	-2.319	0.217	0.047	-2.744	-1.894	-10.687	0.000
12_Delen (2014)	metacognitive	cognitive	0.747	0.283	0.080	0.192	1.302	2.639	0.008
13_Huang (2015)	metacognitive	cognitive	1.728	0.548	0.301	0.654	2.803	3.153	0.002
14_Huang (2015)	metacognitive	cognitive	-0.595	0.360	0.129	-1.300	0.110	-1.655	0.098
15_Huang (2015)	metacognitive	cognitive	0.007	0.461	0.213	-0.897	0.911	0.015	0.988
16_Huang (2015)	metacognitive	affective	1.154	0.502	0.252	0.170	2.137	2.299	0.022
17_Huang (2015)	metacognitive	affective	-0.032	0.352	0.124	-0.721	0.657	-0.091	0.928
18_Huang (2015)	metacognitive	affective	0.490	0.469	0.220	-0.429	1.409	1.045	0.296
19_Huang & Liu (2014)	conceptual	cognitive	1.347	0.309	0.096	0.741	1.953	4.355	0.000
20_Ge (2010)	metacognitive	metacognitive	1.675	0.236	0.056	1.213	2.138	7.103	0.000
21_Ge (2010)	metacognitive	metacognitive	2.479	0.270	0.073	1.950	3.009	9.174	0.000
22_Ge (2010)	metacognitive	metacognitive	1.850	0.243	0.059	1.375	2.325	7.626	0.000
23_Ge (2010)	metacognitive	metacognitive	1.453	0.228	0.052	1.006	1.899	6.369	0.000
24_Ge (2010)	metacognitive	metacognitive	1.631	0.234	0.055	1.172	2.090	6.962	0.000
25_Ge (2010)	metacognitive	metacognitive	1.591	0.233	0.054	1.134	2.047	6.832	0.000
26_Ge (2010)	metacognitive	metacognitive	2.713	0.282	0.079	2.161	3.265	9.631	0.000
27_Ge (2010)	metacognitive	metacognitive	2.741	0.283	0.080	2.186	3.296	9.681	0.000
28_Ge (2010)	metacognitive	metacognitive	1.533	0.231	0.053	1.081	1.986	6.643	0.000
29_Ge (2010)	metacognitive	metacognitive	1.497	0.230	0.053	1.047	1.947	6.521	0.000
30_Ebner (2013)	procedural	cognitive	0.720	0.244	0.060	0.242	1.199	2.950	0.003
31_Ebner (2013)	procedural	cognitive	0.327	0.238	0.057	-0.139	0.794	1.375	0.169
32_Ebner (2013)	procedural	cognitive	0.511	0.240	0.058	0.040	0.982	2.126	0.034
33_Ebner (2013)	procedural	cognitive	0.499	0.240	0.058	0.029	0.970	2.080	0.038
34_Ebner (2013)	procedural	cognitive	0.938	0.249	0.062	0.449	1.426	3.761	0.000
35_Ozcinar (2015)	metacognitive	cognitive	1.144	0.328	0.107	0.502	1.787	3.491	0.000
36_Ozcinar (2015)	procedural	metacognitive	1.029	0.323	0.104	0.396	1.663	3.184	0.001
37_Sas (2017)	metacognitive	cognitive	1.403	0.415	0.172	0.589	2.216	3.379	0.001
38_Sas (2017)	metacognitive	cognitive	0.718	0.416	0.173	-0.098	1.533	1.725	0.085
39_Sas (2017)	metacognitive	cognitive	0.350	0.375	0.140	-0.385	1.084	0.933	0.351
40_Tegos (2017)	conceptual	cognitive	0.654	0.240	0.058	0.184	1.124	2.726	0.006
41_Tegos (2017)	conceptual	cognitive	0.920	0.344	0.118	0.246	1.594	2.674	0.007
42_Tegos (2017)	conceptual	cognitive	0.842	0.341	0.116	0.173	1.511	2.468	0.014
43_Tegos (2017)	conceptual	cognitive	1.076	0.350	0.123	0.390	1.763	3.074	0.002
44_Roll (2018)	procedural	cognitive	0.243	0.202	0.041	-0.153	0.640	1.204	0.229
45_Roll (2018)	procedural	affective	0.459	0.204	0.042	0.059	0.859	2.248	0.025
46_Roll (2018)	procedural	cognitive	0.051	0.202	0.041	-0.344	0.446	0.254	0.799
47_Holmes (2014)	metacognitive	cognitive	0.732	0.236	0.056	0.269	1.196	3.100	0.002
48_Holmes (2014)	metacognitive	cognitive	0.647	0.235	0.055	0.187	1.108	2.756	0.006
49_Holmes (2014)	metacognitive	cognitive	0.256	0.231	0.053	-0.196	0.708	1.111	0.267
50_Holmes (2014)	metacognitive	cognitive	0.405	0.232	0.054	-0.050	0.859	1.746	0.081
51_Holmes (2014)	metacognitive	cognitive	0.066	0.230	0.053	-0.384	0.516	0.288	0.773
52_Holmes (2014)	metacognitive	cognitive	0.484	0.233	0.054	0.028	0.940	2.081	0.037
53_Kim (2019)	metacognitive	cognitive	1.884	0.161	0.026	1.570	2.199	11.733	0.000
54_Kim (2019)	metacognitive	cognitive	1.974	0.145	0.021	1.690	2.257	13.644	0.000
55_Feyzi-Behnagh (2014)	metacognitive	cognitive	1.151	0.177	0.031	0.805	1.498	6.516	0.000
56_Feyzi-Behnagh (2014)	metacognitive	cognitive	1.825	0.225	0.051	1.384	2.266	8.111	0.000
57_Yilmaz (2019)	metacognitive	affective	1.210	0.304	0.093	0.614	1.807	3.976	0.000
58_Yilmaz (2019)	metacognitive	metacognitive	1.994	0.343	0.118	1.321	2.666	5.810	0.000
59_Yilmaz (2019)	metacognitive	cognitive	0.962	0.295	0.087	0.383	1.541	3.258	0.001
60_Yilmaz (2019)	metacognitive	cognitive	1.474	0.316	0.100	0.855	2.093	4.667	0.000
61_Cho (2014)	procedural	affective	0.672	0.169	0.028	0.342	1.003	3.984	0.000
62_Cho (2014)	procedural	affective	0.492	0.165	0.027	0.169	0.815	2.988	0.003
63_Cho (2014)	procedural	affective	0.975	0.178	0.032	0.626	1.324	5.478	0.000
64_Cho (2014)	procedural	affective	0.672	0.169	0.028	0.342	1.003	3.984	0.000
			0.866	0.105	0.011	0.660	1.072	8.242	0.000



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The Influence of Successful MOOC Learners' Self-Regulated Learning Strategies, Self-Efficacy, and Task Value on Their Perceived Effectiveness of a Massive Open Online Course

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Abstract

High dropout rates have been an unsolved issue in massive open online courses (MOOCs). As perceived effectiveness predicts learner retention in MOOCs, instructional design factors that affect it have been increasingly examined. However, self-regulated learning, self-efficacy, and task value have been underestimated from the perspective of instructors even though they are important instructional design considerations for MOOCs. This study investigated the influence of self-regulated learning strategies, self-efficacy, and task value on perceived effectiveness of successful MOOC learners. Three hundred fifty-three learners who successfully completed the *Mountain 101* MOOC participated in this study by completing a survey through e-mail. The results of stepwise multiple regression analysis showed that perceived effectiveness was significantly predicted by both self-regulated learning strategies and task value. In addition, the results of another stepwise multiple regression analysis showed that meta-cognitive activities after learning, environmental structuring, and time management significantly predicted perceived effectiveness.

Keywords: self-regulated learning, self-efficacy, task value, MOOCs, perceived effectiveness

Introduction

Although massive open online courses (MOOCs) have potential to broaden educational opportunities, their high dropout rates have been a challenging issue. Only a small proportion of learners who enroll in a MOOC complete their course (Alraimi, Zo, & Ciganek, 2015). In order to address this, factors that influence MOOC retention have been increasingly explored. Among them, perceived effectiveness has been identified as a vital factor that predicted learner retention rates for MOOCs (Sujatha & Kavitha, 2018). Due to the important role of perceived effectiveness, researchers have recently examined instructional design factors that positively affect it, including course structure (Jung, Kim, Yoon, Park, & Oakley, 2019) and interaction with instructors (Hone & El Said, 2016). However, these factors have been examined mainly from the perspective of instructors. Self-regulated learning (SRL) and learner characteristics such as self-efficacy should also be considered in instructional design for effective online learning (Liaw & Huang, 2013).

In MOOCs, learners are required to have a greater ability to regulate their own learning because there is a lack of support or guidance from instructors (Hood, Littlejohn, & Milligan, 2015). In a recent systematic literature review study, it was revealed that MOOC learners commonly use several SRL strategies as well as possess self-efficacy and task value beliefs (Lee, Watson, & Watson, 2019). Although perceived effectiveness is associated with learning strategies employed by learners in online learning settings (Venkatesh, Croteau, & Rabah, 2014), empirical evidence of the effects of SRL on perceived effectiveness in MOOC environments is scarce. The results of previous studies on online learning showed that SRL strategies, self-efficacy, and task value are significant predictors of perceived effectiveness, which is a measure of satisfaction with traditional online learning (e.g., Artino, 2007, 2008; Cho & Cho, 2017). In addition, most studies on SRL in MOOCs have mainly focused on learners who were involved in MOOCs, but did not complete the courses (e.g., Hood et al., 2015; Milligan & Littlejohn, 2016). Considering that successful MOOC learners' behaviors had significantly positive effects on other MOOC learners' success (Davis, Chen, Jivet, Hauff, & Houben, 2016), there is a need to explore successful MOOC learners' SRL strategies, self-efficacy, and task value as well as the relationships of these factors with perceived effectiveness. Findings about the relationships will provide new insight on instructional design for MOOCs as well as how to support learners' self-regulatory processes in MOOCs.

The purpose of this study was to investigate the influence of SRL strategies, self-efficacy, and task value on successful MOOC learners' perceived effectiveness of a MOOC.

Literature Review

Perceived Effectiveness of MOOCs

Perceived effectiveness generally refers to students' "evaluation of the overall effectiveness of the course" (Peltier, Drago, & Schibrowsky, 2003, p. 267). It has been widely used in earlier studies on online learning as a measure of satisfaction with online learning environments (Hone & El Said, 2016). Each of the three aspects of perceived effectiveness defined by Peltier et al. (2003) has been utilized as a measure of students' satisfaction with online courses (e.g., Bolliger & Halupa, 2012; Kang & Im, 2013). For example, referral likelihood was used to measure students' satisfaction with online courses in Kang and Im's (2013) study.

Therefore, in this study, perceived effectiveness has been operationally defined as students' perceptions of the overall effectiveness of the course and their satisfaction with the course.

It is common to consider perceived effectiveness in contexts where it is impractical to measure students' actual learning behaviors (Hone & El Said, 2016). MOOC researchers have increasingly examined perceived effectiveness, since it is not practical to measure hundreds of thousands of individuals' diverse learning behaviors in MOOCs (e.g., Jung et al., 2019). Findings have shown that perceived effectiveness played a vital role in enhancing MOOC effectiveness by predicting learner retention (Sujatha & Kavitha, 2018) or mediating the effect of course content on retention in a MOOC (Hone & El Said, 2016). Therefore, it is essential to explore factors that influence the perceived effectiveness of MOOCs. Findings reported in previous studies showed instructional design components such as course content (Hone & El Said, 2016), and course structure and transactional interaction between course and student (Jung et al., 2019), as vital factors that positively affect MOOC learners' perceived effectiveness of the course. However, previous studies largely examined factors from the perspective of instructors. According to Liaw and Huang (2013), SRL and learner characteristics such as self-efficacy should also be considered in the design of effective online courses. These aspects were also highlighted during learner characteristics analysis in instructional design models such as Dick and Carey's model (Dick & Carey, 1978) and the ADDIE model (Peterson, 2003), showing that they are critical instructional design considerations.

Factors Contributing to Perceived Effectiveness

SRL strategies. According to Zimmerman (2000), SRL is defined as "self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals" (p. 14). SRL theorists commonly explain that SRL includes meta-cognition, behavior, and motivation (Zimmerman, 1986). SRL strategies are behavioral components of the SRL theory. SRL strategies refer to "actions and processes directed at acquiring information or skill that involve agency, purpose, and instrumentality perceptions by learners" (Zimmerman, 1989, p. 329).

Previous research findings showed that SRL strategies predicted perceived effectiveness in online learning environments (Amoozegar, Daud, Mahmud, & Jalil, 2017; Puzziferro, 2008). For example, the results of a study by Amoozegar et al. (2017) showed that SRL strategies of Malaysian undergraduate students who were taking online courses significantly predicted their satisfaction with the course. While a few studies on MOOCs have examined the effects of SRL strategies on perceived effectiveness, Magen-Nagar and Cohen (2016) found that SRL strategies were positively correlated with the degrees to which high school students evaluated the quality of their academic achievement in a MOOC. However, this research finding was limited to high school students and flipped classroom settings where students watched lecture videos from a MOOC every week and then studied in small groups in the classroom. Considering that people from all over the world with differing backgrounds, including age and education levels, enroll in MOOCs, there is a need to further investigate the effects of SRL strategies on perceived effectiveness in fully online MOOC settings.

Self-efficacy. Self-efficacy is defined as "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" (Bandura, 1994, p. 71). Self-efficacy has been identified as a significant predictor of perceived effectiveness in online learning settings (Artino, 2007; Liaw, 2008). For example, the findings of a survey study by Artino (2007) indicated that self-efficacy of US Navy sailors in self-paced online courses significantly predicted their perceptions of how well they learned in the courses as well as their satisfaction with the courses. In addition, Liaw (2008) found that Taiwan students' self-efficacy beliefs were a vital factor that influenced their satisfaction with the Blackboard e-learning system. Although self-efficacy has been identified as a factor contributing to perceived effectiveness in online learning settings, there has been a lack of studies examining the influence of self-efficacy on the perceived effectiveness of MOOCs.

Task value. Task value refers to "students' evaluation of the how interesting, how important, and how useful the task is" (Pintrich, Smith, Garcia, & McKeachie, 1993, p. 11). Task value has been identified as a significant predictor of perceived effectiveness in online learning environments (Artino, 2008; Joo, Lim & Kim, 2013; Miltiadou, 2001). For example, Artino (2008) found that self-efficacy significantly predicted service academy undergraduate students' satisfaction with self-paced online courses. In addition, Miltiadou (2001) investigated community college students who took an online English course and found task value was a significant predictor of their satisfaction with the courses. Through structural equation modeling, Joo et al. (2013) found direct effects of self-efficacy on satisfaction with online courses offered by an online university in South Korea. Although task value has been identified as a factor contributing to perceived effectiveness in online learning environments, little is known about the predictive power of task value for the perceived effectiveness of MOOCs.

Based on previous studies reviewed above, the present study investigated the influence of successful MOOC learners' SRL strategies, self-efficacy, and task value on perceived effectiveness of a MOOC. This study was framed by the following research questions and research hypotheses:

Research question one: Do successful MOOC learners' SRL strategies, self-efficacy, and task value predict their perceived effectiveness of a MOOC?

> H_1: Successful MOOC learners' SRL strategies will significantly predict their perceived effectiveness of a MOOC.
>
> H_2: Successful MOOC learners' self-efficacy will significantly predict their perceived effectiveness of a MOOC.
>
> H_3: Successful MOOC learners' task value will significantly predict their perceived effectiveness of a MOOC.

Research question two: Which SRL strategies are positively related to successful learners' perceived effectiveness of a MOOC?

Method

Study Context

The context of the present study was a MOOC titled *Mountain 101* offered by the University of Alberta on the Coursera platform. The course was designed to provide a broad and integrated overview of the mountain world. It covered interdisciplinary dimensions of mountain places in Canada and around the world (e.g., physical, biological, and human dimensions). The course was delivered fully online and taught by two instructors. It consisted of 12 lessons with lecture videos, readings, and quizzes. Discussion forums were also provided to allow students to discuss course materials with peers or ask questions of the instructors. It was suggested that students complete one lesson each week. However, they were able to complete all lessons according to their preferred pace. The course was free, but if students wanted to get a certificate of completion, they could pay a small fee. The research team had no affiliation with the MOOC instructors or the Coursera platform institution.

Recruitment and Respondents

Once Institutional Review Board approval was granted, the researchers asked the MOOC instructors to forward an e-mail that included a survey link with a recruitment message to students who were identified as having completed the *Mountain 101* MOOC on the Coursera platform. The e-mail was sent out at the end of October in 2018. Since the MOOC launched in January 2017 and ran until the middle of October 2018, by then a total of 4,333 students had completed the course. The survey was voluntary and no compensation was given to participants.

Of the 4,333 students who received the recruitment e-mail from the MOOC instructors, 353 participated in the survey. As 31 students out of the 353 did not complete the survey, their survey responses were excluded. In addition, 31 outliers were detected and removed to conduct stepwise multiple linear regression analyses. Finally, the responses of the 291 students from 26 countries were analyzed. In terms of age, 13 students were 18 to 25 years of age (4.5%); 50 students were 26 to 35 years of age (17.2%); 47 students were 36 to 45 years of age (16.2%); 44 students were 46 to 55 years of age (15.1%); 93 students were 56 to 65 years of age (32.0%); and 44 students were over 66 years of age (15.5%). Regarding gender, 119 students were male (40.9%) and 172 students were female (59.1%).

Instruments

The revised version of the Self-Regulated Online Learning Questionnaire (SOL-Q-R) developed by Jansen, Van Leeuwen, Janssen, and Kester (2018) was used to measure MOOC learners' SRL strategies in this study. Janssen, Van Leeuwen, Janssen, Kester, and Kalz (2017) developed the initial version of the SOL-Q to measure the SRL strategies of learners in MOOC environments. The revised version of SOL-Q consists of seven subscales: (a) meta-cognitive activities before learning, (b) meta-cognitive activities during learning, (c) meta-cognitive activities after learning, (d) time management, (e) environmental structuring, (f) persistence, and (g) help-seeking (Jansen et al., 2018). The items were rated on a 7-point Likert scale ranging from *not at all true of me* to *very true for me*. In this study, the reliability with Cronbach's alpha value was .93.

Seven self-efficacy items from the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, Garcia, & McKeachie, 1991) were used to measure MOOC learners' self-efficacy. The items consisted of a seven-point Likert scale ranging from *not at all true of me* to *very true of me*. The items were slightly modified to reflect the context of the *Mountain 101* MOOC. For example, "I'm confident I can understand the most complex material presented by the instructor in this course" was modified to "I was confident I could understand the most complex material presented by the instructor in the *Mountain 101* MOOC." The reliability with Cronbach's alpha value was identified as .95.

Six task value items from the MSLQ (Pintrich et al., 1991) were used to measure MOOC learners' task value. The items utilized a seven-point Likert scale ranging from *not at all true of me* to *very true of me*. The items were slightly modified to reflect the context of the *Mountain 101* MOOC. For example, "I am very interested in the content area of this course" was modified to "I was very interested in the content area of the *Mountain 101* MOOC." In this study, the reliability with Cronbach's alpha value was .75.

Three items developed by Peltier et al. (2003) were used to measure MOOC learners' perceived effectiveness. The items consisted of a five-point Likert scale ranging from *strongly disagree* to *strongly agree*. As well, the words "this course" were modified to "*Mountain 101* MOOC" to better fit the specific MOOC in question. For example, "I would recommend this course to friends/colleagues" was modified to "I would recommend the *Mountain 101* MOOC to friends/colleagues." The reliability with Cronbach's alpha value was identified as .75.

The content validity of the revised version of SOL-Q items, self-efficacy items, task value items, and perceived effectiveness items was established through content-related evidence by two professors in the area of educational technology. They reviewed the modified items and assessed the degree to which each one appropriately represented the content domain. Content-related evidence is "validity evidence based on a judgement of the degree to which the items, tasks, or questions on a test adequately represent the construct domain of interest" (Johnson & Christensen, 2017, p. 380). Judgements of content validity have to be done by experts in the content domain (Johnson & Christensen, 2017).

Data Analysis

Survey datasets were analyzed by using the SPSS statistical software program. Stepwise multiple regression was employed to address research questions 1 and 2. While stepwise multiple regression is appropriate for exploratory studies, hierarchical multiple regression is used when the order of entry for predictor variables is determined based on a theory. Since existing SRL models do not explain contributions of predictor variables to dependant variable, stepwise multiple regression was used. In this study, independent or predictor variables were SRL strategies, self-efficacy, and task value. The dependent variable was perceived effectiveness. All assumptions for multiple linear regression were checked. A violation of homoscedasticity was detected by the Breusch-Pagan test ($p < .05$) (Breusch & Pagan, 1979). Therefore, weighted least square (WLS) where "each case is weighted by a function of its variance" (Field, 2013, p. 222) was used to address homoscedasticity.

Results

The Results of Stepwise Multiple Regression Analysis for Research Question One

In order to conduct stepwise multiple regression analysis, all assumptions for multiple linear regression were tested. First, the variance inflation factor (VIF), which was lower than 10, showed that multicollinearity does not exist. In addition, the Durbin-Watson test result, which was 2.00, indicated that the assumption of independent errors was met. After WLS estimation was performed, stepwise multiple regression analysis was conducted with an entrance level of 0.05 and an exclusion level of 0.10. Table 1 shows the results of descriptive statistics and Pearson correlation analysis. The results of Pearson correlation analysis indicated that task value was positively correlated with self-efficacy, SRL strategies, and perceived effectiveness. On the other hand, self-efficacy was not positively correlated with SRL strategies, or with perceived effectiveness.

Table 1

Means, Standard Deviations, and Pearson Correlations for Self-Efficacy, Task Value, SRL Strategies, and Perceived Effectiveness

	Variable	*M*	*SD*	1	2	3	4
1	Self-efficacy	6.07	.60	-	.26**	.05	.09
2	Task value	5.96	.65	.26**	-	.34**	.31**
3	SRL strategies	4.25	.77	.05	.34**	-	.23**
4	Perceived effectiveness	4.83	.38	.09	.31**	.23**	-

Note. ** $p < .01$.

Table 2 shows the results of stepwise multiple regression analysis. In the first step, SRL strategies were first entered into the regression model. Model 1 was identified as statistically significant with $F(1, 289) = 36.48$, $p < .01$. It accounted for approximately 11% of the variance of perceived effectiveness ($R^2 = .11$, adjusted $R^2 = .11$). On the second step, task value was added to the model. Model 2 was statistically significant ($F(2, 288) = 31.03$, $p < .01$) and accounted for approximately 17% of the variance of perceived effectiveness ($R^2 = .18$, adjusted $R^2 = .17$). Self-efficacy was excluded in the final model because it did not make a statistically significant addition to the current regression equation. The final model indicated that perceived effectiveness was mainly predicted by SRL strategies, and to a lesser extent by task value. Therefore, hypothesis 1 and 3 are supported, but hypothesis 2 is not supported.

Table 2

Results of Stepwise Multiple Regression Analysis

Variable	Model 1			Model 2		
	B	*SE*	*β*	B	*SE*	*β*
SRL strategies	.72	.01	.34**	.06	.01	.29**
Task value				.07	.01	.26**
Self-efficacy						
R^2			.11			.18
Adjusted R^2			.11			.17
F			36.48*			31.03*

Note. B = unstandardized beta; *SE* = standard error. * $p < .01$ ** $p < .05$.

The Results of Stepwise Multiple Regression Analysis for Research Question Two

Prior to carrying out stepwise multiple regression, 34 outliers were detected within each SRL strategy variable and removed from data analysis. Then, all assumptions were checked and met. The result of Koenker's test confirmed homoscedasticity ($p > .05$). VIF which was lower than 10 showing that there was no multicollinearity. In addition, the Durbin-Watson test result was 2.01 indicating that the residuals were uncorrelated. Stepwise multiple regression analysis was performed with an entrance level of 0.05 and an exclusion level of 0.10. Table 3 presents the results of descriptive statistics and Pearson correlation analysis. As shown in Table 3, there were positive correlations between sub-SRL strategies and perceived effectiveness except between persistence and perceived effectiveness, and between help-seeking and perceived effectiveness.

Table 3

Means, Standard Deviations, and Pearson Correlations for Sub-SRL Strategies and Perceived Effectiveness

	Variable	*M*	*SD*	1	2	3	4	5	6	7	8
1	MTBL	4.59	1.85	-	.74*	.68*	.42*	.41*	.27*	.17*	.20*
2	MTDL	4.50	1.21	.74*	-	.73*	.41*	.31*	.32*	.23*	.21*
3	MTAL	4.65	1.06	.68*	.73*	-	.33*	.30*	.22*	.16*	.25*
4	TM	4.47	0.54	.42*	.41*	.33*	-	.21*	.28*	.10	.15**
5	ES	5.36	1.19	.41*	.31*	.30*	.21*	-	.12**	.06	.21*
6	PER	4.26	1.22	.27*	.32*	.22*	.28*	.12**	-	.13*	.03
7	HS	1.95	1.08	.17*	.23*	.16*	.10	.06	.13**	-	.00
8	PEFF	4.83	0.38	.20*	.21*	.25*	.15**	.21*	.03	.00	-

Note. MTBL = meta-cognitive activities before learning, MTDL = meta-cognitive activities during learning, MTAL = meta-cognitive activities after learning, TM = time management, ES = environmental structuring, PER = persistence, HS = help-seeking, and PEFF = perceived effectiveness. * $p < .01$ and ** $p < .05$.

As shown in Table 4, in the first step, meta-cognitive activity after learning was first added into the regression model. Model 1 was statistically significant ($F(1, 255) = 24.64$, $p < .01$). It accounted for approximately 9% of the variance of perceived effectiveness ($R^2 = .09$, adjusted $R^2 = .09$). On the second step, environmental structuring was added to the model. Model 2 was statistically significant ($F(2, 254) = 18.51$, $p < .01$) and accounted for approximately 12% of the variance of perceived effectiveness ($R^2 = .13$, adjusted $R^2 = .12$). On the third step, time management was entered into the model. The final model was identified as statistically significant ($F(3, 253) = 13.81$, $p < .01$) and accounted for approximately 13% of the variance of perceived effectiveness ($R^2 = .14$, adjusted $R^2 = .13$). The final model showed that perceived effectiveness was primarily predicted by meta-cognitive activities after learning, and to a lesser extent by environmental structuring, followed by time management.

Table 4

Results of Stepwise Multiple Regression Analysis

Variable	Model 1			Model 2			Model 3		
	B	*SE*	*β*	B	*SE*	*β*	B	*SE*	*β*
MTAL	.12	.02	.30**	.10	.03	.24**	.08	.03	.21**
ES				.08	.24	.21**	.07	.02	.19**
TM							.11	.06	.12**
MTBL									
MTDL									
PER									
HS									
R^2			.09			.13			.14
Adjusted R^2			.09			.12			.13
F			24.64*			18.51*			13.81*

Note. B = unstandardized beta; *SE* = standard error. * $p < .01$ and ** $p < .05$.

Discussion

This study investigated the influences of successful MOOC learners' SRL strategies, self-efficacy, and task value on perceived effectiveness of a MOOC. Factors that affect perceived effectiveness have been examined in MOOCs mainly from the perspective of instructors, which has resulted in limited instructional design implications for MOOCs. In addition, the understanding of SRL strategies, self-efficacy, and task value of learners who successfully completed MOOCs is scarce, which has limited our understanding of how to support other learners' SRL based on successful MOOC learners' self-regulation.

Research Question One: Do Successful MOOC Learners' SRL Strategies, Self-Efficacy, and Task Value Predict Their Perceived Effectiveness of a MOOC?

The results of stepwise multiple regression analysis indicated that successful MOOC learners' perceived effectiveness of the course was significantly predicted by both their use of SRL strategies and the task value of the *Mountain 101* MOOC. In model 1 of stepwise multiple regression, SRL strategies were a significant and positive predictor of perceived effectiveness. In the final model where task value was added, SRL strategies significantly predicted perceived effectiveness. These study findings are consistent with previous studies on SRL in traditional online learning, showing that SRL strategies and task value significantly predict perceived effectiveness (e.g., Amoozegar et al., 2017; Puzziferro, 2008). In the final model of stepwise multiple regression, task value was also a significant predictor of perceived effectiveness, congruent with previous study findings (Artino, 2008; Miltiadou, 2001). These findings support an assertion that learners' SRL should be also considered in instructional design for effective online learning (Liaw & Huang, 2013). For example, MOOC instructors should provide an activity where learners set their own goals and make plans for effective time management at the beginning of courses, as suggested in MOOC design guidelines developed by Park, Cha, and Lee (2016). In addition, MOOC instructors should decrease monotony in designing and developing MOOCs as suggested for online learning environments by Chiu and Wang (2008).

On the other hand, successful MOOC learners' self-efficacy was not correlated with the perceived effectiveness of the *Mountain 101* MOOC. Furthermore, it was excluded in the final model of stepwise multiple regression, indicating that self-efficacy did not predict perceived effectiveness. This finding is in contrast to previous study findings showing that self-efficacy significantly predicted perceived effectiveness in traditional online learning environments (e.g., Artino, 2007; Liaw, 2008). One of the possible explanations is that the self-efficacy items used in this study might not fit with the context of *Mountain 101* MOOC. Although self-efficacy is often domain-specific (Bandura, 1982), self-efficacy items used in this study were general. As the development of self-efficacy has been increasingly emphasized in MOOCs (Hodges, 2016), new self-efficacy items or other methods to correctly measure learners' self-efficacy in different MOOC contexts should be developed and used.

Research Question Two: Which SRL Strategies Are Positively Related to Successful Learners' Perceived Effectiveness of a MOOC?

The perceived effectiveness of the *Mountain 101* MOOC was significantly predicted by successful MOOC learners' meta-cognitive activities after learning. Meta-cognition is positively correlated with academic outcomes as shown in a systematic review on SRL in online higher education learning environments (Broadbent & Poon, 2015). The effects of meta-cognition in MOOCs have recently been given attention by researchers (e.g., Tsai, Lin, Hong, & Tai, 2018). The findings of the present study contribute to the body of studies examining meta-cognition in MOOCs as well as shed new light on the role of meta-cognitive activities after learning in a MOOC. It was important for learners who successfully completed the *Mountain 101* MOOC to use meta-cognitive strategies after learning. Therefore, MOOC instructors or instructional designers should provide meta-cognitive support for students as it has been emphasized in traditional online learning environments (An & Cao, 2014). For example, since evaluating thinking process is one of the basic meta-cognitive strategies (Dirkes, 1985), students should be offered prompt questions to allow them to evaluate their learning process right after finishing each module or whole course.

Successful MOOC learners' environmental structuring significantly predicted their perceived effectiveness of the *Mountain 101* MOOC. Environment structuring "involves selecting or creating effective settings for learning" (Zimmerman, 1998, p. 78). A few empirical study findings have shown the importance of environment structuring in traditional online learning environments. However, in general, students need to set a dedicated space for studying to succeed in online learning (Pappas, 2015). In addition, online learners are easily distracted because of their personal life activities such as taking care of family (Kerr, 2011). The findings of the present study showed that learners who successfully completed the *Mountain 101* MOOC employed an environment structuring strategy, which significantly predicted their perceived effectiveness. Therefore, as García Espinosa, Tenorio Sepúlveda, and Ramírez Montoya (2015) suggested, MOOC instructors could offer activities where learners can identify the distractions they face while taking MOOCs, and then discuss ways to reduce them in an online forum.

The perceived effectiveness of the course by learners who successfully completed the *Mountain 101* MOOC was significantly predicted by the learners' use of time management strategies. This result is supported by the importance of time management in MOOC environments. In fact, time management has been identified as one of the most important SRL strategies in MOOCs. For example, Nawrot and Doucet (2014) conducted a survey with 508 MOOC learners and found that poor time management was the main reason for withdrawing from a MOOC. In addition, in Kizilcec, Pérez-Sanagustín, and Maldonado's (2016) survey study, 17 learners who completed a MOOC responded that time management was one of the most important SRL strategies for succeeding in MOOCs. While little has been identified about the effect of time management strategies in MOOC environments, the finding of this study provides empirical evidence of it. MOOC practitioners should support learners' use of time management strategies to help them succeed in MOOCs. For example, as Nawrot and Doucet (2014) proposed, based on learners' behavior and performance datasets from MOOC platforms, MOOC practitioners could predict the amount of time learners will need to complete a specific type of task, rather than a complete unit, and provide suggestions for learners who plan to complete this type of task.

Conclusion

This study investigated the influence of SRL strategies, self-efficacy, and task value on perceived effectiveness of a course by learners who successfully completed the *Mountain 101* MOOC. While SRL strategies and task value significantly predicted successful learners' perceived effectiveness of the MOOC, self-efficacy did not. These study findings provide new insights on instructional design considerations for MOOCs by revealing the importance of learners' use of SRL strategies and task value beliefs. They support Liaw and Huang's (2013) assertion that SRL should be considered in instructional design for effective online courses. In addition, learners' perceptions of interest, importance, and usefulness of the MOOC should be considered when designing MOOCs. In terms of sub-SRL strategies, meta-cognitive activities after learning, environmental structuring, and time management strategies significantly predicted successful MOOC learners' perceived effectiveness of the course. As it has been shown that successful MOOC learners' behaviors positively affected other learners' success (Davis et al., 2016), it is important for MOOC instructors to support their learners' use of these SRL strategies in MOOCs.

There are limitations to this study. First, the data used in the present study only represents the context of the *Mountain 101* MOOC. For more generalizable results, future research should investigate other MOOCs addressing the same topic or different topics. In addition, this study relied on data drawn from self-reported questionnaires and used a quantitative method. Although self-reported questionnaires have been widely used in empirical studies to examine SRL in MOOC environments (e.g., Alario-Hoyos, Estévez-Ayres, Pérez-Sanagustín, Kloos, & Fernández-Panadero, 2017; Morales Chan, Hernandez Rizzardini, Barchino Plata, &

Amelio Medina, 2015), future research could benefit from employing qualitative methods to explore more deeply individual learners' SRL strategies, self-efficacy, and task value and their effects on perceived effectiveness of MOOCs.

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Applying the Rasch Model to Evaluate the Self-Directed Online Learning Scale (SDOLS) for Graduate Students

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Abstract

With the rapid growth of online learning and the increased attention paid to student attrition in online programs, much research has been aimed at studying the effectiveness of online education to improve students' online learning experience and student retention. Utilizing the online learning literature as a multi-faceted theoretical framework, the study developed and employed a new survey instrument. The Self-Directed Online Learning Scale (SDOLS) was used to examine graduate student perceptions of effectiveness of online learning environments as demonstrated by their ability to take charge of their own learning, and to identify key factors in instructional design for effective improvements. The study applied the Rasch rating scale model to evaluate and validate SDOLS through a psychometric lens to establish the reliability and validity of SDOLS. Results from Rasch analysis addressed two research questions. First, evidence was found to generally support the new instrument as being psychometrically sound but three problematic items were also identified as grounds for future improvement of SDOLS. Second, the study assessed the importance of various factors as measured by the SDOLS items in contributing to students' ability to self-manage their own online learning. Finally, the new instrument is expected to contribute to the work of various stakeholders in online education and can serve to improve students' online learning experience and effectiveness, increase online retention rates, and reduce online dropouts.

Keywords: self-directed learning, online teaching and learning, scale development, Rasch analysis

Introduction

Existing research on online education effectiveness has identified essential characteristics of a successful online learning environment (Hone & Said, 2016; Mayes, Luebeck, Ku, Akarasriworn, & Korkmaz, 2011; Palloff & Pratt, 2007). Among them, students' self-directed learning (SDL), or self-management of learning is one consistent and foundational factor recognized in online learning readiness and effectiveness (Prior, Mazanov, Meacheam, Heaslip, & Hanson, 2016; Rovai, Ponton, Wighting, & Baker, 2007). Research indicates SDL contributes to learners' abilities to manage their overall learning activities, to think critically, and to cognitively monitor their learning performance when navigating through the learning process. SDL also helps students better interact and collaborate with the instructor and peers for feedback and support (Beach, 2017; Garrison, 1997, p. 21; Hyland & Kranzow, 2011, p. 15; Kim, Olfman, Ryan, & Eryilmaz, 2014, p. 150).

Conceptual Framework

SDL has been a core theoretical construct in adult education and its research has evolved over time (Garrison, 1997). The existing literature on SDL has established an understanding of SDL as both a process and a personal attribute (Song & Hill, 2007, p. 38).

Knowles (1975) defined SDL as adult students' ability to self-manage their own learning, and his work served as a how-to book for adult students planning to develop competency as self-directed learners (Long, 1977). Next, Caffarella (1993, pp. 25–26) described three principal ideas underlying the SDL process: (a) a self-initiated process of learning, (b) more learner autonomy, and (c) greater control by the learner. Under SDL, learners take primary responsibility for their own learning to meet their unique needs and achieve personal goals. Hiemstra (1994) interpreted self-directed learning as indicating individual adults had the capacity to plan, navigate, and evaluate their own learning on the path to their personal learning goals. By contrast, Garrison (1997) presented a more comprehensive theoretical model of self-directed learning, focused on the learning process itself containing both motivational and cognitive aspects of learning. This model integrated three overlapping dimensions related to learning in an educational setting: (a) external management, (b) internal monitoring, and (c) motivation. Finally, noting that SDL may function differently in different learning situations, Song and Hill (2007) examined various learning contexts (the online context, in particular) where self-direction in learning takes place. They argued that a better understanding of trans-contextual SDL attributes unique to the online setting contributes to better online teaching and learning experiences.

Online Teaching and Learning

The past decades have witnessed a rapid development of technology contributing to the rise of online teaching and learning, which has led to increasing interest in SDL (Chou & Chen, 2008). Known for its flexibility allowing learning to accommodate adult learners' busy schedules, online education has been the right place for them to take charge of their own learning. On one hand, online learning supports the self-management dimension of Garrison's SDL model (1997). Online learning platforms lend themselves to greater learner control and autonomy, and ultimately, intrinsic motivation to learn. Due to being able to self-direct their own learning, learners more willingly turn what they have learned into professional practice (Beach, 2017). On the other hand, SDL is a critical characteristic a learner should possess for better adjustment and success in online learning, and for improving learning outcomes (Bonk, Lee, Kou, Xu, & Sheu, 2015; Heo & Han, 2018, p. 62; Hyland & Kranzow, 2011; Kim et al., 2014; Loizzo, Ertmer, Watson, & Watson, 2017). With interest, curiosity, and desire for self-improvement being among the most important motivating factors, learners are independent and autonomous in their use of various devices and places to learn, and for meeting their self-directed learning needs at their own pace (Bonk et al., 2015; Heo & Han, 2018, p. 62). Therefore, given the increasing opportunities for online learning, an area of particular interest to online learning researchers addresses the learner's ability to guide and direct his or her own learning (Beach, 2017; Hyland & Kranzow, 2011; Song & Hill, 2007, p. 27).

Existing SDL Measures

The measurement of self-direction in learning has been operationalized in studies that develop and validate instruments measuring various aspects of SDL, and, many times, revalidate these instruments again in culturally relevant settings, in different student populations, and so on.

Many SDL instruments are based on Knowles's andragogic theory (Cadorin, Bressan, & Palese, 2017; Knowles, 1975). First, in Guglielmino (1977), the Self-Directed Learning Readiness Scale (SDLRS) was developed based on Knowles's original concept of self-directed learning. Here, SDL readiness refers to the extent to which the individual possesses the abilities, attitudes, and personality characteristics necessary for self-directed learning (Wiley, 1983, p. 182). The SDLRS purported to measure the complex of attitudes, skills, and characteristics comprising an individual's current level of readiness to manage his or her own learning. Next, also adding to the SDL literature is the Self-Rating Scale of Self-Directed Learning (Williamson, 2007) measuring self-directed learning abilities in five dimensions. The instrument was subsequently revalidated in the Italian context to have a reduced number of items measuring SDL in eight dimensions (Cadorin, Bortoluzzi, & Palese, 2013; Cadorin, Suter, Saiani, Williamson, & Palese, 2010).

Besides SDL instruments designed for the general student population, SDL assessment tools have also been developed for students in specific domains. For example, in nursing education, multiple SDL instruments have been constructed measuring students' SDL skills to enhance the quality of their professional practice, including: (a) Self-Directed Learning Instrument (Cheng, Kuo, Lin, & Lee-Hsieh, 2010); (b) Self-Directed Learning Readiness Scale for Nursing Education (Fisher, King, & Tague, 2001); and (c) Autonomous Learner Index (Abu-Moghli, Khalaf, Halabi & Wardam, 2005).

Finally, many more SDL scales have been developed to serve various purposes and student populations, including: (a) Self-Directed Learning Scale (Lounsbury & Gibson, 2006); (b) Self-Directed Learning Inventory, for elementary school and college students (Jung, Lim, Jung, Kim, & Yoon, 2012; Suh, Wang, & Arterberry, 2015); and (c) Oddi Continuing Learning Inventory (Oddi, 1986). For a comprehensive listing of SDL measures, readers should refer to systematic reviews of SDL scale development studies, such as Cadorin et al. (2017) and Sawatsky (2017).

New SDL Instrument

Despite the existence of multiple SDL instruments, the literature review in this study has not identified any such instrument which is designed specifically for the online learning environment and dedicated to students who have had prior online learning experience. First, there are indeed a few SDL items written for the online environment buried somewhere in large scale surveys that measure multiple aspects of online education, such as items measuring student autonomy in the lengthy, 62-item Online Learning Environment Survey (Trinidad, Aldridge, & Fraser, 2005). A long, complicated survey tends to be associated with a low response rate, and when administered, may not collect any responses to the items specific to SDL. Second, among the existing SDL items for online education, many are formulated as prospective, instead of retrospective. Questions surveying students' future opinions when taking an online course may not always, when administered, be answered by students with prior online education experience. Students with no prior online education experience can also respond to those questions by imagining what their experiences would be like if they were to take an online course, and responses from such students are likely to lack validity.

Taking into account the two issues outlined above, as part of a larger study, a new, concise SDL instrument, Self-Directed Online Learning Scale (SDOLS; Su, 2016) has been developed to use retrospective, instead of prospective, questions aimed to collect responses from only students with prior online learning experience. The instrument measures students' SDL ability after he or she has taken an online course; it helps instructional designers determine if an online course meets the needs of students and identifies grounds for improvement. The construction of the SDOLS items was based on brainstorming, referring to existing SDL measures and adapting items from available SDL instruments (Abu-Moghli et al., 2005; Cheng et al., 2010; Fisher et al., 2001; Garrison, 1997, Guglielmino, 1977; Jung et al., 2012; Lounsbury & Gibson, 2006; Oddi, 1986; Suh et al., 2015; Trinidad et al., 2005; Watkins, Leigh, & Triner, 2004; Williamson, 2007). University faculty members with expertise in scale development and instructional design were also consulted to enhance the content validity of the instrument. Although SDOLS was developed based on the responses of graduate students in one research university in the Southeast US, the items are universal enough as an inquiry into the online learning experiences of students in other universities as well.

Research Questions

This study utilized a non-experimental survey research design, based in a post-positivist worldview (Creswell, 2013; Devlin, 2006) to explore graduate students' self-directed online learning ability. The study aimed to assess the psychometric properties of SDOLS, and examine issues related to graduate student perceptions of their SDL ability. Post-positivism holds "a deterministic philosophy in which causes probably determine effects or outcomes" (Creswell, 2013, p. 7). This study was passive in design, as there was no intent to manipulate any variables. The study was also exploratory, as it provided only preliminary psychometric evidence of the instrument and its use in investigating SDL and served as the foundation for examining future application of the instrument to broader contexts.

A Rasch measurement approach was taken using the rating scale model (RSM) to evaluate the psychometric properties of SDOLS (Bond & Fox, 2015). Rasch modeling and its variants have been used in similar research in online education (Choi, Walters, & Hoge, 2017; Wilson, Gochyyev, & Scalise, 2016). Besides scale validation, the study also examined students' perceptions of their SDL ability. Specifically, the study addressed two research questions:

1. What are the psychometric properties of SDOLS as measured by the Rasch rating scale model?

2. How important do students think various factors, as documented by SDOLS items, are in terms of contributing to their self-directed online learning ability?

Methodology

Research Context

The draft SDOLS instrument was pilot-tested in the fall semester of 2014. A group of 10 graduate students taking an online course in that semester participated in the pilot testing. They were surveyed through Qualtrics after the conclusion of the semester and provided the feedback which was later incorporated into the final survey instrument. Their feedback revolved around identifying any aspects of the draft instrument that could lend themselves to misunderstanding or logical flow problems in the survey delivery and revising such aspects. After factoring in the feedback, the final instrument had 17 items and was administered to another, larger group of students.

Table 1 presents the final SDOLS instrument; each item is a question related to how students take charge of their learning on a 1 to 5 Likert scale: 1 for *strongly disagree* (SD), 2 for *disagree* (D), 3 for *neutral* (N), 4 for *agree* (A), and 5 for *strongly agree* (SA). The 17 items make up two subscales—autonomous learning (AUL; eight items) and asynchronous online learning (AOL; nine items). Finally, all SDOLS items were worded positively; a higher score indicates a higher level of SDL ability.

Table 1

Self-Directed Online Learning Scale

Item	Item statement	Subscale
Q01	I was able to make decisions about my online learning (e.g., selecting online project topics).	AUL
Q02	I worked online during times I found convenient.	AUL
Q03	I was in control of my online learning.	AUL
Q04	I played an important role in my online learning.	AUL
Q05	I approached online learning in my own way.	AUL
Q06	I was able to complete my work even when there were online distractions (e.g., friends sending e-mails).	AUL
Q07	I was able to complete my work even when there were distractions in my home (e.g., children, television).	AUL
Q08	I was able to remain motivated even though the instructor was not online at all times.	AUL
Q09	I was able to access the discussion forum at places convenient to me.	ASL
Q10	I was able to read posted messages at times that were convenient to me.	ASL
Q11	I was able to take time to think about my messages before I posted them.	ASL

Q12	The process of writing and posting messages helped me articulate my thoughts.	ASL
Q13	My writing skills have improved through posting messages.	ASL
Q14	I was able to ask questions and make comments in online writing.	ASL
Q15	I was able to relate the content of online course materials to the information I have read in books.	ASL
Q16	I was able to understand course-related information when it was presented in video formats.	ASL
Q17	I was able to take notes while watching a video on the computer.	ASL

Research Participants

After securing required Institutional Review Board approval, the study proceeded to obtain a nonprobability convenience sample. The sample consisted of all 909 graduate students in the aforementioned university who were taking online courses during the fall semester of 2014. In January 2015, these 909 graduate students were contacted by e-mail through Qualtrics, inviting them to participate in the study.

To address the possible low response rate issue common in online surveys, the study first sent a mass pre-notification e-mail to all 909 students, informing them of an upcoming solicitation to participate in a study about their online learning experiences during the fall semester of 2014. After the data collection started, several follow-up e-mails were sent to remind the students to complete the survey. This continued until the data collection came to an end in April 2015. As an incentive to participate in the survey, all potential participants were entered into a draw to win one of five gift cards valued at $50 each. In the end, 238 participants provided complete responses to all 17 items, which, despite a low response rate of 26.2%, still led to a high student-item ratio of about 14:1, satisfying the criterion that the sample size should be at least six times the number of items for stable results (Mundfrom, Shaw, & Ke, 2005).

Table 2 provides demographics of the sample of 238 participants. The sample consisted of 50 male and 188 female students. Respondents age ranged from 21 years to 51 years (or older), but almost half (45.8%) were under 30 years old. Regarding ethnicity, there were 22 African American students, 15 Asian students, 5 Hispanic/Latino students, 188 White students, and 8 students who identified as being of more than one race. Finally, regarding marital status, the proportion of students who were married was moderately higher than that of students who were not (58.0% for married vs. 42.0% for not married).

Table 2

Demographics of Student Participants

Category	Variable	n	Percent
Gender	Male	50	21.0
	Female	188	79.0
Age	21–25 years	49	20.6
	26–30 years	60	25.2
	31–40 years	58	24.4
	41–50 years	44	18.5
	51 years or older	27	11.3
Race/Ethnicity	Hispanic/Latino	5	2.1
	Asian	15	6.3
	African American	22	9.2
	White	188	79.0
	More than one race	8	3.4
Marital Status	Married	138	58.0
	Not married	100	42.0
Total		238	100.0

Data Analysis

First, the responses of the 238 students were used to compute two sets of descriptive statistics: (a) cumulative response category percentages from all 17 items, and (b) response category percentages for each individual item. In Figure 1 (consisting of subfigures 1a through 1r) the statistics are presented graphically using bar charts (from left to right: SD, D, N, A and SA). Subfigure 1a represents the cumulative percentages of response categories from all 17 items put together. As is seen, as high as 77.7% of the responses were in the *agree* and *strongly agree* categories, indicating the participants tended to endorse item statements. From subfigures 1b through 1r for individual items, the highest bar is always associated with either the SA or the A category, whereas the SD category is always selected least frequently. Therefore, all 17 items elicited similar response patterns and the participants tended to hold a favorable view of the statement for each item.

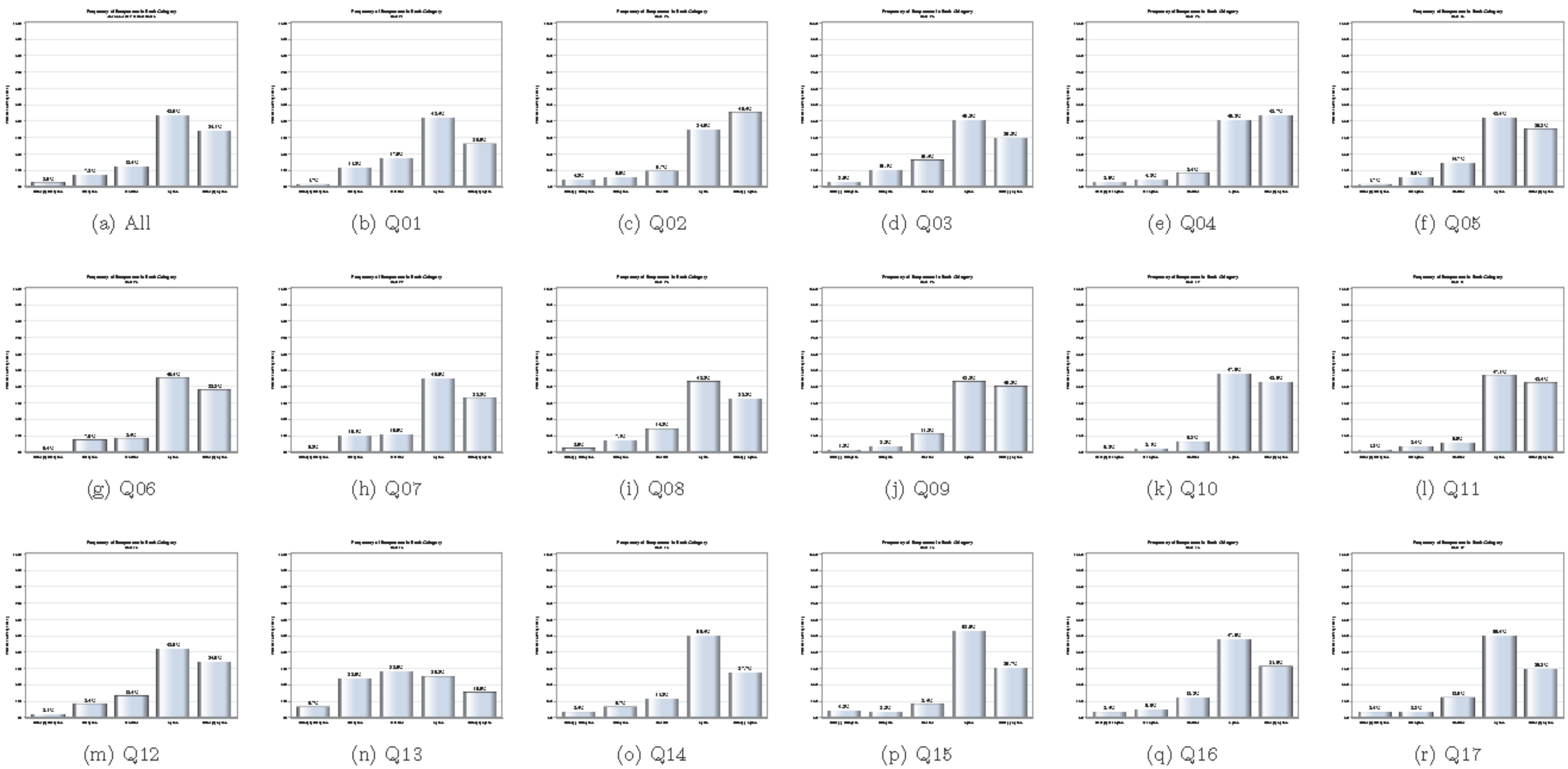

Figure 1. Response frequency distributions for all and individual items.

Next, a unidimensional RSM-based Rasch analysis was conducted within Winsteps 4.1.0 to assess the degree to which students agree with item statements covering various SDL factors (Linacre, 2018). A unidimensional Rasch model assumes the survey items measure only a single underlying construct (e.g., ability to self-manage one's own learning) and establishes the relative difficulty (or relative endorsability) of each item statement with regard to that latent construct (Bond & Fox, 2015).

In the Rasch analysis, several aspects of SDOLS were investigated.

- Unidimensionality: The study investigated the fundamental Rasch analysis assumption of a single underlying construct. The assumption was assessed using a principal component analysis of the correlation matrix of the Rasch standardized residuals.

- Reliability and validity: To identify reliability and validity evidence for SDOLS, person/item reliability and separation statistics were examined. First, person separation classifies people whereas item separation verifies item hierarchy. Next, person and item reliability statistics refer to reproducibility of relative measures or score location (e.g., high reliability of persons (or items) means the probability is high that persons (or items) estimated with high scores actually do have higher scores than persons (or items) estimated with low scores).

- Rating scale effectiveness: The quality of the rating scale was critiqued to see if the response categories functioned as intended, and if students were able to consistently and correctly understand and interpret the response categories.

