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Editorial - Volume 22 Issue 2

Constance Blomgren
Associate Editor, Athabasca University

Welcome to this issue of *IRRODL*. Our authors, reviewers, and editors have all been busy working to bring you the following contributions. We have 13 research articles, two book reviews, and three substantial literature reviews.

"Investigation of Emerging Trends in the E-Learning Field Using Latent Dirichlet Allocation" by **Fatih Gurcan**, **Ozcan Ozyurt,** and **Nergiz Ercil Cagitay** applied text mining to determine topic modeling and trends in the e-learning field.

Aras Bozkurt and **Olaf Zawacki-Richter** authored "Trends and Patterns in Distance Education (2014–2019): A Synthesis of Scholarly Publications and a Visualization of the Intellectual Landscape." Using social network analysis and text mining Bozkurt and Zawacki-Richter analyzed the changes in distance education scholarship ending with future research suggestions.

Florence Martin, **Doris U. Bolliger**, and **Claudia Flowers** developed and validated an online course design element instrument and report their findings in "Design Matters: Development and Validation of the Online Course Design Elements (OCDE) Instrument."

Adding to the scholarship of OER, **Angela R. Hillman**, **Anna R. Brooks**, **Marcus Barr**, and **Jesse Strycker** report their findings of "Evaluation of Open Educational Resources for an Introductory Exercise Science Course."

"Impact of Changes in Teaching Methods During the COVID-19 Pandemic: The Effect of Integrative E-Learning on Readiness for Change and Interest in Learning Among Indonesian University Students" is authored by **Anggun Resdasari Prasetyo**, **Harlina Nurtjahjanti**, and **Lusi Nur Ardhiani.** They report on the effectiveness of an integrative e-learning method examining scales for readiness for change and interest in learning.

George Veletsianos, **Charlene A. VanLeeuwen, Olga Belikov**, and **Nicole Johnson** provide a qualitative study of digital education in their article, "An Analysis of Digital Education in Canada in 2017-2019."

"Ready to Do OpenCourseWare? A Comparative Study of Taiwan College Faculty" is a study completed by **Huei-Chuan Wei** and **Chien Chou.** They examine teaching readiness of open courseware with respect to experience and factors of perception including administrative support, personal characteristics, and OCW recognition.

Hanife Çivril and **Ali Ekrem Özkul** examine virtual laboratories as part of open learning and apply the technology acceptance model to their mixed methods study, "Investigation of the Factors Affecting Open and Distance Education Learners' Intentions to Use a Virtual Laboratory."

"IDEAS for Transforming Higher Education: An Overview of Ongoing Trends and Challenges" is an exploratory three-part study. **Lourdes Guàrdia**, **Derek Clougher**, **Terry Anderson**, and **Marcelo Maina** examine technological, organizational, and pedagogical higher education trends and challenges to formulate the IDEAS framework for transformational next-generation pedagogy.

"What Is Open Pedagogy? Identifying Commonalities" examines the literature of open pedagogy and proposes a five-part framework. **Phil Tietjen** and **Tutaleni I. Asino** argue for a robust analytical framework to further research of open pedagogy.

Ermira Idrizi, **Sonja Filiposka**, and **Vladimir Trajkovijk** contributed their study, "Analysis of Success Indicators in Online Learning." They conducted a case study to determine significant factors of academic performance of students taking online courses.

"Parents' Perceptions of Their Children's Experiences With Distance Learning During the COVID-19 Pandemic" provides research that is very timely for understanding young online learners. **Diala Hamaidi**, **Yousef Arouri**, **Rana Noufal**, and **Islam Aldrou** conducted a study in Jordan that provides the parental perspective on online learning for children.

Megan Ennes reports on her study, "Museum-Based Distance Learning Programs: Current Practices and Future Research Opportunities." Again, due to the global pandemic, museum-based distance learning programs have become a timely area of research.

Our first book review is by **İrem Demirbağ** and **Sedef Sezgin** and they provide their take on *Guidelines on the Development of Open Educational Resources Policies*. **Özlem Oktay** and **Fırat Sösuncu** examine the book, *Learning Online-The Student Experience*.

We have three literature reviews with the first, "Mentoring Graduate Students Online: Strategies and Challenges," authored by **Rhiannon Pollard** and **Swapna Kumar**. The second offering, "A Systematic Review of Questionnaire-Based Quantitative Research on MOOCs," is by **Mingxiao Lu**, **Tianyi Cui**, **Zhenyu Huang**, **Hong Zhao**, **Tao Li**, and **Kai Wang**. The final literature review by **Jewoong Moon** and **Yujin Park** provides "A Scoping Review on Open Educational Resources to Support Interactions of Learners with Disabilities."

Best wishes and enjoy this issue.

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Investigation of Emerging Trends in the E-Learning Field Using Latent Dirichlet Allocation

Fatih Gurcan[1]*, Ozcan Ozyurt[2], and Nergiz Ercil Cagiltay[3]
[1]Distance Education Application and Research Centre, Karadeniz Technical University, Trabzon, Turkey; [2]Karadeniz Technical University, OF Technology Faculty, Software Engineering Department, Trabzon, Turkey; [3]Software Engineering Department, Atilim University, Ankara, Turkey
**Corresponding Author*

Abstract

E-learning studies are becoming very important today as they provide alternatives and support to all types of teaching and learning programs. The effect of the COVID-19 pandemic on educational systems has further increased the significance of e-learning. Accordingly, gaining a full understanding of the general topics and trends in e-learning studies is critical for a deeper comprehension of the field. There are many studies that provide such a picture of the e-learning field, but the limitation is that they do not examine the field as a whole. This study aimed to investigate the emerging trends in the e-learning field by implementing a topic modeling analysis based on latent Dirichlet allocation (LDA) on 41,925 peer-reviewed journal articles published between 2000 and 2019. The analysis revealed 16 topics reflecting emerging trends and developments in the e-learning field. Among these, the topics "MOOC," "learning assessment," and "e-learning systems" were found to be key topics in the field, with a consistently high volume. In addition, the topics of "learning algorithms," "learning factors," and "adaptive learning" were observed to have the highest overall acceleration, with the first two identified as having a higher acceleration in recent years. Going by these results, it is concluded that the next decade of e-learning studies will focus on learning factors and algorithms, which will possibly create a baseline for more individualized and adaptive mobile platforms. In other words, after a certain maturity level is reached by better understanding the learning process through these identified learning factors and algorithms, the next generation of e-learning systems will be built on individualized and adaptive learning environments. These insights could be useful for e-learning communities to improve their research efforts and their applications in the field accordingly.

Keywords: e-learning, text mining, topic modeling, trends, developmental stages

Introduction

Today, e-learning has become a very important topic, with applications in every field, as supportive training, lifelong learning modalities, and support tools, for all types of educational systems. Due to the effects of the COVID-19 pandemic on teaching and learning environments, research into e-learning studies has become even more critical. A recent study by Chavarría-Bolaños et al. (2020) reported the importance of e-learning in dental education, for example. E-learning studies can be considered as multidisciplinary, as several fields contribute to it from different perspectives. The roots of e-learning studies go back to the late 1950s, and therefore, there is a large amount of available literature detailing improvements and achievements in this field over the decades. Furthermore, as highlighted by some researchers, since 2000, the number of studies conducted on e-learning has significantly increased (González, 2010) and will likely accelerate in the current pandemic situation. By analyzing these studies, one can get a general overview of e-learning studies that can help us understand how the field is evolving and where it is going. Such studies are very critical in guiding future research and developments related to all kind of e-learning studies. In the literature, there have been several attempts to analyze earlier studies and provide