- Item and person measure quality: Infit and outfit mean square (MNSQ) statistics were used to assess the fit of the 17 items to the Rasch model. According to Linacre (2018, pp. 582-588), the ideal value of an item infit/outfit mean square statistic should fall between 0.50 to 1.50, and values exceeding 2.00 may suggest a noisy problematic item.

- Construct hierarchy: The Wright map was assessed to investigate the construct hierarchy of SDOLS (Wilson, 2005). The map visually presents relative difficulty of items and students' ability to self-manage their learning. From top to bottom, items (to the right of the vertical line) are ranked from the least favorite item (hardest to endorse) to the most favorite item (easiest to endorse); students (to the left of the vertical line) are ranked from those who are most able to self-manage their learning to those who are least able to.

Results

The results support SDOLS as having excellent psychometric properties with the exception of three items. The results also rank-order various factors of SDL regarding their relative importance to students' self-directed online learning ability.

Dimensionality Analysis

Results indicate as high as 51.1% of the raw variance is explained by the Rasch dimension, with 30.9% attributed to persons and 20.2% to items. The largest secondary dimension, indicated by the first contrast under Winsteps, explains only 8.1% of the raw variance with an eigenvalue of 2.8, the strength of at most three items. Therefore, the ratio of the variance explained by items (20.2%) to that explained by the second largest dimension (8.1%) is about 2.50. Despite a possible secondary dimension made up of at best three items, it is also true that virtually all survey datasets consist of multiple dimensions (hardly any dataset is perfectly unidimensional), albeit to varying degrees (Royal & Gonzalez, 2016). Given evidence to support a single, primary underlying construct being measured by the Rasch dimension, the study concludes the unidimensionality assumption is reasonably satisfied for a unidimensional Rasch analysis (Linacre, 2018, pp. 557-558; Royal, Gilliland, & Kernick, 2014).

Reliability and Validity

Person and item separation statistics are, respectively, as high as 2.71 and 4.64. The high person separation statistic indicates SDOLS is sufficiently sensitive to distinguish between individual students with higher and lower levels of SDL ability, and the high item separation statistic suggests the student sample is large enough to confirm item difficulty hierarchy. Overall, these observations support the construct validity of the instrument.

Person reliability is 0.88 (i.e., SDOLS discriminates the sample into enough levels), and item reliability is even higher at 0.96 (i.e., the sample is large enough to precisely locate the items on the latent difficulty continuum). Person reliability being high could be due to ability variance being large. By contrast, item reliability being high could be attributed to large variability in item difficulty and a relatively large number of students.

Rating Scale Effectiveness

First, based on the response category probability curves in Figure 2, each category has a distinctive peak suggesting it is a meaningful endorsement choice for students at a specific ability level. Stated differently, students are able to sufficiently separate one response option from another, thus providing additional evidence of validity.

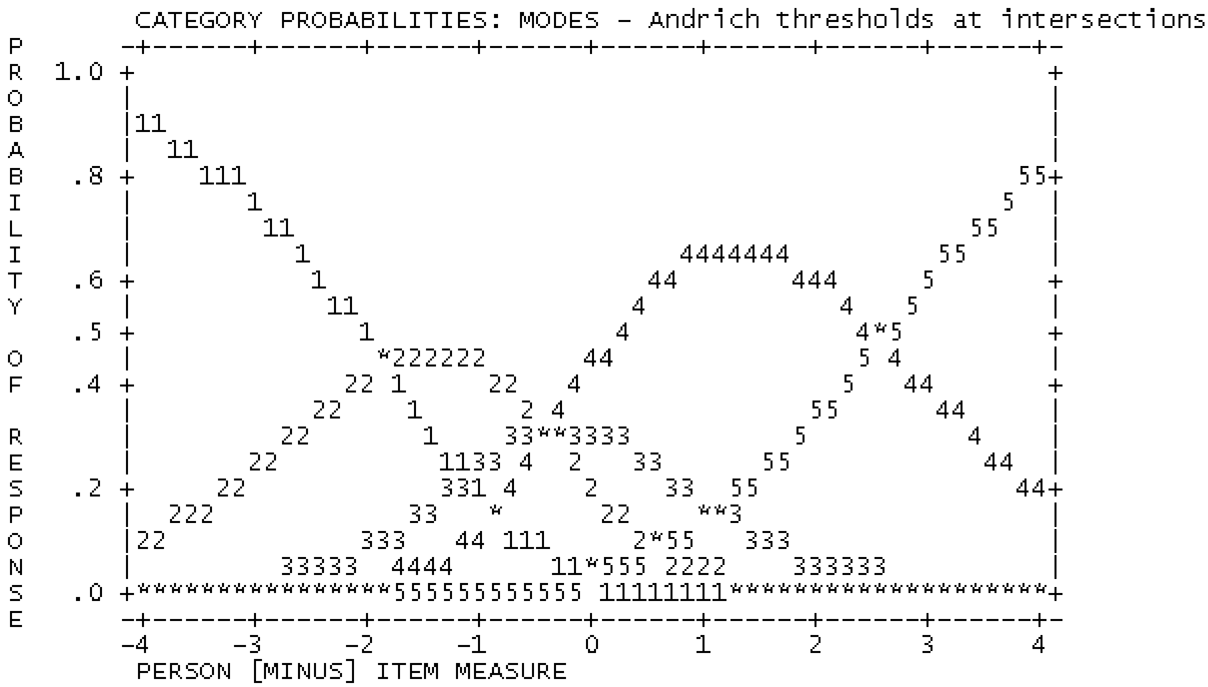

Figure 2. Response category probability curves.

Next, based on the shape of the response category count distribution in Table 3, it is evident that, although students do make full use of all five response categories, they still prefer to select those on the side of agreement (the *agree* category, in particular). Notably, almost all infit and outfit MNSQ statistics fall into the recommended range of 0.50 to 1.50 (Linacre, 2018, pp. 582-588) with only the outfit MNSQ for the SD category being only 0.04 points higher than 1.50. Besides, the category measures and Andrich threshold measures each advance in a stepwise manner, as expected.

Table 3

Category Structure Calibration

Responses		Observed sample		Mean square		Stepwise	
Options	Labels	n	Percentage	Infit	Outfit	Andrich threshold	Category measure
1	SD	104	3	1.14	1.54	None	(-3.10)
2	D	294	7	1.14	1.25	-1.84	-1.40
3	N	502	12	1.11	1.50	-0.43	-0.26
4	A	1,766	44	0.97	0.78	-0.32	1.29
5	SA	1,380	34	0.90	0.90	2.59	(3.73)

Third, the study examined the construct key map for the five response categories (see Figure 3). In the map, items are ordered from the least endorsable item Q13 (top) to most endorsable item Q10 (bottom). Evidently, the ordering of categories remains consistent as 1, 2, 3, 4, and 5 across all 17 items. Such consistency indicates none of the 17 items might cause misunderstanding or unexpected answers, thus supporting the validity of SDOLS (Ren, Bradley, & Lumpp, 2008). In summary, the results here support that the rating scale structure of SDOLS functioned in the intended way, and the response options were consistently and correctly interpreted by research participants.

```
-5       -3        -1         1         3         5         7
|---------+---------+---------+---------+---------+---------|  NUM   ITEM
1                1   :    2  : 3  :    4       :   5        5   13  Q13
|                                                           |
|                                                           |
1           1   :   2  :  3  :    4      :    5             5    1  Q01
1          1   :    2  :  3  :   4      :    5              5    3  Q03
|                                                           |
1         1    :   2  :  3  :   4       :    5              5   14  Q14
1         1   :    2  : 3  :    4      :    5               5    8  Q08
1         1   :   2  :  3  :    4      :    5               5   12  Q12
1         1   :   2  :  3  :    4      :    5               5   16  Q16
1         1   :   2  :  3  :    4      :    5               5    7  Q07
1         1   :   2  :  3  :    4      :    5               5   17  Q17
1        1   :    2  :  3  :   4       :    5               5   15  Q15
1        1   :    2  : 3  :    4      :    5                5    5  Q05
|                                                           |
1       1   :    2  : 3   :   4      :    5                 5    2  Q02
1       1   :    2  : 3  :    4      :    5                 5    6  Q06
1      1   :    2  :  3  :   4       :    5                 5    9  Q09
1      1   :    2  :  3  :   4       :    5                 5    4  Q04
|                                                           |
1     1   :    2  : 3   :   4      :    5                   5   11  Q11
1     1   :   2  :  3  :    4      :    5                   5   10  Q10
|---------+---------+---------+---------+---------+---------|  NUM   ITEM
-5       -3        -1         1         3         5         7

                          1 111 21  1   1        1         1
     1          1 22225395093468629646141 292 2  0  4      8   PERSON
              T         S          M         S         T
     0                 10 20 30 50 70  80       90        99   PERCENTILE
```

Figure 3. Construct key map.

Item Measure Quality

In Table 4, Q13 has an unusually large outfit MNSQ statistic (2.35). Because 2.35 > 2.00, it indicates that, with this item, off-variable noise is greater than useful information. Because this item degrades measurement, it should be revised to remedy the misfit. Besides Q13, Q01 and Q02 have relatively serious misfit issues with inflated infit and outfit MNSQ statistics for each item being greater than 1.50 (ranging from 1.52 to 1.84). These two items may be problematic and thus require further scrutiny to reduce their off-variable noise and improve their fit to the model. Table 4 also indicates all remaining 14 items are productive of measurement, because each item's infit and outfit MNSQ measures fall into the acceptable range of 0.50 to 1.50. Finally, point biserial correlations are all high and positive (ranging from .56 to .72), indicating the orientation of the scoring on each item is consistent with the orientation of the latent variable, and that the items have excellent discriminatory abilities (Linacre, 2018, pp. 526-532).

Table 4

Item Quality Indicators

Item	Total	Measure estimate	Measure SE	Infit MNSQ	Infit ZSTD	Outfit MNSQ	Outfit ZSTD	Point biserial
Q13	759	1.54	0.08	1.34	3.40	2.35	9.90	.66
Q01	905	0.45	0.09	1.52	4.40	1.84	6.30	.56
Q02	979	-0.25	0.10	1.73	5.40	1.79	5.40	.56
Q17	951	0.04	0.10	1.13	1.20	1.22	1.80	.62
Q04	995	-0.42	0.11	1.17	1.50	1.04	0.30	.64
Q07	951	0.04	0.10	1.13	1.20	1.07	0.70	.66
Q14	934	0.20	0.10	0.98	-0.10	1.11	1.00	.66
Q03	915	0.37	0.09	0.94	-0.60	1.00	0.00	.70
Q05	961	-0.06	0.10	0.95	-0.40	0.96	-0.30	.68
Q09	994	-0.41	0.11	0.89	-0.90	0.83	-1.40	.67
Q06	984	-0.30	0.10	0.85	-1.30	0.87	-1.10	.68
Q16	950	0.05	0.10	0.83	-1.60	0.87	-1.10	.69
Q15	957	-0.02	0.10	0.84	-1.50	0.72	-2.70	.69
Q08	944	0.10	0.10	0.81	-1.90	0.80	-1.90	.71
Q12	946	0.09	0.10	0.81	-1.90	0.77	-2.20	.72
Q11	1014	-0.65	0.11	0.69	-3.10	0.63	-3.30	.69
Q10	1023	-0.76	0.11	0.63	-3.70	0.58	-3.80	.70

Item/Construct Hierarchy

According to the Wright map in Figure 4, students most easily endorse items Q10 and Q11, suggesting students highly value the ability to read posted messages at convenient times and to take time to think about their own messages before posting them. Next, students equally easily endorse items Q04, Q06, and Q09. This indicates students believe discussion forum access at convenient places is a very important factor in online learning. Plus, students believe they take control of their own online learning and are confident of completing their work despite online distractions. Next, students easily endorse Q02, indicating they tend to work online during convenient times. Then, at the average item difficulty level is a group of six items: (a) Q05 (approaching online learning); (b) Q07 (completing work despite home distractions); (c) Q12 (articulating thoughts); (d) Q15 (relating course materials to books); (e) Q16 (understanding course information in video formats); and (f) Q17 (taking notes). Evidently, these are more difficult to endorse than all items already discussed but are easier to endorse than items to be presented next. Next, Q08, Q14, Q01, and Q03 follow closely with virtually identical endorsability measures. Students find it relatively difficult to (a) stay motivated, (b) ask questions and make comments, (c) make decisions, and (d) stay in control in online learning. Finally, the hierarchy continues upward until it reaches the most difficult items to endorse, Q13 staying away from all other items (i.e., there is a large gap between Q13 and all other items in the Wright map), indicating students hardly agree their writing skills have improved through posting messages.

```
MEASURE    PERSON - MAP - ITEM
               <more>|<rare>
   6     #########   +
                     |
                     |
                ##   |
                     |
   5                 +
             #####   |
                    T|
                     |
                 #   |
   4                 +
                 #   |
             .####   |
                 #   |
                     |
   3        .##### S+
                ##   |
                 .   |
               ###   |
           #######   |
   2           ###   +
             .####   |
            ###### M|   Q13
     #############   |
              ####   |
   1      ########   +T
           #######   |
           .######   |S
             .####   |  Q01      Q03
             #####   |  Q08      Q14
   0           .## S+M Q05      Q07      Q12      Q15      Q16      Q17
             .####   |  Q02
                .#   |  Q04      Q06      Q09
               .##   |S Q11
                 #   |  Q10
  -1             #   +T
                 #   |
                 #   |
                    T|
                 .   |
  -2                 +
                     |
                     |
                     |
                     |
  -3                 +
                     |
                     |
                     |
                     |
  -4             .   +
               <less>|<freq>
EACH "#" IS 2: EACH "." IS 1
```

Figure 4. Wright hierarchy map.

Discussion

The study assessed the psychometric properties of SDOLS for measuring students' perceptions of their self-directed online learning ability. Overall, the study supports SDOLS as having decent psychometric properties. Next, the study rank-ordered items regarding students' level of endorsement to offer insights into how important the attributes are for facilitating students' online, self-directed learning.

Psychometric Properties of SDOLS

Regarding psychometric properties of SDOLS, the study was based on the validity framework by Messick (1989) which has been implemented in the Rasch literature (Long, Wendt, & Dunne, 2011, pp. 388–389; Royal & Elahi, 2011, p. 369; Royal et al., 2014, pp. 458–459). According to Messick, validity is the integration of any evidence that impacts the interpretation or meaning of a score. Messick's framework is made up of six unique aspects of validity: (a) substantive, (b) content, (c) generalizability, (d) structural, (e) external, and (f) consequential. The Rasch analysis findings are discussed next within four of these six aspects of validity.

First, the fundamental assumption of unidimensionality is satisfied from a practical perspective due to the existence of a single, primary Rasch dimension which explains over 50% of the raw variance. This finding supports the substantive aspect of validity. Next, measures of reliability are extremely close to or above .90, which serves as evidence of the generalizability aspect of validity. Also, a diagnostic of the rating scale effectiveness indicates the response categories of SDOLS functioned as intended, and the participants were able to correctly and consistently interpret response options, which supports the structural aspect of validity. An assessment of the item fit measures indicated the vast majority of the 17 items provided an adequate fit to the Rasch model; this finding speaks to the content aspect of validity. In summary, multiple pieces of evidence under Messick's validity framework supported SDOLS as being psychometrically sound, thus indicating the instrument is able to produce high-quality data.

Next, the analysis of item misfit reveals three items (Q13, Q01, and Q02, presented in order of misfit per Table 4) that did not provide adequate fit to the Rasch model. These items should be either removed or revised in future iterations of SDOLS.

Implications for Online Teaching and Learning

The SDOLS instrument addresses many issues associated with students' ability to self-manage their learning in online education. Because SDOLS offers insights into online students' feelings regarding various aspects of their SDL ability, the instrument is likely to be relevant to various stakeholders in online education including students, instructors, administrators, instructional designers, researchers, and so on. For example, instructional designers may use the SDOLS data to identify grounds for improvements to an online learning environment, and as a guide in their work to improve their designs. In another instance, they may use the instrument as a diagnostic tool to measure online learners' readiness, and screen for learners whose self-directed learning ability is likely to be weak, before tailoring course designs in a way that improves online learners' success. On the other hand, data collected through the SDOLS instrument will enable instructors, administrators, and researchers to better understand how students' self-directed learning characteristics may relate to their success in online courses and completion of online programs, thus effectively contributing to improving online course and program designs. In summary, the study recommends the SDOLS instrument should be used for improving student online learning experience and effectiveness, increasing online retention rates, and reducing online dropouts.

Limitations and Future Research

The study is not without limitations, but limitations could be directions of future research. First, the research data could have been subject to self-selection bias, due to the self-selected sample being non-probabilistic and therefore lacking in randomization, and to nonresponse bias exacerbated by a low response rate of 26.2%. Graduate students who chose to complete the online survey could be different demographically and behaviorally than those who chose not to. Second, the study has not assessed SDOLS on two other aspects of validity under Messick's framework. On one hand, because the study is the first introducing and validating SDOLS, there is no way to investigate the consequential aspect of validity, since the instrument was not previously used. On the other hand, findings from the study have not been correlated with those from others, so the external aspect of validity has not been evaluated. Third, the study is yet to examine the extent to which items remain invariant across various subgroups (e.g., by gender). In future research, a differential item functioning analysis could further assess whether SDOLS items function differently across these subpopulations. Finally, given the limitations described above, although the findings here support the scale as having potential, they are still preliminary regarding the issues in the two research questions. Fortunately, the research design and the analytic methodology are straightforward to implement, which makes it easier for future researchers to replicate the study under broader research contexts.

Conclusion

The study develops and validates SDOLS measuring students' ability to self-manage their online learning with a secondary goal of understanding their perceptions of various SDL factors. First, the study finds validity evidence for SDOLS from multiple perspectives under the Messick framework as well as evidence supporting SDOLS as a reliable instrument. The study also finds three problematic items (Q13, Q01, and Q02) based on criteria from the Rasch literature and suggests they should be revised or removed. Second, the study provides insights into students' perceptions of various SDL factors regarding contributions to their SDL ability.

As a final reflection, SDOLS is designed to survey students with prior online learning experience regarding their perceptions of SDL ability under the unique nature and features of the online education environment. The preliminary results here indicate SDOLS can be administered with confidence to students for a reliable and valid measurement of their SDL ability. Because these characteristics of students ultimately determine whether self-directed learning will take place, the instrument is expected to help researchers better understand students' self-directedness in learning within the online environment, which in turn will contribute to the call for adequate social and academic support to enhance students' online learning experience and to reduce the rate of attrition. Besides, despite limited coverage in this study, SDOLS can be used for diagnostic purposes by analyzing the Wright map to identify, characterize, and rank-order learners regarding their level of self-directedness in learning (i.e., distinguishing students who are more independent learners good at determining their learning needs, planning, and implementing their own learning from students who feel more comfortable with more structured learning options such as traditional classroom environments). This diagnostic use of SDOLS is valuable because, until very recently, there have been few validated tools for identifying the self-directed learners (Sahoo, 2016, p. 167).

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An Analysis of Course Characteristics, Learner Characteristics, and Certification Rates in MITx MOOCs

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Abstract

Massive Open Online Courses (MOOCs), capable of providing free (or low cost) courses for millions of learners anytime and anywhere, have gained the attention of researchers, educational institutions, and learners worldwide. Even though they provide several benefits, there are still some criticisms of MOOCs. For instance, MOOCs' high dropout rates or predominantly elite participation are considered to be important problems. In order to develop solutions for these problems, a deeper understanding of MOOCs is required. Today, despite the availability of several research studies about MOOCs, there is a shortage of in-depth research on course characteristics, learner characteristics, and predictors of certification rates. This study examined MOOC and learner characteristics in detail and explored the predictors of course certification rates based on data from 122 Massachusetts Institute of Technology MOOCs (MITx) on edX platform as well as data about the 2.8 million participants registered in these MOOCs. The results indicated that as the number of courses offered and the number of learners enrolled increased in years, there was a decrease in the certification rates among enrolled learners. According to our results, the number of average chapters completed, total forum messages, and mean age predicted course certification rates positively. On the other hand, the total number of chapters in a course predicted the course certification rates negatively. Based on these results, shorter and more interactive MOOCs are recommended by considering the needs of the learners, course content design, and strategies encouraging the enrolled students to enter the courses.

Keywords: online learning, massive open online courses, MOOCs, MITx

Introduction

MOOCs have the potential to support traditional education activities both in- and out-of-class, such as homework and exercises, as well as individuals' lifelong learning. There are several benefits of MOOCs, as they are open-access and offered at little or no cost, with thousands of participants able to enroll and earn credits or receive certificates without constraints of space or time (De Barba, Kennedy, & Ainley, 2016; Porter, Graham, Spring, & Welch, 2014). MOOCs serve learners from all over the world, and there is no limit to learners' age, educational level, individual characteristics, or culture. Currently, more than 800 universities worldwide offer MOOCs and the number of these courses exceeds 10,000 (Shah, 2018b). Thus, the number of learners registered in MOOCs is huge compared to traditional courses. According to Shah (2018a) the top five MOOC providers (and number of registrations) are Coursera (37 million), edX (18 million), XuetangX (14 million), Udacity (10 million), and FutureLearn (8.7 million). This massive number of learners comprises people from diverse backgrounds with different motivations (DeBoer, Stump, Seaton, & Breslow, 2013; Kizilcec & Schneider, 2015). Deng, Benckendorff, and Gannaway (2019) have reported that MOOC learners' age distribution is mainly between 25 and 65 years. Even though MOOCs are open to everyone, the majority of learners hold higher education degrees, and most are male (Christensen et al., 2013).

MOOCs offer the possibility of providing free education for everybody; however, they have some limitations in terms of their, effectiveness, and benefits for both learners and educational organizations. Learners' behavior in MOOCs, instructional design of MOOCs, assessment processes, and interactions among learners and instructors are significantly different from traditional educational platforms. For instance, MOOC learners are rarely able to obtain direct and timely feedback from instructors (Kop, Fournier, & Mak, 2011). Furthermore, a study performed on four edX MOOCs reported that on average, certificate earners skipped 22% of the course content and made use of non-linear navigation (Guo & Reinecke, 2014). In the same study, it was also noted that older learners and those from lower learner-teacher ratio countries showed more comprehensive and non-linear navigation. Hence, MOOC learners present different behaviors than do learners in traditional courses. Another significant finding showed that less than 10% of the enrolled learners tended to complete their MOOC (Ho et al., 2015; Jordan, 2014). Providing course content in such a way so as to address these different individual requirements is a great challenge for MOOC instructional designers (Adair et al., 2014; Beaven, Codreanu, & Creuze, 2014). In addition, understanding the culture of learning in MOOCs is a complex process, and learners also face problems in adapting to these platforms (Loizzo & Ertmer, 2016). Compared to traditional education, learning outcomes from MOOCs, learners' purposes for enrolling in them (Watson et al., 2016), and their educational preferences are changing significantly (Watson, Watson, Yu, Alamri, & Mueller, 2017). A recent study reported that the same engagement measures may result in different achievement levels for different learner groups (Li & Baker, 2018). In other words, the instructional design of MOOCs is critical and essential (Yang, Shao, Liu, & Liu, 2017). Hone and El Said (2016) found that the MOOC content affected learners' retention and perceived effectiveness. Transactional interaction between learner and content, as well as the structure and assessment of course design factors are reported as significant predictors of learner control and sense of progress in MOOCs (Jung, Kim, Yoon, Park, & Oakley, 2019). Aparicio, Oliveira, Bacao, and Painho (2019) reported that gamification is contributing significantly to the overall success of MOOCs by reducing dropout rates and improving learner satisfaction and user experience. Therefore, because of its very nature, the instructional design of MOOCs also needs to incorporate new approaches, rather than traditional ones (Adair et al., 2014; Margaryan, Bianco, & Littlejohn, 2015; Rodriguez, 2012). Currently, MOOC quality is reported as suboptimal (Margaryan et al., 2015), while quality instructional design can improve learning outcomes in distance learning (Hsu & Shiue, 2005).

In recent years, several studies have been conducted to better understand MOOC learners (e.g., Cagiltay, Esfer, & Celik, 2020; Hew & Cheung, 2014; Khalil & Ebner, 2014). However, there have been a limited number of studies offering a bigger picture on MOOCs. Jordan (2015) analyzed 221 MOOCs from different providers and the results indicated decreased average total enrolments in these courses over time, but an increase in completion rates. Jordan proposed some significant predictors for course completion rates, which were reported as positively correlated with the start date and assessment type, and negatively correlated with the course length. Ho et al. (2014) analyzed 17 Harvard University and MIT MOOCs offered in 2013, and reported a decrease from 3.2% to 2.5% in course certification for registered learners and an increase in the registration rates However, there is not sufficient evidence to confirm the results of these studies. In order to see the big picture, there is a need to analyze a larger number of courses, whereas previous studies only cover a limited number of MOOCs.

Accordingly, this study investigated 122 MITx courses with approximately 2.9 million learners, in order to provide feedback for MOOC developers on how to improve their courses. Specifically, this study analyzed the data provided by MITx, categorized these MOOCs into 15 course subjects classified into three course levels, and revealed the predictors of course certification rates. Although these MOOCs were from just one specific MOOC provider, they included heterogeneous learners from different backgrounds and countries. Therefore, this study is not limited to a particular region or country and can be generalized globally to some degree. In this sense, this study provides a unique contribution to open and distributed learning.

Methodology

Research Questions

The current study focused on the following six research questions:

1. How are the courses and number of enrolled learners distributed, in terms of subject areas?
2. How are the courses distributed in terms of course levels?
3. How is learner activity distributed in terms of subject areas and course levels?
4. How is learner activity and course certification distributed, in terms of course levels?
5. How is learner activity distributed in terms of specific course subjects?
6. What are the predictors of course certification rates?

Research Method

This quantitative study utilized descriptive and correlational research methods. Since it is difficult to confine educational events within controlled laboratory conditions, some types of educational research questions call for descriptions in order to explain the data (Knupfer & McLellan, 1996). The main focus of descriptive studies is to depict patterns rather than answer questions that ask why (Neuman, 2014), as they aim to describe and interpret what is happening (Cohen, Manion, & Morrison, 2007). In correlational research, the associations among variables are explored without any manipulation, and the variables can be used for prediction (Fraenkel & Wallen, 2009).

Data Collection and Analysis Process

The data were obtained from MITx MOOCs on the edX platform. In total, the available course data from 122 MITx MOOCs offered between 2012 and 2016 were obtained. The data provided by MITx was organized to represent details of each course. The level of each course was taken from the MITx website and combined with the course data. Then, the data were analyzed using descriptive statistics (mean, standard deviation, frequency, and percentage) and inferential statistics (multiple linear regression). Multiple linear regression (MLR) requires absence of outliers among the independent variables (predictor variables) and on the dependent variable (outcome variable), normality, linearity, and homoscedasticity of residuals, absence of multicollinearity, and independence of errors assumptions (Tabachnick & Fidell, 2007). Before carrying out an MLR analysis, its assumptions were checked. The data from four MOOCs, identified as outliers, were removed from the analysis. Due to the residuals not being completely normally distributed, a Box-Cox transformation was applied to the outcome variable, namely course certification rates. Thus, it was ensured that residuals were completely normally distributed. The homoscedasticity of residuals was evaluated by checking the scatterplot of the residuals, which showed no obvious pattern. Variance inflation factor (VIF) values were checked to determine whether there was multicollinearity between predictor variables. All the predictor variables had VIF values less than 3, ranging from 1.00 to 2.09, and no multicollinearity was detected. The Durbin-Watson value was checked for the independence of errors and found to be 1.81. To summarize, all assumptions were met for the multiple regression analysis. As a result, the MLR analysis was carried out with 118 MOOCs.

Results

Research Question One

Most of the courses (22.13%, $n = 27$) were offered in the computer science subject area; accordingly, the highest number of learners were also registered in these courses (38.24%; $n = 1{,}107{,}780$), followed by engineering subjects (15.57%; $n = 19$) and business and management (14.75%; $n = 18$). The mean age of the learners enrolled in each course ranged from 28.27 to 32.49 years. Table 1 shows the numbers and percentages of the analyzed courses according to subject area.

Table 1

Number of Courses According to Subject Area

	Courses		Enrolled learners		
Subject area	*n*	%	*n*	%	Mean age
Biology and life sciences	13	10.66	173,944	6.01	30.53
Education and teacher training	6	4.92	131,063	4.52	32.49
Business and management	18	14.75	358,048	12.36	31.81
Physics	9	7.38	80,940	2.79	29.67
Social sciences	9	7.38	101,665	3.51	31.44
Data analysis and statistics	5	4.10	200,318	6.92	30.61
Engineering	19	15.57	307,348	10.61	27.67
Math	3	2.46	91,002	3.14	29.00
Computer science	27	22.13	1,107,780	38.24	29.34
Communication	2	1.64	106,694	3.68	30.34
Humanities	3	2.46	119,658	4.13	31.07
Philosophy and ethics	2	1.64	43,786	1.51	30.07
Chemistry	3	2.46	23,424	0.81	28.27
History	2	1.64	42,151	1.46	32.23
Art and culture	1	0.82	8,718	0.30	29.76
Total	122	100	2,896,539	100	30.29

Research Question Two

Most of the courses (45%) were at introductory level and 60% of the learners registered for these courses, followed by intermediate (31%) and advanced level (24%) courses. In all these course levels, the mean age of the learners was 30.03 years. Table 2 shows the number of courses and their percentages according to course level.

Table 2

Number of Courses According to Course Level

Courses			Enrolled learners		
Course level	*n*	%	*n*	%	Mean age
Introductory	55	45.08	1,748,008	60.35	30.08
Intermediate	38	31.15	680,112	23.48	30.18
Advanced	29	23.77	468,419	16.17	29.84
Total	122	100	2,896,539	100	30.03

Research Question Three

As shown in Table 3, about 50% to 60% of the learners viewed the course content only once and the remainder left the course after enrolling. Around 5% to 15% of the learners completed half of their course.

Finally, approximately 2% to 4% completed their course. Rates of course completion and certification were very similar.

Table 3 also reveals that the percentage of learners enrolled in education and teacher training courses was 4.52% and was lowest for chemistry courses (0.81%). In data analysis and statistics courses, 66.81% of the enrolled learners viewed the course one or more times. This rate was lowest for the math and physics courses (around 50%). It should be noted from Table 3 that the certificate rates were similar (on average 2%–3%) for the courses with higher or lower course effort (e.g., data analysis and statistics courses at 210 hours, and art and culture courses at 30 hours, respectively). The certificate rate was highest for history courses (4.70%) and lowest for math courses (1.25%).

Table 3

Percentage of Learner Activity According to Subject Area

Subject area		Enrolled learners	Viewed course at least once	Viewed half the course	Completed course	Received certificate
Biology and life sciences	*n*	173,944	104,906	17,003	5,916	5,676
	%	6.01	60.31	9.77	3.40	3.26
Education and teacher training	*n*	131,063	74,442	19,306	4,688	4,382
	%	4.52	56.80	14.73	3.58	3.34
Business and management	*n*	358,048	194,664	46,168	15,180	13,806
	%	12.36	54.37	12.89	4.24	3.86
Physics	*n*	80,940	40,141	8,400	1,366	1,150
	%	2.79	49.59	10.38	1.69	1.42
Social sciences	*n*	101,665	55,130	10,191	4,482	4,410
	%	3.51	54.23	10.02	4.41	4.34
Data analysis and statistics	*n*	200,318	133,836	19,252	5,185	4,878
	%	6.92	66.81	9.61	2.59	2.44
Engineering	*n*	307,348	183,207	30,846	5,928	5,563
	%	10.61	59.61	10.04	1.93	1.81
Math	*n*	91,002	45,784	10,436	1,188	1,136
	%	3.14	50.31	11.47	1.31	1.25
Computer science	*n*	1,107,780	681,693	93,299	44,879	44,556
	%	38.24	61.54	8.42	4.05	4.02
Communication	*n*	106,694	56,645	12,563	3,414	3,413
	%	3.68	53.09	11.77	3.20	32.0
Humanities	*n*	119,658	65,489	10,344	2,492	2,418
	%	4.13	54.73	8.64	2.08	2.02
Philosophy and ethics	*n*	43,786	26,555	2,809	1,082	1,082
	%	1.51	60.65	6.42	2.47	2.47
Chemistry	*n*	23,424	14,318	1,128	433	433
	%	0.81	61.13	4.82	1.85	1.85
History	*n*	42,151	22,887	3,559	1,983	1,983
	%	1.46	54.30	8.44	4.70	4.70
Art and culture	*n*	8,718	4,879	798	254	254
	%	0.30	55.96	9.15	2.91	2.91

Note. Percentage figures represent the percent of the total number of learners.

The completion rates were higher for the courses in subjects such as education and teacher training, business and management, social sciences, computer science, and history compared to those related to biology and life sciences, physics, data analysis and statistics, engineering, math, communication, humanities, philosophy and ethics, chemistry, and art and culture.

Research Question Four

For those learners enrolled in an introductory level course, 59.92% viewed the course at least once (Table 4). This ratio was 58.05% for the intermediate and 56.01% for the advanced level courses. Of the learners enrolled in the introductory level courses, 9.09% viewed at least half of their course. This ratio was 11.18% and 10.94% for the intermediate and advanced course levels, respectively.

Table 4

Percentage of Learner Activity According to Course Level

Course level	Enrolled learners	Viewed course at least once	Viewed half the course	Completed course	Received certificate
Introductory					
n	1,748,008	1,047,383	158,854	61,702	60,613
%	60.35	59.92	9.09	3.53	3.47
Intermediate					
n	680,112	394,821	76,007	24,484	23,802
%	23.48	58.05	11.18	3.60	3.50
Advanced					
n	468,419	262,372	51,241	12,284	10,725
%	16.17	56.01	10.94	2.62	2.29

Note. Percentage figures represent the percent of the total number of learners.

The completion rate for the advanced level courses was 2.62%, 3.60% for the intermediate, and 3.53% for the introductory level courses. The majority of the learners who completed their course also received a certificate. These findings show that there is a huge gap between enrollment and certification rates. Thus, it is quite possible to refer to those who register but never look at the course content as MOOC window shoppers.

Research Question Five

As shown in Table 5, the highest average number of forum messages was in the humanities courses (4,004.67) and lowest was in the education and teacher training courses (0.50). The highest number of total forum messages was in computer science courses (51,696) and lowest was in education and teacher training courses (3). However, when the percentages of forum messages were compared to the number of enrolled students, the result was highest in history (10.29%) and humanities (10.04%) courses, and lowest for education ad teacher training (0%) courses.

Table 5

Learner Activity According to Subject Area

	Courses	Forum messages		Enrolled students and percentage of forum messages		Total chapters		Chapters visited per course
Subject area	*n*	*n*	*M*	*n*	%	*n*	*M*	*M*
Biology and life sciences	13	9,971	767.00	173,944	5.73	203	15.62	3.74
Education and teacher training	6	3	0.50	131,063	0.00	45	7.50	2.69
Business and management	18	25,185	1,399.17	358,048	7.03	204	11.33	3.93
Physics	9	2,322	258.00	80,940	2.87	97	10.78	2.54
Social sciences	9	4,980	553.33	101,665	4.90	120	13.33	3.62
Data analysis and statistics	5	3,814	762.80	200,318	1.90	84	16.80	3.41
Engineering	19	7,692	404.84	307,348	2.50	325	17.11	3.38
Math	3	2,241	747.00	91,002	2.46	34	11.33	2.35
Computer science	27	51,696	1,914.67	1,107,780	4.67	368	14.15	3.78
Communication	2	6,629	3,314.50	106,694	6.21	28	14.00	4.23
Humanities	3	12,014	4,004.67	119,658	10.04	25	8.33	2.31
Philosophy and ethics	2	1,798	899.00	43,786	4.11	27	13.50	3.26
Chemistry	3	763	254.33	23,424	3.26	78	26.00	3.91
History	2	2,411	1,205.50	23,424	10.29	40	20.00	4.89
Art and culture	1	360	360.00	8,718	4.13	10	10.00	3.18

Depending on the subject area, the average length of the courses ranged from 6 to 15 weeks, and the average weekly workload ranged between 5 and 14 hours. Course effort, which was calculated by multiplying the course length and average hours required per week, were between 30 hours and 210 hours. The highest total number of chapters was in the computer science courses (368) and the lowest was in the art and culture courses (10). The mean of the average completed chapters was highest in history courses (4.89) and lowest in humanities courses (2.31). Table 6 reveals that the highest number of forum messages pertained to the introductory courses (90,158) and the lowest to the advanced courses (15,096). There was a similar pattern for the total number of chapters and average chapters completed, which were higher in the introductory courses and lower in the advanced courses.

Table 6

Learner Activity According to Course Level

	Courses	Forum messages		Chapters		
Course level	*n*	n	*M*	*n*	*M*	Completed
Introductory	55	90,158	1,639	847	15	204
Intermediate	38	26,625	701	487	13	132
Advanced	29	15,096	521	354	12	88

Research Question Six

The variables of (a) viewing the course once, (b) viewing half the course, (c) total forum messages, (d) total number of chapters, (e) average chapters completed, (f) length of the course in weeks, and (g) mean age of users were used to predict earned certification rates in MITx courses. The descriptive statistics regarding these variables are given in Table 7.

Table 7

Descriptive Statistics of Outcome and Predictor Variables

Variable	*M*	*SD*	Min	Max
Certification rate	2.74	2.27	.05	10.03
Certification rate (transformed)	1.25	.41	.38	2.07
Viewed the course once	14,413	14,479	231	65,380
Viewed half of the course	2,394	2,246	72	9,748
Total forum messages	1,092	1,688	0	9,018
Total number of chapters	14.05	7.56	4.00	50
Average number of chapters completed	3.42	.87	1.69	6.41
Length of the course	9.52	3.86	3.00	18
Learners' mean age	29.85	1.90	25.33	35.48

A stepwise multiple linear regression was carried out to explore the predictors, and to determine which contributed most to the course certification rates in the 118 MITx courses. The results of the multiple regression showed four significant models (see Table 8), in which four predictors explained 54.3% of the variance in course certification rates ($F(4,111) = 33.03$, $p < .05$). It was found that average chapters completed ($\beta = .80$, $p < .05$), total number of chapters ($\beta = -.41$, $p < .05$), total forum messages ($\beta = .18$, $p < .05$), and mean age ($\beta = .15$, $p < .05$) significantly contributed to the model. Viewing the course once ($p > .05$), viewing half the course ($p > .05$), and length of the course ($p > .05$) did not make significant contributions.

Table 8

Stepwise Multiple Linear Regression Results

Model	Predictor	B	*SE* B	β	t	sr^2	R^2	ΔF
1	Average chapters completed	.28	.04	.59	7.72*	.34	.343	59.56
2	Average chapters completed	.43	.04	.92	10.62*	.50	.502	35.99
	Total number of chapters	-.03	.01	-.52	-6.00*	.16		
3	Average chapters completed	.40	.04	.84	9.34*	.37	.525	5.42
	Total number of chapters	-.03	.01	-.49	-5.75*	.14		
	Total forum messages	.00	.00	.16	2.33*	.02		
4	Average chapters completed	.37	.04	.80	8.66*	.31	.543	4.52
	Total number of chapters	-.02	.01	-.41	-4.42*	.08		
	Total forum messages	.00	.00	.18	2.59*	.03		
	Mean age	.03	.02	.15	2.13*	.02		

The average number of chapters completed, total forum messages, and mean age positively predicted the course certification rates. On the other hand, the total number of chapters predicted the course certification rates negatively. When the unique contributions of the predictors were examined to determine how each one explained the variance in course certification rates, the average number of chapters completed explained 31%, the total number of chapters explained 8%, the total number of forum messages explained 3%, and mean age explained 2% of the variance.

Discussion and Conclusion

Course and Learner Characteristics

The purpose of this study was to provide a deeper understanding of the MITx MOOCs presented on the edX platform and the predictors of the course certification rates in these courses. Between 2012 and 2016, both the number of MITx courses and the number of enrolled learners increased. This is consistent with MOOCs being offered by more than 800 universities worldwide, and the number of MOOCs having exceeded 10,000 (Shah, 2018b). However, the current study found a decrease in the certification rates among the enrolled learners. These findings conflict with Jordan's (2015) comprehensive study that reported a decrease in enrollments over time and an increase in course completion percentages.

Based on the number of courses and the total registered learners, computer science as well as business and management courses were the most popular. According to Shah (2018b) technology courses (n = 17) dominated Class Central's list of the all-time, top 50 MOOCs; business courses (n = 6) were very popular as well. Moreover, the top 10 most popular courses on Coursera included a significant number of computer science and similar courses (Young, 2018), and the trend was similar in 2017, with cutting-edge tech skills being those most demanded in online education (Sinha, 2017). Thus, it can be inferred that MITx MOOCs are effective in satisfying individual's learning needs in both computer science and business and management courses.

While Cohen, Shimony, Nachmias, and Soffer (2019) reported that only 50% of registered learners actually started their course, among the courses analyzed in the current study, the rate was slightly higher, with 50% to 62% of learners starting their courses. However, the completion rates in this study were slightly lower compared to the earlier results reported as 4.6% (Pardos, Bergner, Seaton, & Pritchard, 2013) and 5.6% (Despujol, Turró, Castañeda, & Busquets, 2017) for edX courses, and 8% to 10% for MOOCs in general (Cohen et al., 2019; Jordan, 2014). In addition, completion rates were lower for both gender groups in the advanced level courses as compared to the introductory level courses. The results of the current study support the findings in the relevant literature. In general, course completion rates were lower in the MOOCs; however, in this study, it was shown that once learners were able to complete their course, it was most likely they would also receive certificates. Accordingly, when course completion rates improved, certification rates also improved.

In general, the majority of the enrolled learners had bachelor's or master's degrees, or both. Enrolled learners with a middle or high school diploma (equivalent to secondary, high school, or junior secondary/high/middle school) was 24%. Learners having completed primary or elementary school or who had no formal education accounted for 10% of those enrolled in the courses, as small minority of enrolled learners. These results parallel those in earlier studies, indicating that the majority of MOOC learners had some educational background including a higher degree (Bayeck, 2016; Christensen et al., 2013; Macleod, Haywood, Woodgate, & Alkhatnai, 2015). Furthermore, in the intermediate and advanced level courses, the percentages of learners having bachelor's degree, master's degree, or a doctorate, were higher than in the introductory courses. On the other hand, in the introductory level courses, the percentage of learners having an associate degree and secondary or high school diploma were higher than the participants in the intermediate and advanced level courses. The results also indicated that the rates of completing at least half of the course increased with higher education levels. Based on these results, MOOCs benefit the educated population, but they have not yet satisfied initial expectations because they do not serve the potential needs of those from lower educational levels.

Regarding course levels, the (a) total number of courses, (b) number of enrolled learners, (c) course length, (d) percentage of learners who viewed their course at least once, and (e) percentage who viewed half the course were higher for the introductory level courses than the advanced courses. The situation was similar for the total number of chapters, number of forum messages, and average number of completed chapters. Similarly, in the advanced level courses, course completion and certification rates were lower than the introductory and intermediate level courses. The introductory level courses were more popular considering the number of courses and registered learners with higher completion rates. Additionally, compared to the intermediate and advanced level courses, in the introductory level courses there was a higher number of learners who had completed secondary or high school, or who had no formal education. Accordingly, a course that provides basic, introductory information could be added to existing introductory level courses. Thus, learners with lower education levels could be supported by MOOCs, for a variety of purposes, such as returning to school and preparing for college.

Predictors of Certification Rates

This study revealed that the average number of chapters completed, total number of forum messages, and mean age positively predicted course certification rates. On the other hand, the total number of chapters in a course negatively predicted course certification rates. Overall, the results of the current study support earlier results in the literature. When the average number of chapters completed increased, a learner was closer to completing the course. Consistent with this finding, Hone and Said (2016) commented that the MOOC learners who passed the midpoint of a course were likely to complete it.

Similar to our results, previous research reported that viewing online forums and participating in online discussions were significant influencing factors for predicting MOOC completion rates (Bonafini, 2017; Goldwasser, Mankoff, Manturuk, Schmid, & Whitfield, 2016). Social interactions in online groups are crucial for successful learning (Barak, Watted, & Haick, 2016). Furthermore, engaging with forum comments is related to greater commitment to the course materials (Ferguson & Clow, 2015). MOOC forums can have different functions; for example, in MOOC forums, learners can socialize with their peers, while also asking questions about the course material and exams. In this way, forums take on the traditional classroom role of offering assistance during office hours or talking to and helping a classmate understand a challenging subject (Diver & Martinez, 2015). However, it is important to mention that discussions might be problematic in MOOCs due to the massive number of participants. Regarding age, in a study conducted with 33,938 learners in a MOOC offered in 2013, Greene, Oswald, and Pomerantz (2015) found that older participants were less likely to leave a MOOC. A similar finding was reported by Morris, Hotchkiss, and Swinnerton (2015), who indicated that older learners were more likely to complete a MOOC. Concerning the length of MOOCs, Jordan (2014) revealed that completion rates were negatively associated with course length. However, in this study, course length was not significant in predicting course certification rates, but the total number of chapters was. As the chapters in MITx courses are also aligned with the course sections, they are related to the volume of the course, and thus indirectly related to the course length. The associations mentioned above were observed in the courses investigated in this study. For example, computer science, business and management, and history courses can be seen as more successful in terms of course completion and certification rates. According to the number of forum messages, learners in these courses were also more active. However, the chemistry courses could be evaluated as less successful considering their course completion rates and less interaction in terms of the number of forum messages. Accordingly, it can be concluded that in some courses, the level of interaction and success was higher than others. There could be different reasons for this (e.g., instructional design features of the courses, how the content is represented, usability features of the courses). Jung et al. (2019) provided evidence that instructional design factors were more often linked to successful MOOC experiences, compared to content and demographic factors, and that instructional components were significant predictors of learning in MOOCs. According to Deshpande and Chukhlomin (2017), content, accessibility, and interactivity influenced participants' motivation to learn. Furthermore, Junjie (2017) found that knowledge outcome was a strong predictor of continuance intention of MOOC learners. Furthermore, learners' attitudes, motivations, and backgrounds could also be influencing factors. Hence, these factors need to be analyzed in depth to improve the interaction level and success of MOOCs.

Implications

Several recommendations for MOOCs regarding course length, course activities, learner needs, course content design, and learner motivation can be represented in the acronym SINCE: Shorter and more Interactive courses that consider learners' Needs, as well as Course design and strategies that encourage enrolled students to Enter their course. These recommendations, explained in detail below, might be useful for people who are interested in designing and developing MOOCs.

Shorter courses. Certification rates increase when the number of chapters learners complete and the number of forum messages learners post also increase. On the other hand, certification rates decrease when the number of chapters in a course increases. Therefore, courses should be divided into smaller sections while also keeping the total number of chapters in the course low, so that courses can be designed to be an easily digestible size. Similarly, as the number of learners who completed half of their course is high, perhaps the optimal length for a course is half as long.

Interactive courses. As learners enter the course for the first time, they should encounter interactive components, such as forums or activities, to boost learner motivation and retain learners in the course; MOOC learners should also be rewarded for the chapters they complete. In addition, since the number of forum messages predicted certification rates positively, forum activities should be promoted and course discussions should be carefully designed.

Needs. Learner profiles (e.g., education level, gender) as well as their needs and expectations should be analyzed carefully in relation to the offered MOOCs. Course content and design should be updated regularly, taking these needs into consideration.

Content of courses. Completion rates are lower in some course subjects, such as chemistry, while higher in others, such as business and management. Course content should be critically analyzed in terms of its appropriateness for the MOOC format. This issue should also be further researched in order to find more effective ways of developing and designing MOOCs.

Entering courses. Since most of the enrolled learners do not even enter the course, such window shoppers should be encouraged to enter the course through use of motivational strategies. Regular reminders to enter the course could be sent to learners. Moreover, as in the design of a shopping mall, participant attraction strategies could be employed and new course marketing approaches could be tested and evaluated.

Limitations and Further Research

This study has a number of limitations. First, it was limited to 122 MITx courses offered between 2012 and 2016. As well, the current study was based on the log data kept by MITx only, so the scope of this study was limited to the content of these log data.

Future research studies should consider using multiple data sources, as well as merging the log data with learners' self-reported data in order to get a more comprehensive view of course and learner characteristics, and how these influence course certification rates. Future work could also include and compare other MOOC portals with regards to course characteristics, learner characteristics, and certification rates. Third, the recommendations this study yielded for MOOCs regarding course length, course activities, learner needs, course content design, and learner motivation could be empirically tested in future studies. Finally, research could explore ways to motivate learners to enter their course, as many learners who register for a MOOC never attempt to start the course.

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Evaluation of Student Feedback Within a MOOC Using Sentiment Analysis and Target Groups

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Abstract

Many course designers trying to evaluate the experience of participants in a MOOC will find it difficult to track and analyse the online actions and interactions of students because there may be thousands of learners enrolled in courses that sometimes last only a few weeks. This study explores the use of automated sentiment analysis in assessing student experience in a beginner computer programming MOOC. A dataset of more than 25,000 online posts made by participants during the course was analysed and compared to student feedback. The results were further analysed by grouping participants according to their prior knowledge of the subject: *beginner*, *experienced*, and *unknown*. In this study, the average sentiment expressed through online posts reflected the feedback statements. Beginners, the target group for the MOOC, were more positive about the course than experienced participants, largely due to the extra assistance they received. Many experienced participants had expected to learn about topics that were beyond the scope of the MOOC. The results suggest that MOOC designers should consider using sentiment analysis to evaluate student feedback and inform MOOC design.

Keywords: MOOC, teaching programming, sentiment analysis, target group, feedback, learner analytics

Introduction

Since 2011, technological development has enabled the growth of online learning with free courses known as Massive Open Online Courses (MOOCs) attracting thousands of learners. The success of MOOCs depends on the active involvement of large numbers of learners who, through dynamic engagement, self-organise into learning communities where they share skills, objectives, knowledge, and interests, by commenting within the learning system and using other social networking tools (McAuley, Stewart, Siemens, & Cormier, 2010).

A challenge when running a MOOC is gaining an accurate understanding of learner experience because the number of participants makes it impossible to follow all posts and interactions. Participant comments and actions can provide an impression of the sentiments and concerns of learners within a course. For example, some disgruntled participants may leave a course, trolling by engaging in fruitless argumentation (Donath, 1999), while other participants, struggling with course material, may vent frustration. Analysis of individual learner experience is an important aspect of course evaluation but difficult to undertake when there are thousands of participants. Without analytical tools to understand overall sentiments and how they may vary across different groups of learners, it is easy to disproportionately focus on negative posts.

This paper presents a method for evaluating learner group experiences within a MOOC using automated sentiment analysis of the posts and comments made by participants within the course and compares this to statements given in a dedicated feedback section within the MOOC. The purpose is to provide insight into learner groups' experiences during the course that is not limited to survey responses at the conclusion of the course.

Studies that investigate individual MOOCs from a learner's perspective have drawn data from learner experience surveys, participant demographics, and learner progression through courses, such as the number of videos viewed or tests taken (e.g., Kop, Fournier, & Mak, 2011), participant size and completion rate (e.g., Adamopoulos, 2013), or from the behaviour, motivation, and communication patterns of online students (e.g., Swinnerton, Hotchkiss, & Morris, 2017). These metrics mirror attendance and completion data used to evaluate formal higher education. However, retention alone does not reflect the quality of a MOOC (Downes, 2015). Applying the same measures used in formal learning is problematic as MOOCs are free and usually stand-alone courses and, as such, there are limited consequences for learners who choose to not engage in aspects of a course. Those enrolled may stop participating due to other time commitments, course design, or the content being too challenging or too easy. Instructional designers should consider why groups of learners disengage from a course in order to better inform pedagogical decisions (Liyanagunawardena, Parslow, & Williams, 2017).

While MOOCs have high levels of organization and a range of course material presented, they can be poorly designed (Margaryan, Bianco, & Littlejohn, 2015). Good instructional design follows constructivist principles; it promotes learning through problem-solving, encourages the use of prior knowledge to form understanding, and includes reflection on learning through discussion and critique (Merrill, 2002). However, the size of MOOCs makes it difficult to both provide personalized learning relevant to the diverse backgrounds and prior experiences of the participants and offer individualized feedback and support. The digital nature of a MOOC can provide aggregated data from target groups, allowing the opportunity to investigate whether the design meets the needs of the intended learners. An aspect of constructivist theory is that adult online learners need to be self-directed and motivated to enable learning from their course experience (Huang, 2002). Negative sentiments about a course can impact motivation and ultimately the learning experiences of participants in a MOOC.

MOOC datasets are complex to analyse due to the variety of types of data available. MOOCs produce large amounts of interaction data between learners including discussion statements, likes, and follows, and individual interactions with the system, such as timestamps of actions, videos watched, test results, and logins, which provide evidence of participant engagement and experience. MOOC learners can be encouraged to engage in social learning; therefore, textual data in the form of comments and forum posts can be a valuable source for understanding participants' sentiments within a MOOC.

Sentiment analysis was first used as a term in 2003 and is therefore a relatively new area of study within natural language processing (Liu, 2012). With the growing popularity of social networking, sentiment analysis techniques have been used with social networks, especially text-rich sources such as blogs and Twitter (e.g., Hong & Skiena, 2010; Miller, Sathi, Wiesenthal, Leskovec, & Potts, 2011; Tumasjan, Sprenger, Sandner, & Welpe, 2010). Advances have enabled data-mining techniques and artificial analysis to be applied to MOOCs (e.g., Crossley et al., 2015; Wen, Yang, & Rose, 2014) and, more recently, analysis has begun to be used to identify sentiment from within MOOCs (Moreno-Marcos et al, 2018; Pérez, Jurado, & Villen, 2019).

The purpose of this study was to develop a nuanced understanding of the sentiments of MOOC participants. From a constructivist perspective, how participants feel about a course will influence their experiences and engagement. The study was guided by two research questions:

- How does feedback about a course align with the general sentiment expressed in online posts in a course?
- How does sentiment vary between different groups of MOOC learners?

Context

This study examines "Begin Programming: Build Your First Mobile Game" a MOOC designed to introduce computer programming to beginners. According to Perkins, Hancock, Hobbs, Martin, and Simmons (1986), there are two different types of novice programming learners: *stoppers* and *movers*. Stoppers stop when they encounter a problem, whereas movers experiment with the code and use feedback from the system combined with what they know to try to solve the problem. The course provided small steps to support stoppers and a large code base as a safe sandpit to experience and explore the taught concepts using mover tactics. The MOOC participants developed a mobile game from the provided code base, learning from the examples while playing with the code to modify the behaviour of the code. Anecdotally, this appeared to work well to avoid stopper behaviour and provide a constructivist learning experience for aspiring programmers. The approach aligns with the socio-constructivist aspirations behind the FutureLearn platform, where the MOOC was hosted (Sharples, 2013).

The course ran for seven weeks, with one new topic per week (see Table 1). Each week was structured into steps, which contained textual content, video, tests, and/or assignments. All steps had a commenting facility similar to a Facebook wall to allow real-time and in-context discussions. The aim of the first week was to set up the development environment. If learners could not set up the environment, they were unable to participate in the rest of the MOOC. The next three weeks introduced data type, conditional statements, arrays, and looping. The last three weeks introduced algorithms, problem solving, and functions, with the final week having a test and steps for reflection.

Table 1

Weekly Topics

Week	Topic
1	Welcome Set up development environment
2	Data types Variables
3	Conditional statements
4	Arrays Looping
5	Algorithms Problem solving
6	Functions
7	Student evaluation Student reflections

The course ran eight times (sessions), each time with improvements, but with three main iterations. The initial iteration was designed for the first standard Android programming environment integrated within the Eclipse development environment. During sessions one to four, the course only had minor updates, because most of the critical feedback from learners in the early sessions was about Eclipse or the lack of functionalities on the FutureLearn platform.

Shortly after the fourth offering of the MOOC, Google changed the development environment to Android Studio and, therefore, all material needed to be updated. This was the second iteration. The third iteration was developed for the final session after the original academic lead had left. At that time, some of the content and support provision were changed by the new academic lead (Table 2).

Table 2

Different Sessions of the MOOC

Session	Start date	Type
1	October 28, 2013	Eclipse
2	February 24, 2014	Eclipse and minor updates
3	October 20, 2014	Eclipse and new minor updates
4	February 16, 2015	Eclipse and new minor updates
5	June 01, 2015	Android Studio and major revision
6	September 12, 2015	Android Studio
7	April 04, 2016	Android Studio
8	October 31, 2016	Android Studio with new teaching team

Available Data

The FutureLearn platform provides comma-separated values (CSV) files with engagement data to individual MOOC developers. These include enrolment, learner activity, statements, and test data. The statement file has each comment made in the course and includes a statement identifier, learner identifier, the step number, time it was made, time it was modified (if it was), number of likes, and, if it is a reply to another comment, the identifier of the "parent" statement.

It was difficult to gauge learner perspectives from within the MOOC and respond with changes to the teaching material due to the size of the cohort and the nature of the online platform. As the course began, the focus was on emerging issues and interventions to support the more than 10,000 learners. The focus and reflection while running the new MOOC became distorted because of negative critique by participants. This potential disconnect between the teacher's experience and the overall feedback given in the course was the first main motivator for investigating sentiment.

Across the sessions, retention rates increased yet engagement levels decreased and interaction through posting and commenting also decreased. To understand why, participants were asked to provide feedback from within the MOOC. From those statements, it appeared that participants with prior experience of learning programming were critical of how the course was structured around a large code base without having introduced smaller examples first. This observation provided a reason to explore learner groups within this study. The patterns among different types of learners were anecdotal, with no scientific validation. Therefore, it seemed pertinent to perform an in-depth learner-group-based analysis to understand if the pedagogical design of the MOOC was working for students new to programming.

Method and Research Design

The information collected from comments and posts in sessions one to four was focused on external issues rather than sentiment about the course. To investigate learner experience, we decided to perform an in-depth investigation of sessions five to seven, comparing sentiment with participants' programming experience. These later sessions were the most homogeneous, with minor changes in content and teaching staff. Differences between the sessions would have been unlikely to have contributed to the results through bias caused by changes.

Sentiment Analysis

Sentiment analysis was employed to investigate the online comments of participants in the MOOC. The VADER (Valence Aware Dictionary for sEntiment Reasoning) sentiment algorithm was used (Hutto & Gilbert, 2014). VADER was designed using sentiment ratings from more than 90,000 English statements originating from social media. Using VADER does not require any prior training, and it has been found to be more consistent than human investigators on large English-text datasets from online sources. The algorithm was benchmarked against seven other automated sentiment algorithms, and VADER both outperformed the others (Hutto & Gilbert, 2014) and was found to be the most accurate algorithm that did not require training (Gonçalves, Dalip, Costa, Gonçalves, & Benevenuto, 2016). Because there are no training corpora available from MOOCs, VADER was used in this study. VADER produces four sentiment scores: positivity, negativity, neutrality, and a compound score. The compound score is not an average of the other three, but a reflection of the overall sentiment of the provided text. The compound score was used in this study.

Feedback Groups

Starting in the fourth week of the course, participants could provide feedback. There was a free text comment box where, under the title, "The good, the bad, and the ugly," they could respond to, "Please post a comment below with one good thing and one bad thing about the course." Statements made during this step (n=337), including the replies, were analysed, and the individuals (n=264) who made the statements and replies were categorised into types:

- *Positive*: No negative point or an insignificant negative point. For instance, statements about anonymous learner functionalities or service were disregarded because the course developers did not influence these aspects.

- *Structure*: Critiquing the teaching/pedagogical approach, i.e., using a large code base instead of small examples. Could include positive points. If a statement was mainly positive but also critiqued the structure, it would be categorised here.

- *Negative*: Negative about the course. Could include structure critique as well, but no positive points about the course.

- *Irrelevant*: Comments without positive or negative value, such as questions. These learners were subsequently added to the *other* group of participants who did not provide feedback.

- *Other*: Not making a feedback statement. This group (merged with *irrelevant*) was used as a baseline for statistical analysis.

Staff statements were not included in the analysis. Statements and replies made by the same person were merged, so that the evaluators would have the full picture of each individual's feedback. Many comments were both positive and negative, and, of these, most commonly critiqued the pedagogy, teaching, structure, or methods used in the course.

Two researchers, the academic lead and a research assistant, independently categorised the statements. The first categorisation had a Krippendorff alpha of -0.106. This indicates disagreement or systematic difference. Out of the 337 total feedback statements, there were 39 disputes. To rectify this, the evaluators met to discuss and reach consensus on the statements they had assigned to different categories. The relatively high number of inconsistencies mostly originated from grammar and language, including the common abbreviations and slang of textspeak, which was not known to one of the evaluators.

To explore whether the feedback provided in the course reflects sentiment within the online posts, the following hypotheses were then tested:

- Hypothesis_{A1}: Participants who were positive in the feedback were more positive overall than participants who gave no feedback or irrelevant feedback.
- Hypothesis_{A2}: Participants who were negative in the feedback were more negative overall than participants who gave no feedback or irrelevant feedback.
- Hypothesis_{A3}: Participants who criticised the pedagogy in the feedback were more negative overall than participants who gave no feedback or irrelevant feedback.
- Hypothesis_{A4}: Participants who were positive in the feedback were more positive overall than participants who gave negative feedback.
- Hypothesis_{A5}: Participants who were positive in the feedback were more positive overall than participants who criticised the pedagogy in the feedback.
- Hypothesis_{A6}: Participants who were negative in the feedback were more negative overall than participants who criticised the pedagogy in the feedback.

Data Analysis

The VADER score was calculated using Algorithmia.com. This study used the compound score resulting from running the algorithm on each full comment made by participants. This included the programming code, which only rarely has a sentiment. A test was run on ten representative posts containing ordinary text with embedded programming code and it was found that the positive and negative sentiment of the ordinary text was not affected by the embedded code.

Each post made in the MOOC was analysed at an individual learner level. Then, the scores from all posts made by an individual were averaged. The comments were saved separately in a CSV file using the original database files, and then encoded into JSON (JavaScript Object Notation) files as required by the Algorithmia.com service.

An initial calculation was run on all posts from the three Android Studio-based sessions. Using the statistical programming language R to run the Shapiro-Wilk normality test (Shapiro & Wilk, 1965), it was found that the *p*-value was lower than 2.2e-16; thus, using an alpha value of 0.05, the data could not be considered normally distributed. The Wilcoxon rank sum test with continuity correction (using zero method Pratt) was selected to evaluate the statistical significance of the sentiment data because it does not assume normality and incorporates tied values in the ranking procedure (Pratt, 1959).

Target Groups

A selection of participant were manually evaluated to establish the level of prior learning. A selection from other (150 out of 7,562) and positive (150 out of 239) were randomly assigned a floating-point number between zero and one. These participants were then sorted according to this random number and used in this order. In addition, all participants from negative (n = 2) and structure (n = 38) were used. Evaluating all of their statements these participants were then grouped by the two researchers using the following experience categories:

- *Prior*: Indication of prior programming teaching and learning experience.
- *Beginner*: No indication of prior programming learning experience.
- *Unknown*: No indication that supports membership of *prior* or *beginner*.

All posts and feedback made within the course by the selected participants were used in the categorisation. However, most evidence came from the learner introductions, help provided to other participants, or in the feedback statements.

For *other* and *positive*, margin of error calculations were used to find confidence intervals to evaluate significant statistical differences of experience between the various categories of opinion (Calder, 1953). The other two groups had full categorisation of all participants, so no similar evaluation was needed.

Results

Of the 3,531 participants who made at least one post in sessions five to seven, 264 (7.5%) individuals also wrote something in week four's feedback step. The final distribution among the feedback groups was:

- *Positive*: 218
- *Structure*: 28
- *Negative*: 2
- *Irrelevant*: 16 (these participants were added to other, i.e., treated as participants who did not provide feedback.)

After running the VADER algorithm on the posts made by all learners from each group (see Table 3), it was discovered that *positive*, *negative*, and *other* all had relative averages following the hypothesis. However, the statements made by *structure* had a higher score than the *other* group, indicating a more positive attitude in their statements. This was a surprise and therefore, without further analysis, Hypothesis_{A3} was rejected.

Table 3

Average and Standard Deviation of Compound Sentiment Scores by Groupings

Category	Average	*SD*	*n*
Positive	0.2897	0.4524	4,746
Negative	0.1100	0.4416	36
Structure	0.2783	0.4487	417
Other	0.2770	0.4232	30,985

The results of the Wilcox Pratt test are presented in Table 4. There is statistical significance to support that the *positive* participants were more positive than the *negative* and *other* participants in their general statements. *Negative* were more negative than *structure* and *other*, with statistical significance. Therefore, Hypothesis_{A1}, Hypothesis_{A2}, Hypothesis_{A4}, and Hypothesis_{A6} were accepted.

Hypothesis testing was carried out to explore the first research question. The results show that the voluntary feedback does reflect the general sentiment within the rest of the posts. However, participants who critiqued the teaching method and underpinning pedagogy were not negative in their other comments in the MOOC.

Table 4

Statistical Tests (Wilcox Pratt) of Hypotheses

Hypothesis	*p*-value	Effect	Support (p<0.05)
Hypothesis_{A1} *Positive > Other*	0.0007	-4.3e-05	Accepted
Hypothesis_{A2} *Negative < Other*	0.0367	0.166	Accepted
Hypothesis_{A3} *Structure < Other*	NA	NA	Rejected
Hypothesis_{A4} *Positive > Negative*	0.0165	-0.200	Accepted
Hypothesis_{A5} *Positive > Structure*	0.5061	NA	Rejected
Hypothesis_{A6} *Negative < Structure*	0.0344	-0.180	Accepted

Target Groups

To explore the second research question, the different target groups were identified and analysed against feedback sentiment. The results of assigning target groups for learners in the feedback groups are presented in Table 5. With a 98% confidence level, those criticising the structure were more likely to have had prior experience and were less likely to have been beginners to programming than the participants giving positive or no feedback (*positive* and *other* groups). They were also more likely to self-identify their skill level. A large proportion of participants who did not provide feedback said very little in the comments, and thus, their experience level is not known. The *positive* group disclosed their experience level less often than the *structure* group. The *negative* group was too small to make any meaningful comparisons with other groups. However, all disclosed prior experience.

Table 5

Target Group Results

	Prior	Beginner	Unknown	Sample	Total
Other	37.3% (56)	25.3% (38)	37.3% (56)	150	7,562
98% conf.	31.3%-43.4%	19.9%-30.7%	31.3%-43.4%		
Positive	48.0% (72)	24.7% (37)	27.3% (41)	150	239
98% conf.	43.9%-52.1%	21.3%-28.0%	23.9%-31.2%		
Structure	62.3% (18)	14.3% (4)	21.43% (6)	28	28
Negative	100% (2)	0%	0%	2	2

Discussion

Through the use of feedback and target groupings, this study evaluated the sentiments of learners and compared participants new to programming with those who had prior experience. The participants who had prior experience criticized the MOOC structure but remained positive overall: 78.3% were positive while only 21.7% were negative or criticised the structure.

People with prior experience appeared to be more likely to disclose their level of expertise. For example, the study showed that in the feedback groupings, the lower the number of experienced learners, the higher the number of participants with an unknown background. This is a very human result that could be expected given that revealing oneself as a beginner creates vulnerability, especially if disclosures are made when providing feedback. Many participants used their prior experience as an argument to validate their feedback. For example, a *structure* participant with prior experience said: "I think that I would prefer a bit more of a 'hello world' approach, as I did with BBC basic [sic] years ago." This participant criticises the choice to use a large code base instead of use the traditional approach to start with no code. Participants without prior knowledge could not critique course design in the same way as they would have had no comparative experience.

No matter what feedback group they belonged to, participants with prior experience were helpful in their posts. Many contributed 20 or more posts meant to help other participants. These helpers supported learners who found activities in the course challenging. For example, the first week was especially demanding as it required participants to set up on their computer a development environment that was needed for subsequent activities. Even with extensive online guidance in the MOOC, the activity was error prone, and, for beginners, this was problematic and frustrating. While those with experience tried to aid the beginners, they also acknowledged the frustrations and offered solutions: "I think the course should be split in to two: 'Begin Programming' and 'Build Your First Mobile Game'. I think the current compromise is too abstract for beginners and doesn't have enough progressions…" (*structure* participant with prior experience who had helped many)

All beginners who criticised the structure of the MOOC mentioned the difficulty of working with something that one does not fully understand. For example, a beginner who commented on the structure said: "I guess the disadvantage amongst many great things of this course is that one can barely understand how to develop a game from scratch…[sic]"

This research suggests that the course design may have been effective in shifting beginning participants' ways of learning. Perkins et al. (1986) described the differences between stoppers and movers, and this MOOC was developed with these modalities in mind. Data, especially those gathered from the positive beginner participants, seem to suggest that some stoppers turned to mover learning. None of them mentioned having difficulties working with a larger code base and most instead focused on what they enjoyed about the course. For example, one beginner, in responding to the request for one good and one bad thing about the course, said, "Good: I think the entry level is appropriate and almost everyone should be able to follow it. Bad (no [sic] too good): I would have liked to have more questionaries [sic] during the weeks.", therefore indicating that they enjoyed the tests and would have liked more of them. Further study is needed to investigate and validate the design approach.

The *negative* group was small and consisted mainly of participants with prior experience. Much of their feedback seemed to be founded on the fact they had expectations that were based on their backgrounds. For example, one *negative* participant said:

> To be honest, I'm very disappointed so far. Nothing of the original promise seems to be delivered, and instead, the reader gets a slow paced, very-very crude and underquality [sic] 'programming basics' course, which is demoed on the Android platform, via something that remotely resembles an app that was intended to look like a game, but that could actually be just about anything else with no effect on the course itself. I'd gladly mention positives as well, but frankly, there was nothing so far I liked about the course.

Such strong sentiments may generate an emotional response in course designers. However, these should be put in perspective; it was a very small minority who reported such views, and many participants who were in the *negative* group expected an advanced course on game development, which was never the intention of this MOOC.

Impact of Learners with Prior Experience

Promotional information for the course stated that it was meant for beginners, yet it attracted learners with prior programming experience. The impact of having these experienced participants in the course was investigated. Although some of these learners gave negative feedback, many engaged with other students with positive sentiment. Therefore, their contribution to the course was classified as positive, which meant that their general sentiment was not significantly different from learners in the *other* or *positive* categories.

However, it should also be noted that the *negative* learners were so few overall that the impact of their comments should be negligible. A participant with prior experience is disproportionately more likely to give feedback. This is a problem because they were not the target group for the course and their views therefore are less relevant.

Beginners who provided feedback were almost 10 times more often positive than negative when compared to the participants with prior experience. The participants with prior experience were only five times more often positive than negative. Therefore, the constructivist approach adopted in course design, that is, to engage with beginners, appears to have been successful.

Participant Sentiment Indicated by Feedback and in Posts

There was a connection between the views that participants expressed when asked for feedback from within the course and the sentiments articulated in their posts. Positive and negative feedback were mirrored in the two sets of data. Likewise, the sentiments expressed by both beginners and more experienced learners followed the same pattern regardless of the source of the data.

There is a concern however with the results generated by the *other* group, which had a higher number of beginners and yet expressed more negative sentiments overall. The first observation is that on average these beginner participants were generally positive in their statements; they were much closer to the *other* group than the *negative* group. Their statements expressed the frustration of setting up the development environment. Having a milestone at the beginning of a course that must be completed in order to follow the rest of the course skews the sentiment scores negatively. The course has been improved continuously in this aspect, through videos, text content, and FAQs, but this remains an issue which the design team continues to address.

MOOC Target Groups Versus Other Participants

While the intention of this research was not to predict behaviour, sentiment analysis has been a valuable tool to analyse and better understand learners. Before this study was undertaken, course evaluation was primarily based on anecdotal evidence and speculative and skewed observations from a teacher's standpoint, and the students' perspectives had not been given enough attention. This study has shifted the perspective and helped identify areas of concern.

Two studies have found a significant relationship between sentiment expressed in comments from within a MOOC and the dropout rate of participants (Adamopoulos, 2013; Wen et al., 2014). However, neither study examined the reasons for the sentiment. This paper has expanded these findings, showing there is a connection between the sentiment expressed in direct feedback and posts made throughout the course. Furthermore, participants who are not part of the target group of a course can show tendencies that appear to be contradictory. People with prior experience may provide critical feedback on the structure or content of a course, while their other sentiments, expressed as support for participants without prior learning experience, are positive. The implication is that the open nature of a MOOC can cause dissonance, and that MOOC designers have to judge whether this is a concern.

Recommendations

Any MOOC which offers learners the opportunity to interact by text can use automated sentiment analysis to measure general sentiment within that course. Evaluating these results can be used to investigate how participants experience learning and their attitudes towards a course. Designers and instructors can confidently make appropriate modifications without having to depend on the results of traditional questionnaire-type evaluations carried out at the conclusion of a course.

Limitations

A limitation in this study is the low response rate, which could bias the sample. Only 264 individuals provided feedback during the fourth week of the course in the free text comment box, which is a reflection of the number of participants commenting in MOOCs in general. In the very first MOOC run on the edX platform, only 3% of all active participants made one or more comments (Breslow et al., 2013). In this course, 38.4% of all active participants made one or more comments, with 2.3% of those giving feedback. If there were no self-selection present, i.e. negative participants were not more likely to provide feedback, then with a confidence level of 95% there would be up to 1.7% of negative participants in the MOOC.

Conclusion

Using sentiment analysis on text data from a MOOC has helped the teaching team make evidence-based observations and conclusions that otherwise might have been overshadowed by anecdotal evidence from teaching experiences. The study found that there is a relationship between general sentiment of posts and the feedback given about the MOOC, and that the general sentiment within this course was positive. A few learners were both positive in their general comments and critical in their feedback about the practical experimental learning method used in the course. Grouping the learners by level of prior experience identified that the negative statements were made by participants with prior learning experience, which appeared to influence their views of how the subject should be taught and learnt. However, the course was designed for beginners; therefore, the levels of prior experience needed to be considered when analysing data. Sentiment analysis has enabled a nuanced evaluation of learner experience by learner group and has aided the course team to make design decisions informed by research, thereby improving the MOOC for future learners.

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Promoting Intercultural Competence in a Learning Activity Supported by Virtual Reality Technology

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Abstract

Virtual reality (VR) technology makes it possible to create an authentic virtual environment that benefits immersive learning. We designed an intercultural learning activity and applied VR technology to support it. Then, we investigated students' perceptions of the learning activity, VR technology, and intercultural competence (IC) development during learning. Students from China and Uzbekistan participated in the activity, in which a pragmatic mixed-methods approach was used. The data were collected through student reports, three questionnaires, and interviews, and then analyzed. Three main findings were obtained. First, 13 items related to perception of the learning activity were revealed. When compared with earlier studies, new items were found, including presence, immersion, and authentic cultural experience. Second, the results showed that the participants intended to continue using VR technology, were satisfied with intercultural learning supported by VR technology, and felt that the technology confirmed their expectations. Third, the results showed that intercultural learning supported by VR technology helped facilitate IC development. Based on these results, we discuss implications and offer suggestions for educators and researchers.

Keywords: intercultural competence, learning activity, virtual reality, technology

Introduction

Intercultural communication is defined as interaction between people of different cultures (Çiftçi, 2016). Intercultural learning aims to cultivate the ability of students to communicate effectively with people from different cultural backgrounds. To best develop students' intercultural abilities, the ideal choice would be to immerse them in another culture for a period of time and allow them to engage in face-to-face communication with local people (Yang, 2018). However, for various reasons (e.g., time, expense, and recent travel restrictions due to the pandemic), few people have the chance to go abroad. The use of computer technology can break through the limitations of time and space and create an environment in which people from different cultural backgrounds can have immersive experiences (Avgousti, 2018; Çiftçi, 2016).

A significant amount of literature has been published on technology-supported intercultural learning. According to Avgousti (2018) and Çiftçi (2016), a number of technological tools have been used to support intercultural learning, including e-mail, blogs, Facebook, and Skype. However, none of these is able to create authentic contexts in which participants can experience a sense of presence and immersion. Emerging technology (e.g., a new technology or an existing technology under continuing development), such as virtual reality (VR), offers potential for making the intercultural learning environment more immersive and authentic, providing participants with a good sense of presence. However, to the best of our knowledge, few studies have been carried out using VR technology to support the communication of interlocutors from different cultures. Specifically, whether such a technological approach facilitates intercultural competence (IC) has not yet been tested. This study is an attempt to address the existing gaps in research. Informed by related studies on IC, VR, and expectation-confirmation theory, a theoretical framework was built, and a pragmatic mixed-methods approach was used for data collection and analysis.

Literature Review

Online Intercultural Learning

Culture is generally considered to consist of a set of knowledge, behaviours, attitudes, ideas, and traditions formed within a group of people and shared generation to generation (Shih, 2015). According to Shadiev and Sintawati (2020), intercultural learning is a process in which individuals acquire new knowledge and skills through experience and participation, as well as absorb new attitudes and values from different cultures. In our globalized society, people with different cultural backgrounds are becoming closer, and interaction between them is becoming common. In addition, understanding the culture of others helps maintain harmonious relationships. Although the best way to learn about another culture is to be in that environment, few people have this opportunity. The development of technology is providing the possibility of achieving distant intercultural learning, i.e., a kind of education in which the main elements include physical separation of the instructor and students during instruction (Shadiev & Sintawati, 2020; Shadiev, Sun, & Huang, 2019). Various technological tools can be used in distant intercultural learning to facilitate student-teacher and student-student communication, e.g., e-mail, blogs, Facebook, and Skype (Avgousti, 2018; Çiftçi, 2016).

Online intercultural learning has received a significant amount of attention in the past few years (Avgousti, 2018; Çiftçi, 2016). For example, in the work of Bueno-Alastuey and Kleban (2016), participants from Spain and Poland engaged in a project to develop their English language and intercultural skills. They used Dropbox and e-mail to exchange recorded text and audio files, and Skype for synchronous communication. The results demonstrated that participants were satisfied and appreciated the opportunity to use the target language authentically. In addition, they valued the potential of the project for enhancing IC. Hsu and Beasley (2019) carried out a project in which students from the USA and Taiwan interacted with each other using e-mail and Skype. These scholars found that participants positively perceived their intercultural learning experiences: intercultural communication facilitated efficient online discussions between non-native and native speakers of the target language and promoted their IC. Yang (2018) introduced a questioning strategy to online intercultural communication among students from the USA and China. Students asked each other self-generated questions using instant chatting tools. The results showed that the questioning strategy was useful for cross-cultural understanding and language development.

In previous studies, participants used both synchronous and asynchronous online tools for communication. These tools enabled them to use the target language authentically and communicate with representatives of the target culture. However, participants were unable to get a sense of presence and immerse themselves. Emerging technology makes this possible by creating intercultural learning environments that are immersive, authentic, and lead to a good sense of presence.

Assessing Intercultural Competence

Byram (1997) and Deardorff (2006) are seminal authors on the concept of IC. They argue that the primary goal of any online intercultural learning program is to develop learners' IC. Deardorff (2006, p. 247) defined IC as the "ability to communicate effectively and appropriately in intercultural situations based on one's intercultural knowledge, skills, and attitudes." Fantini (2009) suggested that IC includes four components: knowledge, skill, attitude, and awareness. Byram (1997) defined these components as follows: *knowledge* is "knowledge of social groups and their products and practices in one's own and in one's interlocutor's country"; *skill of interpreting/relating* is "the ability to interpret a document or event from another culture, as well as to explain it and relate it to documents or events from one's own experiences"; *skill of discovery and interaction* is "the ability to acquire new knowledge of a culture and cultural practices and the ability to operate knowledge, attitudes, and skills under the constraints of real-time communication and interaction"; *attitude* is "curiosity and openness, readiness to suspend disbelief about other cultures and belief about one's own culture"; and, *awareness* is "the ability to evaluate critically on the basis of explicit criteria, perspectives, practices, and products in one's own and other cultures and countries."

According to Fantini (2009), IC can be measured by the Assessment of Intercultural Competence (AIC) instrument. Using only one set of data (e.g., questionnaires) makes it difficult to comprehensively measure IC development because the process is complex and may be influenced by many factors, such as the learners themselves or their partners and the learning environment. Therefore, different sets of data (e.g., interviews and student reflections) should be used to make findings robust.

360-Degree Video-Based VR Technology

VR is a computer simulation environment in which users navigate and manipulate virtual objects in a virtual world. VR can simulate immersion and interaction in a target culture and language, and users can interact with the simulated environment through special wearable devices (Walshe & Driver, 2019).

In recent years, VR based on 360-degree video has emerged. It comprises a VR multi-lens camera and image Mosaic technology, which combines video shots from multiple lenses into a spherical image to build a dynamic virtual space. The video viewing methods include direct displays and head-mounted displays (HMDs), both of which can be supported by mobile and PC terminals (Rupp et al., 2019). Compared to a direct display, using a HMD is a more immersive approach to learning. According to Rupp et al. (2019) and Walshe and Driver (2019), HMDs induce a greater sense of place illusion, have greater positive effects, and are more convenient compared to a direct display. Previous studies created VR based on 360-degree video and HMD (Rupp et al., 2019; Vettehen, Wiltink, Huiskamp, Schaap, & Ketelaar, 2019; Walshe & Driver, 2019), and their results showed that VR has strong potential as a learning technology. For example, Walshe and Driver (2019) applied a 360-degree video to help pre-service teachers gain a nuanced understanding of microteaching practice, as well as to support their self-efficacy in teaching. Vettehen, Wiltink, Huiskamp, Schaap, and Ketelaar (2019) investigated the use of 360-degree video as a means for conveying news stories to determine what it might add to traditional two-dimensional video. The results showed that 360-degree video received a higher evaluation in terms of presence, enjoyment, and credibility, with no negative effects on recognition and understanding. Research has identified a number of desirable characteristics of 360-degree video including broad perspective, large information capacity, easily produced immersion, and strong interaction, and it can provide rich visual and auditory information, showing learners a very realistic, broad-space picture (Rupp et al., 2019). However, to the best of our knowledge, few studies have been carried out using this kind of technology for IC learning. Particularly, whether such a technological approach facilitates IC has not yet been tested. Therefore, this study is an attempt to address this gap.

Expectation-Confirmation Theory

Bhattacherjee (2001) is considered by many to be the seminal author on expectation-confirmation theory (ECT). According to Bhattacherjee (2001), ECT describes the relationship between consumer expectations before buying a product, the perceived effects after purchase, the degree of confirmation between expectations and effects, the degree of satisfaction after purchase, and the intention of buyers to buy again. Based on ECT, Bhattacherjee (2001) proposed the expectation-confirmation model to compare the behaviour of people using information systems with the purchase behaviour of consumers, positing there to be a high degree of consistency between the two. In addition, the type of experience on the first use of an information system will determine a person's intention to use the system either again or continuously. According to the expectation-confirmation model, users' perceptions of technology include the degree of satisfaction and confirmation of expectations, which in turn affect their continuance intentions. Studies on intercultural learning supported by technology have typically investigated participants' perceptions of the technology (Lee & Markey, 2014; Shadiev, Hwang, & Huang, 2015; Shadiev & Sintawati, 2020). In a study reviewed by Çiftçi (2016), participants had a positive attitude and overall satisfaction with digital technologies and intercultural learning, and the technologies provided enjoyable intercultural experiences. Since many new technologies are emerging and can be applied to support intercultural learning, researchers should explore learners' perceived experiences (e.g., expectation-confirmation) with them.

Research Questions

This study was aimed toward addressing the following research questions:

1. What were participants' perceptions of the intercultural learning activity?
2. What were participants' perceptions of VR technology during the intercultural learning activity?
3. To what extent did the learning activity supported by VR technology promote intercultural competence?

Method

Our study used a pragmatic mixed-methods approach as a way of gaining a deeper understanding of the phenomenon of interest. This research method can be used to collect a substantial amount of evidence and information.

Participants

We used a convenience sampling method, i.e., participants were selected based on availability and willingness to take part. Twenty-one university students, ten from China and eleven from Uzbekistan, voluntarily participated in the learning activity. They were recruited by means of messages posted to online student groups in two universities and provided informed written consent. The students ranged in age from 20 to 25, and they were majoring in education science. The participants' English level was good enough for intercultural communication; all had passed a national college entrance examination, which included English as a foreign language. The participants had no experience with using the VR technology employed in this study, nor did they have any intercultural learning experience. To protect their privacy in this paper, each participant was assigned an identification number ranging from ID1 to ID21.

Intercultural Learning Activity

A three-step intercultural learning activity was designed for this study:

1. Self-introduction. The participants were asked to introduce themselves, their hobbies, and interests, as well as their daily life and their culture. Each student recorded his/her self-introduction using a 360-degree camera and uploaded it to the activity website.
2. Introducing local culture. The participants were asked to choose a topic of interest from a list of predetermined options, to introduce it with relation to their local culture, to record their introductions using a 360-degree camera, and then to upload their recordings online. For example, student ID8 described a traditional breakfast and its history in relation to his/her culture.

3. Experiencing foreign culture. In this step, each participant was asked to watch videos using Gear VR, to reflect on his/her personal experience of a foreign culture and tradition in a reflective report, and then to share it with other participants online. These videos had to be on the same topic introduced by the student. That is, if student ID8 introduced traditional food, he/she had to watch videos created by student ID17, who also introduced traditional food, and reflect on them.

Each step took one week. Videos were of different lengths, ranging between three and nine minutes. Communication among participants during the three steps was carried out in English on the activity website and took place asynchronously. The participants communicated in pairs (i.e., two students who selected the same topic of interest), and no instances of collaboration on each other's videos were observed. The participants received guidelines on how to communicate with their partners (e.g., communication content had to be appropriate and relevant to the topic), and there was not a required minimum number of responses.

The website used for the activity was created on the server in the research lab and included instructions for use of VR tools, the steps in the learning activity, and guidelines to complete them efficiently, as well as the videos created by the participants.

One may argue that the sample size of this study was small and that the learning activity was short. Our review of related studies showed that many also involved a small number of participants (e.g., four students in the research of Liao and Lu [2018], twelve students in Yang's work [2018], eighteen students in Bueno-Alastuey and Kleban [2016], and thirty-four students in Hsu and Beasley [2019]), and their projects were short (e.g., one week in the case of Liao and Lu [2018], five weeks for Bueno-Alastuey and Kleban [2016], and six weeks for Yang [2018]).

360-Degree Video-Based VR Technology

Two pieces of VR-related technology facilitated the learning experience: a 360-degree video recorder and an HMD to view the videos. Samsung Gear 360 was used to make the videos. It is a camera that can capture a full 360-degree view around a person in the form of a video using a smartphone. Samsung Gear VR was used to watch the 360-degree videos. It is a lightweight headset device powered by Oculus and is compatible with Samsung Galaxy flagship smartphones. We used Samsung Galaxy S9 plus mobile phones to connect to Samsung Gear 360 to record the 360-degree videos and to connect to the Samsung Gear VR to watch the 360-degree videos without transferring the videos to Gear VR. These tools were selected because of their availability and current use in the field.

We used 360-degree video-based VR technology instead of artificially simulated VR (e.g., Second Life) because people, objects, and scenarios in the former look the same as they do in real life, so we assumed that the degree of perceived authenticity and immersion of the participants would be higher as compared to the latter. In addition, it is difficult for non-professionals such as teachers to design artificially simulated VR; however, due to the ease of 360-degree cameras use, non-professionals can create their own 360-degree video-based VR.

Two screenshots from a 360-degree video are shown in Figure 1. The participant in the first screenshot demonstrates *kelin ko'ylyagi*, a traditional Uzbek dress for young brides, and the participant in the second screenshot explains *zhongzhi*, a traditional Chinese rice dish. Figure 2 demonstrates a participant watching a 360-degree video using Samsung Gear VR (1), and a participant (in the background) recording a 360-degree video using Samsung Gear 360 (2).

Figure 1. Screenshots from a 360-degree video.

Figure 2. VR technology: (1) Samsung Gear VR, and (2) Samsung Gear 360.

Research Procedure

The learning activity was carried out and the data were collected both in China and Uzbekistan. We collected demographic information and assessed the IC of the participants before the learning activity (i.e., a pre-test) using a paper-based questionnaire. Then, the participants were informed about the learning activity. After that, the participants were taught how to use the VR technology and the online website, and then they practiced using them. Next, the participants carried out the learning activity. After the learning activity, we surveyed the participants' IC (i.e., a post-test) and perceptions of the VR technology using another paper-based questionnaire. In addition, the participants completed reflective reports, and we carried out one-on-one interviews with them. The researchers in this study were not teachers but were involved in the data collection and analysis process.

Data Collection

To answer the research questions, both quantitative and qualitative data were gathered. We collected data from participants' reflections and interviews to answer research question 1, participants' perceptions of VR technology to answer research question 2, and participants' perceived IC to answer research question 3. Descriptions of the components of the data are presented here:

- Reflective reports. The students wrote reflective reports in which they described their experiences related to intercultural learning supported by VR technology.

- One-on-one semi-structured interviews. Each interview lasted approximately 30 minutes, in which the students were asked open-ended questions:

    1. What was your development of IC in terms of four dimensions, i.e., knowledge, attitude, skills, and awareness?

    2. Please describe your experience with the use of VR technology.

    3. What do you think about the usefulness of VR technology for intercultural learning?

- The expectation-confirmation questionnaire. This questionnaire (Bhattacherjee, 2001) was used to measure participant perceptions of VR technology. It included three dimensions, with a total of 12 items: continuance intention (3 items), satisfaction (4 items), and confirmation (5 items). We used a Likert scale and anchored the end points with *completely disagree* (1) and *completely agree* (7).

- The assessment of intercultural competence (AIC) questionnaire. This questionnaire (Fantini, 2009) included four dimensions and 39 items: *knowledge* (10 items), *attitudes* (11 items), *skills* (8 items), and *awareness* (10 items). These items were rated on a six-point Likert scale. We anchored the end points of the scale with *no competence* (0) and *very high competence* (5). The scope of IC was narrowed to student competence related to the topics covered in this study.

All data were anonymized to ensure confidentiality.

Data Analysis

Twenty-one valid answer sheets to the questionnaires were obtained from the 21 students. We analyzed the responses to the questionnaire following the general recommendations of Hsu and Beasley (2019). First, we checked all responses, and no evidence of response bias was found. Second, we checked for the internal consistency of each questionnaire using Cronbach's alpha. The values in each dimension ranged from 0.802 to 0.943, which demonstrated satisfactory reliability. Third, we calculated the descriptive statistics for each dimension and analyzed the data to provide answers to the research questions. An independent sample *t*-test was used to compare the IC scores before and after the activity. SPSS statistical analysis software was employed to make the calculations.

All interviews were audio-recorded, transcribed, and translated from Chinese/ Uzbek into English. The interview transcripts and reflective reports from all students were used for the qualitative data analysis. We used a content analysis method in which the transcripts and reflections were read through, text segments in the data relevant to the research questions were highlighted and coded by two raters individually, and codes with similar meanings were aggregated. All codes were gathered into different categories to report the findings. Finally, raters compared and discussed the codes and categories to reach a consensus.

Results and Discussion

Perceptions of the Intercultural Learning Activity

Thirteen codes were derived, and three categories emerged from them (see Appendix A).

Authenticity of learning environment. This category included a real environment, a real partner, and visualization codes. The students indicated that they felt the environments and partners were real when they used VR technology. Compared with other VRs (e.g., Second Life), the one used in this study provided a real-world scene rather than an artificial, human-made environment. In addition, intercultural partners communicated with real people, not avatars. This finding is consistent with other studies. The participants in Liao and Lu (2018) who were visiting a campus through VR felt they were experiencing another real world while controlling a telepresence robot. In our study, the participant ID3 mentioned that, "[The technology] can create a real atmosphere for me, and the intercultural partners are also real. This three-dimensional perspective of her is pretty strong, and I could observe this person, the way she dresses, the way she behaves." In addition, the participants mentioned that the learning content was more vivid than content in textbooks or on the Internet because it could materialize and visualize abstract knowledge. For example, participant ID8 mentioned that, "When introducing traditional food, I can change my perspective as if I am in the scene, to see how the food is made, what ingredients are used, and I can capture its color and shape, which is very vivid."

In this study, VR technology enhanced the participants' sense of immersion and presence. As a result, the participants felt that the learning content and contexts were authentic. This is very important for intercultural learning because such advantages facilitate learning. This is something that previous studies were unable to show.

Authenticity of the foreign culture. Three codes, including authentic experience, presence, and immersion, were in this category. Authentic experience means that the VR learning content was authentic, i.e., created by a real person in his/her country, and the participants learned about the foreign culture using it. Because the participants perceived the learning environment as real, they had a sense of being in the real world, which is called *place illusion* or *presence* (Slater, 2009). Scholars have suggested that highly immersive VR experiences may lead users to feel as if their consciousness has been relocated to the virtual space (Slater, 2009). For example, participant ID3 mentioned, "When I studied my partner's culture, I felt like I was standing beside her." According to Liao and Lu (2018), authentic learning experiences are created by making learners feel that they are engaged in the activity as if they are physically present. The participants in our study said they gained real cultural knowledge and experience by participating in VR-supported learning activities. Similar findings have been reported in other related studies (Liao & Lu, 2018). In addition to giving participants a sense of presence

(Higuera-Trujillo, Maldonado, & Llinares Millán, 2017), the VR technology created an immersive learning environment (Rupp et al., 2019; Walshe & Driver, 2019). According to Higuera-Trujillo et al. (2017), higher levels of immersion elicit a greater sense of presence, which is understood as an unmediated perceptual illusion that can only be quantified by user experience (Rupp et al., 2019; Walshe & Driver, 2019). In previous studies, participants with different cultural backgrounds exchanged cultural information with each other using technology to achieve intercultural learning. Although the cultural knowledge learned by the participants in these studies was authentic, or came from the authentic culture, the participants did not have a sense of presence in the specific culture, so they couldn't have an authentic experience, let alone a sense of immersion.

Learning category. This category included the following seven codes: enthusiasm, motivation, curiosity, attention, understanding, convenience, and interest. In term of enthusiasm, motivation, and interest, the participants said in the interviews that VR made their learning experience new and interesting (Hsu & Beasley, 2019; Lee & Markey, 2014; Shadiev et al., 2015), which greatly improved their enthusiasm related to intercultural learning (Shih, 2015). In addition, participants were very motivated to learn about other cultures in VR (Bueno-Alastuey & Kleban, 2016; Lee & Markey, 2014; Shadiev & Huang, 2016; Shih, 2015). For example, participant ID9 said, "This way to learn interculturally has increased my enthusiasm, and I love to learn about their culture," and "I want to know more about their culture." Participant ID5 stated, "I can learn about their culture, and it is interesting and fun."

Curiosity was stimulated by the fact that participants could use their senses to explore and discover other cultures (Shih, 2015). For example, participant ID7 stated, "I am very interested in their buildings and surrounding environment, and as a result, I have a feeling that I want to visit this place, and there is a sense of curiosity."

VR technology has the potential to improve attention. The participants reported that when they were engaged in intercultural learning in VR, their attention was focused on the content. For example, participant ID7 stated, "I was totally focused on learning about their culture. I didn't know what was going on outside, and I wasn't disturbed by it."

As mentioned earlier, the learning environment created by the VR technology was real, so participants could understand the cultural information provided by their partners. For example, participant ID5 stated, "When I knew that she was introducing me to their traditional clothes, I could barely imagine what it looked like. When I watched the 360-degree video, I could fully understand what she said about traditional clothes."

The participants expressed that the learning activity supported by VR technology was easy and convenient because it enabled a long-distance intercultural immersion experience. For example, participant ID2 stated, "This way of intercultural learning is convenient. I don't need to spend a lot of time and money to go to another country."

Our findings are similar to those from earlier research (Bueno-Alastuey & Kleban, 2016; Rupp et al., 2019; Shadiev & Huang, 2016; Shadiev et al., 2015; Shadiev et al., 2019; Shadiev, Wu, Sun, & Huang, 2018; Vettehen et al., 2019; Walshe & Driver, 2019). However, since we used VR technology based on Gear 360 and Gear VR, participants' sense of immersion and presence increased, and they perceived the learning content and contexts to be real. As mentioned earlier, learning content and contexts are important because they facilitate intercultural learning.

The above-mentioned advantages can be useful for learners, educators, and researchers when designing courses as well as during intercultural learning activities supported by VR technology. If learners, educators, and researchers know the advantages then they can make good use of these in future learning projects.

Participants' Perceptions of VR Technology

The mean values and standard deviations of the participants' perceptions of VR technology are presented in Appendix B. Participants had positive perceptions related to their intention to use VR technology continuously, degree of satisfaction, and confirmation of expectations. According to the results, the participants planned to continue to use VR technology (total *M*=5.92; *SD*=0.989; 92%). For example, 90.5% of participants were willing to use VR technology continuously rather than alternatives. Only three students were undecided. In the interviews, they said that the VR technology had greatly assisted their learning; however, because technology is developing very rapidly, they may choose to use alternatives if there are better ones.

Almost all participants were satisfied with their decision to use VR technology and with their usage experience (total *M*=6.19; *SD*=0.828; 97%). For example, participant ID10 said in the interviews that, "This technique gives me a full view of the learning content and context. When my partner was introducing a tradition, I could observe the environment around me as if I was really there. I am very satisfied with my learning experience."

The participants had positive perceptions about their expectations being met (total *M*=5.81; *SD*=1.000; 90.5%). Only two students either somewhat disagreed or were undecided regarding items 9, 10, and 11. In the interviews, they mentioned that their partners' 360-degree videos did not provide all the information they would have liked to have had, so they had to search for additional information on the Internet. In addition, their expectations regarding VR technology had been too high; i.e., they thought it would be like watching commercially made 5D movies.

Our results are consistent with those obtained in previous studies (Hsu & Beasley, 2019; Lee & Markey, 2014; Shadiev & Huang, 2016; Shadiev et al., 2015; Shadiev et al., 2019; Shadiev et al., 2018). The students in related studies also had positive perceptions regarding their expectations being met.

Participants' IC Development

The results of the independent sample *t*-test (see Appendix C) showed that there was a significant difference between the IC pre- and post-test in four dimensions. The results suggest that the participants developed IC in all four dimensions. That is, the participants learned and mastered the cultural information they were exposed to in the activity, used skills to promote learning traditions and their own culture as well as that of their partners, and had a positive attitude and strong curiosity about the other culture. The results of the interviews and reflective reports confirmed these findings.

Knowledge. The participants scored significantly higher on the post-test (total M=3.77; SD=0.763) as compared to the pre-test (total M=0.70; SD=0.704), $p < .005$. The result shows that there was a significant increase in participants' intercultural knowledge. This suggests that the intercultural activity affected the participants' knowledge of the foreign culture they were exposed to. In the interviews and reflective reports, the participants mentioned that they had no prior knowledge about the foreign cultures and traditions before participating in this activity, so they didn't know the essential norms and taboos of the foreign culture. In addition, the participants said they had been unable to contrast aspects of their own culture with those of the foreign culture prior to the activity, so they did not know how to describe the similarities and differences between them. The participants also mentioned that before participating in this activity, they only knew one technological tool to help learn about foreign culture, which was the Internet. Therefore, they did not know how to aid their learning, nor were they able to cite any strategies for learning about a foreign culture. The participants gained information about foreign cultures, values, and traditions by participating in the activity. All participants admitted that they had obtained cultural knowledge and had learned about their foreign peers, their cultures, and their traditions. In their reflective reports, they were able to recall what they had learned about the foreign culture and always compared the information they had learned with their own culture to find similarities and differences. They also attempted to cite strategies for their learning. Here is an extracted excerpt from a reflective report of student ID5:

> I learned that they have a historical building called "memory square," which shows their respect for the soldiers who fought in WWII. In our country, we also use historic buildings or traditional festivals to show our respect for those who have passed away. Our cultures are similar in this respect. Also, in our country, people hold such ceremonies, too, but I was surprised by the respect their country had for the soldiers who fought in WWII. Compared with them, we also have differences. For example, we don't offer flowers, but we do pay the highest tribute to the deceased.

Attitude. The participants scored significantly higher on the post-test (total M=4.232; SD=0.800) as compared to the pre-test (total M=1.39; SD=1.069), $p < .005$. This result shows that there was a significant increase in participants' intercultural attitude. This suggests that the intercultural activity affected the participants' attitudes toward their foreign peers and the new culture they were exposed to.

In the interviews and reflective reports, the participants said they were not familiar with the values of the foreign culture they were learning about, so they did not know how to interact or communicate with their peers from that culture. In addition, the participants had never communicated with foreigners and had no experience with intercultural learning. Therefore, they did not have a positive attitude towards intercultural communication before participating in this activity. For example, participant ID8 initially said she felt nervous and uneasy about communicating with strangers, and also had no confidence that she could obtain or share cultural information properly in English in such a way so as to not offend her partners. However, after the learning activity, she had no such issues. All participants mentioned that because of the learning activity, they were interested in different aspects of the foreign culture and in introducing their own culture to others. In addition, they had the opportunity to try to understand and respect cultural differences and to try to interpret them. Here is another extract from the reflective report of student ID2:

> I am also interested in the national characteristics of their cultures and would like to continue to learn about those cultures that are special/different from other cultures. I also want to introduce to them to our unique culture to give them a sense of our history, such as the hot pot in Chengdu, Sichuan embroidery, and the thatched cottage in Du Fu.

Skills. According to the results, the participants scored significantly higher on the post-test (total M=3.98; SD=0.746) as compared to the pre-test (total M=0.81; SD=0.758), $p < .005$. The result shows that there was a significant increase in participants' intercultural skills. This suggests that the intercultural activity affected the participants' skills related to the foreign culture they were exposed to.

In the interviews and reflective reports, the participants said that due to lack of intercultural communication, knowledge about their partners' culture, and experience with intercultural learning, they had no idea how to interact with their partners or to understand the differences between their cultures. Therefore, it was difficult for them to adjust their behaviour or dress appropriately to avoid offending their partners. They also indicated that they did not have any appropriate strategies for learning about a foreign culture and adapting to it in order to reduce cultural stress. All participants mentioned that these issues were resolved thanks to the activity. In addition, the participants were able to compare and contrast the foreign culture with their own. Here is one extract from reflective report of student ID4:

> What impressed me most is that after the bride and groom get married, the couple go to the groom's home to sit down for a while. The groom's parents and relatives give gifts to the bride; the parents give jewelry, and the relatives give practical objects that are often used in married life. In addition, one student mentioned a historical building that contains the tomb of Suzukotas, where people read the Koran. In China, for example, in the Zhongshan mausoleum, tourists will visit Sun Yat-Sen's mausoleum, but they will not read and recite sutras there, which is quite different. This difference has to do with the country's economy, historical development, and political system. I used the strategies of knowledge transfer and empathy. By recalling the information introduced by the teacher in the history class, I analyzed how China developed to the present step by step. In this way, I looked at the culture of Uzbekistan and guessed the reasons for the differences.

Awareness. The participants scored significantly higher on the post-test (total M=3.80; SD=0.690) as compared to the pre-test (total M=0.70; SD=0.672), $p < .005$. The result shows that there was a significant increase in participants' intercultural awareness. This suggests that the intercultural activity affected the participants' awareness about the foreign culture they were exposed to.

In the interviews and reflective reports, participants mentioned that they had limited intercultural awareness before the activity. After participating in the activity, their intercultural awareness had developed. For example, they were able to identify the diversity in the foreign culture. Furthermore, they recognized the danger of interpreting individual behaviour as representative of a whole culture, and they knew how their own values were reflected in the intercultural learning process. In addition, they were able to contrast the foreign culture with their own and find similarities and differences which led to the development of cultural awareness. This is illustrated in this extract from the reflective report of student ID7:

> I was most impressed by a square with a monument containing the names of soldiers who fought in the Second World War and a statue, all of which are meant to honour them and remind us to remember the history of that war. In our country, there are also monuments with historical and educational significance. We also hold activities on special days to remind people not to forget national pride and to remember historical events.

These results, related to IC development (i.e., knowledge, attitude, skills, and awareness), were confirmed by the instructors and researchers in this study. We therefore can conclude that intercultural learning supported by VR technology helped develop the participants' IC in all four dimensions. In intercultural education, the cultivation of IC has been the concern of many researchers. This finding is consistent with those of previous studies (Bueno-Alastuey & Kleban, 2016; Hsu & Beasley, 2019).

Conclusion

The results of this study showed thirteen advantages of intercultural learning supported by VR. Many of these advantages have been mentioned in related studies. However, three have not and therefore are new to this field of research: presence, authentic cultural experience, and immersion. The participants positively perceived the VR technology as supporting intercultural learning, i.e., they intended to use the technology in the future, were satisfied with their learning experiences, and felt that the technology met their expectations. In addition, the intercultural learning supported by VR technology was helpful in facilitating IC development.

The results of this study may be useful for educators and researchers in the field of open and distributed learning because this study spans geographic and cultural boundaries using educational technology, where resources created by students are in open access and therefore easily accessible.

Based on these results, we suggest that researchers and educators use VR technology to support long-distance intercultural learning. Apart from the ten previously identified advantages of intercultural learning, VR technology can provide participants with a sense of presence, immersion, and authenticity. As technology develops, we suggest that researchers and educators use VR tools to support both asynchronous and synchronous communication in long-distance intercultural learning. Scholars have warned that learners may experience fatigue/sickness in VR (Rupp et al., 2019). Therefore, we suggest that, to avoid discomfort, videos should not be too long. Finally, videos should have interesting, easy topics so that the students who record and watch them will be motivated to learn.

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Research Trends in Mobile Learning

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Abstract

A total of 1023 selected articles published in 2016–2019 related to mobile learning were examined and classified according to the categories in this research: 40% of these articles used quantitative approaches, 18% of them used mixed, and 13% of them were literature reviews. The published studies were analyzed according to research model, sample size, sample level, learning fields, subject-area classification, data collection tool, data analysis technique, dependent variable, independent variable, mobile device, number of authors, and publication year. The findings were analyzed and interpreted as a percentage and frequency. This research will be useful for reviewing current research trends related to mobile learning studies, indicating potential research on the topics, and revealing the needs of the field.

Keywords: mobile learning, m-learning, trend analysis, research trends, distance education

Research Trends in Mobile Learning

Open and distance learning (ODL) has become indispensable in educational environments because of its flexible learning method, the opportunities it gives students to study at their own pace, independent of time and place, and its evaluation opportunities (Towobola & Raimi, 2011). ODL in digital environments provides individuals with the opportunity to access course content whenever and wherever they want (Yüksekdağ, 2016). In addition, its collaborative and participatory features offer a learning-centered process. As these digital environments become mobile compatible, mobile devices are also involved in the learning process. The ability to structure information regardless of location and time has made mobile learning (m-learning) a significant learning vision.

Many studies have revealed the effectiveness, efficiency, and superiority of m-learning. These include studies on its use in medicine (Chase et al., 2018; Lin & Lin, 2016; Nerminathan, Harrison, Phelps, Scott, & Alexander, 2017); in language learning (Alkhezzi & Al-Dousari, 2016; Chinnery, 2006; Klímová, 2018); in special education (Judge, Floyd, & Jeffs, 2015; Karanfiller, Yurtkan, Rüştüoğlu, & Göksu, 2018); and in the learning of motor skills (Hung, Shwu-Ching Young, & Lin, 2018); as well as research on the different age groups in different areas and the effects on academic achievement, attitude, motivation, and interaction. These studies have discussed m-learning in different research patterns through variables. By compiling m-learning studies up to the present that have been carried out independently in various cultural environments and depending on emerging technological developments, this study will contribute to the literature by revealing the current situation and determining the research gaps.

Mobile Learning

Beyond using portable technology and devices in learning environments and focusing on students' mobility, m-learning offers a variety of opportunities to educational theory and practice (Al-Adwan, Al-Madadha, & Zvirzdinaite, 2018). Changes in understanding of access to information, communication, and cooperation have created a new generation of students who can create their own learning context by interacting with each other and their environments in the real and virtual worlds (Al-Adwan et al., 2018). In addition to student roles that can access the information resources they need at any time, question the correctness of the information they reach, produce, and share in collaboration, learn at their own pace and evaluate their own learning. The roles of the teachers that contribute to the motivation of the students, facilitate the process, and are open to learning together with the students are considerable (Özdamlı & Çavuş, 2011). In the place of predetermined classes with limits and timelines, m-learning community had to redesign learning, embracing the world as its learning environment. Adapting to such developments, which can also be envisaged as life-long learning skills, can remove formal and informal learning limits in the "mobile age" (McQuiggan, Kosturko, McQuiggan, & Sabourin, 2015). The advantages offered by m-learning, in fact, constitute its distinctive aspects from other distance-education applications.

Students of m-learning create a continuous meaning between location, time, and learning content through mobile devices connected to the wireless network, in accordance with their objectives. The portable feature of mobile personal devices makes them the most attractive way for students to process ideas and information that can be encountered by chance in long-term learning (Sharples, Arnedillo-Sánchez, Milrad, & Vavoula, 2009). For example, students learning a language can combine device mobility and the real world, learning the words they do not know through their smartphone applications while roaming the streets (Cohen & Ezra, 2018). Another feature emphasized in m-learning is that it is personalized. With the help of adaptive technologies, the content is presented and updated according to the learning styles and contexts of the students (Song, Wong, & Looi, 2012). Unlike other distance education applications, mobile devices increase students' sense of ownership (Perry, 2003) and control (Laurillard, 2007). Finally, the feature of being situated means that students interact with real situations and produce meaningful information based on their own experience. Accordingly, concepts can be reformatted as they are used in new situations. In this way, knowledge develops as part of the culture, time, and context (Brown, Collins, & Duguid, 1989). Students can learn anywhere, anytime using m-learning tools, and they can discuss how their new knowledge can be used in real situations (Huang, Yang, Chiang, & Su, 2016).

We examined the following studies and created criteria by blending the headings: Hwang and Tsai (2011); Hung and Zhang (2012); Wu et al. (2012); Hwang and Wu (2014); Chee, Yahaya, İbrahim, and Hasan (2017); and Kavaklı and Yakın (2019). Within this framework, we aim to identify trends by examining articles on m-learning published from 2016 to 2019.

This work is important in terms of its contribution of current data to researchers working on m-learning. We analyzed the data on m-learning according to the following criteria: research models, sample sizes, sample levels, learning fields, subject area classifications, data collection tools, data analysis techniques, dependent variables, independent variables, mobile devices, number of authors, and publication years.

Related Research

The following trend analysis studies are based on different databases, year ranges, and research problems. In this section we have examined these studies in detail.

Hwang and Tsai (2011) examined 154 articles published in six major The Social Sciences Citation Index (SSCI) journals between 2001 and 2010. They analyzed the articles in their study according to the sample group, learning field, and country identity. Their results showed a significant increase in the number of articles in the last 10 years and they observed that higher education students are the most frequently used research sample. Most of the articles did not focus on a specific learning field and investigated students' motivations, perceptions, and attitudes towards learning in all environments, along with orientations to the course (such as computer literacy or other skills necessary to take the course online or for a new subject area) for subject areas such as engineering, languages, arts, and science.

Hung and Zhang (2012) investigated the trends of m-learning in 144 articles published in five journals between 2003 and 2008. In general, they investigated the publication year, publication category, subject area classification, country, university, and journal identities. As a result, more studies were found on effectiveness, assessment, personalized systems, strategies, and frameworks within the scope of m-learning in the studies they examined.

In a study by Wu et al. (2012), the authors discussed 144 articles indexed by SSCI between 2003 and 2010. They analyzed m-learning studies around the number of citations, data collection tools, methods, sample groups, the results of the study, and the variables of mobile devices used. In the studies they examined, the survey was the most used data collection tool and experimental studies showed the majority. Also, most of the studies are focused on system design. The most commonly used tools in the studies were mobile phones and PDA. In addition, the most preferred working group has been primary and university students. Wu et al. (2012) examined the studies according to the number of citations. The most cited articles focused on the design of the m-learning system and the effectiveness of the system.

Hwang and Wu (2014) analyzed 214 publications on the use of mobile technologies in educational technologies in seven major SSCI journals published between 2008 and 2012. As a result of these examinations, they stated that m-learning was promising in improving students' learning success, motivation, and interests. In addition, it has been concluded that smartphones and tablets have been adopted as m-learning devices in recent years.

Chee et al. (2017) examined 144 articles published in six journals in the category of training technologies between 2010 and 2015. They analyzed the studies in the scope of research purpose, learning field, sample group, mobile devices, research design, training context (formal/informal), learning outcome (positive, negative, neutral), journal, country, and publisher.

In a content analysis study carried out by Sönmez, Göçmez, Uygun, and Ataizi (2018), the authors examined studies on m-learning conducted between 2013 and 2017. The study, which examined 11 articles published in English only, concluded that quantitative methods are preferred to other methods. In addition, the study reported that researchers focused on the topic of determining learners' views on m-learning more often than other topics.

Kavaklı and Yakın (2019) examined 37 studies on m-learning published in *Educational Technology Theory and Practice*, *Turkish Online Journal of Educational Technology*, and *Turkish Online Journal of Distance Education* between 2015 and 2018 and in the first quarter of 2019. They found that m-learning technologies, attitude, and perception were the most investigated subjects and that the majority of studies used quantitative research methods.

Research Problem and Significance

In studies similar to this study in the literature, a maximum of 233 studies were analyzed. In this study, we have analyzed many more studies and conducted a more comprehensive analysis. We blended studies and brought together and put forward different variables and analyses.

In the research on m-learning published between 2016 and 2019, we examined the distribution according to the following 10 categories; (1) method; (2) sample size; (3) sample level; (4) learning field; (5) subject area; (6) data collection tool; (7) data analysis technique; (8) dependent variable; (9) independent variable; (10) used mobile devices.

Limitations

The study was limited in terms of the database used in the selection of the analyzed articles, the year range of the analyzed articles (2016–2019), and the language of the analyzed articles. In addition, the analyzed articles prevent the generalization of the results of this study.

Methodology

This study, we analyzed articles on m-learning between 2016 and 2019 according to the trend analysis method. We analyzed the data according to this method's descriptive analysis technique. This is a qualitative technique with the aim to present the findings in an organized and interpreted way (Yıldırım & Şimşek, 2018, p. 239). And we explained descriptions and discussed the cause-effect relationship.

Through research on m-learning, we found 1046 articles through the SCOPUS database and Google Scholar. We excluded 23 articles that were repeats, conference papers, or in a non-English language, and thus examined 1023 articles. In researching the articles, we used the keywords “mobile learning” and “m-learning.” Then, to determine the compatibility of the article, we randomly selected 35 articles by year to be examined and coded. We then created categories and then created an analysis table. We used a Kappa test to determine the compliance rate. The Kappa test measures the reliability of the agreement between categorical examinations by two or more coders (Kılıç, 2015). In our first coding study, the coefficient of fit between us was ".62". Since this value is lower than .75 for Kappa, we came together to convince each other. As a result of the discussions, we revised each other’s studies within a week and conducted compliance testing. The compliance testing found a reliability coefficient of .82, thus reaching an ideal coefficient of concordance (Kılıç, 2015). After reaching the sufficient compatibility ratio, 35 articles were reduced from the total number of articles and the remaining “988” articles were distributed randomly by years among researchers, who coded them using the relevant categories tables. The codings were then brought together and the following findings were reached.

Findings

We investigated the research models, sample size, sample level, learning field, subject area classification, data collection tool, data analysis method, dependent and independent variables, and distribution of the studies within the scope of m-learning.

Research Model

We carried out descriptive analysis by analyzing the studies on m-learning according to their method. The classification in the research method is based on Göktaş, Küçük, Aydemir, Telli, Arpacık, Yıldırım and Reisoğlu (2012). If the feature being analyzed was not included in the classification, the study was defined as “others”; if it was not specified in the article, it was defined as “not specified”; if it was not suitable for classification, it was defined as “not available.” These definitions are used in all the tables. The distribution of the studies examined according to method is provided in Table 1.

Table 1

Distribution of Studies by Method

Model	Research design	f	%
Quantitative	Comparative Descriptive Correlational Quasi-experimental Survey Weak experimental True experimental Ex post facto Single subject (group)	409	39.98
Mixed	Triangulation Explanatory Exploratory	188	18.38

Literature review	Literature review Meta-analysis	133	13.00
Others	System development, design-based research, etc.	128	12.51
Qualitative	Case study Grounded theory Concept analysis Culture analysis Phenomenology	116	11.34
Not specified		49	4.79
	Total	1023	100

Of the 1023 studies analyzed according to classification, 39.98% were quantitative, 18.38% were mixed, and 13% were literature review studies, including system development and design-based research studies. To summarize, the classification of the studies according to research method is provided in Figure 1.

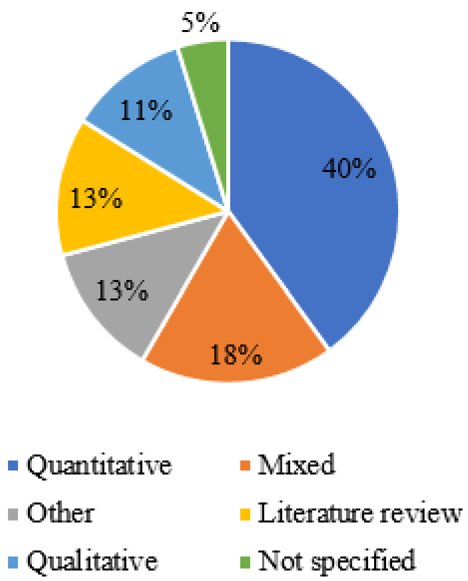

Figure 1. Distribution of studies by method.

An examination of the studies in which quantitative studies are predominant reveals that they use a questionnaire a data collection tool. Quantitative research in m-learning studies have focused on quantitative, mixed, and system development studies.

Sample Size

We examined the sample sizes of the studies on m-learning and carried out descriptive analysis, using the sample-size classification of Göktaş et al. (2012) as a basis. We updated Table 2 based on the needs of the research. The distribution of studies according to sample size is provided in Table 2. Sample size was between 31 and 100 in 27.57% of the studies, and between 101 and 300 in 20.14% of the studies. In 17.79% of the studies, the size could not be determined; these are classified as non-samples. In m-learning studies, the sample size was 31 and above, and studies without sample are more common.

Table 2

Distribution of Studies by Sample Size

Sample size	f	%
31–100	282	27.57
101–300	206	20.14
Non-sample study	182	17.79
301–1000	108	10.56
11–30	112	10.95
1–10	45	4.40
> = 1001	32	3.13
Not specified	56	5.47
Total	1023	100

Adapted from "Educational Technology Research Trends in Turkey: A Content Analysis of the 2000-2009 Decade," by Göktaş et al., 2012, *Educational Sciences: Theory and Practice*, *12*(1), p. 199. Copyright 2012 by the Educational Consultancy and Research Center.

Sample Level

We carried out descriptive analysis of the sample levels in studies related to m-learning, basing the sample level classification on that of Göktaş et al. (2012). These categories have been taken as the basis of m-learning studies addressing wide ranks. In 42.60% of the studies, the sample level was higher education; and in 16.41% of the studies, the sample level was K–12 level. In 20.40% of the studies, the sample levels were not available. Most m-learning activities are aimed at students with a higher education (f = 449). The distribution of the studies according to their sample levels is given in Table 3.

Table 3

Distribution of Studies by Sample Level

Sample level	f	%
Higher education	449	42.60
K–12	173	16.41
Instructor	96	9.11
In-service/Employee	42	3.98
Other	30	2.85
Preschool	15	1.42
Parents	6	0.57
Not available	215	20.40
Not specified	28	2.66
Total	1054	100

Learning Fields

We carried out descriptive analysis of m-learning studies related to learning fields, basing our classification of learning fields on OECD (2007). We found that 22.68% of the studies were in the field of social sciences, 18.18% in humanities, and 14.37% in natural sciences. Studies on m-learning are mostly carried out in the social sciences. The distribution of the studies by learning fields is given in Table 4.

Table 4

Distribution of Studies by Learning Fields

Discipline	Sub-discipline	f	%
Social sciences	Psychology Economy and business Educational sciences Sociology Law Political science Social and economic geography Media and communication other social sciences	232	22.68
Humanities	History and archeology Language and literature Philosophy, ethics, and religion Art (art, art history, performing arts, music) Other humanities	186	18.18
Natural sciences	Mathematics Computer and information sciences Physical sciences Chemistry sciences World and related environmental sciences Biological sciences Other natural sciences	147	14.37
Engineering and technology	Engineering (construction, electrical, electronics, knowledge) Mechanical Chemical Materials Medical Environment (environmental biotechnology) Industrial biotechnology Nanotechnology Other engineering and technologies	122	11.93
Medical and health	Basic medicine Clinical medicine Health sciences Health biotechnology Other medical sciences	98	9.58
Others	A learning field outside the classification	38	3.71
Agricultural sciences	Agriculture, forestry, and fisheries Animal and dairy science Veterinary science Agricultural biotechnology	14	1.37

	Other agricultural sciences		
Not available		103	10.07
Not specified		83	8.11
Total		1023	100

Subject Area Classification

We analyzed studies on m-learning according to the subject-area classification of Drysdale, Graham, Spring and Halverson (2013). We updated Table 5 based on the needs of the research. As indicated in Table 5, the subject area in 32.66% of the studies was technology, and in 22.67% of the studies was learner outcomes.

Table 5

Distribution of Studies by Subject Area Classification

Domain	Subdomain	f	%
Technology	Usage and role; effect; type; application; and familiarity	340	32.66
Learner outcomes	Independence in performance outcomes; learner satisfaction; participation; effectiveness; motivation and effort; learning; and retention rates	236	22.67
Instructional design	Models, strategies, and best practices; design process; implementation; environment and course structure; and assessment tools	147	14.12
Disposition	Perceptions; attitudes; preferences; student expectations; and learning styles	123	11.82
Other	Benefits and challenges; access and availability; support system; time efficiency; the nature and role of blended learning; and international issues.	114	10.95
Comparison	Blended and face-to-face; and blended and online.	38	3.65
Interaction	Learner-instructor; general interaction; learner-learner; collaboration; community; and social being	27	2.59
Professional development	Professional development	15	1.44
Demographics	Learner and instructor	1	0.10
Total		1041	100

Adapted from "An Analysis of Research Trends in Dissertations and Theses Studying Blended Learning," by Drysdale et al., 2013, *The Internet and Higher Education*, *17*, p. 95. Copyright 2013 by Elesvier.

Data Collection Tool

We analyzed the data collection tool in studies on m-learning according to the classification of Beissel-Durant (2004). We updated Table 6 based on the needs of the research. As seen in Table 6, 39.69% of the studies used a survey as a data collection tool.

Table 6

Distribution of Studies by Data Collection Tool

Tool	Subcategory	f	%
Questionnaire	Question design; self-managed questionnaire; state survey; questionnaire design; question types; question statement; structure of questionnaire; preliminary questionnaire; Web-based questionnaire	429	39.69
Advanced technologies	Computer-aided data collection; grid technology; audio and video; data mining; e-social science approaches to data collection	134	12.40
Interview	Question design; qualitative and quantitative; telephone; face-to-face; focus groups/group, interview; computerized; standardized and non-standardized; interview practice; interviewer; interview procedure; interviewer training; responders; response records	123	11.38
Mixed	Combinations of two or more data collection tools	89	8.23
Observation	Field observation; field test; participant observation; laboratory observation	65	6.01
Self-administrative non-specified questioning	Question design; mail survey; e-mail survey; Web-based questionnaire; public opinion polls	32	2.96
Sample	Sample and survey designs; sample types (cluster sample; multiphase sample; etc.)	22	2.04
Use of administrative resources		18	1.67
Measurement	Measurement of attitude; behavior; ability; etc.	17	1.57
Visual methods		1	0.09
Not available		116	10.73
		35	3.24
Total		1081	100

Adapted from "A Typology of Research Methods Within the Social Sciences," by Beissel-Durant, 2004, NCRM Working Paper. (http://eprints.ncrm.ac.uk/115/1/NCRMResearchMethodsTypology.pdf). In the public domain.

Data Analysis Technique

We examined data analysis techniques used in m-learning studies according to the classification of Karataş, Ozcan, Polat, Yilmaz, and Topuz (2014). We updated Table 7 based on the needs of the research. As Table 7 shows, after analyzing the distribution of studies according to data analysis techniques, we found that 22.28% of the studies used a descriptive technique.

Table 7

Distribution of Studies According to Data Analysis Technique

Technique	f	%
Descriptive	281	22.28
t-Test	154	12.21
Content analysis	149	11.82
(M)ANOVA	112	8.88
Correlation	77	6.11
Other	53	4.20
Structural equation model	52	4.12
(M)ANCOVA	43	3.41
Chi-Square	30	2.38
Multiple regression	35	2.78
Factor analysis	22	1.74
z-Test	16	1.27
Not available	140	11.10
Not specified	97	7.69
Total	1261	100

Adapted from "Trends in Distance Education: Theories and Methods," by Karataş et al., in , T.V. Yuzer and G. Eby (Eds.), *Handbook of research on emerging priorities and trends in distance education: Communication, pedagogy, and technology* (p. 141), 2014, Hershey, PA: Information Science Reference; IGI Global . Copyright 2014 by IGI Global.

Dependent Variable

Descriptive analysis was carried out to determine (1) whether the studies covered within the scope of m-learning research include dependent variables and (2) the distribution of dependent variables frequently used in the studies. The classification of dependent variables is based on Karataş, Yılmaz, Dikmen, Ermiş, and Gürbüz (2017). We updated Table 8 based on the needs of the research.

As shown in Table 8, the most studied dependent variable was learning outcomes (20.24%). This was followed by studies categorized as not available (19.68%). Similarly, a high frequency rate was obtained from studies categorized as not specified (15.02%). The results of the analysis on the dependent variable are presented in Table 8.

Table 8

Distribution of Studies According to Dependent Variable

Dependent variable	f	%
Learning outcomes	252	20.24
Attitude	105	8.43
Motivation	65	5.22
Availability	60	4.82
Satisfaction	45	3.61
Students' views	41	3.29
Efficiency	28	2.25
Participants' views	23	1.85
Participation	19	1.53
Interaction	19	1.53
Cooperation	13	1.04
Instructor's performance	7	0.56
Readiness	5	0.40
Communication	4	0.32
Social readiness	3	0.24
Other	124	9.96
Not available	245	19.68
Not specified	187	15.02
Total	1245	100

Adapted from "Interaction in Distance Education Environments" by Karataş et al., 2017, *Quarterly Review of Distance Education, 18*(1), p. 63. Copyright 2017 by Information Age Publishing Inc.

Independent Variable

We carried out descriptive analysis to reveal (1) whether the studies within the scope of m-learning research included independent variables and (2) the distribution of independent variables frequently used in the studies. The classification of independent variables is based on that of Karataş et al. (2017). We updated Table 9 based on the needs of the research.

As shown in Table 9, the most studied independent variable was the impact of the learning environment on dependent variables (35.71%). This was followed by the variable of gender (2.31%). This was followed by studies categorized as not available (24.54%). Similarly, a high frequency rate was obtained from studies categorized as not specified (18.09%) and other (7.60%). In addition, we found no studies analyzing the country variable in the data source used to classify the independent variables. The results of the analysis on the independent variable are presented in Table 9.

Table 9

Distribution of Studies by Independent Variable

Independent variable	f	%
Learning environment	371	35.71
Gender	24	2.31
Availability	21	2.02
Participants' views	21	2.02
Experience	17	1.64
Training method	13	1.25
Age	11	1.06
Class level	10	0.96
Satisfaction	9	0.87
Interaction	9	0.87
Participation	8	0.77
Academic achievement	3	0.29
Other	79	7.60
Not available	255	24.54
Not specified	188	18.09
Total	1039	100

Adapted from "Interaction in Distance Education Environments" by Karataş et al., 2017, *Quarterly Review of Distance Education, 18*(1), p. 63. Copyright 2017 by Information Age Publishing Inc.

Use of Mobile Devices

We undertook a descriptive analysis to determine (1) whether the studies within the scope of m-learning research included any mobile devices and (2) the distribution of mobile devices frequently used in the studies. Mobile device classification was based on that of Chee et al. (2017). Table 10 indicates the distribution findings of mobile devices in primary studies. We updated Table 10 based on the needs of the research.

Table 10 shows that mobile phones were the most used mobile device (37.27%). Ordinary mobile phones (which have no smart features) showed up in a limited number of studies. We also included these devices in the mobile phone category. While the tablet (18.25%) was the second most widely used mobile device, we observed that studies that did not use any mobile device (evaluated in the category of not available) were in the majority (18.68%). The number of studies that do not specify the mobile device in their research reports is also high (17.38%). PDAs (0.87%) have been the least frequently used mobile devices in the investigated studies.

Table 10

Distribution of Studies by Mobile Devices

Device	f	%
Mobile phone	429	37.27
Tablet	210	18.25
Other mobile devices	87	7.56
Personal digital assistants	10	0.87
Not available	215	18.68
Not specified	200	17.38
Total	1151	100

Adapted from "Review of Mobile Learning Trends 2010-2015: A Meta-Analysis," by Chee et al., 2017, *Journal of Educational Technology & Society, 20(2),* p. 121. Copyright 2017 by International Forum of Educational Technology and Society.

Number of Authors

The grouping of the articles according to the number of authors is given in Figure 2. Figure 2 shows that 21% of the articles were single author, 29% had two authors, and 50% had three or more authors.

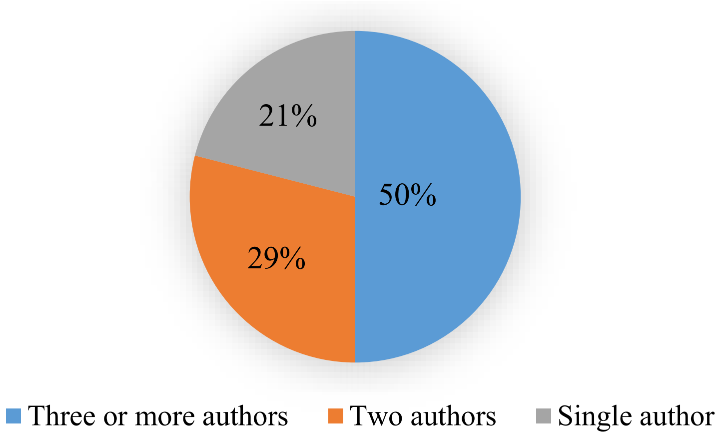

Figure 2. Distribution of studies by number of authors.

Year of Publication

The chart in Figure 3 groups the articles according to the publication year. It shows that the rate of studies conducted in 2016 was 22.48% (f = 230), the rate of studies conducted in 2017 was 21.40% (f = 219), the rate of studies conducted in 2018 was 25.21% (f = 258), and the rate of studies conducted in 2019 was 30.88% (f = 316). In 2019, a slight increase was observed in the number of researches.

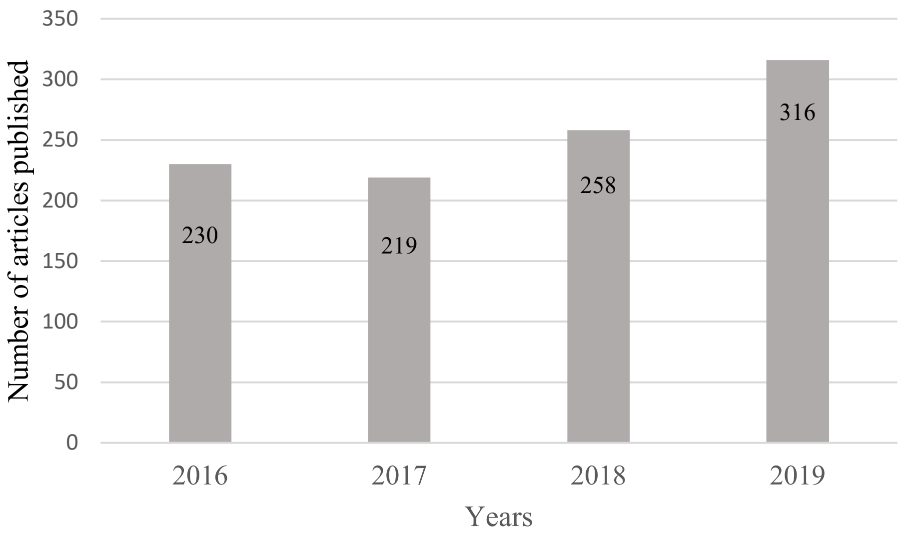

Figure 3. Distribution of studies by publication year.

Discussion

The most used research model in the studies analyzed was the quantitative method. The most common dependent variable in the studies is learning outcomes. The quantitative studies we examined generally addressed the learning outcomes through pre-tests and post-tests. Wu et al.'s (2012) meta-analysis study, in which they examined trends in m-learning studies between 2003 and 2010, also concluded that quantitative studies were more preferred than qualitative studies. In some of the studies, we identified the links and trends between variables related to the sample. The most commonly used test technique (Orhan, 2018) in the articles was descriptive analysis (22.28%). When we review all the articles, the most-studied variables were earning outcomes (20.24%), attitude (8.43%) and motivation (5.22%). We investigated these variables using experimental design. Variable types examined in this direction may have affected this finding. With regard to these variables, quantitative estimates were preferred in the studies (Miyata & Kai, 2009). In the study by Zawacki-Richter, Bäcker, and Vogt (2009), which examined m-learning studies between 2000 and 2008, the authors found that quantitative studies were the majority. The study of Bozkurt et al. (2015), which examined dissertations between 1986 and 2014, concluded that the quantitative method was the most preferred. In other research on recent m-learning studies, the most preferred method found has been quantitative studies (Kavaklı & Yakın, 2019; Zengin, Şengel, & Özdemir, 2018; Chee et al., 2017).

When we analyzed the studies in terms of sample size, we found the most preferred size to be between 31 and 300. The literature (Kavaklı & Yakın, 2019; Korucu & Biçer, 2019), has found that most studies on m-learning have been carried out within this sample size. When the studies are analyzed in terms of sample level in this study, the most studies preferred a level of higher education. The study by Wu et al. (2012) found that the majority of studies that used the level focused on a higher education level. Similarly, Bozkurt et al. (2015) concluded that higher education students were the preferred level for samples. In other studies as well, the preferred sample level has been higher education (Açıkgül, 2019; Padmo, Idrus, & Ardiassih, 2019; Kavaklı & Yakın, 2019). Easier access to higher education students may have caused this finding. In the context of higher education, the number of students in classes is over 30.

Learning fields of the studies differed. We found that 22.68% of the studies were in the field of social sciences, 18.18% in humanities, and 14.37% in natural sciences. We found that the studies are concentrated in the fields of social sciences and the humanities. Wu et al. (2012) also observed that social sciences and the humanities are the most studied learning field. Studies have been done in the field of education. Students' experiences and behaviors and learners' interactions with applications have been examined. These conclusions support our findings that social sciences and the humanities were the preferred fields.

Within the scope of this study, we examined the subject areas of the articles and determined that the majority of the studies were focused on technology. Sub-areas - such as the impact of tools and equipment, the role of these tools in learning, students' familiarity with the tools, especially in technology - were among the most discussed topics, which is similar to findings in Wu et al. (2012). In many studies, m-learning is integrated into education and used as a tool or for some specific purpose. In this case, our finding that the majority subject area is technology was expected.

We observed that the questionnaire was used to collect data in the clear majority of the articles within the scope of the study. This result supports studies carried out by Wu et al. (2012) and Chee et al. (2017). Data collection tools—such as question design, self-managed questionnaire, mail survey, question types, question statement, structure of the questionnaire, and Web-based questionnaire—are generally combined within the category of the questionnaire.

When we examined the data analysis techniques of the studies, we found that the descriptive analysis is the most used technique. We determined that studies whose second place is not expressed with data, statistical data are not needed and not available.

Learning outcomes include test results and end of the year degrees used in cognitive performance measurements, academic achievement, and knowledge acquisition. Similarly, the dependent variable, which was also handled by Lai (2020), showed a majority in academic achievement.

The determining factor among those affecting the choice of technological devices used in learning environments, besides suitability for the purpose and student needs, may be that they are the most widely used tools of their period. In this sense, literature reviews are very useful in revealing technology trends. Chee et al. (2017) also state that customer preferences in the mobile technology market affect the type of device selected to use in m-learning research. This study found that the most used mobile device type is the smartphone, and that tablets take second place. These results overlap with different study results in the literature (Baran, 2014; Chee et al., 2017; Crompton, Burke & Gregory, 2017; Hwang & Wu, 2014; Kaliisa & Picard, 2017; Wu et al., 2012). However, contrary to the results of our study showing PDAs to be the least preferred mobile devices, literature reviews have found that PDAs are the second most used mobile device (Crompton et al., 2017; Hwang & Wu, 2014; Wu et al., 2012). This difference may be due to the fact that the articles examined in this study are more current.

Conclusion

Studies that reveal the effectiveness of a learning or teaching method often share their data on the results achieved by learners who use this method, such as success, attitude, and satisfaction. In particular, the primary aim of students that continue their education activities within the scope of formal education is to increase academic achievement. Within the scope of m-learning research, the literature indicates that the most discussed dependent variable in the studies is the learning outcome. The dimensions examined in the analyzed studies were effective in assisting the selection of the quantitative estimates for this study. There are few studies using qualitative methods to examine the behaviors of learners with m-learning. This study of m-learning issues forms an important reference for future research in m-learning by adding to the limited existing research.

Suggestions

Regarding the distribution of the studies, recent and previous studies show similar findings to ours, evidence of the continuing trend in m-learning. However, the studies differ in research models, sample sizes, sample levels, learning field, data collection tools and techniques, and dependent and independent variables. On the other hand, we found that the studies in the field of m-learning are usually quantitative or are literature reviews. In future studies, the effectiveness, usability and message design of m-learning applications can be examined using qualitative methods. In addition, in the scope of mobile applications, the literature can be enriched with qualitative research that investigates metaphor studies and misconceptions.

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Revisiting Textbook Adaption Through Open Educational Resources: An Inquiry into Students' Emotions

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Abstract

This qualitative study explored the emotional trajectories students experienced when faced with open educational resources (OER) that expanded the learning available from a required textbook. Data included students' reflections, group discussions, and interviews, along with field notes which were collected in a classroom at a Chinese university in one semester. The study showed that students' initial positive emotions arose from their understanding of their own learning needs. Their positive emotions toward the conjugated use of OER and a textbook fluctuated over the semester but were gradually enhanced through their involvement in classroom practices (e.g., knowledge building and teacher mediation). Through the process, students' positive and negative emotions respectively facilitated and hampered their learning practices; however, negative emotions were not always detrimental—they also facilitated students' learning. Students' emotions gradually stabilized in the direction of being positive, especially in tandem with (a) achievement of sufficient knowledge gained through OER-based textbook use and teacher-mediated learning, and (b) their augmented confidence in proficiently using the new knowledge to navigate their practices.

Keywords: textbook, OER, student emotion, knowledge building, material use

Introduction

Textbooks are crucial components of educational settings in that teachers rely on them to impart knowledge and fulfill instructional goals (Hilton, 2016; Tomlinson, 2003). Nevertheless, no textbook contains everything needed for students in a given classroom and, as a result, educators also use open educational resources (OER) to complement their teaching (Stockwell et al., 2015; Vo, Zhu, & Diep, 2017). Indeed, the wide scope of OER (e.g., free Web-based texts or audio-visual resources), along with their convenient accessibility, offers instructors optimal choices for supplementing students' knowledge with content missing from the chosen textbook (Hess, Nann, & Riddle, 2016). As such, a conjugated use of textbooks and OER has emerged as a popular and valuable assemblage, meeting both institutional demands and students' learning needs (Zhang, 2018). Researchers have found a positive effect on students' mobilization of complementary knowledge when they combine traditional textbook usage with OER (Hilton, 2016).

However, research into Web-enhanced teaching has ignored the aspect of emotion, especially in situations involving materials use (i.e., a textbook and OER) (Henritius, Löfström, & Hannula, 2019). This component merits our attention because it affects students' motivation for learning, as revealed in the field of general education (Pekrun, Goetz, Frenzel, Barchfeld, & Perry, 2011). For example, studies have shown that emotions are contextually shaped (e.g., relating to the difficulty of learning content or a change of instructional style) (Mainhard, Oudman, Hornstra, Bosker, & Goetz, 2018) and that positive emotions facilitate students' learning, while negative emotions impede learning (Rienties & Rivers, 2014). In cases where students are exposed to a combination of textbook and OER use, textbook content may be adapted, rearranged, or even deleted, and OER used as a supplement, offering additional or alternative content (Hess, Nann, & Riddle, 2016). This means that students may experience a change of curriculum or instructional practices, which can cause emotional turmoil and, in turn, affect students' learning (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011). Caring for students in the context of Web-enhanced learning, especially in relation to textbook adaption and OER use, is necessary and important (Stockwell et al., 2015). However, this line of research clusters around students' learning outcomes (Hilton, 2016) or focuses on their emotions in a static manner, such as how they feel after completing a course (Parlangeli, Marchigiani, Guidi, & Mesh, 2012); fluctuation of students' emotions within specific contexts has not yet been adequately explored. As stated above, a qualitative exploration of students' emotions in relation to Web-enhanced learning is needed, especially as it concerns the combined use of OER and textbooks and the complexity of the emotions they elicit (Henritius, Löfström, & Hannula, 2019), in order to best meet students' needs. As such, this qualitative study aims to explore the trajectory of student emotions in the context of a blended use of textbooks and OER. It is hoped that the study can help instructors channel some attention to the complexity of students' emotions when offering them the pedagogical affordances of textbook adaption through Web-based resources.

Literature Review: Students' Emotions and Relevant Studies

From among diverse definitions (see Rienties & Rivers, 2014), there is one that describes emotion as "an acute, intense, and typically brief psycho-physiological change that results from a response to a meaningful situation in an individual's environment" (Artino, 2010, p. 1,236). It can be understood as an affective state that emerges out of a person's interaction with sociocultural contexts. In the case of students, such a context may involve the instructor, teaching materials, and instructional methodology (Mainhard et al., 2018). As a response to sociocultural context, emotion is changeable and evolves fluidly, differing among individuals (Parlangeli et al., 2012), although students also experience stabilized emotional states (Henritius, Löfström, & Hannula, 2019). In the process of contextual interaction, students' emotions are particularly mediated by their awareness of the usefulness of and their interest in the learning, whether the process or the outcome, and their perception of themselves (e.g., self-confidence) in handling the learning offered in a teacher-mediated context (Pekrun, 2014; Rienties & Rivers, 2014).

Emotion is an important part of the educational researcher's agenda because students' emotions have been found to be closely related to their learning performance. Generally speaking, positive emotions (e.g., happiness, anticipation) have facilitating effects while negative emotions have hindering effects on students' motivation to learn (Pekrun et al., 2011). However, these distinctions are not always straightforward, as negative emotions can be drivers of learning, for example, when negative emotions, such as anxiety, compel students to work harder (Lang & Lang, 2010). Meanwhile, students' engagement with learning can also feed into their reconstruction of emotional states; for example, positive practices contribute to or enhance students' positive emotions (Artino, 2010; Pekrun, 2014).

Within the field of Web-enhanced learning, much research has demonstrated the complexity of students' emotions and the role of these emotions in practices involving diverse disciplines (Rienties & Rivers, 2014). For learning that combines mandatory textbooks and OER, relevant research has thus far been limited to students' learning processes and outcomes (Henritius, Löfström, & Hannula, 2019; Hilton, 2016; Stockwell et al., 2015). It is possible that researchers' and educators' attention has been focused on the technological affordance and richness of knowledge offered by Web resources (Parlangeli et al., 2012). Among the few studies that may relate to this current study, Parlangeli, Marchigiani, Guidi, and Mesh's (2012) research concerned a blended course on English learning (in the classroom and online learning). The course was offered to adult learners and undergraduate students. Using quantitative analysis of questionnaires, their study showed that students generally had positive emotions toward both face-to-face and online learning. However, such emotions also differed among students depending on contextual factors experienced at an individual level. Students who were used to social interactions engaged more effectively in face-to-face teaching, but even students who had limited knowledge of technology felt more interest in online teaching. In discussing the results, Parlangeli et al. (2012) noted the importance of the instructional design of Web-based courses in relation to meeting students' learning needs and style (their learning of vocabulary from the combined teaching methods; adults' preference for more time online) and attributed good design to the formation of positive emotions. In all, these findings echo the results in the field of general education (e.g., Pekrun et al., 2011) that have illustrated the importance of positive emotions in relation to students' learning and how students' positive emotions are related to instructional design that balances contextual factors and fosters students' emotions.

In terms of methodology, the research on student emotion in the fields of both general education and Web-enhanced learning has tended to use retrospective data, such as that collected from post-semester interviews or surveys (e.g., Parlangeli et al., 2012). However, such approaches have limitations. "These methods [are] often not able to capture the dynamic nature of state-type emotions" (Henritius, Löfström, & Hannula, 2019, p. 97). Researchers have suggested that it would be more optimal to elicit emotional states in the process of learning via qualitative approaches in order to gain a contextual understanding, since students' emotions in relation to learning are contextually grounded and changeable (Artino, 2010; Xu, 2018). Therefore, the current qualitative study seeks to fill these research gaps in both methodology and content by focusing on students' emotions when exposed to the conjugated use of textbooks and OER. To achieve this, the study was guided by the following two questions:

1. What was the students' emotional trajectory in the context that involved OER-based textbook use?

2. How did their emotions interact with the learning and instruction?

Methodology

The research was conducted through a case study. The decision to take this approach was driven by the research purpose, which focuses on the contextual understanding of a phenomenon. A case study approach, with an interpretive paradigm, would meet our needs and be most suitable for the study (Merriam, 1988).

Research Context

The study took place within the context of an argumentative writing course at a Chinese university. The classroom used a mandatory textbook; however, the textbook did not cover all necessary aspects of the course, as it did not provide sufficient content in composition. Indeed, valued writing regards writing as a meaning making process, where writers are expected to use appropriate linguistic resources, including grammar and vocabulary, to construct meanings beyond structural accuracy (Miller, Mitchell, & Pessoa, 2014). The meaning making occurs in valued writing at the levels of: (a) ideational meaning, which is the literal meanings as well the logical relationships that underlie a text; (b) interpersonal meaning, or the stances exuded by the text author or other participants, such as an external voice different from the text author; and, (c) textual meaning, indicating the meaning of coherence in organizing the two aforementioned meanings (Martin & White, 2005). For example, an assignment in the class that involved creating a counter-argument and a follow-up rebuttal required students to navigate opponents' arguments and their own argument at the level of interpersonal meaning (Miller, Mitchell, & Pessoa, 2014). This assignment also required students to use appropriate lexical and grammatical resources to achieve this, such as words indicating concessions (e.g., *admittedly*), and expressions indicating the transition to authorial rebuttal (e.g., the explicit use of transitional words, such as *however*, and of attitudinal words to show authorial stance, such as *the argument is invalid, because* ...).

However, the mandatory textbook provided reading texts, focusing on students' comprehension, without sufficiently mentioning how the three types of meaning intersect with linguistic resources. A sporadic mention of the resources was made (e.g., *modal verbs in relation to interpersonal meaning*). To best help students use the book, the instructor, who was proficient in writing from the perspective of meaning making, included OER to systemically guide students to use the mandatory textbook. These OER were selected from websites and included multimodal resources such as texts and audio-visual materials. In order to ensure their reliability, they were peer reviewed in line with the mechanism of valued writing (Miller, Mitchell, & Pessoa, 2014; see also Zhang, 2018). These materials were sent to students one week prior to in-class instruction. In the classroom, students' knowledge was then mediated to ensure a deeper understanding through teacher-student co-deconstruction. Based on students' needs, additional materials, whose content difficulty was compatible with students' comprehension, were sent to students, along with relevant assignments, such as those that might allow students to apply independent use of knowledge in relation to their writing. Individual tutoring was also provided by the instructor based on need. As a part of a three-year research project on students' academic development, the current study focused on how students responded emotionally to material use.

Participants

The participants were from a sophomore argumentative writing course, in which students relied mainly on textbook learning. Twelve students were involved in the study and were each assigned a number from 1 to 12. They were chosen for the study because they were willing to share their emotions. Among the participants were students who had never experienced the conjugated learning of OER and a textbook. This group could be considered similar to students who do not have sufficient knowledge about writing and who need conjugated material use to enrich their knowledge repertoire. That is, their knowledge about writing was constrained more to language accuracy, rather than focusing on meaning making, which is a requirement of the valued writing approach (Zhang, 2018).

These students were categorized into two groups based on their self-reporting, and an analysis of their pre-semester writings conducted by two native English speakers to determine their level of language and content. Group 1 (students 1–6) was considered average and below; group 2 (students 7–12) was considered above average. In all, these students were representative of students who had to use textbooks, but who needed OER to fortify their learning.

Data Collection and Analysis

Data were collected from students' reflections, interviews, group discussions and field notes over one semester. Students' written reflections in the form of short essays occurred bi-weekly on average, with each student having produced eight pieces for a total of 96 pieces. Each essay is about 600 words. In these 96 pieces of reflection, students' feelings or emotions about their learning were revealed. Interviews were conducted bi-weekly. In them, students were asked about their feelings about their learning, or questions were asked to clarify their reflections. Group discussions took place three times and were used to maximize the retrieval of information about students' emotions in relation to the use of OER. Field notes documented students' learning processes and the development of their writing, in terms of how they constructed three meanings with linguistic resources.

The data were combined and subjected to vigorous comparison (Merriam, 1988; Thorne, 2000). Initial codes were generated in this process. These codes included students' initial excitement, interactive feelings about the constantly changing variables, and malleable feelings over time. These codes were then combined to form themes that would allow the research questions to be answered. In particular, a further grammatical and lexical analysis was conducted on these themes in order to refine understanding of the students' emotions (Pekrun et al., 2012; Martin & White, 2005). For example, in the category of lexical analysis, the response, "it gets much better" suggested that students' emotions changed in a positive way and was thus coded that way, but "feeling a lack of motivation" was labeled and coded as a negative emotion. The analyses were checked by two other researchers for agreement prior to being reported below.

Results

Students initially stated that they had positive emotions (e.g., anticipation and interest) about the combined use of a textbook and OER and the blended knowledge they expected as a result. These emotions diverged later when students were challenged by classroom practices that guided their learning in different directions. Some students maintained their positive emotions, but others transitioned to negative emotions. When teacher mediation occurred and students' knowledge accumulated to a sufficient level, there was another change evident in the data. Students unanimously reported that their emotions had been enhanced and had moved in a positive direction, as the course supported their aim to develop literacy proficiency.

Students' Initial Emotions About OER-Based Textbook Adaption: Being Positive but Different in Willingness to Act Upon Emotions

Students' emotions in the initial phase were exemplified by their support of OER-based textbook adaption in terms of content and instructional styles. They used words such as *anticipation* and *interest* when talking about the course. As student 4 said, "It is not enough to learn from the textbook .... The combined use can provide a richer knowledge supply. We all know this. The more … the better." Echoing student 4, student 10 noted, "We have been exposed to the mere use of the textbook, and we need some innovation and supplementary knowledge." The students' positive emotions were also related to the instructor's role. As student 9 noted, "The use of OER along with the textbook has been decided based on the teacher's evaluation of our learning performance. And I trust the choice." Overall, the inceptive emotions in relation to the OER-based textbook use were positive and emerged out of the students' prior experiences with textbook-based learning and their trust in the instructor.

Despite the dominance of the positive emotions expressed prior to the implementation of the material use, there were nuanced differences between the two groups. Group 2, which was the more proficient group, felt emotionally energized and displayed willingness to increase their knowledge. Student 7, who wanted to learn more about writing composition, wrote: "I am ready to learn this with the teacher … [in order to] become a better writer." Similarly, student 9 noted: "I need more than just language knowledge or general comprehension skills to write better … and I am also ready to learn using these new blended materials." However, students in group 1, although emotionally motivated, seemed more passive and a bit upset about the forthcoming learning. Student 3 stated, "I want to learn with these learning materials …. I do not want to be a bad student. But I do not know whether I can handle this." Positive emotions did not manifest unanimously between the two groups with the same level of strength. This seemed to be related to students' confidence based on their self-evaluation of their writing proficiency. As student 5 noted in the group discussion, "I am not a good writer even at the language level … and feel a lack of confidence in meeting the needs of learning at the both language and content, so I worry I am not ready." Taken together, students' positive emotions in relation to experiencing a new mode of learning and instruction were also entangled with their level of confidence in their existing writing proficiency, yielding individual differences in the strength of their emotions.

Students' Emotion-Driven Practices and Practices Grounded Emotional Reconstruction: Regularity and Irregularity

Students' positive emotions were sustained in the early phase of actual OER-based textbook adaption. These positive emotions were buttressed by their experience with the instructor. For example, as revealed in the field notes, in the mandatory textbook, there was a section on the use of conjunctions. Prior to in-class teaching on conjunctions, the instructor had sent students OER, including both reading texts and audio-visual materials, about using conjunctions to construct meaning and other devices that were missing from the textbook, such as repetition through the use of synonyms. Additionally, the instructor later offered further instruction to supplement these materials. In response to this, students showed emotional endorsement. As student 7 said, "OER made it clear why textual meaning is the case and how textual meaning is important." Even students who had less confidence in learning from OER and the textbook felt invigorated. As student 6 noted, "The learning started with the part I feel comfortable with. Maybe I had been over thinking." In a group discussion, student 2 noted that: "This is the easiest part of all … and we had part of the knowledge … thanks to the instructor's scrupulous design." The student's positive emotion in relation to the learning was connected to the instructor having considerately placed the more accessible content at the beginning of the course.

In addition, when students were applying their new knowledge to their writing, their emotional alignment was further enhanced. For instance, as revealed in the field notes on student 8's second paper, she used synonymous repetition: *"Researchers conducted a study about…"* followed by, *"And in the study…."* As student 8 said, "I did not know about synonymous repetition, [and] now I have more ways to examine my writing in terms of textual meaning." Putting their knowledge into practice made the students feel excited about OER-based textbook use. Student 5 said, "So far so good, [and] it [using OER] is a good beginning."

In all, students unanimously expressed positive sentiments when talking about application of their newfound knowledge.

Nevertheless, students' emotions diverged when they were challenged with new content, especially the interpersonal meaning from OER. Student 8 noted, "The writing knowledge [from OER] is not only different from what we had learned but also there is difference between the paragraph of pro-argument and that of counter-argument." Student 9 said, "I felt I can understand what the instructor said in class but could not put it [the knowledge as delivered by OER] to practice on my own." The efforts needed to overcome the influence of their previous learning and the efforts needed to put newly acquired knowledge into practice affected their emotional states. This was understandable since informational text writing they had learned emphasizes implicit authorial stances, but they had to show their authorial stances in argumentative writing.

Although they were challenged, some students still felt emotionally energized. The students in group 2 felt the need for the use of OER, even though it was the source of some challenging content. Student 10 claimed, "The textbook content is accessible … but I need to get out of my comfort zone … and learn what is needed from OER." As student 8 noted, "It is difficult, but manageable. It only takes time …. I believe in myself. I have been good in my previous class." These students' sustained positivity seemed to be related to their self-confidence and their understanding of their own need to be challenged. Their emotions kept driving them to engage.

Indeed, field notes revealed that while the students from group 2 did not do well on their own with certain challenging content, when assisted by their instructor, they were able to actively analyze and use the new material. For example, in the first draft of their second paper, when the construct of interpersonal meaning had just been introduced and learned, some students failed to make concessions for counter-arguments, deeming them false though they lacked sufficient evidence for such a stance. Other students failed to project their authorial stance through the use of lexical resources, such as using *wrong*, or *illogical* when making rebuttals. In the face of these failed attempts, field notes showed that these students chose to interact with the instructor or seek assistance after class. They were challenged, but still emotionally invigorated in a positive sense; one used the word *manageable* to describe the emotional state. Their confidence in themselves and awareness of their learning needs motivated them to learn and apply the knowledge through their own will.

In comparison, when students from group 1 were challenged, the positive emotion they experienced early on started to wane, especially at the level of the blended knowledge. Student 6 claimed, "Now, I feel my passion is wearing out." Student 4 also noted, "It is difficult to continue with the OER … I guess I am not ready for the content beyond the textbook." As the content from OER increased in complexity, students either kept silent, displayed limited passion, or simply did not make attempts to internalize the knowledge in class, as shown in field notes. Because of their negative emotions, these students, in writing their counter- arguments, simply did not try to incorporate their new knowledge. In student 3's writing, she simply relapsed into her old habits when introducing counter argument: "*In my opinion…*" In the group discussion, student 3 noted, "I was not in a good condition so I did not use the knowledge, and got carried away .... Now I realize this [*in my opinion*] is used in opinionated essays." Echoing student 3, student 4 said, "I am not a fast learner .... I am not good enough ... and feel a bit anxious." These students' general emotional state transitioned to being negative, which affected how they approached the learning and, in some cases, caused the students to give up. The differences in emotions experienced by these students from those in the second group may be a result of the students' perceptions of their own competence.

Interestingly, some of the students who experienced negative emotions found that their emotional state motivated them to learn. These cases seemed to be related, at least in some way, to peer pressure. Student 6 said, "Other students are doing well, and were praised by the instructor, and I guess I need to work hard." Student 3 said, "Since they are so good, I am lagging behind .... I guess I need to power through." This increase in motivation might also relate to a regained awareness of their own learning needs. Student 2 noted in the discussion, "But lacking confidence or weak background is not an excuse. My failure in writing makes me understand the need for the knowledge to be a better writer." Students had negative emotions but were nevertheless motivated to improve their practices.

The students who were driven to succeed because of negative emotions sought assistance from the instructor to clarify their new knowledge and make improvements in their follow-up drafts. As revealed in the field notes, students sought assistance in several ways. First, the students used their first language to ask for clarification in class, to which the instructor responded in the students' first language. Second, they made additional rounds of editing as a result of the teacher's mediation. Third, they visited the instructor for individualized assistance out of class. As student 1 noted, "It is taking me crucifying efforts but I feel I am making it." In all, their negative emotions, when interacting with contextual variables such as peer pressure and the need for an expanded knowledge base, provoked them to work harder.

The Redistribution of Student Emotions: Dissimilar Trajectories but a Similar Ending

The students' emotions affected their interactions with the aforementioned contextual factors related to each group in the classroom. In the end, their emotions became more stable and positive overall. As student 6 noted in the discussion, "My emotions are not fluctuating anymore .... It encourages me to use the knowledge from OER and the textbook with pleasure." Agreeing with student 6, student 9 wrote, "The gains from the practices are rewarding .... It cheers me up and dissipates my diffidence .... My feelings have been the same for a while."

Indeed, along with their stabilized positive emotions, students reported that their writing process had become less problematic and more aligned with expected standards. For example, field notes showed that student 11 had not been used to using logical connectors (e.g., *because,* or *as a result of*) in her writing, and had found it challenging both to learn how to use them and to change her habit of not using them. In her final essay, however, she used them explicitly. In the interview, she noted, "Keeping a positive attitude all the time is important. You see, I have made it .... It makes me feel more confident about being a persistent learner." Students who had once had negative sentiments and temporary misalignment with the blended materials also exemplified their updated practices. For example, field notes documented that student 5 appropriately used reporting verbs (e.g., *suggest* or *show*) to pull out evidence in a pro-argument paragraph. In the counter-argument paragraph, she also used an explicit sign, showing her authorial stance, when making rebuttals. She then noted, "Writing composition becomes a thing to be completed in a different yet happy way .... The success gives me a rewarding feeling." In all, students' emotional states, as a response to experiencing new contexts, moved in a positive direction and galvanized as a passion for their writing practices. The knowledge gained in the learning also fed into their emotional experiences, contributing to a more stable state where all of the students' emotions were positive and they became inspired to use their new knowledge in their practices.

Meanwhile, students' emotions in relation to the combination of a mandatory textbook and OER also stabilized. Student 8 said, "Through the semester's experiences, I firmly feel that we need the textbook, but we also need supplementary materials like OER to engage in improved learning." Even students who had thought about the potential challenges of blended use projected their new understanding. Student 2 noted, "Although it may involve more than the textbook ... and it needs additional efforts ... this way of material use should be promoted." This new alignment seemed to be related to their experiences with knowledge provided from the blended materials. Student 6 noted, "The blended use enhanced my understanding of the value of blended use ... and the blended use is rewarding once we see what we get from the practices." No matter what emotional state they started from, all students came to think positively and remain positive about the concurrent use of a textbook and OER in their course.

Conclusion and Implications

This case study centered on students' emotional trajectories in relation to the simultaneous use of a mandatory textbook and OER. It has yielded the following important findings.

First, the study shows that students emotionally embraced the use of OER as a complement to their textbook because they were already aware of the limitations of the textbook content. In addition, constraints on students' readiness was contextual; for example, individual differences, such as the level of students' self-confidence in relation to their writing proficiency, seemed to weaken their support of OER-based textbook adaption. These contextual variables affected students' emotional states and willingness to embrace the approach (cf. Stockwell et al., 2015; Tomlinson, 2003). In all, this finding echoes other researchers' calls for the combined use of OER and textbooks, and their reminders of the constrained value of stringently learning from a textbook (Hess, Nann, & Riddle, 2016).

The study also reveals that when exposed to the conjugated use of OER and a textbook, students' emotional configuration was complex and that it continued to interact with learning-related factors such as teacher assistance and the difficulties associated with knowledge assimilation. Regarding the emotional trajectory, some students maintained a positive outlook throughout the course, which also motivated their learning. Other students, who had limited confidence, transitioned to a more negative state, in which their emotions caused them frustration before eventually motivating them to carry on learning and, in the end, regaining their positive feelings, with the help of teacher mediation. In this sense, this finding echoes previous studies on the fluctuation of student emotion and the impact of emotion on students' learning practices in general (Pekrun, 2014). At the same time, the finding contributes to research on material use (e.g., Tomlinson, 2003; Zhang, 2018), uniquely showing through a qualitative approach the importance and complexity of students' emotions in relation to the use of blended learning materials (cf. Parlangeli et al., 2012). In addition to affirming the benefits of a generally positive relationship between student emotions and practices, this finding is one of only a few (e.g., Lang & Lang, 2010) that have shown that students' negative feelings can also motivate learning. This may have arisen in this case because students felt ashamed of their learning progress and realized a need to catch up with others. The effects of this type of peer pressure have been seen in other research (Connor, 1994).

All students in this study ended up in a positive emotional state in terms of the combined use of OER and a textbook, and how it influenced the instructional style as well as their knowledge, although they arrived at this state at different paces. In particular, a stabilized positive emotional state was first facilitated at the knowledge level, attributable to the students' positive experiences in practice, and then at the macro level of blended material use, set against a teacher-mediated backdrop. This was understandable, as the knowledge imparted from the combined use was transparent and efficient in helping students' navigate the complexity of writing (Miller, Mitchell, & Pessoa, 2014), and thus may have enhanced the two levels of emotions through a chain reaction. In this sense, despite the complexity or fluctuation of student emotions (Rienties & Rivers, 2014), this study contributes to understanding the potential of fostering students' emotional stability by constantly mediating contextual factors in OER-based textbook use and developing positive experiences with academic navigation (Pekrun, 2014). The finding especially suggests the importance of the teacher's role in the use of blended materials, which is largely ignored in the research into material use (Zhang, 2018). The teacher's role, as revealed in this study, is important. A teacher can both provide manageable yet practical knowledge that helps students gain confidence through practice and re-conceptualize the value of material use, which stabilizes students' positive emotions (Mainhard et al., 2018; Parlangeli et al., 2012; Pekrun, 2014; Vo, Zhu, & Diep, 2017).

Implications of the study are relevant in several areas. One concerns research into the trend toward blending textbooks and OER. Integration of the two in relation to students' academic outcomes or aspects of the technology itself is usually the focus of research (Parlangeli et al., 2012). However, students' emotions need to be closely monitored in the process. This type of learning does not necessarily ensure a positive response from students but sometimes a moderation of students' negative emotions is also productive, as it may facilitate learning (Pekrun, 2014). Overall, teachers need to create a comfortable and friendly context through an instructional design that best suits students' level (Durlak et al., 2011; Stockwell et al., 2015).

A second concern is that complementing the textbook with OER may be a challenging process for a teacher (Durlak et al., 2011). Teachers may experience emotional fatigue when working to better suit students' needs (Xu, 2018). Administrators may combat this problem by giving teachers support and professional knowledge through, for example, organized workshops to help make curriculum changes (Pekrun, 2014). Without these external supports, teachers would empower themselves and rely on themselves to regulate the emotions generated by the challenges presented by the integrated use of OER and mandatory textbooks (Stockwell et al., 2015; Xu, 2018). However, this may create additional stress and discomfort that can be avoided through extra support and training.

Third, while educational technology has been used in teacher education programs, research focused on understanding students' emotions is still lacking in relation to technology-based teaching (Henritius, Löfström, & Hannula, 2019). Teacher education courses should include information related to the regulation of student and teacher emotion. Such initiatives need administrators' attention and follow-up approval. In particular, the triadic relationship among textbooks, OER, and emotion should be highlighted in teacher education programs, given the importance of the three in context, especially where there is compulsory use of textbooks, but where the content has limitations (Rienties & Rivers, 2014; Zhang, 2018).

The limitations of this study also need consideration. First, the research was conducted though a case study approach; therefore, findings regarding students' emotions may not be easily transferable to a different context. Second, the research into students' emotions was limited to a specific discipline; future research can be conducted in other content areas (e.g., science). Third, the study only involved students who were willing to participate. Those unwilling to participate may have experienced different emotional states. Future research could involve more participants and thus provide added understanding of students' emotions in regard to OER use.

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A Qualitative Inquiry of K–12 Teachers' Experience with Open Educational Practices: Perceived Benefits and Barriers of Implementing Open Educational Resources

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Abstract

Teachers in K–12 schools have shown an increasing desire for open educational resources (OER) to ensure all students can learn effectively. OER provide teachers with free access to open-licensed educational resources that they can retain, reuse, revise, remix, and redistribute for personalized instruction. Open educational practices (OEP) have been considered a pathway to reinforce the acceptance and readiness of K–12 teachers to use OER. This research thus showcases a qualitative study that investigates teachers' experiences with OEP. This research explains K-12 teachers' perceived benefits of implementing OER and also discusses their perceived barriers hindering OER usage in K–12 settings. The study also discusses the practical implications of integrating OER in K–12 curriculum.

Keywords: open educational resources, open educational practices, K–12 teachers, barriers, benefits, qualitative inquiry

Introduction

To date, providing differentiated instruction has been trending for K–12 education in the United States, resulting in teachers' increasing need for educational resources beyond traditional textbooks. To fulfill teachers' needs, implementing open educational resources (OER) in K–12 curriculum can be a viable option (Hilton, Larsen, Wiley, & Fischer, 2019). OER allow teachers to retain, reuse, revise, remix, and redistribute a rich collection of open licensed resources (Hilton, 2016; Read, Tang, Dhamija, & Bodily, 2020). Compared with traditional textbooks, open licensed textbooks are more likely to fulfill teachers' needs to provide differentiated instruction (Blomgren, 2018). In addition, research has indicated that classes that implement OER show no harm to course outcome and student motivation when they are compared to classes that use traditional textbooks (Lin & Tang, 2017; Tang & Bao, 2020). Therefore, advocating that K–12 teachers implement OER has become necessary for personalized instruction in the United States.

Understanding how teachers perceive technology is critical to advocate for technological integration in K–12 classrooms (Granić & Marangunić, 2019). However, K–12 teachers' voices seem absent regarding their perception of OER (Tang, Lin, & Qian, in press). Many K–12 teachers in the United States are still not aware of OER despite the widespread #GoOpen network, an initiative launched by the Office of Educational Technology (n.d.) to encourage OER usage in K–12 school districts (Morales & Baker, 2018). Without awareness of OER, teachers might lack sufficient knowledge and skills to integrate OER into their teaching (Hassall & Lewis, 2016) or have a low self-efficacy to do so (Kelly, 2014). To raise teacher's awareness of OER, teacher educators have enabled open educational practices (OEP) to create a contextualized setting for teachers to adapt, produce, and publish OER (Kimmons, 2016; Wiley & Hilton, 2018). OEP is a broad descriptor for "creation, use, and reuse of open educational resources (OER) as well as open pedagogies and open sharing of teaching practices" (Cronin, 2017, p. 16). Kimmons (2016) indicates that OEP has improved teachers' awareness and understanding of OER, but whether this experience can alter teachers' acceptance of and readiness for using OER in K–12 settings remains unknown (Wiley, Webb, Weston, & Tonks, 2017). To fill this gap, researchers need to understand how OEP influences teachers' intentions to accept OER as well as any perceived barriers to implementing OER in K–12.

This research thus investigates the actual OEP experiences of U.S. teachers in implementing OER in K–12 classrooms, with a focus on understanding how teachers perceive adopting OER and the perceived barriers they met in implementing OER. Specifically, this research follows the technology acceptance model (TAM) to interpret teachers' acceptance of OER. To understand the barriers teachers encounter in implementing OER, this research refers to prior works by Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur (2012) and Hew and Brush (2007). The findings of this research benefit professionals investing in teacher education and open education, especially the effort to promote differentiated instruction in K–12 settings.

Conceptual Framework

Technology Acceptance Model

Numerous models address factors influencing technology acceptance in K–12 settings. The most common one is TAM, proposed by Davis (1989). The original version of TAM considered *perceived ease of use* (PE) and *perceived usefulness* (PU) as two fundamental determinants of individual intentions to accept technology, with *attitudes* (AT) as a mediating variable (Davis, 1989; Granić & Marangunić, 2019).

PE describes the perceived extent of effort needed to use technology (Davis, Bagozzi, & Warshaw, 1989). Seminal works on TAM identified PE as the most fundamental determinant, affecting PU and AT regarding technology (Davis, 1989; Granić & Marangunić, 2019). For K–12 teachers, the primary concern involved in accepting OER is whether they are easy to use (Kelly, 2014). This concern impacted teachers' PU of OER and then determined their intention to use OER (Kelly, 2014). Therefore, reinforcing the ease of using OER is critical to their further implementation in K–12 settings (Kelly, 2014; Tang et al., in press).

PU describes the extent to which individuals perceive that the use of technology can improve their job performance (Davis et al., 1989). For K–12 educators, their intention of accepting technology is highly dependent on whether it can benefit their teaching (Granić & Marangunić, 2019), including implementing OER (Tang et al., in press).

AT represents individuals' appraisal of behaviors/objects in a dichotomy of positive and negative (Davis, 1989). Attitude is an important predictor of whether teachers intend to accept technology (Granić & Marangunić, 2019), especially as a variable mediating the influence of PE and PU on teacher intention to implement OER in K–12 classrooms (Tang et al., in press).

Barriers to Technology Integration

Hew and Brush (2007) found six general barriers that K–12 schools typically face when integrating technology into the curriculum for instructional purposes. These include (a) lack of resources, (b) inadequate knowledge and skills, (c) institutional barriers, (d) attitudes and beliefs, (e) assessment, and (f) subject culture. In particular, these six categories of barriers were further grouped into two overarching types: first-order and second-order barriers. Lack of resources, institutional barriers, assessment, and subject culture are the first-order barriers; and teachers' insufficient knowledge and skills as well as their attitudes and beliefs towards technology are categorized as the second-order barriers (Ertmer et al., 2012; Hew & Brush, 2007).

The first-order barriers mainly address external factors out of teachers' control. For example, the lack of resources may include one or more of the following: (a) technology, (b) access to available technology, (c) time, and (d) technical support. The institutional barriers may include (a) leadership, (b) school time-tabling structure, and (c) school planning. In addition, assessment mainly addresses a perceived tension between using technology and the need to conform to the external requirements of traditional examinations (Hew & Brush, 2007). In contrast, the second-order barriers mainly concern internal factors within teachers' control. Specifically, they concern teachers' knowledge, skills, attitudes, and beliefs regarding technology use in the classrooms (Ertmer et al., 2012; Hew & Brush, 2007).

Methodology

Research Context and Participants

This study was conducted through a 16-week, graduate level online course offered by a public university in the southeastern United States. This course asked students to mentor a client on assessing technology-enhanced learning. Students chose clients, but students who were certified teachers had to coach another teacher certified by the same state. The course had six major modules, including (a) Orientation, (b) Measurement, Assessment & Evaluation, (c) Assessment Planning, (d) Tech-based Assessment, (e) Assessment Implementation, and (f) Reflection.

This course provided summative and formative assessments. The summative assessment was the overarching project, through the course duration, wherein students individually developed an OER-based assessment for the client's technology-enhanced instruction. Students submitted their implementation reports at the end of Module 5. Formative assessments included three major assignments, each of which was geared towards the final summative project. The first major assignment was completed in Module 1. Students reviewed existing assessment instruments used in K–12 settings to familiarize themselves with effective assessment. The second major assignment was an assessment plan in Module 2. In this module, students received instructions on OER and how to search through OER repositories. Then students submitted their plans about how to create/adapt OER-based assessments to efficiently meet clients' needs. The last assignment was reflection notes in Module 6, wherein students responded to questions specifically addressing their experience with OER. Furthermore, students completed several discussion forum activities, with one about students' perceptions of OER and plans to use OER.

A total of 78 students registered this course, 68 of whom were certified teachers and voluntarily participated in this research. Of the 68 participants, 84% (N = 57) were female teachers, 43% (N = 29) taught at elementary school teachers, 28% (N = 19) were middle school teachers, and 29% (N = 20) were high school teachers. Of all the participants, 91% (N = 62) of them had taught in K–12 settings for more than five years. Only five participants had previously used OER, but their usage was limited to reusing resources on Khan Academy. The others never used or heard about OER.

Open Educational Practices

The open educational practice provided in this course was to give the participants an experience of creating renewable assignments to compare the difference in their acceptance of OER before and after intervention. This intervention was completed in four steps throughout the course. First, the participants reviewed instructions on OER, Creative Commons license, and how to find OER in repositories. Second, the participants adapted OER to develop their own assessments for final projects, following five "R" principles - retain, reuse, revise, remix, and redistribute. Third, the participants implemented the assessments in their client's classrooms and then revised them based on the instructor's and their clients' feedback. Last, they published their OER-based assessments in OER repositories.

Procedures

Before collecting data, I obtained Institutional Review Board (IRB) approval.

Data collection. I conducted a phenomenological inquiry to corroborate and extend the quantitative understanding (Creswell, 2007). The phenomenological inquiry (Moustakas, 1994) sought to understand the participants' experience with adopting OER in K–12 curriculum while creating renewable assignments. To understand the participants' experience and perceptions, I collected qualitative data from a triangulated source (Creswell, 2007), including the 68 participants' open-ended questions and their reflection notes.

Open-ended question responses were collected at the end of this course. Eight open-ended questions consisted of five questions about their positive experience with five "R" principles (e.g., Do you have great experience with retaining/reusing/revising/remixing/redistributing OER?), one question asking about challenges with OER (e.g., Do you have any concerns about OER?), and two questions looking into their desired support and suggestions for OER adoptions (e.g., "What support do you think K–12 educators will need to implement OER in their classroom?" and "Do you have any suggestions for the future use of OER in K–12 education?").

Self-reflection was a required assignment in Module 6 to reflect on their learning experience. A list of questions was provided to structure participants' responses. For example, students were asked to review their experience with OER, reflect any pros and cons regarding using OER in K–12 settings, and plan how to efficiently integrate OER in teaching.

Data analysis. I applied a deductive-inductive coding approach to make sense of the qualitative data (Fereday & Muir-Cochrane, 2006). Specifically, top-down deductive coding identified patterns geared towards two research questions. These questions became "sensitizing concepts"—the starting point to build up the qualitative analysis and determine the directions of the analysis—of this qualitative inquiry (Bowen, 2006). Thematic analysis was chosen as the inductive approach to elicit the themes from the patterns (Braun & Clarke, 2006). I recruited a second coder with expertise in OER and teacher education. Specifically, two researchers (myself and the second coder) independently reviewed the qualitative dataset and added initial codes (e.g., "access," "usefulness," "colleagues") to each sentence. Then we met to review sentences with inconsistent codes to reach an agreement on codes. The next step was inductive coding. We worked together to category the patterns and incorporate them into themes (Braun & Clarke, 2006; Fereday & Muir-Cochrane, 2006). Constant comparison strategy was applied to ensure the emerged themes "at minimum describe[d] and organizes the possible observations and at maximum interpret[ed] aspects of the phenomenon" (Boyatzis, 1998, p. 161). We identified a total of seven themes (see Table 1 in Appendix).

Validity and reliability. Three measures reinforced the validity and reliability of qualitative findings. First, we triangulated the qualitative data source to avoid a validity threat of self-report bias (Creswell, 2007). Second, constant comparison ensured the reported findings were grounded in the data itself (Patton, 2002). Third, I conducted member checks on the validity of findings directly after the initial data analysis (Merriam, 1998). A summary of preliminary findings was sent to five members and all of them confirmed the findings reflected their experience with OEP.

Results

Teachers' Perceptions of Implementing OER after OEP

Three themes emerged in the findings regarding teachers' perceptions of implementing OER after participating in OEP: (a) participating in OEP empowered teachers' perceived ease of using OER; (b) participating in OEP afforded teachers' perceived usefulness of OER; (c) participating in OEP developed teachers' positive attitudes about implementing OER.

Participating in OEP empowered teachers' perceived ease of using OER. Most participants (*N* = 40) wrote about the ease of using OERs in teaching in their reflection notes and open-ended question responses. Specifically, I identified three categories: "easily accessible," "no costs," and "no copyright restrictions."

First, many participants insisted the number of available OER and OER repositories made them easily accessible for teachers. Many participants found it easy to find desired resources in OER repositories, such as OER Commons (P15, P22, P42). In particular, participants saw OER repositories as a centralized platform for resources from multiple sources, which allowed participants to avoid moving between platforms back and forth to search for resources (P11).

> Through OERs, teachers have so much more information accessible to use in a myriad of ways. (P22, open-ended responses)

> I find it extremely easy to find an OER that is useful in my classroom and reusing it. It saves me a lot of time. There are so many great resources out there already made. (P15, open-ended responses)

> I chose OER Commons because it was user friendly and searching for OERs seemed to be very easy and accessible. (P11, self-reflection)

> They [OER] are easy to reuse, revise, retain, remix, and redistribute. It is accessible to anyone around the world with Internet. (P42, self-reflection)

Second, participants perceived the benefit of the free access to OER, which allowed them to easily use OER. Participants easily found free educational resources in OER repositories, which otherwise might be expensive in copyright-restricted sources (P10). Especially for teachers in school districts with limited budgets, OER were easy to use without the financial burden of purchasing them (P35).

> OERs provide great resources for little to no cost to the teacher or school. They can provide the teacher with lessons that include multimedia materials and are easily accessible. (P10, open-ended responses)

> Since districts have such limited budgets for materials these days, OERs need to be introduced and modeled as something that can help them provide as much as possible to their students without a hefty price tag. (P35, self-reflection)

Third, participants preferred the ease of using OER without copyright restrictions. Teachers easily accessed, used, and shared desired resources without concerns about copyrights (P5, P49). The open licenses provided teachers with the flexibility of using OER, which also improved teachers' perceived ease of using OER (P25).

> I have no concerns regarding the use of OERs. I think it is the best kept secret because we are not breaking copyright rules. (P5 in open-ended responses)

> Very easy to do. Made me feel good about using the work knowing 100% what the copyright was on the resource. (P49, open-ended responses)

> There is an opportunity to revise OERs in order to align the learning and assessment with the needs of the audience. The licensing of OERs allows for such flexibility. (P25, self-reflection)

Participating in OEP afforded teachers' perceived usefulness of OER. Most participants (*N* = 46) discussed their perceptions about how OER improved teaching in K–12 settings. Specifically, I marked four categories: "useful resources for course design," "personalized instruction," "saving teachers' time," and "reciprocal community of educators."

First, participants indicated that OER provided useful resources for course design. For example, teachers were inspired by OER that were relevant to course topics in planning their instruction accordingly (P17). Some teachers referred to OER as a base for their course preparation, which might be especially useful for new teachers (P33). OER were also supplementary resources for teachers, especially when textbooks were not sufficient for course goals (P27).

> OERs can also provide teachers with ideas on different ways of teaching various topics. (P17, open-ended responses)

> OERs can help increase student engagement by supplementing traditional teaching mediums, such as books, with digital resources. (P27, open-ended responses)

> I wish I had known about OERs when I was an undergraduate right before I began student teaching. I remember feeling so intimidated and had never had any real practice or application with lessons; I had to come up with everything from scratch. (P33, self-reflection)

Second, participants found OER useful for personalized instruction with the afforded flexibility of customizing open-licensed resources. Teachers felt great about being given permissions to revise and remix OER at their discretion (P3, P34). With OER, teachers also had flexible options of open-licensed multimedia products tailored to students' individualized needs to learn effectively (P26, P66).

> The great thing about OERs is that you can change the resources to fit your specific needs. (P3, open-ended responses)

> The advantages of OERs is that you have many ways to differentiate your lessons, with the huge variety of videos, animations, simulations, and text. (P26, open-ended responses)

> The various OER resources have given me ideas to help students of various learning styles. It has given me the resources to meet the needs of all my students (on level, advanced, gifted, and below level). (P34, self-reflection)

> One area that I needed to revise with regard to using this assessment before implementing in the future is differentiation. I would like to efficiently integrate OERs that challenge the more intellectually advanced students and promote reflection. This added component would offer more opportunities for enrichment. (P66, reflection notes)

Third, participants agreed that implementing OER saved time in developing instruction and assessment materials. Teachers adapted high-quality OER to meet their classrooms needs rather than creating a new instruction or assessment from scratch (P6, P33).

> One pro to OERs is the fact that so many resources are available for use and that can cut lesson prep time drastically. (P33, open-ended responses)

> I think the biggest pro to integrating OERs in my assessment project was that there were many resources available that would have taken me a very long time to create. This saved me time while still providing quality materials to the students. (P6, self-reflection)

Fourth, participants perceived that using OER allowed them to collaborate with colleagues worldwide in creating and sharing useful resources. Teachers using OER formed an online reciprocal professional community of colleagues with similar interests and needs (P53, P62). Teachers benefited from collaborating with colleagues who "have already developed successful strategies" to address similar challenges (P53).

By using OERs, you are collaborating with teachers from all over the world. By sharing, creating, and using OERs, I am collaborating with thousands of educators. (P62, open-ended responses)

OERs can serve as a tremendous tool for teachers. They offer a network of other educators that have experienced similar situations and have already developed successful strategies for addressing some of the common challenges in special education. (P53, self-reflection)

Participating in OEP developed teachers' positive attitudes about implementing OER. Many participants (N = 42) expressed positive attitudes about implementing OER. Specifically, three categories were identified: "positive experience," "continued implementation," and "agents of change."

More than half of the participants (N = 39) had positive experience with implementing OER. Teachers enjoyed searching, using, and sharing OER and developed a positive perception of OER's ease of use and usefulness in K–12 teaching (P33, P37). Producing and sharing OER were perceived as valuable for teachers given the benefits of OER for teaching (P28).

> Overall, I find OERs to be a great resource both new and veteran teachers alike. (P33, open-ended responses)

> I enjoyed exploring the online OER website. I had not seen a resource like this and it was really great to see that this is available for teacher use. (P37, open-ended responses)

> I am now aware of the valuable resource OERs provide for my instruction My work from this course will be valuable as I share my knowledge of assessment and OERs. (P28, self-reflection)

Many participants indicated their willingness to continue with implementing OER. Teachers planned to use OER and OER repositories frequently in their future teaching (P23, P59). The experience with implementing OER helped improve teachers' expertise in using OER (P59). Furthermore, teachers planned to invest in probing efficient ways to use OER (P6, P59).

> I plan to further research OERs for my specific subject area and use them when I can in my teaching. (P6, open-ended responses)

> In the future, I plan to use the OER commons to find resources and implement them into my own classroom. (P59, open-ended responses)

> I believe this is largely a reflection of the course that I, along with my client, teaches. In the future, it is my goal to strive to adopt more OER assessments into my teaching practices. (P23, self-reflection)

> For future purposes, I plan on implementing OERs more frequently. I feel that in using them more often, I will become more comfortable and willing to use OERs in my classroom. I feel that in doing this, it would have helped me effectively integrate OERs into my work. (P59, self-reflection)

Participants (N = 14) described their intention of being an agent of change for OER integration in K–12 settings. Participants were willing to contribute to OER repositories by sharing their self-created works (P33). They also planned to help colleagues or any other teachers increase the awareness of OER and provide support and mentoring for colleagues to overcome the barriers (P33, P46). In all, they hoped to become the "transformative force" to advocate for OER usage in the school district or a broader community.

> I believe that if more teachers knew about the need for materials, they would be willing to contribute. In the future, I plan to post any material that I have personally created to OER. (P33 in open-ended responses)

> I think they will need a lot of support, and I intend to learn more about them and offer support to the teachers in my school and district on them. (P46 in open-ended questions)

> Considering the benefits of using OER in the classroom, I hope to be a transformative force at my school to encourage other teachers to use OER to deliver information and assess student learning. (P31 in self-reflection)

> I am just beginning to use OERs in my professional work . . . I have already started sharing what I have learned with my colleagues and will continue to use them in my instruction. (P55 in self-reflection)

Teachers' Perceived Barriers to Implementing OER in K–12 Settings?

Two themes emerged regarding teachers' perceived barriers to OER use in K–12 settings: first-order barriers and second-order barriers.

First-order barriers. Over half of the participants (*N* = 38) discussed the perceived first-order barriers of integrating OER in K–12 education by reflecting on their coaching experience. Four categories emerged: "a lack of quality assurance," "limited time," "unsupportive climate," and "inadequate support."

First, most participants (*N* = 42) were concerned about a lack of high-quality OER fitting their needs. Particularly, participants noted that few OER aligned with the course standards existed for them to reuse in instruction and assessment (P4, P64). Participants teaching certain subjects (e.g., special education) and early grades (e.g., K1–5) struggled using OER given limited availability of age- and grade- appropriate resources (P24, P53). Additionally, participants discussed the concerns about validity and sustainability since some OER were not validated by education authorities or appropriately maintained (P17). The unreliable quality of some OER created a barrier that impeded teachers' further implementation of OER in K–12 settings.

> When exploring OERs, I would find resources that may be specific to a standard that I teach, but it does not fully cover the required standard that students are supposed to know within my classroom. (P4, open-ended responses)
>
> Most resources I found were too cognitively high for my students, or not age-appropriate for my students. (P24, open-ended responses)
>
> Disadvantages associated with OER include lack of quality control and sustainability issues. Since OER are free, its creators have little to no incentive to ensure the content they share remains relevant, accurate, and accessible. (P17, self-reflection)
>
> I also had difficulty finding appropriate lessons and assessments for high school special education. This is a very common problem with high school special education, as most lessons that are cognitively appropriate, basic reading comprehension for example, is usually at an age-inappropriate level of elementary school. (P53, self-reflection)
>
> There is definitely a lack of good OERs relating to assessment. Finding more rigorous assessment or assessment that relates to performance tasks was much more difficult, especially in the areas of language arts (P64, self-reflection)

Another barrier for participants was that they did not have sufficient time to sift through appropriate OER. Teachers were bombarded with excessive resources and were concerned about whether they had adequate time to prudently look into the resources (P14, P51). Allowing teachers sufficient time to search for OER that best fit their needs became a prerequisite for expediting OER adoption in K–12 settings (P37).

> Teachers don't have time and need things to be immediately relevant. PD workshops on implementing them into actual lessons [were needed]. (P51, open-ended responses).

> They will need to know they exist. Teachers are bombarded with resources. Education is resource rich, but time poor. It is imperative that teachers know how much this could help them and benefit their instruction. (P14, self-reflection)

> I personally believe that we could improve on our usage of OERs. Having more time to explore the world of OERs and finding ones that best suit our needs is the first step. (P37, self-reflection)

Furthermore, participants were challenged by the lack of a positive climate for implementing OER in K–12 schools. Participants (*N* = 36) were concerned about an unsupportive institutional culture of OER usage, as some school districts encouraged teachers to use standardized resources. Other participants (*N* = 16) complained that some OER were disabled by the local school district.

> Before OER can make a big impact in K–12 education, teachers and administrators need to have a better understanding about OER. They need to have a solid understanding about how OER can be used to maximize learning for students. (P42, open-ended questions)

> The major con of the use of OER was that my school district is discouraging the use of all but "vetted" resources. We are being asked to focus on using materials that have been purchased by the school district, as well as resources supplied by the Department of Education. I find this frustrating and a bit limiting, but it is the current landscape in which I am teaching. (P56, self-reflection)

> The cons would be that sometimes it is hard to access some of the sites. Many schools, including my own, have very strict firewalls. They block inappropriate sites, but sometimes appropriate ones are blocked as well out of an abundance of caution. (Participant 29, self-reflection)

Moreover, participants noted that a lack of relevant training thwarted OER usage in K–12 classrooms. Some school districts offered professional development opportunities for integrating OER, but further improvements were needed to increase teachers' awareness of OER and ability to use OER. Particularly for those teachers without exceptional background in technology, they desired effective training to "feel more comfortable to use [OER] with students in the classroom."

> The cons are that they should be promoted more in teacher trainings. Schools and counties could save so much money if they learned how to better use these free educational resources in the classrooms (P45, open-ended responses).

> Prior to this course, my experience with OERs were limited. While attending several professional developments provided by my district, the topic of OERs had been mentioned, but I haven't expanded my understanding of these resources until now. (P18, self-reflection)

> There are a lot of "tech savvy" teachers now in the classroom, but there are a lot of teachers that have a much more difficult time buying in to this new concept. Teachers should be trained in these so they feel more comfortable to use with students in the classroom. (P61, self-reflection)

Second-order barriers. A majority of participants (*N* = 46) described the perceived internal barriers (second-order) impeded implementing OER in K–12 settings. Three categories emerged from the analysis including a lack of (a) awareness of OER, (b) proficiency in finding OER, and (c) expertise in integrating OER in teaching.

First, participants reported that they were not aware of OER at all before this course, much less aware of the benefits. Some participants had used OER but did not realize it until attending this course (P51). Participants' low awareness of OER also became a barrier to efficient implementation of it, because they struggled to understand why they needed OER.

> At the beginning of the course, I had never heard of the term open educational resource. (P33, open-ended responses)

> Unfortunately, I did not do an excellent job of integrating OERs into my assessment. In fact, what I thought was an OER ended up not being an OER at all. (P34, open-ended responses)

> Because I did not feel that I fully understood the intended purpose of OERs at the beginning of the course, it hindered my understanding of implementing an OER into my assessment plan. (P43, self-reflection)

> When I first began to research OERs, I was surprised that I had used them in the past but wasn't aware of the terminology. They are a resource. As a teacher, we are bombarded with resources. (P51, self-reflection)

Second, participants (*N* = 39) outlined a lack of proficiency in efficiently finding OER tailored to their needs. Participants had difficulty determining whether a resource was open-licensed. Participants also described struggling to narrow down the search to locate appropriate resources from an overwhelming number of resource options. Teachers' insufficient proficiency in sifting through appropriate OER hampered their intention to adopt OER.

> Another issue with OERs is figuring out the permissions for a specific resource: what am I allowed to do with a resource once I've found it, and how do I know it's an OER? (P9, open-ended responses)

> I am concerned at narrowing down my search. There seems to be so much available that I get overwhelmed. It is easy to get lost. (P12, open-ended responses)

> The only concern I have with the use of OER is that there is so much out there that it can be overwhelming. When I search 7th grade equations on one OER site, so many resources came up. I tried to refine my search to find exactly what I needed and there were still a lot of resources to look through. (P26, self-reflection)

Third, many participants (*N* = 31) reported insufficient expertise in adapting and integrating OER in their classroom. Participants had difficulty integrating OER into assessment because of their ignorance of OER (P57). Other participants struggled to efficiently integrate OER because they hoped to find resources that perfectly "match[ed] the idea in [their] head" without any revision or remixing (P27). Moreover, participants found it challenging to develop skills adapting and integrating OER because they needed to be well-versed in content knowledge and instructional design skills.

> Integrating the OERs into my assessment project was one of the most challenging aspects of the course. One reason for this was that I did not have prior experience using OERs before this course. (P57, open-ended responses)

> I think my biggest downfall in efficiently integrating OER's into my work was having a lesson plan in mind and trying to find an OER that matched the idea in my head. However, I found that it's much more efficient to look for ideas within an existing OER and create extensions off them rather than try to make the OER fit my mental image. (P27, self-reflection)

> The integration of an OER into the assessment plan was not as seamless as anticipated. It became necessary to develop a deeper understanding of OERs in order to realize that there needed to be a clearer integration of OERs into the assessment plan with the client. The incorporation of OERs requires a review and modification of the instructional design process. The assessment plan that was initially developed would need to be revamped in order to include an OER for assessment. (P38, self-reflection)

Discussion

This qualitative inquiry tapped into K–12 teachers' perspective, revealing their view of implementing OER. In particular, the teachers in this study underwent OEP wherein they could search, adapt, implement, and redistribute OER-based assessment. OEP are a viable option for increasing teachers' awareness of OER (Kimmons, 2016), but evidence is still needed to understand how OER can influence teachers' acceptance of and readiness to use OER (Wiley et al., 2017). Understanding these teachers' perception of OER as well as the barriers to implementing OER after participating in OEP is thus valuable: it fills the gap in the literature and also presents implications on further usage of OER in K–12 schools.

The interpretation of the findings on the teachers' perception of implementing OER after the experience with OEP was grounded in the technology acceptance model (Davis, 1989). Specifically, OEP allowed the teachers to develop positive attitudes towards OER usage given their perceived ease and usefulness of using OER in K–12 classrooms, corroborating the findings of Tang et al. (in press). First, teachers in this research found it easy to access, use, and share OER without being restrained by copyright and cost concerns (Kelly, 2014). Second, teachers also found OER useful to improve their teaching efficiency and performance (Kimmons, 2015; 2016). OER provided a variety of resources as a base that teachers can build on to efficiently design courses and personalize instructions. Rather than creating resources from scratch, teachers can use OER with rich resources to save time in course preparation. Furthermore, the teachers attending the OEP experience were involved in an online community of educators through which they benefited from ideas shared by those with successful strategies resolving similar issues. This finding echoes Wiley and Hilton's (2018) conclusion that OEP extends the benefits of OER beyond one classroom or school district and forms a large community of open sharing, which in turn further reinforces OER adoption in K–12 settings. Grounded in TAM (Davis, 1989), the findings of my study provided an alternative perspective of understanding OER acceptance in K–12 schools. Although this inquiry cannot quantify the effectiveness of OEP in increasing OER acceptance, it directs a new line of inquiry to systematically understand OER acceptance in K–12 settings (Tang et al., in press).

This inquiry of teachers' perceived barriers in OER implementation is closely aligned with seminal works by Ertmer et al. (2012) and Hew and Brush (2007). The findings of this research reviewed several first-order barriers (e.g., a lack of high-quality resources, time, supportive climate, and support) and second-order barriers (e.g., a lack of awareness of, proficiency in finding, and expertise in integrating ORE) that impeded the integration of OER in K–12 settings. It is worth noting some contradictions between teachers' perceived benefits and barriers. For example, a variety of resources made OER easy to use and access and were also useful for course preparation, but teachers who are not proficient in sifting through appropriate OER might view the number of options for course resources to be overwhelming. Another example is teachers' varying appraisal of open licenses of OER. Some teachers found it easy to adapt and share OER with the open licenses, but teachers without efficient awareness of OER or expertise in integrating OER might struggle to determine whether an online resource was open-licensed, which might hamper their continued usage of OER. Actually, these contradictions reinforce the need to provide tailored training and support for teachers to efficiently understand, use, and advocate for OER. For example, district-wide teacher training and a positive climate are needed to further promote using OER in K–12 schools (Kimmons, 2016).

This research offers practical implications for educators, administrators, and practitioners to improve teachers' usage of OER in K–12 setting. First, they should reinforce K–12 teachers' awareness of OER, especially the ease of and usefulness of using OER in teaching. Second, they should provide professional development opportunities for K–12 teachers to learn how to efficiently search and adapt OER for their own classroom. One viable option is to enable OEP in professional development programs for teachers to provide a contextualized experience with OER (Kimmons, 2016; Wiley et al., 2017). Third, they should improve the quality assurance of OER. The fact that limited high-quality OER are available for K–12 teachers thwarts the potential of OER in K–12 settings (Kimmons, 2016). Strengthening quality assurance to maintain the quality, credibility, and sustainability of OER is necessary to promote OER implementation in this setting.

This research also has some limitations. First, the research relied solely on data collected from participants in one class at the same institution in the United States. The cultural difference between different countries might also influence the interpretation of findings (Tang & Bao, 2020). Future research might consider validating the findings of this research in multiple research sites with a large sample of participants from various cultures. Second, though I attempted to increase the validity and credibility of the findings, the limitation of qualitative research needs to be addressed (Creswell, 2007). Most of the findings were rooted in the my interpretations of the qualitative data which brought in subjectivity and inaccuracy. For future research, multiple sources of data, such as surveys, and interviews, would provide supplemental insights into teachers' perceptions of OER.

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Appendix

Table 1

Summary of the Qualitative Data Analysis Results

Question(s)	Theme(s)	Categories	Sample code(s)
What are teachers' perceptions of implementing OER after participating in OEP?	Participating in OEP empowered teachers' perceived ease of using OER.	• easily accessible • no costs • no copyright restrictions	access, search, save money, easy, copyright
	Participating in OEP afforded teachers' perceived usefulness of OER.	• useful resources for course design • personalized instruction • saving teachers' time • reciprocal community of educators	base, reference, 5R, time-saver, network, collaboration, sharing, worldwide
	Participating in OEP developed teachers' positive attitudes about implementing OER.	• positive experience • continued implementation • "agents of change"	like, enjoy, valuable, use, sharing, advocates, support
What are teachers' perceived barriers towards implementing OER in K–12 settings?	First-order barriers of implementing OER	• a lack of quality assurance • limited time • unsupportive climate • inadequate support	resources, colleges, school district, unaligned, missing, outdated, validated
	Second-order barriers of implementing OER	• a lack of awareness of OER • a lack of proficiency in finding OER • a lack of expertise in integrating OER	awareness, why to use, finding, searching, matched, integrating

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Profiles of Online Students and the Impact of Their University Experience

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Abstract

In recent decades, there has been a steady growth in the population who enter higher education in both brick-and-mortar and, in particular, online universities. This has led to an increase in heterogeneous student profiles in a relatively short period of time. The purpose of this paper was to explore the student profiles at a university that gives all its courses online, namely the Universitat Oberta de Catalunya (UOC), and analyse students' perceptions of their university experience. With this goal in mind, we constructed a student typology based on their social conditions and backgrounds using multiple correspondence analysis. Subsequently, an analysis of variance (Kruskall-Wallis test) was run to detect whether there were any differences in students' perceptions of the impact of their university experience (N = 1850). Although the prevailing profile of students in the online university continues to reflect students with responsibilities outside of the university (e.g., work and/or family), new profiles have been observed, made up of younger students without any work or family responsibilities. In turn, younger students' distinct perceptions of their university experience has been observed, depending on student profiles, with older students having more intrinsic perceptions, focused on learning and the acquisition of theoretical knowledge.

Keywords: online education, online university students, student profiles, distance higher education, impact, social conditions

Introduction

In the last few decades, a large number of studies have analysed university students' admission, participation, and graduation, taking into account their social conditions. The conclusions showed an increase in student participation in university as a result of the expansion of education, which in turn has increased the heterogeneity of university student profiles (Ariño Villaroya, Hernández Pedreño, Llopis Goig, Tejerina Montañana, & Navarro Susaeta, 2008; Soler Julve, 2013; Troiano & Torrents, 2018). Some of the more salient features of this research pointed to a greater frequency in terms of age (older students), social background, educational access routes, previous educational experience, place of residence, students with external responsibilities (work or family), ethnic minorities, and so on. This trend may have been influenced by a series of changes and innovations that have introduced, creating new rules of play in higher education. The reforms enacted with entry into the European Higher Education Area (EHEA), the abolition of admission quotas for students who have completed higher vocational education and training programmes, and increased university fees have had an impact on opportunities for young people and their strategies for adapting to the new university context (Troiano, Torrents, Sánchez-Gelabert, & Daza, 2017).

With the implementation of the EHEA (also known as the Bologna Process), changes such as an obligation to be physically present at the university or the use of continuous assessment have had detrimental effects on those students who need to combine their studying with other activities, whether work- or family-related (Elias, Masjuan, & Sánchez-Gelabert, 2012). As a result of these changes, non-traditional students may find themselves forced to leave university or look for more flexible educational options or systems such as an online university. Although university enrolments have shown a clear upwards trend, most of this growth has been in institutions that offer online courses rather than in those that only offer face-to-face teaching (Ashby, Sadera, & McNary, 2011). Even so, some authors have stressed that admission and participation processes, as well as student profiles, are not the same in brick-and-mortar and online universities; they have concluded it is unlikely that online education is cannibalizing on-site students in significant numbers (Cavanaugh, 2005).

The dynamic pace of change is particularly apparent in distance education, to the point of redefining the profile of distance university students who have traditionally had to combine their studies with other responsibilities outside of university. In line with this outlook, some studies performed in the 1990s in countries where distance education was more consolidated, such as Canada, have shown that major changes in the type of students choosing this option have taken place in a relatively short period of time (11 years; Wallace, 1996). Specifically, the results showed an increase in participation by younger students who study full-time at the university and live in urban environments. Some of the explanations proposed by Wallace (1996) attribute the increased economic pressure among students with more responsibilities to the recession and university fee hikes.

Given this background, recent changes in the Spanish context may have triggered an increase or shift of certain student profiles towards the so-called distance universities, which in turn has led to a growing internal diversity of students enrolled in these universities. The importance of these changes lies in the fact that they may generate a new conception of higher education, and a new way of understanding the university experience among the different profiles of students who choose to study at distance universities.

This research pursued a two-fold purpose. First, it sought to explore the profile of distance university students based on their social conditions, factoring in sociodemographic aspects, external responsibilities, prior education, and social background. Our goal was to identify the sociodemographic composition and internal heterogeneity of distance university student profiles. Second, it proposed to explore the impact of the university experience on different aspects of students' personal and professional lives, and to analyse whether the impact varied among different student typologies.

The Traditional Profile of Distance University Students

By definition, one of the main features of a distance university is the flexibility it offers, in a broad sense (e.g., schedule, geographical location, hours of study), and the fact that it facilitates participation by a specific student profile that has difficulty attending a brick-and-mortar university. In this respect, some studies highlighted the role of the distance university in the case of students who live in rural areas, geographically remote places, or who must travel long distances to get to a brick-and-mortar university (Bocchi, Eastman, & Swift, 2004; Cavanaugh, 2005; Dutton & Dutton, 2002). The existence of distance universities may also increase participation by students who have some type of disability, by avoiding possible interaction problems that may arise at brick-and-mortar universities (Moisey, 2004; Richardson, 2009).

However, over all these factors, the possibility of combining studying with other responsibilities outside of the university, such as work or family, has been the central factor in this notion of flexibility offered by the distance university (Bocchi et al., 2004; Dutton et al., 2002; Sikora, 2002). In this respect, empirical findings have shown that the likelihood of participating in distance universities is higher among students who do not depend financially on their family (Sikora, 2002), and students who combine studying with full-time (Cavanaugh & Jacquemin, 2015; Hillstock & Havice, 2014) or part-time employment (Wallace, 1996). Students who combine studying with work has had a clear translation in sociodemographic terms, with online students' average age higher than that of students enrolled at brick-and-mortar universities (Johnson, 2015; Ortagus, 2017).

In parallel with the need to work, some studies have pointed to gender as one of the most discriminating features for distinguishing internally between different distance student profiles (Yukselturk & Top, 2013). Distance students were characterized by a higher proportion of female students among the university population (Latanich, Nonis, Sarath, & Hudson, 2001; Wojciechowski, 2004). As an explanation for this increased participation by women, some studies have pointed to the preponderance of women in care-related tasks and the possibility of combining these with more flexible education options (Ortagus, 2017), although other studies questioned whether female students enrolled at distance universities aligned with the stereotype of the full-time mother (Johnson, 2015).

The results in the Catalan context were similar in terms of the increased proportion of female students who stayed at university (Grau-Valldosera & Minguillón, 2014). Specifically, in the case of students who dropped out in the first semester, we have seen that the likelihood of coming back and staying is higher among women and students who had prior experience in the subject studied. Women's greater ability to return to university and stay also contributed to the increased proportion of women in the distance education population.

Regarding family social background, studies have shown that a large number of students at distance universities are the first in their family to enter university (Stone, O'Shea, May, Delahunty, & Partington, 2016). These students have exhibited specific features and needs when it comes to meeting and responding to the institution's requirements.

Although these empirical findings have shown similar patterns, some studies suggested that it was difficult to establish conclusive results due to the incomplete, segmented approaches used in analysing the profile of distance students (Stewart, Bachman, & Johnson, 2010). Accordingly, the authors proposed a multivariate analysis of online and traditional programmes in which they analysed students' motivation to participate on the basis of a set of sociodemographic variables and the interactive effects among these variables. Among other results, the authors showed the complexity of the online university reality and the existence of interactive effects. In the case of age and gender, for example, the authors stated that young males showed differences in their reasons for entry and participation, and were more motivated intrinsically to complete their studies than were women of the same age (Stewart et al., 2010).

However, this prototypal profile is not static and seems to have shown evidence of change in recent decades. This may have made partial approaches even more confusing. Some studies have suggested a change from mainly older, employed students with clear goals and intrinsic motivations towards a more diverse, dynamic, younger profile that responds rapidly to technological changes (Dabbagh, 2007), or to a rejuvenation process among the population entering distance university education (Wojciechowski, 2004).

To find an answer to these recent changes, researchers have explored lifestyles, perceptions of the institution, and personal attributes as identifying elements of online students (Hillstock & Havice, 2014). Their results have shown greater participation by women and also by students belonging to majority racial groups (i.e., white, Caucasian students). As regards lifestyles, most students indicated that they were working while studying and that this was their main source for financing their studies (Cavanaugh, 2005; Cavanaugh & Jacquemin, 2015; Sikora, 2002). In addition, most of them said that they had children and, in about half the cases, children under 18 living in the same home. Thus, students' prototypal profile continues to be characterized by specific life factors: students with responsibilities outside of university such as work and family who choose distance education because it offers flexibility and the possibility of combining studies with other activities.

The Impact of Higher Education

Many studies have shown the multiplicity, interconnection, and diversity of university's impact. Seeking to identify and conceptualize the different types of impact, some authors have identified different dimensions or factors that differentiate between impacts—short- and long-term, monetary and non-monetary, intentional and non-intentional, individual and societal (Brennan, Durazzi, & Tanguy, 2013; Brennan et al., 2010, 2013; McMahon, 2009; Woodall, Hiller, & Resnick, 2014). Some authors have said that it is not correct to attribute the impact solely to the university experience, and that other factors may be involved such as students' own maturing process or the pressure to choose a profession, among many others (Pascarella & Terenzini, 2005, p. 534).

The impact of university on the economic dimension, namely career development and the likelihood of being employed, has been frequently analysed. The results seem to be clear in this respect and have shown that a higher level of income and a greater likelihood of being employed are both impacts of having entered and graduated from university (McMahon, 2009; Organisation for Economic Co-operation and Development, 2019; Pascarella & Terenzini, 2005). This phenomenon has also been analysed in the case of distance universities. According to the results, graduating from a distance university course has a positive effect on increased salary, although this varies depending on the programme or degree completed (Castaño-Muñoz, Carnoy, & Duart, 2016).

Regarding the economic dimension, one of the main motivations expressed by university students for going to university is related to future career and financial aspirations, and the possibility of finding a job or improving future work conditions (Dziewanowska, 2017; Machado, Brites, Magalhães, & Sá, 2011; Soares et al., 2018). However, many rationales have been involved in distinguishing between the impact that their university experience may have had, both in professional and career terms, and in terms of learning and skill acquisition (Arquero, Byrne, Flood, & Gonzalez, 2009; Balloo, Pauli, & Worrell, 2017; Byrne & Flood, 2005).

These results revealed some interesting variations and differences when students' profiles were taken into account, which has led some authors to talk about the differential role played by age in the reasons for studying at university, and the expectations regarding the impact of the university experience (Balloo et al., 2017; Bye, Pushkar, & Conway, 2007; Rothes, Lemos, & Gonçalves, 2017). In general, the results have shown that older students tended to express a higher degree of intrinsic motivation than did their younger fellow students. For their part, younger students were more interested in social dimensions such as making friends at university. In turn, differences were observed when other variables were included, such as students' gender. In sum, male adult students had lower autonomous motivation, while female adult students were overrepresented in a high-quality motivation group, with high values of autonomous motivation and low values of controlled motivation (Rothes et al., 2017). Studies that focused specifically on adult learners stated that the most common motivation for re-engaging in education was related to extrinsic motivations such as career development and performance in the labour market (Jenkins, 2017).

Beyond the economic or work aspects, other empirical findings have pointed to a great diversity of individual impacts attributable to the university experience associated with (a) academic, cognitive, and psychosocial aspects; (b) attitudes and values; (c) moral aspects; (d) quality of life; and (e) economic and career aspects (Pascarella & Terenzini, 2005). Likewise, some authors stated that for most students, the university experience was associated with increased self-confidence, independence, communication skills, understanding other people, and maturity (Brennan et al., 2010).

However, as other studies have pointed out, the impacts vary between older and younger students, as the former may have already acquired some of these competencies or skills in other contexts prior to entering university (Brennan et al., 2010). Other authors have said that students' social conditions or responsibilities—work or family responsibilities—may have influenced the impacts of university experience among university students (Brennan et al., 2010; Pascarella & Terenzini, 2005). This was particularly significant in the case of distance universities, where the dominant profile was that of older students and/or students who combined studying with other responsibilities outside of university.

The increased heterogeneity of the students enrolled in distance universities may have led to greater diversity in students' understanding and conception of university, and the motivations or objectives they expected from their university experience. These changes, both in the students' profiles and in the conceptions of and motivations for university education, may have given rise to differential perceptions of the impact of university experience.

Methodology

Research Goals and Procedures

Our first goal was to explore students' main characteristics and draw up a distance student typology, taking into account their life circumstances. Thus, we performed a multiple correspondence analysis (MCA) to identify the most significant factors differentiating students. A series of variables were introduced in the analysis to put all the students in a space that allowed us to identify groups of similar students based on their proximity to other students. Table 1 shows the variables that defined this space (i.e., active variables) and their values (i.e., modalities or categories). Having defined the main factors, these were used to carry out a classification analysis to identify different groups of students with similar features. This enabled us to explore the university's internal heterogeneity with respect to students' social conditions and characteristics.

Our second goal was to analyse whether belonging to a particular type of student typology was associated with a differential assessment of the perceived impact of the university experience. We used the Kruskal-Wallis test—a non-parametric equivalent of the analysis of variance (ANOVA)—to determine student typology-specific differences.

Sample

The data came from a survey of current and former students at the Universitat Oberta de Catalunya (UOC) in order to analyse this distance university's impact on Catalan society and the Catalan economy. The survey was delivered online through the Qualtrics platform (www.qualtrics.com). A link in the invitation e-mail provided participants with access to a consent form for the processing of personal data. Respondents' explicit consent was a condition sine qua non for participation in the survey. A total of 5,732 respondents completed the survey out of a population of over 50,000 eligible students enrolled at UOC at the time of data collection. For the analysis proposed here, we excluded graduates and dropouts. Thus, we narrowed our focus to students who, at the time of performing the survey, were still at the university studying for a university degree (N = 1,850). Quota sampling was used to ensure the same proportions of students in relation to gender and age.

Measures

In order to explore students' life circumstances, we introduced a series of variables that defined the factorial space. Thus, as shown in Table 1, the variables described various student features such as (a) personal characteristics (e.g., sociodemographic, disability); (b) place of residence; (c) responsibilities outside of university (e.g., family situation, children, current work situation, work situation at the time of admission to the university); (d) previous educational level; and (e) social background (i.e., the family's educational and occupational level).

Table 1

Eleven Active Variables and 38 Categories: Absolute (n) and Relative (in %) Frequencies

Variable	n	%	Variable	n	%	Variable	*n*	%
Gender			**Educational level at admission**			**Family's educational level**		
Male	786	42.5	Below baccalaureate	166	9.2	Up to primary education	629	38.9
Female	1064	57.5	Baccalaureate	347	19.2	Compulsory education	248	15.3
Total	1850	100	Higher vocational education and training	505	28.0	Post-compulsory secondary education	350	21.6
Age groups			Uncompleted university	443	24.5	University studies	391	24.2
Up to 25	27	1.5	University	244	13.5	Total	1618	100
26–30	207	11.2	Postgraduate	101	5.6	**Family's occupational level**		
31–35	270	14.6	Total	1806	100	Highly skilled white collar	321	30.9
36–40	275	14.9	**Job at admission**			Low-skilled white collar	395	38.1
41–45	328	17.7	Yes	1691	91.6	Highly skilled blue collar	109	10.5
46–50	336	18.2	No	156	8.4	Low-skilled blue collar	213	20.5
Over 50	407	22.0	Total	1850	100	Total	1038	100
Total	1850	100	**Family situation**			**Present situation**		
Disability			Single	690	38.2	Unemployed	121	6.8
Yes	350	19.0	Married	1028	56.9	Retired	47	2.6
No	1490	81.0	Divorced or separated	89	4.9	Working	1612	90.6
Total	1850	100	Total	1807	100	Total	1780	100
Place of residence			**Children**					
Catalonia (Spain)	1448	78.3	Yes	587	31.7			
Rest of Spain	324	17.5	No	1263	68.3			
Abroad	77	4.2	Total	1850	100			
Total	1850	100						

Perceptions of the Impact of Higher Education

In order to analyse students' opinions regarding the impact of university on different aspects of their personal and professional life, the survey included the following question: "Please state which of the following items best describes the impact that studying at the UOC is having." This was followed by a drop-down list with eight different items (see Table 2) and respondents were asked to rate each one on a five-point scale ranging on ranging from 1 (*no impact*) to 5 (*a big impact*).

Table 2

Respondents' Perceptions of the Impact of Studying at UOC

Impact	Mean	SD	*n*
Increase my chances of finding a job	3.39	1.237	1823
Improve my theoretical knowledge	4.15	0.841	1838
Improve the practical knowledge that I use in my job	3.23	1.276	1827
Progress in my career	3.71	1.135	1828
Acquire new concepts and new knowledge	4.28	0.795	1836
Consolidate concepts and broaden previous knowledge	4.07	0.905	1837
Improve my personal development (self-assertion, self-discipline)	4.11	0.961	1840
Gain an interdisciplinary, cross-cutting vision	3.92	0.965	1838

In order to simplify this information and find common dimensions, an exploratory factor analysis was carried out, applying the principal component extraction method with varimax rotation. The Kaiser-Meyer-Olkin (KMO) sample adequacy statistic was used to estimate the model's significance and relevance (KMO = 0.851). The principal component analysis established a factorial structure that consisted of two components with a total cumulative explained variance of 62.9%.

The rotated component matrix enabled us to identify each item's extraction and contribution to the different components (Table 3).

Table 3

Rotated Component Matrix of the Exploratory Factor Analysis

Impact	Component	
	1	2
Acquire new concepts and new knowledge	0.810	0.179
Improve my theoretical knowledge	0.794	0.219
Gain an interdisciplinary, cross-cutting vision	0.772	0.142
Consolidate concepts and broaden previous knowledge	0.726	0.291
Improve my personal development (self-assertion, self-discipline)	0.681	0.158
Progress in my career	0.272	0.828
Improve the practical knowledge that I use in my job	0.213	0.759
Increase my chances of finding a job	0.122	0.749
Quality of measures and average variance	1	2

Explained variance	37.6%	25.4%
Composite reliability	0.87	0.82
Average variance extracted	0.57	0.61

Note. Extraction method: principal component analysis. Rotation method: Varimax with Kaiser normalization. The rotation has converged in 3 iterations.

As we can see, the first component was composed of indicators associated with an intrinsic dimension of the university experience, associated in turn with knowledge acquisition and personal development. The second component contained a more extrinsic dimension related to improvement in work and professional terms, both in relation to knowledge acquisition and improved opportunities. Both components yielded values of composite reliability (CR) and average variance extracted (AVE) above the corresponding cut-offs (CR > 0.7; AVE > 0.5).

Results

Discriminating Factors in Distance Education Students' Profiles

The first step after performing the MCA was to select the factors that defined the space formed by students' life circumstances. The factors were defined by the eigenvalue, through which we calculated the inertia or variance; this inertia decreased progressively in each of the factors. Following the instructions given by LeRoux and Rouanet (2010), the modified ratios were calculated using Benzécri's proposal, and this enabled us to identify the importance of each factors and their explained variance. Thus, ACM allows us to explore and visualize the spatial relationships between the variables. The factors can be understood as the axes of the visual representation and are interpreted by assessing the variables' relevant contributions to the factor.The interpretation given here used the first two factors, which account for about 90% of the total. The first factor accounted for 76.7% of the total explained variance, the second for about 13%, and the next two accounted for less than 10% each (7.5% and 3.2%, respectively).

Table 4

MCA with Selection of Active Variable

Factor	Eigenvalue	Corrected eigenvalue	% explained inertia	% cumulative inertia
1	0.2130	0.015	76.7	76.7
2	0.1406	0.002	12.7	89.3
3	0.1290	0.001	7.5	96.8
4	0.1158	0.001	3.2	100.0

When we analysed the variables' contribution to the first factor, we saw that the three variables related to age, having dependent children, and family situation contributed most to explaining the first factor

(Table 5). Thus, there was a correspondence between this first factor, and family responsibilities and the life cycle. These modalities associated with these three variables contributed more than 73% to explaining this factor. Since these variables refer to the students' family sphere, the factor was called family responsibilities.

Table 5

Contributions of Variables and Modalities to Factors

Variable		Modality (positive coordinates)		Modality (negative coordinates)	
Label	Contr.	Label	Contrib.	Label	Contrib.
Factor 1: Family responsibilities					
Age	28.1	over 50 | 46–50	9.7 3.2	26–30 | 31–35	8.8 5.4
Children	23.6	Yes	16.7	No	6.9
Family situation	22.7	Married | Separated/divorced	7.5 2.5	Single	12.8
Family educat. level	9.7	Up to primary education	4.8	University education	3.0
Prior educat. level	5.5	Below baccalaureate	2.8		
Present situation	3.8	Retired	2.7		
Family occup. level	3.4			Highly skilled white collar	2.3
Factor 2: Social and educational background					
Family occup. level	31.4	Low-skilled blue collar	10.4	Highly skilled white collar	19.3
Family educ. level	27.1	Up to primary | Compulsory	4.5 2.7	University education	19.6
Prior educ. level	20.7	Higher Voc. Educ. Training	11.0	University | Postgraduate	5.0 2.2
Age	9.3			Over 50	6.1
Present situation	5.8			Retired	5.1

Figure 1 provides a visual illustration of the contraposition among the variables' modalities: the negative values of the first factor (x) correspond to younger students, either single or with other family situations (other than being in a couple and being divorced or separated).

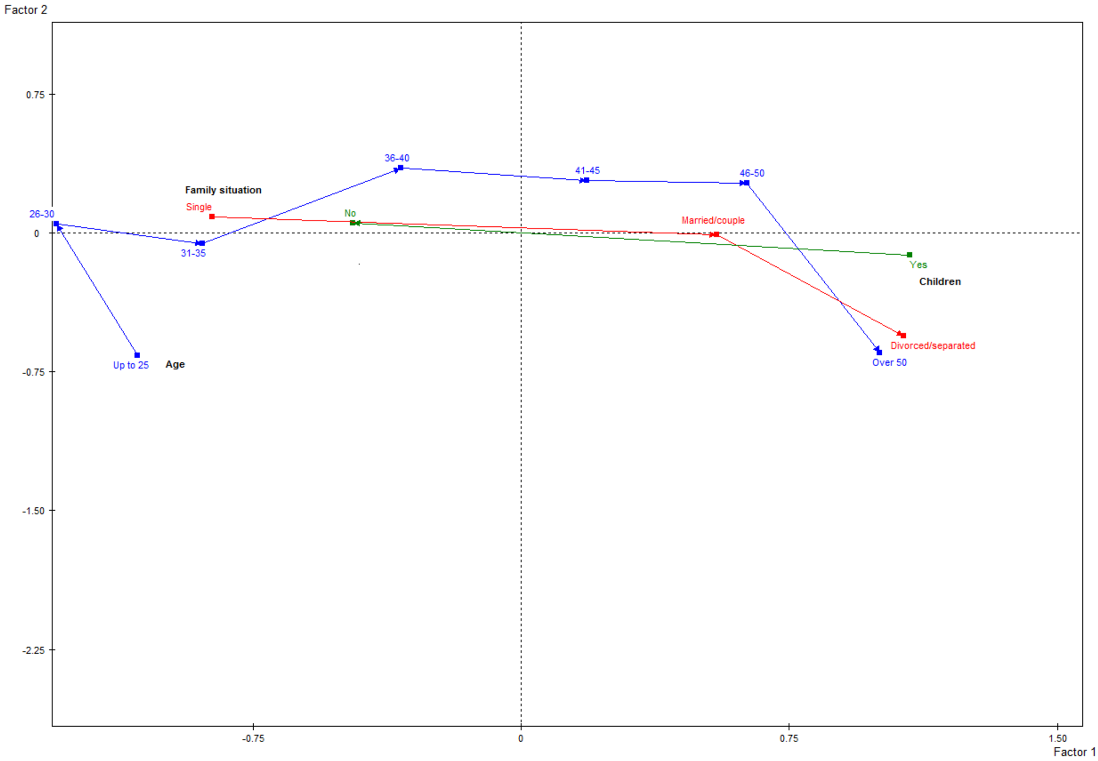

Figure 1. Projection of the variables and modalities that contribute most to factor 1.

As regards the interpretation of the second factor, Table 3 shows that the modalities referring to the students' social background were the most relevant. Both the family educational level and the family occupational level have modalities that contributed more than 50% of the total to this second factor. Contributing less, but still relevant, the modalities referring to the students' previous educational level contributed about 16% to the second factor.

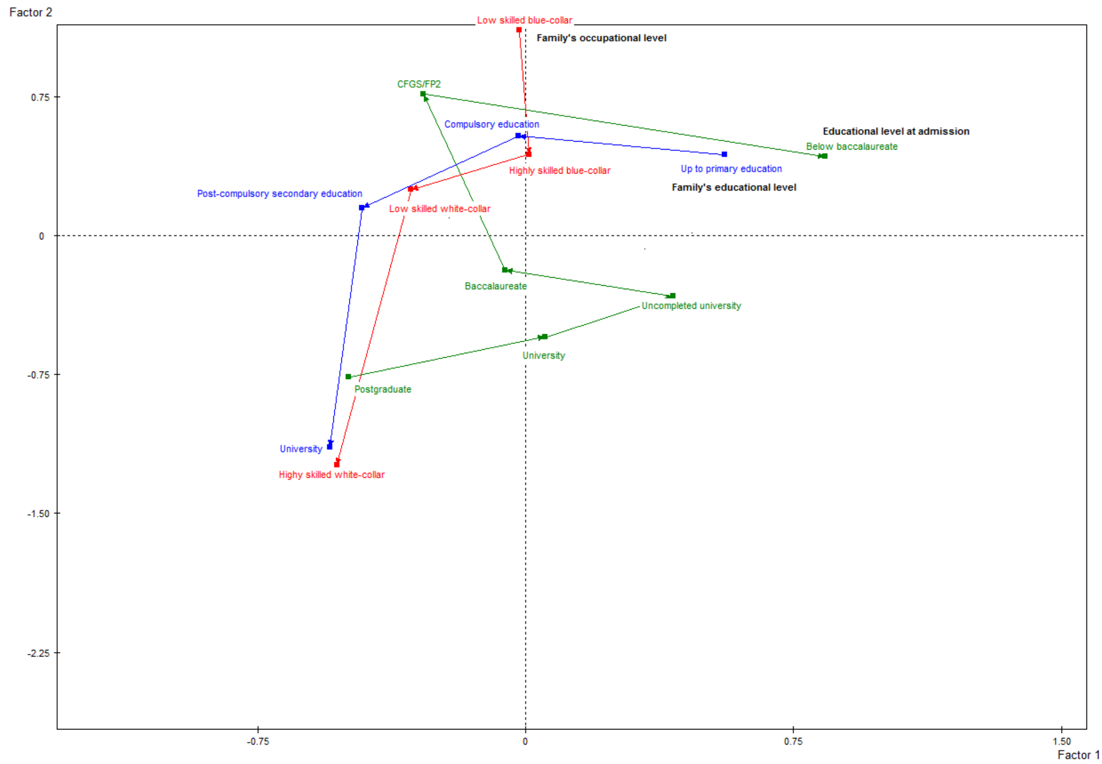

Figure 2. Projection of the variables and modalities that contribute most to factor 2.

Figure 2 shows that the positive coordinates of the second factor (y) included the modalities that refer to families with lower educational (up to post-compulsory studies) and occupational (blue collar and low-skilled white collar) levels. In contrast, the negative coordinates corresponded to the modalities referring to higher family educational and occupational levels (completed university studies and highly skilled occupations).

In addition, there was a relationship between family social background and students' educational level at the time of entry. This showed a contrast between students with lower educational levels (compulsory and higher vocational education and training) in the factor's positive coordinates and students who enter with a baccalaureate or some prior university experience.

A Distance University Student Typology

From the results of the cluster analysis and taking into account the level of aggregation at each level of the histogram, a typology consisting of five student types was chosen, based on each type's social conditions. Figure 3 shows the scatter of individuals within the space defined by the first two factors described above.

The first group—employed students—represented more than a third of the sample (n = 647) and was composed of students aged between 30 and 40, single, without children, and working at the time of entry in university. They entered university through profession-focused forms of admission (i.e., higher vocational education and training) and, to a lesser extent, with a previous university degree. They were related to families with a social background characterized by a high educational level (i.e., university studies) and high occupational levels (i.e., highly skilled white collar). This type had a weak association with male students.

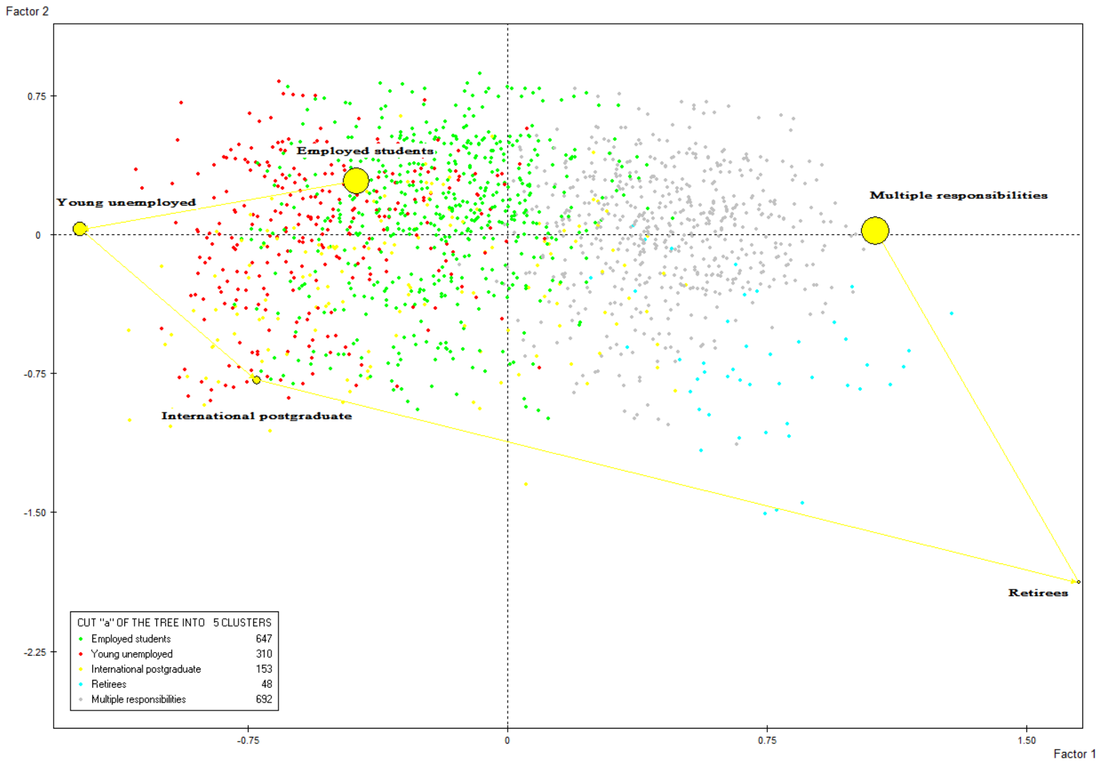

Figure 3. Student typology by social condition.

A second group—young unemployed—corresponded to the group of younger students (i.e., 26–30 years) who were unemployed, and had no work or childcare responsibilities outside university (n = 310; 16.8%). They entered university from baccalaureate studies, and their family's social background was characterized by parents with average education and occupation levels (i.e., post-compulsory education, low-skilled white collar). This is the only group that was associated with students with any kind of disability. It showed a slight female bias.

International postgraduate students represented 8.3% of the sample (n = 153) and were characterized by students in postgraduate studies who resided in a foreign country. They come from highly educated families with high occupational levels (i.e., highly skilled white collar and highly skilled blue collar). As in the previous case, this group had a slight female bias.

The group of retired students was the largest minority, with slightly less than 50 students who represented 2.6% of the total (n = 48). These were mainly students over 50 years old, male, and, to a lesser extent, with other university degrees obtained prior to entering the distance university.

Finally, the last group—multiple responsibilities—was the most numerous and represented 37.4% of the total (n = 692). As their name suggests, these students had both work and family (i.e., dependent children) responsibilities. They were associated with low previous educational levels (i.e., below baccalaureate) or with uncompleted university experiences, and low family educational levels as well (i.e., up to primary education).

The Impact of the University Experience by Student Profile

Finally, we analysed the impact perceived by different types of students as a result of their university experience. The results of the Kruskal-Wallis test (Table 6) revealed that the differences by student type in their ratings of university impact were statistically significant both in relation to the intrinsic dimension associated with knowledge acquisition ($x^2(4) = 42.525$; $p < 0.000$) and in relation to the extrinsic dimension related with career improvement and acquisition of professional competencies ($x^2(4) = 34.518$; $p < 0.000$).

Table 6

Results of the Kruskal-Wallis Test

Component	Student typology	*n*	Average range	Post-hoc pair-wise comparison
Intrinsic dimension / knowledge	Employed students	633	835.60	Retirees**; Multiple responsibilities**
	Young unemployed	305	843.88	Retirees**; Multiple responsibilities*
	International postgraduate students	147	841.42	Retirees**
	Retirees	42	1217.60	
	Multiple responsibilities	663	968.03	Retirees*
	Total	1790		
Extrinsic dimension / professional	Employed students	633	924.94	Retirees**
	Young unemployed	305	930.94	Retirees**
	International postgraduate students	147	855.15	Retirees**
	Retirees	42	458.83	
	Multiple responsibilities	663	887.70	Retirees**
	Total	1790		

Note. * p < 0.05. ** p < 0.001.

Specifically, the students with multiple responsibilities and, most especially, the retired students showed a greater average range in the intrinsic dimension score associated with the acquisition of theoretical knowledge. There was also an age-related pattern, with older students (i.e., students with multiple responsibilities and retirees) showing significant differences compared with the younger students, whether unemployed or working.

With respect to the dimension associated with professional competencies, it was seen that retired students had a significantly lower score compared to their fellow students. Indeed, the pair-wise comparison found significant differences between the retired students and the other distance student profiles.

Conclusion and Implications

The results show the importance of social conditions as a differentiating factor for today's online distance university students. Students can be differentiated by their life cycle and, specifically, by their family situation and external responsibilities, such as having dependent children and work responsibilities. This is in line with the findings of other studies on distance students (Cavanaugh & Jacquemin, 2015; Dutton et al., 2002; Sikora, 2002). In turn, the introduction of social background enables us to identify a second factor for differentiating and discriminating among students on the basis of their family social background. Students with a higher social background—families with university education who are highly qualified—are differentiated from the rest of the students, revealing a new internal differentiating factor in the case of the distance university. This brings to light a certain degree of diversity in UOC students' social background, although students who are the first in their family to enter university still make up the majority, as other studies have suggested (Stone et al., 2016).

Different student types emerge from these two factors, hinting at a certain degree of internal heterogeneity in the distance students' profile, with a total of five student types. Although differences and features are observed that are specific to each profile, two of the five types (i.e., employed students and multiple responsibilities) account for three out of four students, and become a core student profile in the distance university. However, alongside these two groups, three other student types are observed that contribute further heterogeneity to distance students: retired students, on the one hand, and international postgraduate students and young unemployed, on the other. The last two groups bring to light the existence of a substantial group of students who share similarities with the traditional student profile in brick-and-mortar universities, namely, young students, without any family or work responsibilities, who enter university through academic pathways. This group's relative weight is by no means insignificant, as it accounts for 16.8% of the total sample. These students may account for the recent rejuvenation of the distance university student profile that has been observed by other international studies as a result of recent social and institutional changes (Dabbagh, 2007; Wallace, 1996; Wojciechowski, 2004). These results may point to the existence of a new relationship between the brick-and-mortar and distance university models, in that the distance university may be attracting a student profile that traditionally studied at the brick-and-mortar university, diverging from the trends suggested by other studies (Cavanaugh, 2005).

The importance of this diversity in the distance university student profile lies in the fact that it leads in turn to a differential perception of university's impact on different aspects of students' personal and professional life. Thus, older students, whether those who have multiple responsibilities or, especially, those who are retired, show a more intrinsic conception of university's impact. For instance, they refer more often to aspects associated with the acquisition and consolidation of new knowledge and with improving their personal development.

On the other hand, with respect to the more extrinsic or professional dimension, retired students give significantly lower scores than the other student types analysed, insofar as the younger students and the employed students perceive that university has a greater impact in professional or extrinsic terms. These results are consistent with studies that showed the role played by age in the reasons for studying at university and the expectations regarding the university experience's impact (Balloo et al., 2017; Bye et al., 2007), and specifically in the trend shown by older students towards a higher degree of intrinsic motivation than their younger fellow students.

The internal diversity of distance students and the impacts of the university experience indicate a degree of heterogeneity that goes beyond the traditional conception of distance education. In turn, this scenario enables us to delineate or infer multiple rationales for university entry and participation in university, driven by student profiles who traditionally did not consider this education option. For example, second opportunity rationales are observed by which students without any prior higher education and who come from low or intermediate family educational levels are able to acquire a university qualification. These upward social mobility strategies can be observed both among the students with family and work responsibilities (i.e., multiple responsibilities) and among those who are unemployed.

In addition, the decision to study at a distance university may be driven by expressive motivations and the acquisition of knowledge in different subjects at different times in life, such as demonstrated by *retirees*. This portrays distance education as an institution for lifelong education. These rationales coexist with other more accreditation-focused, career-focused, or specialization-focused rationales, expressed by young students with prior university experience (i.e., international postgraduate students), with work responsibilities (i.e., employed students), or the unemployed (i.e., young unemployed).

Within the framework of this university population rejuvenation process, it would be interesting to delve into the reasons and motivations for studying at a distance university. The economic recession and increased university fees may have had an impact on the educational decisions of the students who opt for distance education as a strategy for reducing the indirect cost of studying. It is also possible that the younger population has acquired new conceptions of university and education. That is a naturalization of the online environment and distance learning which is no longer an obstacle to entering university. These results show that the distance university has become established as a lifelong educational institution, irrespective of the students' age and their social conditions, and it may satisfy a considerable diversity of needs.

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Challenges of Blended Learning in Refugee Camps: When Internet Connectivity Fails, Human Connection Succeeds

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Abstract

In this paper, we studied the implementation of a course on global history as a blended section of a massive open online course (MOOC) and the learning challenges faced by the students in three crisis contexts: Azraq refugee camp (Jordan), Kakuma refugee camp (Kenya), and Amman urban refugee center (Jordan). The results showed that poor Internet connection in the camps severely impacted both students' and instructors' experience of the course. In the context of chronic Internet connectivity issues, the instructors had difficulties assessing their students' needs and challenges. The results also showed that in light of these intermittent connection problems, the collaborative learning environment helped students navigate the challenges of a blended course. Also, the onsite visit by the online tutors and the face-to-face interactions that resulted from it had a noticeable impact on the human dynamics of the course by allowing instructors to provide targeted solutions to students' problems as well as by building rapport between the students and the instructional team.

Keywords: massive open online course, MOOC, refugees, education in emergencies, blended learning, collaborative learning

Introduction

By the end of 2018, more than 74.8 million people had been forcibly displaced worldwide as a result of persecution, wars, violence, or human rights violations (United Nations High Commissioner for Refugees [UNHCR], 2018). Almost one-third of displaced people are currently under the United Nations Higher Commissioner for Refugees' mandate, and 85% are hosted by countries in low-resource regions, with the least developed countries providing shelter for 26% of the total refugee population (UNHCR, 2018).

In this fragile context, education provision is a complex but pressing issue. While access to education is a human right enshrined in Article 26.2 of the Universal Declaration of Human Rights (The United Nations, 1948), only a tiny minority of refugee youth can access higher education (UNHCR, 2016a). The other 99% makes up a lost generation of young people with no or inadequate access to higher education. As stated in the Framework for Action Education 2030, published by the United Nations Educational, Scientific, and Cultural Organization (UNESCO), "the failure to prioritize education in humanitarian response renders entire generations uneducated, disadvantaged and unprepared to contribute to the social and economic recovery of their country or region" (UNESCO, 2015, p. 5).

Similar to other migrant groups, refugees have strong aspirations for education as a proactive response to their past persecutions and travails (Stevenson & Willott, 2007). Cross-national research has demonstrated that education supports the development of innovation and entrepreneurial skills that are essential for employment and economic activity (Hanushek & Woessmann, 2007). When offered a high-quality education during their exile, refugees increase their chances of economic and, thus, social integration in their host country upon resettlement or repatriation. Humanitarian organizations have, therefore, increasingly adopted a rights-based approach to education and have drawn attention to the link of education and protection. Thus, in 2010, UNHCR's education unit was moved from the Division of Operational Support to the Division of Protection, showing its importance as an immediate right for refugees. More recently, it was moved to the Division of Resilience and Solutions, reflecting a notable shift in considering education as a long-term development imperative rather than an immediate operational emergency.

Traditionally, education in emergencies has prioritized primary education. Current trends show that over 61% of refugee children access primary education, 23% secondary education (UNHCR, 2018), and only an estimated 1% access higher education (UNHCR, 2016a). The small share of higher education in emergencies finds its origin in the 1951 convention relating to the status of refugees, which obliges host countries to provide primary and secondary education to refugees but remains silent on higher education. In the absence of a binding legal framework, infrastructural problems, inherent to any refugee context, are amplified and make any educational interventions particularly challenging.

In this research, we studied the implementation of a blended learning course in a situation of crisis and poor telecommunication infrastructure and focused on the role of face-to-face interactions as well as collaborative learning. We begin by providing background literature and describe how we collected and analyzed the data to support the findings of this study. We then present the themes that emerged from the data analysis before discussing them in detail.

Background

Blended Learning for Higher Education in Emergencies

Blended learning, according to the Innosight Institute, is a formal education program in which a student learns at least in part through online delivery of content and instruction with some element of student control over time, place, path, and pace (Staker & Horn, 2012). Schools all around the world are increasingly using a blended learning model across all grade levels (Zaka, 2013). Access to technology has leveraged opportunities to integrate the best online activities into instruction. Schools in high-income countries are using blended learning models to expand their course offerings (Means, Toyama, Murphy, & Bakia, 2013). Blended learning has been shown to be beneficial for a number of student outcomes beyond solely online or solely face-to-face instruction, because of its potential to provide flexible access to content and instruction at any particular time, from any place (Means et al., 2010). As well, if its affordances are realized, blended learning can be tailored to student needs. In the book *Learning Online*, Means (2014) listed the following purposes for blending instruction:

- Broadening access to instruction.
- Facilitating small-group and one-to-one teacher-led instruction.
- Serving students with very diverse needs.
- Providing more opportunity for productive practice.
- Adding variety to teaching and enhancing student engagement.
- Supporting the learning of complex, abstract concepts.

Considering the potential benefit of all the goals mentioned above, as well as the research on blended learning's effectiveness, blended learning qualifies as a potentially effective pedagogical tool for higher education in emergencies. Through blended learning, academic institutions can bring cutting-edge programs to remote contexts via online technology, while also providing personalized and focused instructional support through local tutors.

In low-resource contexts, blended learning models can be an alternative to schooling in situations where movement is restricted or where educational infrastructure is weak or nonexistent. Despite the purported use of blended learning models to enhance access to education, there is little information on how they can be better adapted to the specific needs and challenges faced by refugees in fragile contexts. However, some parallels could be drawn from previous experiences of implementing MOOCs in developing countries. In fact, in these settings, computer-aided learning has sometimes presented severe limitations in terms of both instructional design and field classroom implementation. For example, Wildavsky (2017) pointed out that finding the most appropriate technology when implementing MOOCs in Africa is a challenge. The authors echoed previous studies highlighting that broadband Internet connections are often hard to access, making mobile phones the best way to reach some students in low-income countries. The issue of Internet connectivity in low-resource countries has pushed MOOC designers to revisit the course elements in light of limited bandwidth. For instance, Murugesan, Nobes, and Wild (2017) studied an online course in research writing offered in a massive open online course (MOOC) format for developing country researchers. In this case, MOOC designers intentionally developed low-bandwidth instructional elements in order to take into consideration the limitation of computer-aided learning in low-resource locations. In addition, Moser-Mercer's (2014) study of a MOOC in Dadaab refugee camp in Kenya also called for the need to consider offering suitable engagement tools for students specific to the particular infrastructural challenges encountered in refugee camps.

Some of the challenges associated with implementing blended learning courses in fragile contexts are inherent to computer-supported learning. In fact, this type of learning requires a shift from traditional teaching practices to a new type of instruction where teachers are aware of the limitations and challenges inherent to technology implementation and can take advantage of the particular affordances of the technology only where it makes sense. Notably, using computers can also change the arrangement of classrooms, the social organization of student learning, and the interactive patterns between teachers and students (Duffield et al., 1999). The reconfiguration of the teaching space, as a direct consequence of computer-supported learning, motivates part of our research goal in studying the way educational technology interacts with the social dimension of the classroom in crisis-affected contexts.

This paper attempted to reach the research goal mentioned above by exploring the case of a massive open online course (MOOC) on global history, called *Global History Lab (GHL),* offered on the edX platform, that was implemented in two refugee camps in Jordan and Kenya and an urban refugee space in Jordan. This MOOC was a blended learning course resulting from a collaboration between Princeton University and InZone, an academic center at the University of Geneva.

Context

MOOCs

As massive open online courses (MOOCs) became a broadly recognized higher education phenomenon (Breslow et al., 2013), education researchers and students alike quickly realized that the spectrum of MOOC classes was broad and diverse. For example, the earliest use of the MOOC term was applied to what became known as cMOOCs, as early as 2008, where the letter "c" stands for connectivist; these MOOCs grew up from a set of diffuse courses and course materials that centered learners and their communication together to co-construct knowledge (Joksimovic et al., 2015). On the other hand, more recent MOOCs like xMOOCs, grown out of the artificial intelligence academic community, focused on automated response systems to give students immediate feedback and other intelligent tutoring systems mechanisms. In both cases, instructors, students, and researchers have had to navigate a re-thinking of familiar educational constructs from face-to-face or distance learning that the MOOC classes expanded or upended (DeBoer, Ho, Stump, & Breslow, 2014). In the class we studied in this article, we identified elements such as student-to-student connection and online lecture recording—derived from aspects of both xMOOCs and cMOOCs—applied in a complex and novel structure, context, and pedagogy.

Course Description

In this article, we studied the case of the *Global History Lab (GHL),* a 16-week blended learning course on global history implemented in three refugees settings. *GHL* was originally develooped as a MOOC by Princeton University and offered on the edX MOOC provider platform. The course studied in this article was an adapted version of the eponym designed by Princeton University in collaboration with InZone, University of Geneva. Following the recommendations of a pilot study on the implementation of MOOCs in fragile contexts (Moser-Mercer, 2014), the adapted version of *GHL* included different assignments and pacing in order to take into consideration the particular context of refugee camps. The course integrated 19 learners in the Kakuma Camp in Kenya, 10 in the Azraq Camp in Jordan, and a cluster of 3 refugees from Syria and 2 Jordanians in urban Amman. As shown in Table 1, different actors and institutions constituted the learning ecosystem of the *GHL* course.

Table 1

The GHL Course Learning Ecosystem

Actor	Affiliation	Role
Lecturer	Princeton University	Provide course material Encourage knowledge generation Evaluate and grade assignments
Course coordinator	InZone Geneva campus	Liaise among the ecosystem's actors Manage and monitor the pedagogical set-up and implementation Deal with administrative matters
Online tutors	Princeton University	Stimulate knowledge acquisition Support and advise learners Encourage group discussion
Onsite facilitators	InZone Kakuma campus	Provide technical support Support students in their learning experience Liaise among learners and other actors Coordinate onsite cooperative learning
Students	Azraq refugee camp (Jordan) Amman urban refugee center (Jordan) Kakuma refugee camp (Kenya)	Engage with course activities and other students with the goal of achieving course learning outcomes

The course consisted of two, one-hour lectures each week that the students accessed via the edX platform. The students were provided with a textbook (both a physical and a digital copy on a USB drive) that contained 12 case studies. The 12 case studies covered pressing themes in global history with a particular focus on the history of migration and statelessness. Those case studies constituted the course's bi-weekly assignments where students were asked to work in teams under the supervision of an onsite facilitator. The onsite facilitator's role was to ensure students' access to the learning hub in each camp and to liaise with the online tutors. The online tutors' role consisted of engaging with the students after they had watched the online lectures to make sure they understood the content. They interacted with the students via a WhatsApp forum in the three locations. Throughout the course, students met face-to-face with each other and with local onsite facilitators multiple times per week to review online materials together and work through assignments. In the middle of the *GHL* course, the online tutors made an onsite visit to the three locations where they met and interacted with the students for the first time. The meetings at the learning hubs, together with onsite visits from online tutors, formed the face-to-face component of the blended course.

With particular regard to conflict-sensitive education, the *Global History Lab* course complied with the Inter-Agency Network for Education in Emergencies (INEE) Minimum Standards for education in emergencies (INEE, 2010). In addition, the course complied with humanitarian principles, particularly that of "Do no harm" as enshrined in international humanitarian law, as well as directives and recommendations on diversity and inclusiveness, prevention of gender-based violence, and so on.

Methodology

Purpose

The purpose of this study was to investigate the limitations faced when implementing a blended learning environment in fragile contexts where technological infrastructure remains deficient. Specifically, this study addressed the research question: What components of the *GHL* course design impacted the students' and instructors' experience of the course? Our research question allowed for a careful analysis of learners' needs, a critical step toward the development of context-appropriate solutions that go hand-in-hand with leveraging informal education offerings in fragile contexts.

Data Collection

As shown in Table 2, our study considered several data sources. These data consisted of (a) tri-weekly reports from online tutors and onsite facilitators, (b) learning community narratives, and (c) WhatsApp conversations. Also, we conducted focus group sessions with the students in order to elicit supplemental data regarding collaborative learning and the use of technology for the three learning sites.

Table 2

Data Sources and Types

Data source	Data type
Online tutors	Tri-weekly report
	Learning community narrative
	WhatsApp conversations
Onsite facilitators	Tri-weekly report
	Learning community narrative
	WhatsApp conversations
Learners	Weekly report
	Learner narrative mid-term
	Learner monthly narrative
	WhatsApp conversations

Data Analysis

In this study, we performed a thematic analysis on available data sources using NVivo software to identify, organize, and develop insights into patterns of meaning (themes) across the data sets. We adopted a five-phase approach in performing the thematic analysis. The five phases, sequentially, were: a) familiarization with the data, b) generate codes, c) search for themes, d) review potential themes, and e) define themes. We chose as a unit of analysis the respondent role in the learning ecosystem. Essentially, before coding that data, we grouped the respondents and their responses into three different categories: students, onsite facilitators, and online tutors. A first pass of open coding was performed on the three units of analysis that led to 59 emergent codes. Following this, the researchers conducted axial coding in order to relate the initial codes to each other in light of the research question. From this step, we identified three themes that aligned with our research question. After identifying the themes that emerged from the data under each code, a final analysis was done to check for overlapping themes across the different codes. To ensure coding reliability, we followed Syed and Nelson's (2015) reconcile differences via consensus method. Following this approach, two members of the research team coded all of the data, then discussed any discrepancies in the coding and resolved them through consensus to ensure inter-coder reliability.

Results

When we explored the components of the course design that impacted the students' and instructors' experience of the course, our data analysis revealed three main themes. These are described in detail below.

Theme 1: Connectivity/Internet Issues

Persistent and recurrent Internet connectivity problems emerged as a salient challenge faced by students and instructors. Interestingly, these problems were noticeable in all three sites, whether due to poor telecommunication infrastructure in remote locations (i.e., the two refugee camps) or to lower-bandwidth services available to students in the urban center. In all three sites, both online tutors and students reported connectivity to be a significant issue. An online tutor recounted, "WhatsApp tutoring has severe limitations, and learners clearly liked to see my face (Skype or other platforms), but poor connection and hardware problems made this problematic." Furthermore, when asked what they would like to change about the learning space in the three sites, many students cited Internet connection as a major point to address. The issue of Internet connectivity was challenging not only for the students but also for the online tutors. As noted by one of the online tutors from the Kakuma refugee camp (Kenya):

> Students also voice considerable frustration at the often-problematic Internet connectivity. Six out of 19 have access to their own computers and can make use of the USBs, while the rest still [use] the USBs from the InZone's Hub. Students only go online to post, comment, report on other case studies, or check their e-mails (most irregularly).

In fact, from the online tutors' perspective, the intermittent connection problems made them feel powerless to help their students engage in the class discussions. As one of them said, "it is demoralizing when students can no longer post because they did not have an Internet connection to do so on time." One interesting feature to note was how online tutors (who worked at a distance) and onsite facilitators (who were based in the camp/urban setting and interacted face-to-face with learners) perceived the issue of poor Internet connection differently and how it impacted students during the online global history course. Online tutors did not raise the issue of poor Internet connection until their field visit, even though some students reported technical difficulties as one reason they reached out to their online tutors. On the other hand, onsite facilitators consistently reported poor Internet/network connectivity as being a challenge for the students. This finding suggests that due to difficulties in communicating with students, online tutors' perception of the students' needs and learning experience were initially inaccurate. The finding also reinforced the idea of how important the role of local facilitators can be.

Theme 2: Teamwork

Teamwork emerged as a salient theme across the data sets, as students expressed their reliance on collaborative work and how helpful it was to work with their peers. For instance, a student from Kakuma described the collaborative learning sessions and the relative importance of teamwork above other learning activities as follows.

> You improve your understanding during discussions, discussions are more important than the readings, we wish we had 2-3 days for discussions, readings were often boring, it was hard to concentrate, videos were difficult to download, the online tutor was helpful, it was important to learn from the group, in little time you learn a lot and you can share responsibilities, summaries really help you understand concepts.

Another student was asked if he would get the same learning benefits if the team were online instead of local to which he replied, "no, of course not; there would not be the same focus and we would miss out on the interaction. We don't believe in communicating online; it is very different." Inadequate Internet infrastructure, as noted in our findings, impacted the students' perception of the course. Also, teamwork constituted an important resource that the students leveraged during a course where the online component was challenged because of connectivity issues. As one of them reported, "group work is the feature that students and local tutors reported as real benefit of this course."

Theme 3: Field Visit of the Online Tutors to the Students Impacted Tutors' Perception of the Course

As noted previously, online tutors' perceptions of connectivity issues changed after their onsite visit. More broadly, we found in response to our research question that the online tutors' visit changed their perception of the students' difficulties at pedagogical as well as technical levels. It was an opportunity for them to hear from the students themselves about their concerns. Further, online tutors were able to work more directly with students on both study skills and course content, perceiving the face-to-face interaction as more efficient than their previous online tutoring support. As one online tutor reported, "I was able to spend three half-days with them and I believe we made significant headway in terms of tangible skills like time management, reading and comprehension, and techniques at the heart of the global history lab."

Also, the onsite visit had the online tutors recalibrate their supporting strategy by helping the students identify successful resource-seeking behaviors. As one online tutor noticed:

> The workshop we facilitated in person about the final assignment was one of our most successful and helpful interactions with the students. We proved to the students that by reading the documents they had all the answers they needed to work on their assignment, without having to consult the Internet or other more dubious sources.

Furthermore, the onsite visit allowed the online tutors to have a better picture of the issues related to connectivity and how they could address these along with the onsite facilitators. “It made it a lot easier to get down to brass tacks with [onsite facilitators] about the students’ connectivity issues, research documents, and coursework.” Another online tutor noted:

> Their access to the Internet appears to have been much more limited than I think we understood in the first month or so of the course before [onsite facilitators joined as a more regular point person in Azraq].

The onsite visit not only changed the online tutors’ perceptions, but it shifted their pedagogical approach and, by extension, the dynamics of the course. As a matter of fact, after their visit, the online tutors opted for printing the online documents and ensured they were handed out to the students to get around connectivity problems. As one online tutor explained:

> We are also making my weekly update e-mails as well as the transcripts of the lectures available in print copy to facilitate students’ independence from Internet connectivity. One thing to take away is that printed out transcripts should also be provided from the start for the Kakuma learners in the future as for the majority, English is not their first language.

Discussion

Issues of Internet connectivity altered the students’ experience during the *GHL* course and compromised the planned online component of the blended-learning design of *GHL*. In fact, intermittent Internet interruption resulted in delayed communication between students and instructors. Delay in communication is one weakness of online learning that is reported by many researchers (Howland & Moore, 2002; Petrides, 2002; Vonderwell, 2003). According to the study by Howland and Moore (2002), the communication between students and instructor was a critical issue. Students felt less confident in guidance when the feedback from their instructor was delayed. In addition, in Howland and Moore’s study, the authors found that many students reported that it was difficult to get clarification on assignments, and other issues, due to lack of communication between student and instructor.

In their systematic literature review of the design of blended learning environments, Boelens, De Wever, & Voet (2017) found that in those environments, face-to-face and online components were generally used for different purposes. While face-to-face components were generally designed to guide the students through the organization of the course and clarify the course’s expectations, the online component was used to monitor students’ learning process through formative peer and teacher assessment. In the case of the *GHL* course, the onsite visit was purposively seeded in the course design in order to strengthen the teacher-student relationship.

The emergent theme that reflected the impact of the onsite visit on the course dynamics shows that online tutors had a better understanding of the challenges faced by the students after the onsite visit. Furthermore, the onsite visit of the online tutors made them realize the importance of the role played by the onsite facilitators and overall, the logistical challenges inherent to education in emergency contexts. As one of them stated:

> Azraq is not a place where we can expect to “set it and forget it” with a course that has as many components (online, offline, research demands, coursework) as this. The logistics don’t self-correct. This visit emphasized that this course needs careful stewardship both from us remotely and locally, both from the onsite facilitators as well ensuring that we have buy-in and support from our local partners.

As reflected in the online tutor’s quote below, the onsite visit of the online tutors brought together the teacher and the student face-to-face and informed the teaching practice of the tutor:

> There are some significant cultural differences I’ve encountered in the last few weeks that crystalized while I was visiting with the students. I am acquainted with the pedagogies and learning culture in Syrian higher education (more along the lines of didactic instruction and rote memorization). It wasn’t initially clear how much of a challenge that this would present for the students in a course like ours that requires a shift towards thinking critically.

Our work also highlighted the intentionality required of blended learning efforts. Specifically, the online tutors’ limited prior understanding and validation of the students’ challenges was shaped by the on-site visit. This information was already available to the tutors, but was only reinforced when they experienced it themselves. Expanding the background information and training for online tutors would also be supported by our data. As found in previous work (Xu & Jaggars, 2013), the social connectedness built by face-to-face interaction is important, and bringing online tutors and students together certainly improved the class because of it. Other aspects of the face-to-face connection would also be well-served by other pedagogical improvements.

Conclusion

The research design adopted for this study limits the results to the settings studied, and while some of the findings were connected to similar challenges in different settings, it is important to note that our results reflect the unique experiences of both the students and the instructors of the *GHL* course. In addition, the research question investigated in this study was elaborated after the data was collected which constrained the interpretation of the results.

Throughout this study, we were able to characterize the challenges faced by refugee students in fragile contexts. We were able to shed light on the limitations faced when implementing a blended learning environment in such contexts where technological infrastructure remains deficient. The results of our study highlight the importance of reconceptualizing the pedagogical and infrastructural model of MOOCs which has been shown to be necessary to achieve a more differentiated and individualized student’s experience (DeBoer et al., 2014). Such reconceptualization is even more important when MOOCs are implemented in fragile settings, since most MOOC platforms are configured for course delivery to learners in highly resourced countries. For instance, issues of poor connectivity in highly resourced countries are not as prominent as in the case of a refugee camp. In such fragile contexts, poor Internet connectivity can deter students from engaging in online learning and thus reinforce their isolation.

Our findings also support the importance of collaboration in higher education in emergencies and highlight the role of onsite visits (i.e., one operationalization of instructor presence) for students. The impact of these concepts is stark in classrooms located in fragile settings, given the precariousness of resources for students. In such precarious settings, efficacious delivery of educational resources must take into account the need for localization to accommodate learners' particular challenges and contextual factors. As recommended by Moser-Mercer (2014), blended learning courses in fragile contexts that aspire to engage learners need to consider offering suitable engagement tools such as lower resolution versions of videos and/or podcasts of short duration, thereby facilitating the use of offline burst connectivity tools that download the minimum text-only information during connection, allow offline reading and composition of replies, and then manage upload interaction in a second burst. These tools need to be built around responsible pedagogical models that engage learners to interact with each other on the ground and allow them sufficient time to engage asynchronously with the learning material.

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Learners' Discussion Patterns, Perceptions, and Preferences in a Chinese Massive Open Online Course (MOOC)

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Abstract

The development of massive open online courses (MOOCs) has proceeded through three generations, and in all three, online discussions have been considered a critical component. Although discussions in MOOCs have the potential to promote learning, instructors have faced challenges facilitating learners' knowledge inquiry, construction, and management through social interaction. In addition, understanding various aspects of learning calls for more mixed-method studies to provide both quantitative, generalized analysis and qualitative, detailed descriptions of learning. This study fills these practice and research gaps. We designed a Chinese MOOC with the support of a pedagogical strategy, a learning analytic tool, and a social learning environment in order to foster learner engagement in discussions. Mixed methods were used to explore learners' discussion patterns, perceptions, and preferences. Results indicated that learners demonstrated varied patterns, perceptions, and preferences, which implies a complex learning process due to the interplay of multiple factors. Based on the results, this research provided theoretical, pedagogical, and analytical implications for MOOC design, practice, and research.

Keywords: MOOCs, knowledge inquiry and construction, mixed methods, discussion patterns, learning analytics tools

Introduction

As one of the prevalent online and distance education modes, massive open online courses (MOOCs) have developed rapidly worldwide (e.g., Coursera, EdX, icourse). Although MOOCs originally focused on social, distributed, learner-centered learning (Cormier & Siemens, 2010; Siemens, 2005), many MOOCs have maintained an instructor-directed, lecture-based teaching mode, which favors one-way knowledge transmission (Gillani & Eynon, 2014; Toven-Lindsey, Rhoads, & Lozano, 2015). MOOCs should continually endeavor to promote social, collaborative learning, as the original aim, since from a sociocultural perspective, learning occurs when learners interact with people, resources, and technologies in socially situated contexts (Bereiter, 2002). To achieve this purpose, MOOC instructors have made extensive use of discussion forums as the main means for interactions to foster learners' knowledge sharing, inquiry, and construction (Cohen, Shimony, Nachmias, & Soffer, 2019; Gillani & Eynon, 2014; Wise & Cui, 2018).

Although MOOC discussions have the potential to promote large-scale communication, in practice, instructors have faced challenges facilitating social, collaborative learning in MOOCs (Cohen et al., 2019; Gillani & Eynon, 2014). Empirical studies of MOOC discussions have consistently shown a lack of reciprocal interaction among learners, a low level of continued participation, and a lack of knowledge contributions (Brinton et al., 2014; Cohen et al., 2019; Gillani & Eynon, 2014). Previous research has also showed that discussion design, instructor facilitation, and technological affordances significantly influence learners' engagement in MOOCs (Cohen et al., 2019; Ouyang & Scharber, 2017; Wise & Cui, 2018). Because of this complexity, research on MOOCs needs to include more mixed-method studies to provide both quantitative, generalized analysis as well as qualitative, detailed descriptions of learning. However, relevant work in MOOCs has encountered practical challenges in fostering social, collaborative learning as well as research challenges in fully investigating various aspects of learning.

To address these practical and research challenges, this work conducted an action research with two purposes: (a) to foster social, collaborative learning in MOOCs through the design and facilitation of a Chinese MOOC; and (b) to fully understand learners' MOOC discussions with a mixed-method research. Based on the results, we propose theoretical, pedagogical, and analytical implications for the future design, practice, and research of MOOCs.

Literature Review

The development of MOOCs has proceeded through three generations, and in all three, social, interactive, online discussions have been a critical component. In the beginning, MOOCs were grounded in connectivism theory. In fact, the first cMOOC titled *Connectivism and Connective Knowledge* was debuted to create a distributed learning environment across varied platforms (e.g., forum, blog, Wikis, social media), in order to help learners aggregate resources, share thoughts, and manage knowledge (Downes, 2011). Next, rooted in cognitive behaviorism theory (Almatrafi & Johri, 2019; Joksimović et al., 2018), the second-generation of MOOCs (i.e., xMOOCs) aimed to extend the subject matter content of campus-based, university-level courses to a larger population. The discussion forum was the main means whereby learners shared ideas and opinions, summarized and reflected on others' ideas, and constructed new meanings together (Wise & Cui, 2018). Third, grounded in social-cognitive constructivism, an emerging generation of MOOCs (e.g., hybrid MOOCs) combined traditional single-platform MOOCs with social, networked learning, and integrated content-centric instruction with social learning activities (García-Peñalvo, Fidalgo-Blanco, & Sein-Echaluce, 2018). In summary, one of the primary goals of MOOCs is to foster knowledge inquiry, construction, and management through social, distributed interactions.

Previous MOOC research has shown that content-related pedagogical strategies (Wise & Cui, 2018), learning analytics tools (Yousef, Chatti, Schroeder, & Wosnitza, 2014), and social, connected learning environments (Cormier & Siemens, 2010) are primary means to foster learning in MOOCs. For example, Gillani and Eynon (2014) used a case-study, inquiry-based strategy in a Coursera MOOC to promote weekly discussions around real-world business problems. Fu, Zhao, Cui, and Qu (2017) developed a visual learning analytics tool, called iForum, that allowed for the interactive exploration of heterogeneous MOOC forum data, in order to make users aware of discussion patterns. Rosé et al. (2015) designed a social, individualized, self-directed learning layer for a traditional, scripted xMOOC, supported with help-seeking and collaborative-reflection functions, through which learners could seek help from peers, create reflection discussions together, and develop social learning experiences in the MOOC forum. In summary, pedagogical strategies, online tools, and social learning environment have all been used to foster MOOC learners' participation, engagement, and reflection.

However, the study of MOOCs has faced practical and research problems that need to be further addressed. First, from a practical perspective, although various design, pedagogical, and technological affordances have been used, there has been a lack of reciprocal interaction, continued participation, and knowledge contributions in MOOCs. For example, Cohen et al. (2019) found that only 8% of learners stayed for the entire MOOC, and a very small portion actively participated and collaborated in the forums. Gillani and Eynon (2014) found that learners started off with a high level of participation in online discussions; over time, however, their commitment to these conversations significantly decreased. In addition, Brinton et al. (2014) concluded that a substantial portion of discussions in MOOCs were not directly course-related. Consistent with Brinton et al. (2014), Wise and Cui (2018) found that a large proportion of discussions in MOOCs was not content-related, idea-centered, or knowledge-based. Last but not least, MOOC learners have demonstrated different participation patterns (Cohen et al., 2019), conversation structures (Wise & Cui, 2018), and linguistic features (Dowell et al., 2015), due to their diverse backgrounds, learning interests, and ways of communicating. Overall, MOOC instructors have faced challenges fostering social, collaborative learning in discussions, as these are influenced by multiple, complicated factors (e.g., course design, pedagogy, tools, learner backgrounds, characteristics, and goals).

Second, from a research perspective, researchers have faced challenges investigating the various aspects of learning in MOOCs, due to the complex interplay of learner interaction, course design, and online technologies. Although several research methods have been used to investigate learning in MOOCs, most studies have used quantitative, algorithm-based methods to examine learners' knowledge mastery, measure retention or drop-out rate, and predict performance (Joksimović et al., 2018). The relevant literature has provided a high-level snapshot of learning in MOOCs as a generalized, summative endeavor, but has resulted in unclear understanding of learners' knowledge inquiry and construction. It is necessary to apply a more holistic, mixed method to understand and interpret individual learners' cognitive inquiry as well as group knowledge construction in MOOCs (DeBoer, Ho, Stump, & Breslow, 2014; Gillani & Eynon, 2014; Joksimović et al., 2018). Echoing this trend, Yang, Wen, Kumar, Xing, and Rosé (2014) used machine learning techniques to model the emerging social and thematic structures in MOOCs discussion forums. Further, these authors used qualitative post-hoc analysis to illustrate the relationship between the learners' expressed motivations regarding course participation and their cognitive engagement with the course materials. Overall, from a research perspective, MOOC research calls for more mixed-method studies to provide both quantitative, generalized analysis as well as qualitative, detailed descriptions of learning in MOOCs.

This study used action research to address the practical and research challenges. First, from a practical perspective, we used a combination of a pedagogical strategy, a learning analytics tool, and a social learning environment to improve learners' engagement in a Chinese MOOC. Second, from a research perspective, we used mixed methods (i.e., social network analysis, content analysis, social-cognitive network visualization, thematic analysis, and thick description) to fully investigate the representative learners' discussion patterns, perceptions, and preferences. Based on the empirical research results, we propose theoretical, pedagogical, and analytical implications for MOOC design, practice, and research.

Research Methodology

Research Purpose and Question

The purpose of this research study was to address a practical challenge (i.e., fostering social, collaborative learning in MOOC discussions) as well as a research challenge (i.e., understanding various aspects of learning in MOOC discussions) through action research (Carr & Kemmis, 1986). First, we applied a combination of knowledge-construction pedagogy, a learning analytics tool, and a social learning environment to design and facilitate a Chinese MOOC. Then, in the empirical research, we adopted mixed methods to investigate the social, cognitive, and perceived perspectives of learning in this Chinese MOOC's discussions. The research question for this study was: *What were learners' patterns, perceptions, and preferences in the MOOC's discussions?*

Research Context

Our research context was an eight-week Chinese MOOC titled *Learning Analytics for Instructional Design, Practice, and Research,* designed and facilitated by the first author (the instructor), and hosted on China's largest MOOC platform, namely icourse (see Figure 1). Due to local regulations, all Chinese MOOCs on the icourse platform must be structured as lecture-based xMOOCs, with the purpose of extending the top-university courses to a larger Chinese population (McConnell, 2018). Following this regulation, the instructor made pre-recorded videos to introduce course content, and designed readings, quizzes, and other assignments (see Figure 1). This MOOC's content included learning and instructional theories, learning analytics concepts, techniques and tools, case studies, and R programming practices. This research was conducted during the first iteration of this MOOC from November 2019 to December 2019; about 850 online learners enrolled in this iteration.

We used a combination of pedagogical strategy, a learning analytics tool, and a social learning environment to foster learner engagement in discussions. First, we used a knowledge-construction pedagogical strategy and related prompts, such as sharing and comparing information, elaborating of opinions, exploring dissonance among ideas, negotiating meanings, and synthesizing knowledge (see Figure 1). Second, from a technological perspective, we designed and devised a student-facing learning analytics tool to demonstrate learners' discussion processes with the interaction, topic, and epistemic networks (see Figure 2). The interaction network demonstrated learners' social interactions with others; the topic network demonstrated learners' use of keywords; and the epistemic network demonstrated five dimensions (i.e., concept, procedure, fact, strategy, and belief) shown by the learners in their posts. This analytics tool was hosted as a Web page and embedded in the course discussion forum. Finally, we built a social learning environment through the use of social media and MOOC forum. We used the group function of a popular Chinese social media tool named WeChat to build a self-organized community through which learners could foster a sense of belonging (see Figure 3). We also designed a social section in the forum for learners to share personal life stories or interesting topics.

Figure 1. The MOOC platform.

From "Learning Analytics for Instructional Design, Practice, and Research," Zhejiang University, hosted through icourse, 2020 (https://www.icourse163.org/course/ZJU-1206577810). In the public domain.

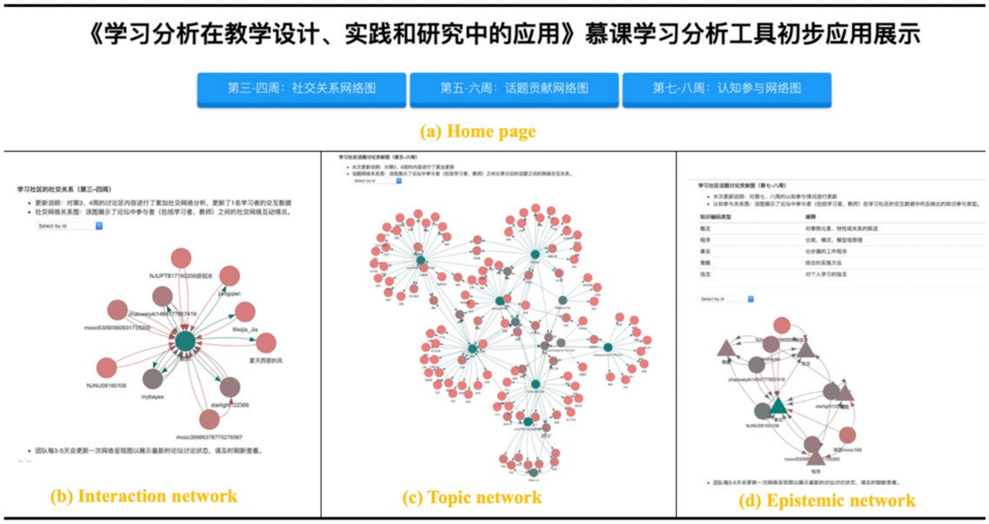

Figure 2. The learning analytics tool.

From "An Application of a Learning Analytics Tool in MOOC," Fan Ouyang research team, n.d. (https://8jrscl.coding-pages.com/). In the public domain.

Figure 3. The WeChat group.

Research Methods

Participants. Using a nonprobability, purposive sampling approach (Cohen, Manion, & Morrison, 2013), we deliberately selected participants who engaged in the discussions from within the wider population of registered MOOC learners. Of the 850 online learners enrolled in the first iteration of the

MOOC, 23 learners participated in the discussions through the MOOC forum and the WeChat group. This proportion was similar to previous MOOC research which indicated that 5% to 25% of registered learners posted in forums at least once (Almatrafi & Johri, 2019). This study was conducted in an unobtrusive way; we sent a consent form to invite learners to participate in the research via WeChat at the end of the MOOC. Six learners agreed to participate in the research and all consented to the data collection approaches. Like most previous MOOC forum research (e.g., Gillani & Eynon, 2014), the sample was not representative of the total population of MOOC learners, but it did represent a certain level of heterogeneity in terms of the learners' gender, age, profession, educational level, and academic major (see Table 1). More importantly, the research results (discussed below) indicated that the six participants showed different discussion patterns in terms of social participatory role and knowledge engagement level. This strengthened the representativeness of the sample.

Table 1

Participant Information

Participant	Gender	Age	Profession	Educational level	Major
Hu	Female	30–39	University lecturer	MS	Educational technology
Jun	Female	30–39	Doctoral student	MS	Literature
Ling	Male	20–29	Data scientist	MS	Psychology
Wei	Female	20–29	Master student	BS	Computer sciences
Xu	Female	30–39	University lecturer	PhD	Educational technology
Zhao	Male	40–49	University associate professor	MS	Educational technology

Note. Participants are identified by pseudonyms.

Data collection. We collected data from three sources. At the end of the course, we saved all the discussion posts and comments from the MOOC forum and from the WeChat group. Discussion content unrelated to course topics was excluded (e.g., social greetings); this content consisted of 5 MOOC forum posts, 16 forum comments, and 18 WeChat comments. The final dataset of discussions included 10 MOOC forum posts, 198 comments, and 22 WeChat comments. Second, we conducted semi-structured, in-depth interviews with the six participants (30–45 minutes duration) by phone within one week after the course ended. The interview questions addressed learners' online learning experiences, motivations and goals, weekly MOOC learning procedures, as well as their perceptions about the MOOC's pedagogy, learning analytics tool, and social learning environment (see Appendix). Finally, one month after the course ended, using the critical event recall approach (Cohen et al., 2013), we invited participants to write a short self-reflection of one or more critical event(s) related to an important learning experience they recalled during or after the course (see Appendix). We specifically asked participants to write about a critical event(s) outside of the MOOC discussions, and through which they applied or relearned the knowledge, such that the critical event(s), to some extent, implied learners' learning preferences.

Data analysis strategies. We used mixed methods (i.e., social network analysis, content analysis, social-cognitive network visualization, thematic analysis, thick description) to analyze and understand the participants' discussion patterns, perceptions, and preferences. First, we analyzed the discussion patterns from both social and cognitive aspects. Specifically, we used the social network analysis method to analyze the social participatory roles of the 23 learners and the instructor. Based on previous research (see Ouyang & Chang, 2019; Ouyang & Scharber, 2017), we identified six types of social participatory roles (i.e., leader, starter, influencer, mediator, regular, and peripheral) in terms of the level of (a) participation (reflected by outdegree and out-closeness); (b) influence (reflected by indegree and in-closeness); and (c) mediation (reflected by betweenness). Then, based on a predefined framework (see Ouyang & Chang, 2019), we used the content analysis approach to analyze individual knowledge inquiry (IKI) capturing three levels of individual knowledge inquiry within learners' initial comments, and group knowledge construction (GKC) capturing three levels of group knowledge advancement within learners' responses to others. The superficial, medium, and deep levels of IKI, respectively, indicated learners' sharing information, presenting their own thoughts without, and with detailed explanation. The superficial, medium, and deep levels of GKC indicated simple (dis)agreement, extension or argumentation of others' ideas without and with detailed explanation. Two raters (the first author and the third author) discussed the coding framework to reach a full understanding of the codes, then they coded all the content independently, and reached an inter-rater reliability of 0.825 in terms of Cohen's kappa. We then calculated the participants' cognitive engagement as a weighted IKI score ($N_{\text{SKI}} * 1 + N_{\text{MKI}} * 2 + N_{\text{DKI}} * 3$) and a weighted GKC score ($N_{\text{SKC}} * 1 + N_{\text{MKC}} * 2 + N_{\text{DKC}} * 3$). Finally, based on the work of Ouyang and Chang (2019), we used social-cognitive network visualization to demonstrate participants' social interaction patterns (i.e., participatory role, network position) and knowledge contribution patterns (i.e., IKI and GKC score). It is worth mentioning that we analyzed the patterns for all 23 learners and the instructor as these could be tracked in the overall network (see Figure 4), but only reported the six participants' results in order to address the research question.

Second, using the thematic analysis approach (Cohen et al., 2013), we analyzed the learners' interview transcripts in order to identify the recurring themes of learners' perceptions regarding the pedagogical strategy, learning analytics tool, and social learning environment. The first author analyzed the original interviews, coded interview transcripts, and identified the themes and evidence. The other authors read transcripts, double-checked the thematic analysis results, and translated the transcripts from Chinese to English.

Finally, the first author read the learners' self-reflections and identified their learning preferences reflected by the critical events. Based on the analysis, we summarized the learners' preferences with supporting evidence from their write-ups.

Results

Patterns

Overall, the six participants demonstrated various patterns in terms of social and cognitive engagement. Socially, they demonstrated six different social participatory roles, and were positioned in three different places in the network (see Table 2 and Figure 4). Regarding the cognitive aspect, they demonstrated low, medium, and high levels of contributions to individual and group knowledge (see Table 2 and Figure 4).

Ling, as a leader (calculated by SNA metrics), not only actively replied to others' comments but also received frequent responses. In addition, Ling had a high-level IKI (score = 56) and a high-level GKC (score = 34). Hu, an influencer, received a relatively high level of responses from the others and replied to others with a medium-level of frequency. In addition, Hu had a high-level IKI (score = 87), and a low-level GKC (score = 3). Jun, a starter, actively replied to others' comments, but received responses infrequently. In addition, Jun had a medium-level IKI (score = 54), and a high-level GKC (score = 28). Overall, socially active students (e.g., leader, starter, influencer) tended to make the most knowledge contributions at both individual and group levels. The results of the influencer indicated that learners may reply more frequently to those who demonstrate the high-level IKI in their initial comments. The results of the starter indicated that learners who proactively initiate interactions tended to have a higher-level GKC.

If subgroups naturally formed in the network, Wei, a mediator, had a high mediatory effect as the bridge between sub-groups. Wei both replied to others and received responses with a medium-level of frequency. In addition, Wei had a medium-level IKI (score = 25), and a medium-level GKC (score = 13). Zhao, a regular learner, replied to others and received responses with a medium-level of frequency. Zhao had a medium-level IKI with a score of 41, and a low-level GKC with a score of 5. Overall, the results implied that one's medium-level social activeness was consistent with the level of contribution to individual and group knowledge.

Finally, Xu was a peripheral who neither actively replied to peers nor did she gain frequent responses. Xu had a low-level IKI with a score of 11, and a low-level GKC with a score of 3. Therefore, socially inactive learners made the fewest knowledge contributions.

Table 2

Pattern Results

	Social engagement		Cognitive engagement	
	Participatory role	Network position	IKI level (score)	GKC level (score)
Ling	Leader	Central	Medium (56)	High (34)
Jun	Starter	Central	Medium (54)	High (28)
Hu	Influencer	Central	High (87)	Low (3)
Wei	Mediator	Middle	Medium (25)	Medium (13)
Zhao	Regular	Middle	Medium (41)	Low (5)
Xu	Peripheral	Peripheral	Low (11)	Low (3)

Note. Excluding the instructor's participation results, the range of replies was [1, 20], and range of responses was [1, 11]; the range of IKI scores was [0, 87], and the range of GKC scores was [0, 34].

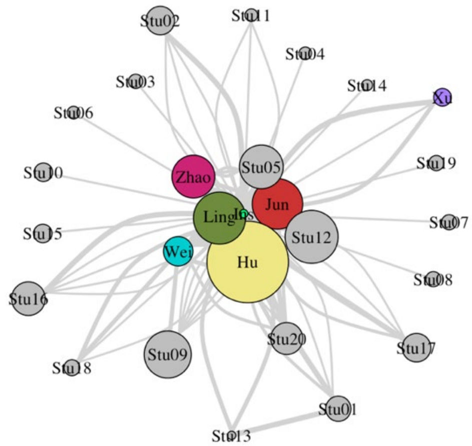

Figure 4. The overall social-cognitive network.

Node color represents the six participatory roles (i.e., leader in green, starter in red, influencer in yellow, mediator in blue, regular in pink, and peripheral in purple). Node size represents the weighted IKI score, and edge width represents the weighted GKC score. Learners who did not participate in this research are marked as grey nodes; edge directions were deleted for network simplicity.

Perceptions

Learners' perceptions of their MOOC discussion experiences were elaborated in terms of their perspectives on the pedagogical strategy, learning analytics tool, and social learning environment. First, regarding the pedagogical strategy, among the six participants, active learners (based on the levels of their social engagement and cognitive engagement) tended to perceive the knowledge construction strategy positively. In particular, they perceived discussion participation, social interaction, and peer sharing as positive factors that fostered their knowledge contributions. For example, Ling mentioned the importance of social interactions with peers, noting that "replying to my classmates' comments . . . receiving responses for my questions . . . reading responses from other students . . . are important approaches to inspire my learning." Wei also perceived the importance of peer response by saying "If you have someone who supports your point of view, or has questions about your points . . . this would help you think more and understand deeper." Jun mentioned the effect of peer sharing, and said that "I read what other students posted, such as sharing of articles, which I may not have read before . . . this deepened my thinking and enriched my views." Hu mentioned the importance of participation in discussion activities. "The discussions [assignment] encouraged me to search and post related materials . . . the learning effect could be better with this participation."

These socially and cognitively active learners also perceived the importance of instructor participation. In particular, instructor response, idea generation, and discussion facilitation were positive factors that promoted learners' knowledge contributions. For example, Hu mentioned the influence of instructor response and stated that "when the instructor replied me on the forum, I'd take it as an encouragement, and would do it better next time." Jun mentioned the importance of the instructor generating and sharing her own ideas. "The instructor's opinion can help the learners better understand an issue . . . it also helped promote the participations (*sic*)." Ling mentioned that the instructor's facilitation fostered his further learning, as when the instructor "reminded us to look back . . . and encouraged us to relearn [materials]. . . . I usually had a better understanding [of the knowledge] in the next a couple of days." Wei viewed the instructor responses as a guidance for learning and said "the instructor's comments seemed to be directive [for us]. For example, when I saw you [instructor] replying to someone's post, I would probably read and think about it a few more times."

Inactive learners, however, tended to perceive the level of difficulty, amount of time consumed, and course design issues in the MOOC. For example, Zhao mentioned the difficulties he faced. "Personally speaking, I only had a limited understanding on certain knowledge. So, I didn't feel like contributing much in the discussions." Xu perceived there was a high level of time consumed by the discussions, which might impede her participation. "In this course, the discussion could not be completed easily like [that in] other courses. I must search resources from other channels like the CNKI database . . . it usually took me another two hours to construct a post." In addition, both Xu and Zhao mentioned course design issues. For example, Xu questioned the effect of the open-ended inquiry for knowledge construction. "If you want to construct knowledge, what knowledge exactly do you want to build? . . . The video content was somehow very open." Zhao mentioned a disconnect between course content and the discussion topics, which negatively influenced his participation. "The forum discussions and instructional videos didn't have much to do with each other. . . . I didn't feel the discussions and video content were closed bonded." He further suggested a step-by-step scaffolding for the discussion forum. "The course content is quite open . . . it would be better when the discussion scaffolding was clearer, like [using a] step-by-step [approach]." Interestingly, the active learners (e.g., Ling and Jun) perceived the open-ended inquiry nature of the MOOC discussion positively. For example, Jun said "I took a SPSS MOOC before . . . I only watched videos to learn techniques. . . . For courses like this in the social science field, knowledge sharing and constructions were beneficial to improve the higher-level cognitive thinking (e.g., critical thinking)."

Second, regarding technological support in the MOOC discussions, most learners responded that the learning analytics tool helped them understand and reflect on the discussions. They also pointed out the drawbacks of this tool and offered revision suggestions including an integrative function, real-time visualization, and simpler tools to better represent and support the learners' knowledge construction processes. For example, Ling said that "it would be better to have a real-time function . . . sometimes the network was shown after I posted something in the forum. . . so, it was not synchronous." Wei suggested an integrative function. "You could consider connecting the participant nodes in the interaction network to the keywords that a participant contributed."

Finally, regarding the social learning environment, both active and inactive learners perceived the importance of building the social, supportive learning community to foster knowledge contributions. Although this research did not focus on the social, off-topic discussions, participants' responses did reveal the importance of these social discussions. For example, the active learner Jun said that "in this type of knowledge-construction process, learners were more likely to establish a learning community, which was very beneficial and important." The peripheral learner Xu also perceived a sense of the social community in the forum. "You [instructor] set a discussion module where we could share our lives. I think this was a great way to make me feel like I was a part of the MOOC community . . . and I was not studying alone." Ling was the only participant who mentioned the usefulness of synchronous communication in the WeChat group. "I liked to share [information] directly in the WeChat group . . . we communicated closely on WeChat. . . . I would like to have more synchronous chatting there."

Preferences

Learners' self-reflections of a critical event(s) of knowledge construction revealed that, in addition to the MOOC discussions, knowledge application, extended learning, and offline collaboration were their three major preferences. For example, although Hu faced difficulty understanding some course literature, she recalled an active participation situation when there was potential to apply the knowledge in practice. "I did seriously participate in some discussions like the topics of social networks . . . [because] it may benefit my teaching and research in the future." In recalling a knowledge application event after the course, Ling noted that:

> I have been leading a research project in the department. . . . I analyzed some data from the student cards. . . . I applied the social network analysis to the student data. . . . I introduced how to apply those analytic techniques to my colleagues later.

Moreover, several learners employed individual, extended learning to better understand their course knowledge. For example, Wei recalled an extended reading process in which "a peer in this course proposed a real-world problem he encountered . . . which was a new way to complement my thinking. … I re-read and downloaded several papers to learn how they addressed the similar data analytical issues." Xu also mentioned an extended process of learning programming. "I was a beginner for programming . . . so I bought in a series of R videos through an online channel as well as R books to learn more." Jun recalled an offline collaboration opportunity with another learner she met in the MOOC:

> Although I was not good at analytical techniques, there were several experts in the group. . . . Ling seemed good at data analytics. . . . I made a phone call to him and he was willing to collaborate with me on my research project.

Discussion

Addressing the Research Question

Although the learners' participation in the MOOC was inconsistent, as revealed in Gillani and Eynon (2014), this study conducted an action research to design and foster social, collaborative learning in a Chinese MOOC. Through empirical research investigation, we gained a detailed picture of the six representative learners' patterns, perceptions, and preferences of MOOC discussions supported with specific pedagogy, a learning analytics tool, and social learning environment.

First, from the pattern perspective, the socially active students made the most knowledge contributions, while the socially inactive learners made the fewest. Consistent with previous research results (e.g., Ouyang & Chang, 2019; Wise & Cui, 2018), learners' social engagement level was a critical indicator of their knowledge contributions. Second, from the perception perspective, the socially and cognitively active learners tended to have a positive perception of the course design, pedagogy, and analytics tool. On the contrary, the inactive learners tended to have negative perception of the MOOC discussions (e.g., the difficulty level, amount of time consumed, and course design issues), which in turn resulted in their inconsistent participation. All the learners perceived the importance of building a social, supportive learning community to foster social interaction. Third, from the preference perspective, the results revealed a complex knowledge construction process that connected the MOOC discussion with further knowledge application, extended learning, and offline communication. Overall, consistent with previous research (e.g., Cohen et al., 2019; Wise & Cui, 2018), our results indicated that learners demonstrated varied patterns, perceptions, and preferences, which implied a complex discussion process due to the interplay of multiple factors (e.g., learner interaction, instructor participation, and pedagogical and technological support). Based on these results, this research offers theoretical, pedagogical, and analytical implications for MOOC design, practice, and research.

Theoretical Implications

As knowledge continues to grow and evolve (Bereiter, 2002), learner agency (Bandura, 2001) for knowledge construction and creation is critical. Regardless of the theoretical foundation upon which a MOOC is grounded (Almatrafi & Johri, 2019; Bell, 2011; Joksimović et al., 2018), the MOOC's design, instruction, and associated learning should enhance learners' thinking and cognitive ability, foster social interaction and collaboration, and advance group knowledge (Bereiter, 2002; Damșa, 2014). As our research results initially revealed, the learning process in the MOOC was socially distributed, locally contextualized, and evolved over time in a network composed of interdependent components (Brown, Dehoney, & Millichap, 2015). Compared to inactive learners, active learners took actions to initiate peer interactions and to advance individual and group knowledge (Ouyang & Chang, 2019; Wise & Cui, 2018). Therefore, with the goal of improving knowledge construction, creation, and management, learners should actively interact with their instructor and peers, course content, and the tools available; instructors should serve as learning facilitators and so put learner agency at the center of their practice (Bandura, 2001). The pedagogical implications discussed below can help develop learner agency.

Pedagogical Implications

To foster learner agency, instructors should design and facilitate MOOC discussions by considering learner diversity, fostering a coherent communication, and providing appropriate social and technological supports. First, consistent with previous research results (Cohen et al., 2019; Gillani & Eynon, 2014), our research indicated that even though the instructor used the knowledge-construction strategy, the learners still had different levels of social and cognitive engagement. This implies that the active and peripheral learners might have different needs for instructional design, support, and intervention. Even so, most MOOCs have a low quality of instructional design (Margaryan, Bianco, & Littlejohn, 2015) and deficiencies in their support structure (Kop, Fournier, & Mak, 2011). To promote learner agency, instructors should carefully consider learners' prerequisite knowledge, backgrounds, and learning goals as they design idea-centered, knowledge-construction discussions (Margaryan et al., 2015; Ouyang, Chang, Scharber, Jiao, & Huang, 2020; Wise & Cui, 2018). To facilitate learning among students who are accustomed to a knowledge transmission mode of teaching, instructors should pay specific attention to balancing open-ended discussions and instructional scaffolding (McConnell, 2018). Second, our results showed that MOOC learners preferred diverse ways of communicating, which implies that MOOC communications need to be facilitated via multiple channels, distributed in various locations, and accessed at varied times (Chen, 2019). More coherent communication should be facilitated among multiple communication channels, including Web objects, online platforms, and offline events (Chen, 2019). Finally, as our results showed, social and technological affordances have potential to cultivate a learning community in which the instructor can adopt a different set of approaches to provide a route for ongoing peer support, self-awareness, and social connection (Bereiter, 2002; Wise & Cui, 2018). It is necessary to devise learning analytics tools that can provide ongoing, real-time support based on learners' social and cognitive engagement, as these are constantly changing during discussions (e.g., Chen, Chang, Ouyang, & Zhou, 2018). Overall, learner needs, ways to communicate, and technological supports are all important factors that need further application and research in order to improve social, collaborative learning in MOOCs.

Analytical Implications

The next generation of MOOC research should aim to explain the learning process in MOOCs and the various factors that influence it (DeBoer et al., 2014; Joksimović et al., 2018). From an analytical perspective, mixed-method research can help capture a holistic picture of learning and instruction in MOOCs (Gašević, Kovanović, Joksimović, & Siemens, 2014; Joksimović et al., 2018). Most previous studies used quantitative, algorithm-based methods to research learners' knowledge mastery, dropout rate, and course performance. Taking a step forward, this study used mixed methods to understand learners' discussion patterns, perceptions, and preferences from the quantitative, qualitative, and perceived perspectives. However, the dataset for this research was small, comparing to the large volume of MOOC data used in other studies. Strategies for the use of mixed methods to deal with a large volume of learners' data is a critical condition for MOOC research and development (Raffaghelli, Cucchiara, & Persico, 2015). In addition, a measure of post-course learning effect can also enrich stakeholders' understanding of the wider impact of MOOCs, and better evaluate the value of MOOCs (Joksimović et al., 2018). Overall, integrative, mixed methods, combining qualitative methods with learning analytics, should be used to better understand learning in MOOCs.

Conclusions and Future Directions

In the current knowledge age, MOOCs should foster learners' knowledge construction, creation, and management in order to meet society's needs (Gillani & Eynon, 2014; Kop et al., 2011; Siemens, 2005). Taking an initial step towards this goal, we designed a Chinese MOOC with the support of a combination of pedagogy, learning analytics tool, and social learning environment, and investigated learners' discussion patterns, perceptions, and preferences. Although this empirical research merely demonstrated the results of a very small proportion of the MOOC's learners, it revealed a complex, interweaving relationship among instructional design, instructor facilitation, as well as social and technological affordances. Moreover, this research opens avenues for future MOOC research and practice. First, it is critical to further understand the learning process in MOOCs, one in which learner agency should be put at the center. Second, it is beneficial to further develop pedagogical strategies that better integrate learner motivations, interests, and goals within MOOCs designs. Finally, empirical research can use mixed methods to capture various aspects of learning in MOOCs. In conclusion, future work should focus on ways to foster learners' knowledge construction, creation, and management through large-scale interaction, communication, and collaboration in the open, networked age.

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Appendix

Interview Questions and Learner Self-Reflection

Interview Questions

1. How much time did you spend on this MOOC each week?
2. Did you have any experiences of online learning?
3. What motivated you to choose this course? Have you gained the expected knowledge or skills after the eight-week study?
4. Please describe a typical one-week learning process during your study.
5. How did the forum discussion affect your study, and why?
6. What is your opinion on the knowledge-construction strategy? How did it affect your study, and why?
7. What is your opinion about the social learning analytics tool?
8. How did the instructor's participation in discussions affect your participation, and why?
9. What is your opinion about the use of WeChat group in this MOOC?
10. Please give other suggestions of the design of this MOOC.

Learner Self-Reflection

Please write about a learning experience related to knowledge inquiry and construction you can recall. Choose a critical event(s) outside of the MOOC discussions, through which you applied or relearned the knowledge you gained in the course.

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Research Trends in K–12 MOOCs: A Review of the Published Literature

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Abstract

Massive Open Online Courses (MOOCs) appeared in the area of educational technologies in 2008. Until 2013, academic research into MOOCs focused mainly on their application to adults as well as students or graduates of tertiary education. However, since 2013, the rising number of K–12 students enrolled in higher education MOOCs made MOOCs a *de facto* reality in pretertiary education and triggered universities, governments, and MOOC providers to (a) develop MOOCs specifically designed for pretertiary education, and (b) research their potential and value in K–12 educational settings. This resulted in a notable number of K–12 MOOCs and pilot research works in the literature that focused on the potential of MOOCs in compulsory education settings, as well as on their ability to reshape and transform the current educational K–12 framework. This work seeks to (a) trace, analyze, and review the existing literature on K–12 MOOCs, (b) identify representative MOOC implementations, (c) classify and organize research trends and patterns, and (d) reveal MOOCs' potential value and impact on K–12 settings. The research used a narrative literature review methodology in order to critically review and qualitatively analyze twenty-one research publications in a systematic manner. Analysis of relevant works demonstrated that MOOCs, under a set of prerequisites, can be effectively incorporated into and positively affect pretertiary education.

Keywords: MOOC, K–12 education, compulsory-age education, narrative review

Introduction

Massive open online courses (MOOCs) are online courses aiming for unlimited participation and open access to knowledge via the Web (Kaplan & Haenlein, 2016). Since their first appearance in 2008, their popularity has increased rapidly, and now it is estimated that more than 11 thousand such courses provide free and open educational content to more than 100 million learners worldwide (Shah, 2018). During these years, research on MOOCs has mainly focused on their application to adults as well as students or graduates of tertiary education, while research on the potential, role, value, and benefits of this new learning tool in pretertiary education was absent until 2013 (Ferdig, 2013).

Since 2012, which was called the year of the MOOC (Pappano, 2012), the growing popularity of MOOCs in higher education triggered discussions about their potential role in lower educational levels (Briggs & Crompton, 2016), but it was the rising number of K–12 students who enrolled in MOOCs designed for tertiary education that made them a reality in compulsory education (Atkeson, 2014; Guo & Reinecke, 2014; Stoltzfus, Scragg, & Tressler, 2015). This increment of K–12 students' participation in MOOCs resulted in a concurrent increase in research interest on K–12 students' perceptions of and experiences with this new, digitally advanced learning tool, as well as the benefits from MOOCs' use in pretertiary education in general (Briggs & Crompton, 2016; Dermirci, 2014; Horn, 2014; Norris & Soloway, 2012).

The use of an advanced digital learning tool such as the MOOC in K–12 education is beneficial, not only due to the digital advantages it provides, but also due to the remarkable potential to provide enriched learning opportunities (Briggs & Crompton, 2016). However, current MOOC types aimed at adult learners often don't meet the needs of K–12 students. The MOOC model for K–12 education must be consistent with pedagogical methods that best fit the ways K–12 students learn, in order to meet the needs of the K–12 educational setting (Bock & O'Dea, 2013; Briggs & Crompton, 2016; Locke, 2013). Anecdotal research has demonstrated that MOOCs can be used in pretertiary education as a supplementary resource to traditional instruction, taking a blended approach (Atkeson, 2014; Pannoni, 2014). A blended learning or flipped classroom model based on MOOCs can enhance the learning process and ensure teaching efficiency by combining face-to-face instruction and online learning, taking advantage of the best of what each has to offer (Briggs & Crompton, 2016; Kassner, 2013). To this extent, MOOCs can effectively be incorporated in school practice in a blended approach, with great potential to benefit students of all ages, providing personalized, engaging, and authentic learning experiences (Briggs & Crompton, 2016; Locke, 2013).

Incorporating MOOCs in K–12 education has several benefits for both students and teachers. MOOCs can successfully be implemented into existing school infrastructures as foundation courses that could either help students prepare for college or supplement the existing school curriculum. Moreover, MOOCs can be used by students either as remedial courses, to help low-level students, or as additional advanced courses, to offer new teaching subjects at a level beyond the K–12 setting. Furthermore, professional development MOOCs for teachers can alleviate disparities, supplement knowledge, and improve student outcomes (Ferdig, 2013; Locke, 2013; Koxvold, 2014).

The rising number of K–12 students enrolled in higher education MOOCs led universities, governments, and MOOC providers to develop MOOCs specifically for students of pretertiary education (Guo & Reinecke, 2014; Atkeson, 2014). The first K–12 MOOCs were provided in 2013, through independent initiatives undertaken by well-established universities, educators, and researchers. One year later, European SchoolNet Academy, Canvas, Coursera, and Edx platforms developed and provided courses for younger audiences, as well as for K–12 educators. Day by day, more and more K–12 MOOCs are made available and can be integrated into school practice and policy, making research on their potential role and value in pretertiary education much easier than in the past. At the same time, an increasing number of academic papers on K–12 MOOCs appears in the peer-reviewed literature. Since 2013, the few pilot research works that have been carried out have highlighted: (a) the considerable potential MOOCs have to play in K–12 education, and, at the same time, (b) the need for further research and experimentation in order to identify and evaluate the opportunities, benefits, risks, uses, and actual value of this tool in the settings of K–12 education (Yin, Adams, Goble, & Madriz, 2015; Wartell, 2012).

Aiming to contribute to this promising research area, this paper seeks to trace, analyze, and review the existing literature on K–12 MOOCs, identify trends and patterns, and classify the academic research on pretertiary educational MOOCs.

Through this process, our work addresses the following research questions:

Q1. What are the most representative K–12 MOOC implementations?

Q2. What are the research trends in the K–12 MOOC field?

Q3. Do MOOCs have a positive impact on K–12 education?

The paper is organized into four sections. Section 1 presents the rationale and defines the objectives and scope of this research. Section 2 presents the methodology used to gather and analyze the literature. Sections 3 and 4 present, analyze, and discuss the research findings and conclusions based on the criteria established by the research questions.

Methodology

In this section, we describe the methodology used for our work and, more specifically, the methods by which we gathered literature on K–12 MOOCs (data collection) and examined, classified, and analyzed that literature (data classification and analysis).

In our research, we used a narrative literature review methodology to identify and summarize what has been previously published, develop a comprehensive overview of K–12 MOOC research, and reveal new study areas not yet addressed (Ferrari, 2015). Such reviews benefit researchers in planning future studies, as well as developing convenient summaries of the literature on a particular issue (Petticrew & Roberts, 2008).

Ferrari (2015) claims that the quality of a narrative review may be improved by borrowing elements from the systematic review methodologies. In this respect, the following three key activities for systematic research proposed by Gough, Oliver, and Thomas (2012) were applied to our approach:

1. identifying relevant research
2. critically reviewing and qualitatively analyzing the identified research works in a systematic manner, using evidence tables (Green, Johnson, & Adams, 2006), and
3. synthesizing research findings into a set of conclusions.

Data Collection

Literature discovery searches were systematically conducted, using the key words "MOOC," "MOOCs," "Massive Open Online Course," and "Massive Open Online Courses" in conjunction with "K12," "K–12," "secondary education," "compulsory education," and "high school."

To be included in the corpus, each identified document had to

- focus on MOOCs used in pretertiary education and address K–12 students;
- have been published in a peer-reviewed journal or in conference proceedings, and present primary research studies;
- have been published or been made available online between January 2013 and March 2020; and
- have been written in the English language.

We started searching with Google Scholar (https://scholar.google.com/), Scopus (https://www.scopus.com/), and Research Gate (https://researchgate.net). Then we continued our search using the same keywords in databases more specialized in education sciences, such as ERIC (https://eric.ed.gov/), Microsoft Academic (https://academic.microsoft.com/), IEEE Transactions on Education (https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=13), and iSeek Education (http://education.iseek.com/iseek/home.page).

Next, we focused our research on educational technology resources, and we used the LearnTechLib Library (https://www.learntechlib.org/) and the Educause Library (https://library.educause.edu/).

Subsequently, we conducted a forward referencing process, similar to the one proposed by Veletsianos and Shepherdson (2016) and Liyanagunawardena et al. (2013), in order to identify relevant research that had cited the papers we had already located. We first located in Google Scholar each of the papers included in our corpus. Google Scholar provides information on how many times a paper is cited and allows researchers to view all papers citing the original. If these new articles met our inclusion criteria, we included them in our corpus. Finally, we examined the references of the papers in our corpus, which were published after 2013, in order to identify any we might have missed.

This data collection process resulted in the identification of twenty-one distinct published works in total, including seven papers published in academic journals and fourteen papers in conference proceedings.

Data Classification and Analysis

Each of the twenty-one identified publications on K–12 MOOCs was read and analyzed by the authors in a systematic and consistent manner. During this process, for every publication, the authors' team identified and systematically recorded:

1. the focus of the research work
2. the aim of the research work

3. the research questions that each work attempted to address
4. the research methodology
5. the aspects related to K–12 MOOC implementation, and
6. the research findings, identified results and conclusions.

The collected data were organized to address the three research questions. In this respect, each piece of evidence drawn from the twenty-one papers was extracted in the same fashion to help decrease potential bias. Evidence tables were used in order to identify similarities and differences in the analyzed studies. These tables are presented in the following section.

Review of the Literature and Discussion on the Research Findings

Research Question 1: What are the Most Representative K–12 MOOC Implementations?

The main goal of this study was to trace and classify the existing K–12 MOOC implementations that emerged during the data collection process. The classification analysis focused on three key aspects: (a) the country where the MOOC is implemented, (b) the teaching subject of the MOOC, and (c) the provider and the learning platform where the MOOC is hosted. Table 1 shows the K–12 MOOC implementations classified based on these criteria.

Table 1

K–12 MOOC Implementation Grouping Factors

Publication	MOOC	Implementation Country
Politis, Koutsakas, and Karagiannidis (2017); Koutsakas, Syritzidou, Karamatsouki, and Karagiannidis (2018); Koutsakas, Karagiannidis, Politis, and Karasavvidis (2020)	A Computer Programming MOOC for Secondary Education	Greece
Blazquez-Merino, Macho-Aroca, Baizán-Alvarez, Garcia-Loro, San Cristobal, Diez, and Castro (2018)	IES Electric Measure MOOC	Spain
Canessa and Pisani (2013)	OpenEya Mathematics MOOC OpenEya Physics MOOC	Italy

Cohen and Magen-Nagar (2016)	Mobile End-Means Robots (MOOC) Introduction to Astronomy	Israel
De Kereki and Paulós (2014)	SM4T: Scratch MOOC for Teens	Uruguay
De Kereki and Manataki (2016)	Code Yourself & A Programar MOOCs	UK & Uruguay
Dziabenko and Persano Adorno (2017)	Resistors in Series Connections microMOOC	Spain
Filvà, Guerrero, and Forment (2014)	Obligatory Secondary Education MOOC 2014 for Mobile Apps (ESOMOOC14MA) Introduction to Mobile App Development (IDAM)	Spain
Grella, Staubitz, Teusner, and Meinel (2016)	Learning to Program in a Playful Way	Germany
Grover, Pea, and Cooper (2016)	Foundations for Advancing Computational Thinking—FACT MOOC	USA
Hermans and Aivaloglou (2017)	Scratch: Programmeren voor kinderen	Netherlands
Khalil and Ebner (2015)	Mechanics in Everyday Life MOOC	Austria
Kurhila and Vihavainen (2015)	Introductory Programming Course MOOC	Finland
Najafi, Evans, and Federico (2014)	Behavioural Economics in Action BE101X MOOC	Canada
Nigh, Pytash, Ferdig, and Merchant (2015)	K–12 Teaching in the 21st Century	USA
Panyajamorn, Kohda, Chongphaisal, and Supnithi (2016)	Chemistry MOOC	Thailand (rural area)
Staubitz, Teusner, and Meinel (2019)	Learning to Program in a Playful Way MOOC Introduction to Object-Oriented Programming in Java MOOC	Germany
Tomkins, Ramesh, and Getoor (2016)	Computer Science MOOC	USA
Yin, Adams, Goble, and Madriz (2015)	Dinosaur Paleobiology MOOC	Canada

The data collection process showed that a significant number of K–12 MOOC implementations are STEM-related courses. More specifically, in Spain, Dziabenko and Persano Adorno (2017) designed a micro-MOOC in the field of physics to introduce school students to the topic of resistors in series connections. The remote experiment VISIR+ of the WebLab at the University of Deusto was incorporated into that micro-MOOC. This course was delivered in the frame of the ERASMUS+ project, "Open discovery of STEM laboratories (ODL)," and the open edX platform was employed to provide the MOOC to students. Similarly, Blazquez-Merino et al. (2018) developed a structured MOOC to optimize learning electricity concepts, magnitudes, and skills. The Virtual Instruments Systems In Reality (VISIR) remote laboratory was incorporated into the MOOC in order to help students move from initial conceptualization to practice-based learning. The MOOC was developed by the Electrical, Electronic and Control Engineering Department of the Spanish Open University (UNED) and provided via the Moodle LMS platform.

In Italy, Canessa and Pisani (2013), designed and implemented a High School Open Online Course (HOOC) in the field of physics and mathematics based on the school curriculum. The MOOC was implemented as a part of the OpenDante project for high school lectures, and the OpenEya software was used in order to archive and share these on-line lessons with students. Likewise, in Austria, Khalil and Ebner (2015) took advantage of a high school STEM MOOC on the subject of physics, mechanics, and aerodynamics sciences in order to apply learning-analytics tools. The MOOC was hosted on the Austrian iMooX platform.

In addition, in the rural areas of Thailand, Panyajamorn, Kohda, Chongphaisal, and Supnithi (2016) used a chemistry MOOC, on the topic of atoms and electronic structures, in conjunction with active learning and flipped learning models. The MOOC was created at the University of Kentucky and delivered via the Coursera platform. In Israel, Cohen and Magen-Nagar (2016) exploited three MOOCs in the field of robotics and astronomy, in combination with a project called Academy Online, in order to integrate academic MOOCs and active learning through the flipped classroom model in the Israeli education system. The MOOCs were developed by the Georgia Institute of Technology and the Open University of Australia and delivered via the Coursera platform.

Most of the collected research papers deal with computer-science MOOC courses. In Germany, Grella, Staubitz, Teusner, and Meinel (2016) designed and ran the MOOC "Learning to Program in a Playful Way," in order to teach young students the Python programming language. The MOOC was hosted by the openHPI learning platform. A few years later, Staubitz, Teusner, and Meinel (2019) redesigned and re-ran "Learning to Program in a Playful Way," and offered at that same time a second MOOC to teach Java programming to high school students. Both MOOCs were given as stretched versions, aiming to lower students' weekly workloads in order to smooth integration. The MOOCs were provided by the MOOC.house, which is based on the openHPI platform.

In Uruguay, De Kereki and Paulós (2014) designed and implemented a MOOC to teach computer programming with Scratch. This MOOC was developed by the Universidad ORT Uruguay as a part of a government project called CEIBAL and offered by the CEIBAL's CREA platform. Two years later, De Kereki and Manataki (2016) in Uruguay and the United Kingdom, collaboratively launched a bilingual MOOC in Spanish and English to teach computational thinking and computer programming with Scratch. The MOOC was developed by the Universidad ORT Uruguay in collaboration with the University of Edinburgh, and the course was implemented using the Coursera platform.

In the USA, Grover, Pea, and Cooper (2016) designed a MOOC for building awareness of computing as a discipline, and for teaching foundational computational concepts using Scratch. The course was deployed on Stanford University's OpenEdX platform. Additionally, in the USA, Tomkins, Ramesh, and Getoor (2016) developed and demonstrated a computer science MOOC to teach object-oriented computer programming. The course was offered by a for-profit education company. Similarly, in the Netherlands, Hermans and Aivaloglou (2017) created and ran an introductory MOOC to teach Scratch programming concepts and software engineering concepts simultaneously. The MOOC was designed following the pattern from the Delft University of Technology and provided on the edX platform.

In Finland, Kurhila and Vihavainen (2015) implemented a university-level introductory MOOC to high school students in the field of computer science to teach programming concepts. The MOOC was developed at the University of Helsinki and offered on the MOOC.fi platform. Similarly, in Greece, Koutsakas, Karagiannidis, Politis, and Karasavvidis (2020) created and implemented a MOOC to teach structured computer programming. After the first implementation, the MOOC was modified and launched the next year, aiming to address K–12 students' requirements recorded during its first implementation. The MOOC was hosted on the Udemy platform and was accompanied by a Facebook group (Koutsakas, Syritzidou, Karamatsouki, and Karagiannidis, 2018). In Spain, Filvà, Guerrero, and Forment (2014) created and implemented two MOOCs, which were conducted using the same structure and organization but with a significant difference in enrollment. The subject of the MOOCs was common and referred to informatics and technology and, more specifically, to the development of mobile apps. Both MOOCs were provided by the Moodle LMS platform.

The classification of the collected data revealed that most MOOC implementations are STEM-related, and, more specifically, computer science courses. Nevertheless, there is also a small number of MOOC courses in other subject areas. In Canada, Najafi, Evans, and Federico (2014) integrated a behavioural economics MOOC into the school-based course, "Analyzing Current Economic Issues." The course was developed at the University of Toronto and provided on the edX platform. By the same reasoning, Yin, Adams, Goble, and Madriz (2015) used an undergraduate level MOOC on the subject of paleontology which could not otherwise fit into the school curriculum to reach students, who were, in this case, accompanied by their parents. The MOOC was created by the University of Alberta and offered via the Coursera platform. Finally, in the USA, Nigh, Pytash, Ferdig, and Merchant (2015) developed a MOOC in the field of K–12 teaching and learning. The MOOC was intended for teachers and students interested in becoming teachers. The MOOC was designed at Kent State University, in collaboration with Michigan Virtual School, and deployed on Blackboard CourseSites CMS.

Research Question 2: What are the Representative Trends in K–12 MOOCs?

The second goal of this study was to identify research trends and patterns in the field of K–12 MOOCs, through analysis of the research aims and objectives of existing studies. The classification analysis focused on the role that the K–12 MOOC played in the educational process and its resulting value in the K–12 setting.

Analysis of the collected papers as shown in Table 2 revealed three different ways in which MOOCs were successfully implemented into existing school infrastructures: (a) as foundation or advanced placement (hence AP) courses to help students in their preparation for higher education, (b) as supplementary courses to the existing school curriculum, or (c) as additional advanced courses, to offer new teaching subjects at a level beyond the K–12 setting.

Table 2

K–12 MOOC Implementation Grouping Factors

Publication	AP exam preparation	Supplementary to school curriculum	Extra curricular	Designed for K–12
Politis, Koutsakas, and Karagiannidis (2017); Koutsakas, Syritzidou, Karamatsouki, and Karagiannidis (2018); Koutsakas, Karagiannidis, Politis, and Karasavvidis (2020)	X			Yes
Blazquez-Merino, Macho-Aroca, Baizán-Alvarez, Garcia-Loro, San Cristobal, Diez, and Castro (2018)		X		Yes
Canessa and Pisani (2013)	X			Yes
Cohen and Magen-Nagar (2016)		X		No
De Kereki and Paulòs (2014)		X		Yes
De Kereki and Manataki (2016)		X		Yes
Dziabenko and Persano Adorno (2017)		X		Yes
Filvà, Guerrero, and Forment (2014)		X		Yes
Grella, Staubitz, Teusner, and Meinel (2016)		X		Yes
Grover, Pea, and Cooper (2016)		X		Yes
Hermans and Aivaloglou (2017)		X		Yes
Khalil and Ebner (2015)		X		Yes
Kurhila and Vihavainen (2015)			X	No
Najafi, Evans, and Federico (2014)	X			No
Nigh, Pytash, Ferdig, and Merchant (2015)			X	Yes

Panyajamorn, Kohda, Chongphaisal, and Supnithi (2016)		X		No
Staubitz, Teusner. and Meinel (2019)		X		Yes
Tomkins, Ramesh, and Getoor (2016)	X			Yes
Yin, Adams, Goble, and Madriz (2015)			X	No

MOOCs implemented into the existing school infrastructures as foundation courses to help students in their preparation for higher education. The data identified four MOOC implementations as foundation courses that support students preparing for college.

Among them, Canessa and Pisani (2013) implemented a High School Open Online Course (HOOC) specifically designed to support the training and basic scientific knowledge of young students. The course helped prepare students for higher education in math and physics. The main goal of the research was to uncover students' and parents' experiences and opinions about the HOOC. The researchers attempted to identify the implications and effects on engagement when high school students were allowed to watch again, at their own place and pace, the same lessons of physics and mathematics held in the classroom. Besides that, the researchers tried to obtain feedback from students on the use and effects of implementing a MOOC in the school setting. There was a quantitative evaluation of the course from students and parents, and qualitative analysis of students' experiences after attending.

In a similar approach, Najafi, Evans, and Federico (2014) integrated a university preparatory economics MOOC not explicitly developed for high school students into a school-based course.. They investigated the engagement of high school students with the learning and assessment components of the course. More precisely, they examined the potential absence or presence of teacher's support in students' learning outcomes, engagement, and persistence during the course. They used a quantitative approach, with pre- and post-questionnaires comparing MOOC-only and blended-mode students.

Tomkins, Ramesh, and Getoor (2016) researched implementation of a preparatory MOOC for Advanced Placement exams in the K–12 context. The students were provided with a year-long computer science high school MOOC. The aim of their research was to understand the applicability of the MOOC model to high schoolers and, at the same time, to gain a better understanding of the teachers' roles as coaches. The research used a machine-learning model to predict students' achievements on AP exams based on their course, forum data, and learning environment.

Finally, Koutsakas et al. (2020) developed and openly offered a computer programming MOOC specifically designed to prepare secondary students for national exams for Greek higher education. The research aimed to observe and analyze students' motives for participation and reasons for early dropout, learning expectations and attitudes toward MOOCs, and students' behaviour within the context of the MOOC. Additionally, the research attempted to determine whether students with special learning disabilities participated in the course and how, if at all, the MOOC impacted them (Politis, Koutsakas, &

Karagiannidis, 2017). The research used quantitative analysis of students' learning analytics, and before- and after-MOOC answers (Koutsakas et al., 2020; Koutsakas et al., 2018).

MOOCs implemented into the school infrastructures as a supplementary resource to the existing curriculum. The data collection process identified twelve MOOC implementations that provided supplementary resources to the existing school curriculum. Five of them were STEM-related MOOCs and seven were computer programming MOOCs.

The first of the five STEM MOOCs was developed by Khalil and Ebner (2015), which provided a physics, mechanics and aerodynamics (STEM) MOOC supplementary to the school curriculum. This MOOC was specifically designed for high school students. The research aimed to apply learning analytics and qualitative analysis in order to examine both students' attitudes in a STEM MOOC from a pedagogical and psychological point of view, as well as their performances during quizzes.

In a similar approach, Panyajamorn et al., (2016) used a chemistry MOOC developed for adult students to propose and recommend a new hybrid learning model for MOOCs suitable and effective for rural high school students. This chemistry MOOC combined active learning (student-centered model) and a flipped learning approach. The main goal of the research was to examine the impact on students' learning as a result of the proposed MOOC hybrid framework. The research used an experimental quantitative pre- and post-test on the taught subject as well as students' satisfaction questionnaires.

Additionally, Cohen and Magen-Nagar, (2016) used an academic xMOOC to integrate an innovative teaching-learning strategy based on curricular continuity between MOOCs and classroom learning through the flipped classroom model. They examined the contribution of learning strategies as mediator for motivation and a sense of achievement in high school students enrolled in a MOOC. The main goal of the research was to delve into the contribution of the proposed learning strategy to learners' empowerment and capability while engaged in self-regulated learning. The research used an adapted version of the Motivated Strategies for Learning Questionnaire (MSLQ), and the collected data were quantitatively analyzed.

The micro-MOOC, which was specifically designed and developed for K–12 settings by Dziabenko and Persano Adorno (2017), was provided as a supplementary resource to the existing school curriculum, supporting the learning and teaching of physics. The aim of the research, which was still in preliminary stages, was to introduce a new methodology for implementation of remote experiments using MOOCs in order to encourage students to acquire scientific inquiry skills using the 5E model in micro-MOOCs.

The last of the identified STEM MOOCs was developed by Blazquez-Merino et al. (2018). It provided a structured MOOC on electronics at a secondary school. The MOOC's design used Bloom's taxonomy to ensure the needs of high school students were being met. The main goal of the research was to evaluate students' perceptions and experiences through quantitatively evaluated pre- and post-questionnaires.

Filvà, Guerrero, and Forment (2014) were the first to provide supplementary learning resources through two computer programming MOOCs designed for K–12 students. The aim of their research was to study how massiveness affects participation and interaction in MOOCs. A qualitative experimental research design was used involving a post-test with a control group in order to contrast the samples involved in terms of participation and interaction.

In a similar work, De Kereki and Paulós (2014) offered a computer programming MOOC specifically designed for K–12 students which provided resources supplementary to the existing school curriculum, aiming to promote the development of procedural thinking and problem-solving skills among K–12 students in Uruguay. The research used a quantitative research methodology. Two years later, De Kereki and Manataki (2016) developed and provided two MOOCs on computer programming aiming to introduce teenagers to programming and computer science, while promoting the development of computational thinking and the use of basic practices in software engineering. Both MOOCs provided additional resources to the existing school curriculum. The research used a quantitative analysis of students' general data and feedback from their course evaluations and qualitative analysis of students' open answers and opinions about the course.

Similarly, Grella et al. (2016) provided a computer programming MOOC designed for young students in order to support secondary education learning and teaching in computer science. Their research aimed to identify the conditions under which the adoption of MOOCs can support secondary education in computer science. To this extent, they collected and quantitatively analyzed high school students' experiences of the MOOC and compared them with the experiences of more than 100,000 adult learners of the openHPI online learning platform. Additionally, the research qualitatively analyzed K–12 teachers' opinions on MOOCs' integration into K–12.

In another research work that adopted a similar approach, Grover, Pea, and Cooper (2016) provided a computer programming MOOC specifically designed for K–12 that aimed to introduce middle-school students to algorithmic thinking and programming. The aim of the research was to identify the variation across middle-school students in learning of algorithmic flow of control, the factors that influence these learning outcomes and the conditions under which the adoption of MOOCs can support learning and teaching in computer science in this educational level. The research used a two-step iterative empirical approach, with the first iteration taking place in a traditional face-to-face classroom setting, and the second in an online version of the MOOC that used a blended model of learning.

Furthermore, Hermans and Aivaloglou (2017) provided an introductory Scratch computer programming MOOC specifically designed for high school students in order to teach programming and software engineering concepts to K–12 students. The research aimed to investigate students' difficulties in programming and engineering concepts, age-related differences in students' performances, and predictions on course completion. The research used a qualitative research methodology, including evaluation and feedback on a weekly basis.

In a similar approach, Staubitz, Teusner, and Meinel (2019) offered two MOOCs specifically designed for high school students in order to support teaching and learning computer programming (Python and Java). The aim of their work was to investigate the use of MOOCs as an instrument to support computer science teachers in secondary schools. The research conducted both quantitative and qualitative analysis.

MOOCs implemented into the existing school curricula as additional (advanced) courses to offer new subjects beyond the K–12 level. The data identified three MOOC implementations developed as additional (advanced) courses to offer new subjects at a level beyond the K–12 setting.

The K–12 MOOC presented in the research of Yin, Adams, Goble, and Madriz (2015) used an undergraduate university level MOOC in order to investigate students' learning experience. This MOOC implementation was slightly different from the previous MOOCs, as it was targeted at both K–12 students and their parents. The MOOC was about dinosaurs and was provided as an option beyond the school curriculum. The research aimed to gather, analyze, and evaluate the complex realities of children's everyday experiences in the MOOC. The research used a qualitative methodology and generated data via in-depth phenomenological interviews with 12 child-parent couplets from around the world.

Nigh, Pytash, Ferdig, and Merchant (2015) implemented and offered a cMOOC to high school students interested in teaching. Apart from providing a new subject outside the existing school curriculum, the cMOOC addressed students' professional development. It was also offered to pre- and in-service teachers who actively participated and enriched the learning community with their experiences. The purpose of the research was to observe and analyze in-depth K–12 students as they participated, while exploring pre- and in-service teachers participating for professional development reasons. The research collected and analyzed both quantitative and qualitative data.

Finally, Kurhila, and Vihavainen (2015) offered a university computer science MOOC as an extracurricular elective course for high school students, aiming to alleviate the lack of computer science education in Finnish schools. The research aimed to analyze Finnish high school students' behaviour in a university-level computer science MOOC, examine the differences between school students and others, and measure how the participants perceived the difficulty and educational value of a MOOC. The research used a quantitative methodology.

Research Question 3: Do MOOCs Have a Positive Impact in K–12 Education?

The third goal of this study is determine whether MOOCs have a positive impact on the K–12 education field. In order to identify the potential of MOOCs in compulsory education and the practical and conceptual benefits that MOOCs have to offer to both teachers and students, we followed a classification analysis that emerged from the research findings and conclusions of the existing K–12 MOOC implementations.

Although much of the K–12 MOOC research is still in the pilot stage, all scientific papers and articles found in the corresponding literature emphasize the potential of MOOCs to reshape the existing school infrastructure by providing a unique learning experience to both students and teachers. On the other hand, the existing MOOC implementations uncover the complex realities and issues of incorporating MOOCs into pretertiary education. High school students have a particular modeling demand as compared to adult learners. Thus, we have to examine the set of prerequisites under which the adoption of MOOCs may have a considerable impact on K–12 education.

Researchers examined in detail students' perceptions, expectations, opinions, attitudes, improvement, and satisfaction regarding participation in MOOCs in order to provide insights into the potential impact of MOOCs on K–12 education. An analysis of the collected papers revealed that all students strengthened their knowledge in the teaching subject (Grover, Pea, & Cooper, 2016; Najafi, Evans, & Federico, 2014), improved their performance, and systematically scored higher in their exams (Canessa & Pisani, 2013; Najafi, Evans, & Federico, 2014). MOOCs could be a valuable tool to support students in their studies (Canessa & Pisani, 2013; Author, 2020), through the provision of valuable content and different learning strategies that could contribute to a positive transformation of education in general (Grella et al., 2016; Nigh et al., 2015). These courses can provide both students and teachers different learning opportunities and experiences and support new relational configurations (Nigh et al., 2015; Yin et al., 2015). Most students had a very positive overall experience with MOOCs (Author, 2020; Staubitz, Teusner, & Meinel, 2019), and they found them quite challenging (De Kereki & Manataki, 2016).

While MOOCs could be a feasible option for K–12 students, there are several concerns about the use of this new learning tool in K–12 education. The analysis of the collected papers showed these concerns could be mitigated in order to provide enriched opportunities for both teachers and students (Staubitz, Teusner, & Meinel, 2019). The main concern is the ability of young students to assume more control and responsibility for their learning in a self-study manner. While a significant number of K–12 MOOC implementations show promise regarding the integration of MOOCs into existing school infrastructures, only highly motivated students thrive in these MOOCs (Canessa & Pisani, 2013; Kurhila & Vihavainen, 2015; Najafi et al., 2014; Tomkins et al., 2016).

In order to address this inequality, research has demonstrated that the best way to implement a MOOC in K–12 education is to blend the MOOC into the traditional classroom, using a didactical approach (i.e., a blended or flipped classroom model) in order to motivate students (Grella et al., 2016; Khalil & Ebner, 2015; Najafi et al., 2014; Panyajamorn et al., 2016; Tomkins et al., 2016). A teacher's presence in these courses is a core element for student achievement because it may positively influence students to remain on track (Khalil & Ebner, 2015; Koutsakas et al., 2018; Najafi et al., 2014; Tomkins et al., 2016). Additionally, MOOCs of shorter duration increase the completion rate, and the use of badges of accomplishment encourage students to continue to participate in MOOCs (Khalil & Ebner, 2015; Staubitz, Teusner, & Meinel, 2019). Finally, using social media to promote interaction, collaboration, and contribution to the course showed a further way of mitigating some of the concerns (Koutsakas et al., 2018; Panyajamorn et al., 2016).

Using MOOCs in K–12 education is quite challenging but offers an unmatched learning experience to both students and teachers. The existing K–12 MOOC implementations are quite promising and highlight the positive impact that MOOCs offer both teachers and students.

Conclusion

The proliferation and success of MOOCs in higher education have led to discussions about the potential of this modern learning tool in K–12 education. The unique digital advantages of MOOCs in conjunction with the rising number of K–12 students who enrolled in typical MOOCs for tertiary education leverage both MOOC providers and standalone researchers to develop MOOCs explicitly targeted at K–12 learning environments. This paper attempted to shed light on the existing literature about K–12 MOOCs in order to identify the most representative MOOC implementations, to classify and organize research trends and patterns, and, consequently, to reveal MOOCs' potential value and impact in K–12 education. We used a qualitative narrative literature review methodology in order to develop a comprehensive review of K–12 MOOC research.

The analysis of the relevant work on K–12 MOOCs demonstrated that a significant number of K–12 MOOC initiatives are STEM and computer science courses, implemented mostly in Europe and the USA. As far as we can deduce from the collected papers, the vast majority of K–12 MOOCs has been designed explicitly to meet the needs of K–12 students in order to extend and enhance the existing school curriculum. The analysis of these studies identified students' motivations, expectations, opinions, experiences, and satisfaction regarding their participation in MOOCs in order to gain insight into the issue of using MOOCs in K–12 learning environments. It appears from the review that the most effective option is to embed MOOCs into the existing school infrastructures in a blended approach. It is concluded that MOOCs, under a set of prerequisites, can effectively be incorporated into and positively affect pretertiary education. Teacher's presence, social interaction, and guided learning in a blended school environment seem to be core elements to ensure MOOCs benefit both students and teachers.

Incorporating MOOCs in the area of K–12 education is still in its infancy and many questions remain unanswered. Further research in the field of design, development, implementation, provision, and evaluation of such courses in compulsory-age education is needed in order to uncover the complex realities of K–12 students and teachers participating in the world of MOOCs.

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Languaging Network Learning: The Emergence of Connectivism in Architectonic Thought

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Abstract

As technological advancements and online education transform higher education, the achievement gap among students is widening rather than closing. Critics suggest that we need to reassess the promises of online education and the connectivism or network learning that is sometimes employed as its pedagogical underpinning. As scholars and practitioners struggle to define connectivism as a learning theory, many often exclude language as a feature in its conceptualization. This practice is at odds with architectonic thought, the philosophical tradition in which constructivist theories of learning are rooted. This article reveals the central role that language and texts play in architectonic thought and why they are inseparable from our understanding of knowledge and network learning. When we recognize language as a medium and model for reflection and criticality in the architectonic tradition, we are better positioned to use pedagogy and computer technology to transform online education and reorient our competing views of connectivism.

Keywords: connectivism, digital management, hypertextuality, intertextuality, network learning

Introduction

In their 2019 study, Protopsaltis and Baum determined that technological advancement and online education had created as many problems as they had solved. While students had more access to higher education, Protopsaltis and Baum (2019) claimed that the achievement gap among them was widening and online education was becoming increasingly unaffordable in some sectors. More importantly, the authors predicted that these problems and others were likely to proliferate as colleges and universities expanded their online programs. Protopsaltis and Baum (2019) offered recommendations that inspire further investigations of the relationship between pedagogy and computer technology. In their study of this relationship, Bernauer and Tomei (2015) indicated that pedagogical discussions did not occur as much as they should have among faculty in higher education. Defining *pedagogy* as the art and science of teaching, Bernauer and Tomei (2015) claimed that professors often did not receive pedagogical training for their roles as teachers. What is even more concerning is the authors' insinuation that faculty were not sure what an effective pedagogy conditioned by computer technology actually involved. In fact, we are uncertain whether our current learning theories are able to help us to find answers.

For example, Siemens (2005, 2008) and Downes (2012) introduced "connectivism" as the learning theory needed for the digital age. Unlike behaviorist, cognitivist, and constructivist approaches to learning, connectivism responds to the diverse ways in which knowledge is created, adapted, and exchanged through networks. Networks simply describe how knowledge and computer technology shape entities and connect information sources. As a result of the connections that one makes, learning or "actionable knowledge" is initiated. For Downes (2012), these connections and their patterns constituted "network learning." However, critics such as Kop (2011), Bell (2011), and Goldie (2016) suggested more caution in the rhetoric used to describe and discuss connectivism, particularly as it is conceived by Siemens and Downes. Mattar (2018) pointed us toward the central question that animates the competing views that we find among the various critical perspectives that color our interpretations of connectivism. That question is: Is connectivism a new theory of learning or an extension of constructivism? While there are those critics who argue that connectivism lacks a substantive theoretical foundation, others contend that connectivism is actually the latest development of constructivism (pp. 210-211). For example, Mattar (2018) valued connectivism as a form of constructivism, but he acknowledged that constructivism requires qualification (also see Hopkinson, 1999). He wrote, "Constructivism can be considered a major theory of learning, and in a broader sense a philosophy of education, used as a general title to classify several other theories" (p. 204). Mattar (2018) described four types of constructivism: cognitive, radical, situated, and co-constructivism. He went on to review four related metaphors that Siemens (2008) and others found most beneficial in reconceptualizing the role of educators in the age of network learning. Respectively, they are master artist, network administrator, concierge, and curator.

For Hui (2016), this list might appear incomplete. It should also account for the growing need for educators to be "philosophers" of digital objects. Digital objects are forms of data that can be made visible and invisible with technology. Digital objects now permeate all aspects of human life, including videos, images, and text files. They are the sources for the development of networks and connectivity through technology and digitalization (Hui, 2016). Because they raise new questions about the nature of being and social interactions in network culture, digital objects are inseparable from philosophy and discursive relations. The two are interwoven (Stiegler, 2016). Ravenscroft (2011) supported this assessment in his dialogic study of constructivism and connectivism. According to Ravenscroft (2011), “thinking in networks will usually mean thinking through collaborative dialogue” (p. 142). He might also agree that our understanding of networks and pedagogy is incomplete without understanding how “dialogue” and its relative “languaging” underpin them. While it is used metaphorically here, languaging is a term typically used to characterize the ways that words mediate cognition, thus shaping knowledge and language learning (Swain, 2006). Nonetheless, this process is inherently dialogic and indispensable to the function of society, pedagogy, and digital objects.

Unfortunately, this worldview is underappreciated in the literature that we tend to associate with connectivism (Downes, 2012; Kop, 2011; Siemens, 2005, 2008) and the use of computer technology in education (Bernauer & Tomei, 2015; Cuban, 2001; Picciano, 2019). However, Ravenscroft (2011) is one of the few scholars who positioned dialogue as a feature rather than an anomaly in both areas. He claimed, “And whilst future learning landscapes will be characterised by the greater penetration of the Web within everyday lives, fundamentally we must remember that we will still be, mostly, people socially interacting with other people” (p. 155). Dialogue and discourse will support this interaction. In order to ground this important articulation, Ravenscroft (2011) evidenced the ways in which influential theorists such as Mikhail Bakhtin and Lev Vygotsky offered us the kind of social constructivist lens that supports a dialogic view of network learning in the age of digitalization. However, their ideas are elements in a larger philosophical tradition that Ravenscroft’s study did not elaborate. As a result, we are missing an opportunity to enrich our understanding of the relationship between language and connectivism with respect to constructivism. We are also missing an opportunity to recast the question that inspires our competing views of connectivism.

In other words, we should no longer ask whether connectivism is a new theory of learning or an extension of constructivism. The more significant question is: Where does connectivism emerge in the architectonic tradition that made the dialogic and constructivist ideas of theorists such as Bakhtin and Vygotsky possible? Architectonic(s) is essentially a means of contemplating the various ways that we build and relate meaning, knowledge, and experiences in all aspects of life, especially in education (Derrida, 2004; Holquist, 1990; Manchester, 2003). As a metaphor for the systematic and constructivist nature of all relations, it is inherently interdisciplinary and integrative (Dennis, 2019; Klein, 1990; Watson, 1993). While one theorist may associate the term with architecture, another could just as easily appropriate it to describe the dialogic relations that help us to make meaning and communicate. In fact, this is how Bakhtin (1981, 1990) developed the term in his theory of dialogue. As Bakhtin’s contemporary, Vygotsky (1986) helped us to imagine what a dialogic perspective looks like in terms of social constructivism (more on this point below). However, it may prove to be a challenge identifying this kind of interrelation without an introduction to the larger architectonic tradition that is more implicit than explicit in Ravenscroft’s study. Dialogic ideas are rooted in a complex genealogy of epistemological thinking that we either fragment or ignore as educators. Therefore, we must not limit our understanding of language and connectivism to the theoretical contributions that Ravenscroft (2011) discovered in Bakhtin (1986) and Vygotsky (1978). If we do, we fail to recognize the ways in which architectonics represents a system of ideas that offers the kind of integrated philosophical perspective we often lack when we discuss connectivism and computer technology in higher education.

Purpose

My purpose in this discussion is to provide a theoretical overview of the key concepts and metaphors that constitute architectonic thought. By reviewing the significant ways in which architectonic thinking manifests across time, we can better navigate the system of ideas that enrich and extend our understanding of the relationship between language and connectivism or network learning. When we connect rather than silo these perspectives, we effectuate the kind of critical and theoretical reflection needed to support network learning as a contemporary articulation of architectonic thought and not a new theory of learning. This reconceptualization not only challenges many of our current interpretations of connectivism, but it also strengthens the idea that the processes of language are inseparable from the processes of network learning in the digital age.

Conceptual Framework

According to Stiegler (2016), digitalization has "exploded" our frames of thought. He asked us to rebuild them in order to prevent digitalization from widening the gap in the social and economic relations that Protopsaltis and Baum (2019) said we needed to close (p. 17). For Stiegler (2016), digitalization was more than the electronic transformation of various objects/texts through computerization. It was a disruptive process that ultimately altered the psyche, space, time, and conditions of publication. The expansion of digitalization has had the same social effect as the initial appearance of writing and the printing press. Stiegler (2016) wrote, "Digital technology is a form of writing, a writing that is produced at the speed of light, through machines to which we have delegated the process of reading and writing" (p. 160). It is within this context that Stiegler situated our understanding of digital objects (Hui, 2016, pp. vii-xii). In order to reveal why this contextualization is significant, a rhetorical approach will be used to frame and survey the key theorists associated with architectonics.

Generally, *rhetoric* describes the "strategic use of communication, oral or written, to achieve specifiable goals" (Kuypers, 2010, p. 288). Historically, rhetoric has been recognized as a speculative tool in philosophy. However, Burke (1969) noted that rhetoric is more than just a means of persuasion. It is also a form of identification. This is the method that Burke (1969) recommended for those who must "confront the implications of division" when presenting arguments (p. 22). Identification can be achieved by connecting and relating the properties of one object or idea to another. According to Burke (1969), we must view rhetoric as a body of identifications that owe their persuasiveness more to repetition and interconnectivity than to the exercise of rhetorical skill (p. 26).

Burke's theory of identification will be used as the conceptual framework for exploring the various iterations of architectonics in epistemological thought. As a theory of relations, architectonics is the master trope that pervades the Western philosophical tradition. Tropes have a double character. They are powerful rhetorical devices and they describe the iteration or reappearance of a word, idea, or metaphor. This repetition accords with Burke's identification process, and it helps us locate the system of ideas that will enrich our view of the interrelationship between language and connectivism in architectonic thought. Dialogue and texts simply model this conceptual system (Lakoff & Johnson, 1980). In order to relate the various epistemological perspectives that develop architectonic thought, I describe Immanuel Kant's theory of cognition and how it was later appropriated by Charles S. Peirce to help form his theory of continuity and signs. As the intellectual heir to Kant and Peirce, Bakhtin made another significant change in the trajectory of architectonic thought when he suggested that it was a synonym for *dialogism* or the interrelation of voices and words. It is on the foundation of dialogism that Julia Kristeva developed her theory of the interconnectedness of texts or *intertextuality*. Around the same time, Ted Nelson developed the idea of hypertextuality, which signaled the digitalization of intertextuality and marked the emergence of the contemporary idea of connectivism in architectonic thought.

The Origins of Architectonics

Often used in the singular, *architectonics* is a concept that permeates the Western philosophical tradition. Manchester (2003) explained why the term has been so influential. She reported that architectonics is "a technical term in philosophy with an interesting history, one with philological anomalies, historical vicissitudes, and philosophical pretensions." Manchester (2003) also stated that the use of the term and its correlates can be "found in metaphysics, jurisprudence, political philosophy, ethics, *belles lettres,* theories of living organisms, and—one suspects—life itself when 'rightly ordered'"(p. 188). According to Holquist (1990), architectonics is essentially "the science of relations" (p. 29). However, earlier meditations on the nature of architectonics can be found in the work of Aristotle and further developed in the philosophy of Gottfried Leibniz, Johann Lambert, Alexander Baumgarten, and Christian Wolff (Manchester, 2003). Generally, the term is associated with Immanuel Kant. In the *Critique of Pure Reason,* Kant (2007) tried to bridge the gap between two competing phenomena in philosophy: the separateness and unity in the knowledge that we acquire through our experiences *(a posteriori)* and knowledge that transcends experience *(a priori).* Kant (2007) argued that there are faculties and categories in our minds that synthesize, construct, and shape what we know. In other words, our minds create the world that we experience. Kant (2007) wrote, "All knowledge arising out of reason is derived either from concepts or from the construction of concepts" (A837/B865). This process that takes place in our minds unifies our knowledge into a system. According to Kant (2007), "our diverse modes of knowledge must not be permitted to be a mere rhapsody but must form a system" (A833/B861). The metaphor that Kant borrowed from his predecessors to characterize this complex cognitive process was *architectonics*. Kant (2007) wrote that architectonics is the art of constructing systems, and systematic unity is what elevates "ordinary knowing to the rank of science" (A832/B860). Hawkins (1994) claimed that Kantian architectonics was actually one of our earliest articulations of constructivism. Noddings (1995) noted that Jean Piaget traced the epistemological roots of his theory of constructivism to Kant. Unlike Kant, Piaget did not view the categories of the mind as static. Piaget's epistemology focused on the development of knowledge and the development of individuals. Noddings (1995) wrote that Piaget's theory was constructivist in the sense that "it claims that all knowledge (and perception itself) is constructed, neither merely received nor innate" (p. 109).

Peirce (1955) reinterpreted Kant's theories along similar lines because of our changing applications of knowledge (p. 316). He wrote, "That systems ought to be constructed architectonically has been preached since Kant, but I do not think the full import of the maxim has by any means been apprehended" (p. 316).

Peirce (1955) contributed to architectonic thought by essentially adapting it in order to extend Kant's ideas. For him, architectonics served as a theory of cognition, a theory of integration, and a theory of being all at the same time. It became a way for Peirce (1955) to examine the relationship between perceptual judgments and behavior. Perceptual judgments are our thoughts. Thoughts embody certain properties or qualities. All thoughts, meanings, and feelings are qualities in Peircean thought. Peirce categorized them as Firstness, Secondness, and Thirdness. He claimed that they were the ingredients in all knowledge and experience. They describe various levels of relationships. Firstness is a monadic relation. Secondness represents a dyadic relation. Thirdness is the integration of monadic and dyadic relations. Integration is a key feature in Peircean architectonics because it characterizes the "synechism" or continuity that results from the process of combination and interconnectivity (Peirce, 1955; Short, 2007).

Peirce (1955) viewed philosophy as a way to help us to create and connect. This was one of the characteristics of his pragmatic philosophy. *Pragmaticism* is an evaluation of the rationality and practicality of truth. Peirce also claimed that it is a way to interpret the logic of arguments. One way that this can be achieved is through the study of signs or semiotics (also known as *semeiotics*). Peirce (1955) wrote, "Logic, in its general sense, is, as I believe I have shown, only another name for semiotic" (p. 98). When we think in terms of Peirce's principle of continuity, we can better imagine pragmaticism and semiotics as interconnected conceptualizations for speculating about the nature of meaning. In Peirce's three-part model of the sign, he said that a sign consists of representamen (form of the sign), interpretant (sense made of the sign), and object (that to which the sign refers). Peirce (1955) wrote, "The sign stands for something, its object. It stands for that object, not in all respects, but in reference to a sort of idea, which I have sometimes called the ground of the representamen" (p. 99). The interaction between these parts is what he called *semiosis*. According to Peirce (1955), signs translate into other signs. Signs are dialogic and so is thinking.

Dialogism and Architectonics

Chandler (2007) argued that Peirce's idea that all thinking is dialogic resurfaces in the dialogic theory of Mikhail Bakhtin (p. 33). For Bakhtin (1981), dialogue was the interrelation of utterances or words. Dialogic relations intersect continuously across all aspects of differences. They are "profoundly unique and cannot be reduced to logical, linguistic, psychological, mechanical, or any other natural relations" (Bakhtin, 1986, p. 124). Bakhtin (1981) wrote, "languages do not exclude each other, but rather intersect with each other in many different ways" (p. 291). In fact, language and its processes serve as a continuum that interconnects disciplines, genres, and texts regardless of boundaries. This effect explains why Ravenscroft (2011) concluded that language and dialogue underpin learning and are consistent with the kind of cothinking that connectivism values (also see Matusov, 2007).

Early in his career, Bakhtin (1990) explored the dialogic potential of architectonics as a response to the formalism that he associated with Kantian thinking. Holquist (1990) stated, "Dialogism is a form of architectonics, the general science of ordering parts into a whole" (p. 29). Dialogism is a philosophy of interrelations that defines and utilizes language as a modeling system for the varied dimensions of human existence. Holquist (1990) went on to describe the web-like nature of Bakhtinian thought. He wrote, "The mutuality of differences makes dialogue Bakhtin's master concept, for it is present in exchanges at all levels—between words in language, people in society, organisms in ecosystems, and even between processes in the natural world." Dialogue is "what keeps so comprehensive a view from being reductive" (Holquist, 1990, p. 41). As a social constructivist with ideas that often mirrored those of Bakhtin, Vygotsky provided the "clinical underpinning" to dialogism (Emerson, 1986, p. 27). Vygotsky (1978, 1986) argued that language is key to our understanding of cognitive development. Words are tools for learning and their use changes as the context for human activity changes (also see Engeström, 2008). The relationship between words and thoughts is reciprocal. Vygotsky (1986) claimed that thought comes into existence through words. He added that thoughts create relationships. They connect one thing to another (Vygotsky, 1986). Influenced by the ideas of Vygotsky and Bakhtin, Shotter (1993) claimed that words and language are the psychological tools we need to mediate the various networks that we encounter every day. As a network, words are always connected by a stream of dialogic relations that add to the flow of conversations always already in progress.

Dialogism and Intertextuality

In her interpretation of networks, Julia Kristeva (1986) built on the work of Bakhtin. She is credited with introducing Bakhtin's theory of dialogue to Western academic audiences. In her appropriation, Kristeva (1986) wrote, "each word (text) is an intersection of word (text) where at least one other word (text) can be read" (p. 37). This assessment of Bakhtin—though controversial—serves as the foundation for Kristeva's theory of intertextuality (also see Orr, 2003). *Intertextuality* is a term that Kristeva coined to describe the interrelation of texts and the transformative and disruptive power of this process (for other influences on the concept see Alfaro, 1996, and Derrida, 1997). More significantly, Kristeva (1984) envisioned intertextuality as a form of critical practice. In intertextuality, every textual construction is a transformation. A new text is constructed in response to a prior text (p. 210). Intertextuality is an architectonic process, but Halliday (1978) also called it a "sociosemiotic process" in order to account for the shifts, irregularities, and conflicts that we encounter in all social interactions. Halliday (1978) claimed that the important feature of a text is that it is a continuous process of exchange and interaction. This mirrors the pedagogical practices that Bernstein (1990) described between those who transmit information and those who must acquire it. Bernstein (1990) wrote, "The relationship basic to cultural reproduction or transformation is essentially the pedagogic relation, and the pedagogic relation consists of transmitters and acquirers" (p. 64).

In his presentation of intertextuality, Barthes (1989) also associated texts with processes of exchange and transformation. He argued that epistemological shifts in our understanding of language and the world have resulted in a change in our understanding of texts and disciplines, which cannot exist without language and dialogue. According to Barthes (1989), the appeal and power of interdisciplinarity are causing these changes in our conceptualization of texts. It is only through activity and production that texts are effectuated and experienced. As a consequence, they resist easy classification and bureaucratization. Texts are continuously "working" and exceeding boundaries. A text never stops because meaning is always "becoming," and the complex processes of language know no cessation. For

Barthes (1989), the text is paradoxical and metaphorical. He claimed, "the metaphor of the Text is that of the network; if the Text expands, it is by the effect of a combinative operation" (p. 61).

In response, Foucault (1980) would argue that texts encounter more restrictions than Barthes's description acknowledges. Foucault (1980) imagined texts as being conditioned by a network of power. As a form of repression, power is inseparable from knowledge and the formation of texts. They are reciprocal processes. Alfaro (1996) identified Foucault as one of the theorists most responsible for applying intertextuality as a critique of political and historical relations. Foucault (1972) argued that history privileges continuity or a linear understanding of events. However, this approach to history often ignores the disruptions and discontinuities that also make history possible. According to Foucault (1972), discontinuities occur in architectonic unities that develop within systems that are antifoundational, nonlinear, and intertextual. Intertextuality is always a factor in what Foucault (1972) called "discursive formations." Discourse formations are the interrelations between statements or texts and their conditioning by rules that regulate their meaning. Foucault (1995) also argued that educational institutions are sites for the regulation of discourse and the exercise of power. Power disciplines students in ways that promote the reproduction of social and economic hierarchies. Pedagogy plays a role in this process. Gore (1998) claimed that the continuity of pedagogical practices across time and sites often involves the exercise of power to reproduce the status quo in education and society (also see Egan, 2002, and Usher & Edwards, 1994). Annesley (2001) and Cuban (2001) asked us to reconsider the faith that we invest in technology as a solution to many of the problems that we find in education and society. Based on their assessments of past innovations, Annesley (2001) and Cuban (2001) suggested that the hyperinteractivity that advanced technology allows can also intensify social inequality. This is paradoxical, considering that digitalization and hypertextuality are often conflated with democracy.

Hypertextuality and Connectivism

In her review of Gérard Genette's theory of hypertextuality, Alfaro (1996) stated that Genette defines hypertextuality as the relationship between one text and another in a direct or indirect reconfiguration or transformation. Alfaro (1996) determined that his conceptualization was not very different from the view of intertextuality as texts "trapped in a network of relations" that we discussed above (pp. 280-281). When Nelson (1987) coined the term *hypertextuality* in the 1960s, he situated his appreciation of hypertextuality firmly in the context of technology. Hypertext, according to Nelson (1987), describes forms of electronic writing or texts that are performative and best presented on a computer screen. Hypertext is non-sequential and multidimensional blocks of texts with branches and links that offer individuals different pathways and connections to information. It has supported the infrastructure that has allowed Tim Berners-Lee's idea of a World Wide Web to become a reality. Landow (1992) said that hypertext links "a passage of verbal discourse to images, maps, diagrams, and sound as easily as to another verbal passage" (p. 4). In essence, Nelson's concept moved our perception of texts from the networking capability of verbal passages to their centrality in the transformation of learning. Foreshadowing the idea of connectivism, Nelson (1987) revealed some of the ways that his ideas impacted our presuppositions about teaching and learning. For instance, he claimed that knowledge is borderless, and learning does not have an order. Also, classifying knowledge by disciplines is more administrative than pedagogical.

Orr (2003) went on to point out another significant contribution that Nelson made to the idea of network learning. Nelson essentially extended the logic of intertextuality into the digital world. Orr (2003) wrote, “hypertext merely develops the status of ‘text’ that is intertextuality’s motor through digitalization” (p. 50). Hypertextuality is intertextuality reimagined for a world that rationalizes itself through computers and the vast networks that they allow. Lyotard (1984) also anticipated this same networking capacity when he predicted that knowledge and learning would be mediated through machines, thus altering the way that we organize knowledge and texts. Lyotard (1984) said that in the future it would not be enough to obtain information. Innovation would rest on how well one can organize information in new ways. Lyotard (1984) wrote, “This new arrangement is usually achieved by connecting together series of data that were previously held to be independent. This capacity to articulate what used to be separate can be called imagination” (p. 52). Those who value network learning might recognize Lyotard’s logic as a central aspect of their pedagogical perspective.

Lyotard (1984) offered us an early assessment of the growing “network culture” that Taylor (2010) discussed in his critique of higher education. Taylor (2010) argued that technology has changed the way that we communicate and organize knowledge. When the organization of knowledge changes, then so must our organizational structures and operating principles in education (also see Barabási, 2014). Taylor (2010) claimed, “Network culture is characterized by the emergence of a new information and communication infrastructure that has been developing since the 1970s” (p. 68). In network culture, technology uses us as much as we use it to interconnect life and learning. In his assessment of the future of online education, Picciano (2019) claimed that technology will transfigure education and society in ways that we have yet to imagine. We are quickly reaching the point in higher education where most courses will feature an Internet component in some form or fashion. According to Picciano (2019), we are already witnessing many of these changes. Increasingly, faculty members are viewed as knowledge managers who can produce and disseminate information electronically. If Picciano’s assessment is an indication of the future of teaching and learning, then the architectonic tradition and its dialogic features may very well prove to be the kind of philosophical orientation that we need.

Conclusion

Hopefully, the review of architectonic thought presented in this discussion provides the kind of introduction that we need to more clearly recognize that, in our roles as educators, we are also “philosophers” of teaching and learning. In architectonic thought, we discover the interrelated conceptual tools that can inform our understanding of theory and practice. More significantly, architectonics offers us a framework in which we can recast our competing appreciations of connectivism. In doing so, one learns that language is much more than a medium for communication. Language actually operationalizes the networking capacities that connectivism values. The networks that language creates through dialogue and texts actually make education possible. This may explain why language is such a dominant feature in many of the theoretical perspectives that shape architectonic thought. Architectonic thinking binds dialogism and constructivism. Intertextuality and hypertextuality reflect this bond, thus making it much more difficult to ignore the ways in which these perspectives also influence our understanding of connectivism. Like constructivism, connectivism or network learning is another iteration of architectonics. As such, we find that the idea of connectivism appears to emerge out of one of our earliest theories of hypertextuality. This evidence rebuts the argument that connectivism is a new theory of learning. It also frustrates the idea that connectivism lacks a substantive theoretical foundation. Ultimately, architectonics challenges us to expand the ways in which we imagine the relationship between pedagogy and computer technology in the future.

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Elements of Open Education: An Invitation to Future Research

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Abstract

This paper explores elements of open education within the context of higher education. After an introduction to the origins of open education and its theoretical foundations, the topics of open and distance learning, international education issues in open education, open educational practices and scholarship, open educational resources, MOOCs, prior learning accreditation and recognition, and learner characteristics are considered, following the framework of macro, meso, and micro levels of research in open and distance learning. Implications for future research at the macro, meso, and micro levels are then provided.

Keywords: open education, open learning, distance education, flexible learning, online learning, open educational resources, internationalization

Elements of Open Education: An Invitation to Future Research

Research on topics of openness has been carried out for more than 30 years (Saba, 2000; Zawacki-Richter & Anderson, 2014; Zawacki-Richter & Naidu, 2016). However, openness now constitutes one area of great excitement in education, taking its place alongside big data, learning analytics, artificial intelligence, and the continuing expansion of technological affordances in learning. Because *open* is octopus-like, with so many tentacles—albeit all connected to one concept—there have been many researchers connected with its development. Wiley coined the term *open content* in 1998; the *International Review of Open and Distributed Learning* (*IRRODL*) was first published in 2000; Downes and Siemens offered the first massive open online course (MOOC) in 2008. Since those seminal innovations, open has begun to permeate every aspect of education. Its progress, however, has not been linear; rather, it has been multi-faceted and complex.

Amid the propagation of myriad MOOCs, OER, journal publications, conferences, and related blog posts, the University of Oldenburg in Germany put forward a plan for the creation of the Centre for Open Education Research (COER). A group of researchers representing global reach gathered in October 2018 to launch COER at the Inaugural COER Research Symposium. As of October 2018, COER had 26 founding members from the fields of open and distance learning, international education research, and higher education research, including 17 professors, 4 post-doctoral researchers and 5 postgraduate doctoral students from nine countries: Australia, Canada, China, Germany, Japan, South Africa, Spain, Turkey, and the USA.

To establish common ground, COER members attending the first meeting in Oldenburg discussed their understanding of the concept of open education and the elements it might entail. Based on this first exploration, consensus was reached among the COER group during a second meeting in September 2019, hosted by Maltepe University in Istanbul, that open education in the context of higher education refers to a set of educational practices, in which the notion of access is complex and has broadened over time, from the initial understanding of it relating only to university entrance. Such efforts are supported by a variety of media, learning materials, assessments, tools, and systems to provide flexible learning opportunities.

Considering the dynamic and constantly changing nature of open education, the aim of this paper is to describe and explore the elements of open education in the context of higher education in order to guide research in the various aspects of open education theory and practice.

Following the framework of macro, meso, and micro levels of research in open and distance learning (Zawacki-Richter, 2009; Zawacki-Richter & Anderson, 2014), the topics of open education and open practices are first described from a theoretical and global perspective (origins of open education, the growth of open and distance learning, and its theoretical foundations), followed by the elements of openness on the organizational, institutional, and individual levels.

This paper is a conceptual reflection written by scholars and practitioners in the field of open and distance learning. The purpose of this article is not to conduct a comprehensive (or even systematic) literature review, but, in contrast, to evaluate the current state of the art by examining different elements of open education. The study further aims to construct a common ground upon which future research can be built and intends to inspire researchers to explore the elements of open education from theoretical and practical perspectives.

Deconstructing Open Education

To fully consider open education, its origins, history, and theory must be understood, along with its various applications, stakeholders, and its place in the field of open, flexible, and distance learning.

Origins of Open Education

The core of open education is its openness. The term builds bonds with critical pedagogy, but is also a colour with many shades, a notion with pluralistic and inclusive connotations, and a stance that defends widening participation. Throughout history, openness has been given many meanings: access, flexibility, equity, collaboration, agency, democratization, social justice, transparency, and removing barriers. However, more importantly, it is a living idea that inspires open education. Because openness is a living thing, its definition continues to evolve and become loaded with many more meanings.

When used as a buzzword, open education is often narrowly perceived to mean the recent phenomena of MOOCs and OER. In fact, there is a much longer scholarly and public discourse surrounding the opening of (higher) education. In the 17th century, John Amos Comenius proposed access to education as one of its core goals (Keatinge, 1907). His statement “teaching all things to all men” can either be interpreted as an early humanistic idea of universal education or as a challenge to make different forms of education available to everybody.

The origins of scholarly discussion of open education are seen by some to be related to the openness of teaching methods and autonomy of children’s learning in schools (Hill, 1975), summarized thus:

> When one investigates this model, one finds that the referents for “open” are variously, spatial, temporal and procedural. That is, the classroom may be termed “open” because children move in, around and out of the classroom at will, or because there is little use of bells to prescribe lesson segments, or because age and sex segregation have been abolished, or because traditional school subjects have given way to integrated learning activities, or any combination of these. (p. 4)

However, Barth (1969) criticized the assumptions and beliefs about the early open education movement, stating that most “accounts of open education have been anecdotal and descriptive” (p. 29). Similarly, in a meta-analysis, Horwitz (1979) stated:

> Another reason is that many variables considered important by advocates of open education have not yet been adequately evaluated because of problems in measurement. Perhaps the most important reason, though, lies in the lingering ambiguity surrounding the definition of open classroom—particularly the confusion between “open space” and “open education.” (p. 72)

Horwitz’s (1979) discussion notes the difference in meaning between open education, open space, and open classroom. Open classrooms were a 1960s innovation that attempted simply to remove walls and create open physical spaces. Open education and open practice are larger, conceptual notions.

Despite the enormous growth of educational systems after World War II, a 1967 UNESCO conference warned the international community of a “worldwide crisis in education” (Coombs, 1968, p. 4), as educational systems had adapted too slowly to respond to the growing demand for higher education at a time of economic and scientific prosperity. The report concluded that true innovation was needed to meet the needs of a much larger and diversified group of learners. Such considerations led to the establishment globally of open and distance learning systems which sustained many innovative ideas at the macro level. Establishment of open education with strong pillars at the macro level (e.g., open universities) resulted in its wide acceptance in higher education and further provided a base to explore more meso and micro levels.

Growth of Open and Distance Learning

Open and distance learning (ODL) can be considered an umbrella term that covers a wide range of open resources and practices. The Commonwealth of Learning (2015) defines ODL as "a system of teaching and learning characterized by separation of teacher and learner in time and/or place; [that] uses multiple media for delivery of instruction; [and] involves two-way communication and occasional face-to-face meeting for tutorials and learner-learner interaction" (p. 2).

The terms *open learning, distance learning* and *distance education* are often used interchangeably, and it seems there is a consensus on combining both *open* and *distance* terms in the title of the field, although they are not synonymous. Many scholars (Rowntree, 1992; Rumble, 1989) prefer to use *open and distance learning* because while the terms are not the same, they represent dynamic connections. When the terms are used distinctly, open learning typically concerns flexibility, access, and the choice of what, when, at what pace, where, and how people learn. Open learning can be offered at a distance, face-to-face (f2f), or in blended format. Distance, or distributed learning, on the other hand, refers to pedagogical aspects and a more structured and formal educational process, characterized by the separation of teachers from learners due to distance in time and/or space (Moore, 1993).

Although the roots of distance education can be traced back to the early 18th century in the form of correspondence study (Keegan, 1996), the establishment of open universities has been noted as one of the major milestones in the historical development in the field (Peter & Deimann, 2013). Following the establishment of the Open University of the UK, many open universities were launched during the 1970s and 1980s. Whilst each has its own rationale for offering ODL, these rationales can be grouped under two major concepts: convenience and necessity. In those countries where there are sufficient numbers of traditional face-to-face education providers, ODL is a convenient way of extending educational opportunities to learners unable to attend f2f learning opportunities due to personal or professional responsibilities, financial constraints, health-related issues, or disabilities. On the other hand, in those countries where there are not enough seats or alternative entry points for everyone to access higher education, ODL seems a necessity to meet demand. Besides, distance education providers can be referred to as single- or dual-mode institutions. Indira Gandhi National Open University (IGNOU), the Open University UK (OUUK), and the Open University of China (OUC) are examples of single-mode ODL providers offering conventional distance education. Dual-mode institutions are those that offer both f2f on-campus and distance education, such as Anadolu University in Turkey, or Penn State University in the USA.

It is relevant to point to several important trends that appear to be shaping the research and practice of ODL. Bates (2018) noted a rapid growth in ODL in higher education with an accompanying dramatic decrease in open and distance teaching universities' enrollments in Canada and the UK. Advances in artificial intelligence and learner analytics now allow institutions to track and learn from students' platform interactions and automatically provide personalized and adaptive learning activities, coaching, guidance, and assessment in ODL environments (Loeckx, 2016; Zawacki-Richter, Marin, Bond, &

Gouverneur, 2019). Furthermore, recent changes in the labour market are influencing higher education, including ODL. Some employers are beginning to look for personnel who have a particular skill set and do not seem to care how they acquired these skills. Such a view partly explains the emergence of the recognition of prior learning as well as micro credentials and nano degrees.

Advances in technology and expanding ODL opportunities call for new pedagogical approaches. Many scholars claim that didactic traditional teaching strategies do not capture the potential strengths of online education (Conrad & Openo, 2018). Most open universities use a similar strategy, which consists of videos and readings as conveyors of information, limited peer interaction, static quizzes and exams, and limited teacher-student interaction. ODL pedagogies should encourage interaction between participants and greater care for learners and their needs and also begin to align with changing labour markets for successful outcomes. In fact, advances in information and communication technologies (ICT) have created a greater impact on ODL at the macro, meso, and micro levels. For instance, at the macro level, ODL practices have reached a global audience, which has triggered new policies and strategies at the meso or institutional level. The most evident example of institutional response can be considered open online learning, which is becoming the new normal. At the macro level, initiatives and efforts at a global scale to provide social justice, lessen information gaps, and remove barriers stemming from the digital divide can be considered significant steps.

Theoretical Foundations of Open and Distance Learning

From a theoretical perspective, "transformation into mainstreaming requires change, adaptation, and evolution" and, accordingly, researchers and practitioners in the field of ODL adopted generic educational theories and then generated their own theories (Bozkurt, 2019a, p. 502). Rather than interpreting the change from a singular point of view, they employed different theoretical approaches to enrich their understanding, guided by openness philosophy (Bozkurt, 2019a, 2019b). The following foundational theories have greatly contributed to the understanding and development of open education and distance education (Jung, 2019). However, it should be noted that while the theories explained below have made great contributions to the field of ODL, the current perception of ODL is not limited only to these theories.

Wedemeyer (1971) conceptualized ODL as independent study, in which students are not only independent from time and space but also responsible for managing and controlling their own learning processes. In his view, openness is related to greater personalization where learners choose their own learning strategies. Holmberg's (1983) theory of guided didactic conversation suggests that independent learning in a learner-centred, open environment is promoted through constant interactions between student and teacher via pre-produced course materials.

Peters' (1983*)* theory of industrialized teaching and learning identified the separation of the production of learning materials from instruction, the division of labour, and the use of standardized procedures and mass production processes as essential aspects of ODL. It implies that the application of industrial practices results in higher quality education at lower costs compared with campus-based education, thus providing increased opportunities for admissions and access to education, two key aspects of openness in ODL.

More recently, new theories of open education have emerged from innovative networked technology-based learning environments. The community of inquiry (CoI) model proposed by Garrison, Anderson, and Archer (2000) focuses on the two-way online interaction between teacher and student and argues that a meaningful online learning experience is created through a combination of cognitive, social, and teaching presence. Openness is shown through open communication, autonomous exchange, and empathetic dialogue. In this way, openness contributes to the ability of students and teachers to establish presence and build an online community that nurtures learning.

Connectivism adopts a non-linear approach to learning, where communities of knowledge are formed through connections forged in the networked learning environment (Siemens, 2005). Connectivism exemplifies openness through its use of OER and the autonomy afforded to the learner. *Heutagogy*, or the study of self-determined learning (Hase & Kenyon, 2000) is built upon principles of self-efficacy and capability, meta-cognition and reflection, and non-linear learning. It is often viewed as part of a continuum with pedagogy and andragogy, emphasizing a shift from teacher-centred to learner-determined environments (Blaschke, 2012). In *rhizomatic learning*, education is an organic process, where "the community is the curriculum," and the learner navigates an integrated, yet diversely connected learning environment by making links, negotiating the learning process, and adapting to change (Cormier, 2008, p. 16). In connectivism, heutagogy, and rhizomatic learning, openness arises from the learner-centred and non-linear design of learning spaces and curricula and the promotion of learner agency and autonomy.

The extended spatial model of e-education proposed by Jung and Latchem (2011) focuses on the expanded nature of teaching and learning spaces in recent ODL. The model highlights the interconnectedness of these spaces through the continuous loop of dialogue and reflection in both processes. By adding the notion of extended time to the model, the open yet interconnected relationship between teaching and learning online is more clearly captured. The learning ecologies approach (Sangrà, Raffaghelli, & Guitert, 2019) adds leadership and decision making to the previous learner-centred approaches. Individuals become aware of their personal learning ecologies as a set of learning opportunities that they can engage with, and they take ownership of this.

In all, the progress in the theoretical foundations of ODL indicates that there is both a tendency to give learners more agency, autonomy, and responsibility, as well as an acceptance of the nonlinear nature of learning, with specific focus on online networked learning. When considering these developments, it is necessary to acknowledge that, at the micro level, the roles of teachers and learners have changed significantly and that, at the meso level, the ways to access knowledge challenge institutional roles. Though formal learning is still important, the rise of nonformal and informal learning signals the need to redesign curricula to meet the needs of learners. Besides, diversity in learners' backgrounds (e.g., cultural, socio-economic) that comes with internationalization and globalization requires institutions that operate internationally to redesign their curricula.

The theories explained above help ODL researchers ask important questions and collect and organize data in meaningful ways in order to provide useful solutions to open education challenges. However, developments in this evolving field demand the continual revision and refinement of existing theories to more clearly and meaningfully understand, explain, and predict changing contexts of open education in the future.

Open Education Practice and Scholarship

The term openness is simultaneously comprehensive and contested, incorporating an adaptive, flexible, and evolving concept with multiple dimensions and layers (Bozkurt, Koseoglu, & Singh, 2019; Cronin, 2017). In this regard, some researchers argue that to truly realize the benefits of openness, there is a need to focus on open educational practices (OEP) (Cronin, 2017; Naidu, 2016). OEP can be defined as "a broad range of practices that are informed by open education initiatives and movements and that embody the values and visions of openness" (Koseoglu & Bozkurt, 2018, p. 455). OEP, in this regard, can be considered as the catalyst for enacting openness into routine teaching and learning processes (Cronin, 2017).

In a similar manner, researchers have explored emerging forms of scholarship that consider openness, emphasizing not just the practice of open, but also the use of related concepts such as *networked* and *social technologies* (Veletsianos & Kimmons, 2012a; Weller, 2014). From this perspective, open scholarship (OS) is defined as "a set of phenomena and practices surrounding scholars' uses of digital and networked technologies underpinned by certain grounding assumptions regarding openness and democratization of knowledge creation and dissemination" (Veletsianos & Kimmons, 2012b, p. 168).

Though OEP and OS are grounded in the philosophy of openness, both terms have emerged partly due to the opportunities provided in the digital knowledge age, and partly due to desires to democratize knowledge and education. In line with these thoughts, Veletsianos and Kimmons (2012b) argue that "openness and sharing in scholarship are seen as fundamentally ethical behaviours that stand as moral requirements for any who value ideals of democracy, equality, human rights, and [social] justice" (p. 172). In short, OEP and OS encourage us to rethink our roles as educators and remind us that teaching, learning, and scholarly practices are about sharing and cooperation, and should resist commodified systems.

While OEP and OS offer promising and exciting opportunities, a variety of issues hinder their full potential and wide adoption. For instance, OEP face a lack of clarity, lip-service adoption, institutional resistance, and cultural norms that contrast with values of openness and quality concerns. Furthermore, Global North advocacy and narratives surrounding openness potentially marginalize concerns from the Global South. These limitations restrain the reach and impact of OEP. OS challenges include digital privacy, technocentrism, professional expectations, financial concerns (e.g., funds needed to support open access initiatives), institutional or scholarly pressures, and ethical issues. In order to be able to mitigate the impacts of these variables, it is useful to approach the development of OEP strategies at three broad levels: macro, as a national or international policy or strategy; meso, as part of an institutional, organizational, or community policy or vision; and, micro, as a personal or professional practice. From a broader view, OEP at macro and meso levels may increase awareness on openness which potentially leads to concrete results in the field. OEP and OS at the micro level, that is, personally and professionally, invite us to reconsider our roles and take on more responsibility as individuals to put the notion of openness in education into practice.

OER, MOOCs, and PLAR

OER has flourished globally over the last two decades, enjoying funding from prestigious organizations such as the Bill and Melinda Gates Foundation. In keeping with OER growth, open access (OA) has flourished as well, advocating for openness in the distribution of research to reach broader audiences.

Prior to this growth, however, open access was used in a more restricted sense to refer to the ability of learners to enter university study without the requisite high school completion or other formal credentials. In this sense, open access has been with us since the advent of open learning institutions, most notably the UK Open University (UKOU), founded in 1969. In Canada, Athabasca University adopted the OU model, as did many other institutions around the world.

The advent of MOOCs marked a further development in the world of openness. The term MOOC is well established, and its aim to challenge learners to think collaboratively through connection while learning is globally accepted.

In the context of postsecondary and tertiary education, we now understand that there are many degrees and forms of openness. Open can refer to admission requirements, registration periods, flexibility in choices, curricula, professional development, curriculum resources, assessment practices, the scholarship of teaching and learning, and research. A less obvious form of openness is Prior Learning Assessment and Recognition (PLAR), a practice that refers to the "evaluation and acknowledgment of learning that occurs outside of formal credit awarding training and educational programs" (Spencer, 2005, p. 508). PLAR is a branch of the more comprehensive term Recognition of Prior Learning (RPL): "Prior learning assessment and recognition is itself an arm of the larger umbrella term, recognizing prior learning (RPL). Under the aegis of the latter is contained, in addition to PLAR, the related (but different) processes of credit transfer" (Conrad, 2006, p. 2). Both can open the access doors and lessen barriers to entering formal higher education. PLAR/RPL, in fact, has been in operation in many global settings for years under many other acronyms, offering hope to learners whose past education has been truncated or unsuccessful for a variety of reasons. PLAR/RPL can be considered, therefore, a pioneer of openness. Spencer (2005) noted that PLAR/RPL had spread to universities worldwide: "PLAR has become a worldwide 'movement' encompassing Australia and New Zealand, Southern Africa, Europe and North America" (p. 508).

With a focus on OER and MOOCs, efforts at the institutional meso level are increasing (e.g., repositories for OER, an increasing number of MOOCs offered by universities); however, there is a need to further support these efforts to remove a greater number of barriers from inside and outside open and distance learning. The biggest challenge, perhaps, is the lip-service use of the term OER. Researchers may feel a responsibility to explain and promote the real idea behind OER and MOOCs.

Learners in Open Education

Research in the field of open and distance education shows that around 50% of studies deal with learner-related topics such as interaction and communication in learning communities, learner characteristics, and instructional design (Zawacki-Richter & Anderson, 2014). Instructional design research typically focuses on learners, their needs, potential, and patterns of usage.

Recent increases in expanded educational opportunities, globalization, and advanced technologies underpinning ODL choices have changed learner demographics. As mentioned above, real change started during the 1960s and 70s, as interest in distance learning awakened and open universities began to flourish (Peters, 2014); universities, in response, began to open their doors to broader and more diverse types of learners.

After a rapid and worldwide growth of higher education systems throughout the last 50 years, higher education institutions are facing increasing challenges, not only in accommodating an increasingly heterogeneous student body, but also in terms of “funding, organization and governance, and of quite different conditions for teaching new kinds of students with diverse aspirations and academic talents” (Trow, 2000, p. 1).

Distance education pioneer Wedemeyer (1981) identified the importance of open and distance learning for widening access for different groups of non-traditional learners: “The new urgency respecting learning […] signals the need for educational approaches that recognize and acknowledge the significance of non-traditional learning throughout life” (p. 206). The challenges to the education system increase when not only larger target groups are addressed for a course of study, but also when the time span in which these groups start studying is extended. Learners need flexible structures so they can manage their studies, family duties, and work in all stages of their lives.

Researchers’ findings address a controversial discussion as regards defining non-traditional students (Wolter, Dahm, Kamm, & Kerst, 2015). Previous studies made the distinction between traditional and non-traditional students based on various criteria (e.g., age, form of study, university entrance qualification), depending on context (Stöter, Bullen, Zawacki-Richter & von Prümmer, 2014). Attempts at international practical definitions (e.g., Schuetze & Slowey, 2012) can serve as a starting point for further investigation into the needs of heterogenic student bodies. Finally, and from an international point of view, the respective country-specific conditions and cultures are important in defining non-traditional students.

Given greater technological possibilities and probable digital disruptions of traditional learning and working roles, future learners’ needs will continue to evolve. Open universities, with their policies of flexibility, reduced barriers to learning, and access will need to explore further options to offer more choice and ease of access. This implies placing greater emphasis on the micro or individual level, and further justifies this emphasis considering that learners are at the center of open learning ecologies.

Internationalization and Globalization

Internationalization has been inherent in higher education from its inception (Enders, 2004). However, its manifestations have increased over the 20th century, especially in the form of academic mobility (Altbach & de Wit, 2015). A major driver of this development has been globalization (Knight, 1999). Over the past 25 years, internationalization has evolved “from a marginal and minor component to a global, strategic, and mainstream factor in higher education” (Knight & de Wit, 2018, p. 2), encompassing not only student and staff mobility but also program and provider mobility and internationalization at home. Knight (2003) defines internationalization as “the process of integrating an international, intercultural, or global dimension into the purpose, functions or delivery of postsecondary education” (p. 2), thus potentially encompassing higher education as a whole. Internationalization is today widely acknowledged as providing various academic, economic, political, and socio-cultural returns to individuals, higher education organizations, and countries (Kehm & Teichler, 2007).

Open higher education, on the other hand, has always been conceived as enhancing access to higher education and increasing knowledge dissemination across society. In the past, a connection to internationalization has not usually been made in institutional strategies (Zawacki-Richter & Bedenlier, 2015). While both internationalization and open education constitute important developments within higher education, they have not been integrated into many institutions and more often simply co-exist. Yet scholars have started to acknowledge connections between the two. De Wit (2016), for instance, regarded concepts of distance education and online learning as closely connected with internationalization. Bruhn (2017), extending Knight's (2003) definition, developed the concept of *virtual internationalization*, highlighting the potential that advancements in technology can have for internationalization: online distance education, MOOCs, and OER are borderless *a priori*, opening up "new ways to be a globally engaged university" (Kinser, 2014, p. 3). This applies to both transnational and "at-home" activities (Bruhn, 2017). A growing body of research highlights the transformational impact of technology on the internationalization of higher education.

Virtual mobility in particular is regarded as opening up mobility to students who would not otherwise have access to it. Scholars have acknowledged the role of virtual internationalization in reaching distant geographies and disadvantaged groups who have few opportunities for international movement (Könings et al., 2016). Open, in this regard, also relates to a geographical and temporal openness, enabling students to access study programs in the forms of transnational education and online distance learning. This is illustrated by the fact that the export of education is among the top service goods of Australia (Latchem, 2018) and that, worldwide, students who cannot be physically mobile turn to international study opportunities offered online. A prerequisite for students to enroll in such open offerings is, of course, that they meet credential criteria, are linguistically and culturally prepared, and have the required financial means as open does not necessarily mean free (of costs).

Given this, enhancing internationalization with information and communication technology does not necessarily lead to more open education. It does, however, provide new opportunities for those already enrolled, and thus, can tentatively be said to open education within higher education. At the macro level, globalization, an increasing number of international student profiles in higher education, international collaborations and partnerships among universities, virtual exchange, and virtual internationalization imply the need to develop new policies and strategies.

Conclusion

The spirit of open education is well established and here to stay. We have shown that the concept of open education concerns more than just issues related to access and widening participation in higher education. Archer and Prinsloo (2017) remind us that providing access also raises a number of ethical concerns. Reaching large numbers of student registration is not enough—they emphasize that widening access comes with fiduciary duties and the responsibility of taking care of and providing support for students, especially for non-traditional students without an academic background. The best intentions of opening up educational opportunities might have harmful effects: "Actually, an ethics of care proposes that providing access without providing reasonable care to ensure success is actually justice denied" (p. 274).

By using the macro, meso, and micro framework outlined by Zawacki-Richter and Anderson (2014), we can provide several topics that researchers could explore, which might result in interesting and useful advancements in open education.

At the macro level, the ongoing monitoring of the impact of national open education policies will provide insight into their appropriateness, as well as into the constraints found in fostering open strategies everywhere. Questions, such as whether ODL is evolving similarly in different countries, will also assist in clearly defining the needs that more localized policies should address, especially from a Global South perspective, where openness could have transformative effects on access, flexibility, and quality of education. On the other hand, the impact of globalization and internationalization, as stated earlier in this text, should also be monitored, to explore how their changes are positively or negatively influencing the adoption of open education in higher education. Finally, accepting that learning is increasingly being achieved through non-formal or informal means, quantitative and qualitative research exploring how to measure and acknowledge these learning achievements is strongly needed.

At the meso level, related to institutional and organizational policy and educational management, the uses of technology in providing new opportunities for learning need to be analysed. Questions such as how machine learning, artificial intelligence, or learning analytics are being applied to ODL must be answered through rigorous research. Do they provide further opportunities? Do they really help to personalize learning? Or are they just standardizing it? Also, new ODL pedagogies have to be explored, including how the use of some forms of digital media and learning materials are supporting the creation of new and more flexible learning opportunities and learning in ecologies that are increasingly networked. The concept of learning ecologies provides us with an analytical framework both to study how institutions can play a role in enriching learners' experiences, and to determine what the changing role of teachers has to be within such a context.

Finally, at the micro level, ongoing study of the increasing number of non-traditional learners needs to continue, focusing on the needs of this very heterogeneous student profile, and relating needs to varying geographic contexts, conditions, and cultures. For example, do the students included in this profile behave differently within open education opportunities for learning? Furthermore, as a keyword for open education, can independence from time and space be balanced with the need for collaboration and interaction in formal settings?

The elements and research areas of open education discussed in this paper are intended as an impetus for further discussion, exploration, and more importantly, as a call to action for local and global parties to exploit the benefits of openness in education. Research teams are encouraged to use these ideas as a starting point, and to build upon them as we approach a new decade that will see further evolution and improvement in the field of open education. As a final remark, we argue that the change starts within, and, therefore, starts with us. Openness is our common ground; it is a core and universal value, and thus, it is time to re-explore the benefits of openness in education to respond to emerging needs, advance the field, and envision a better world.

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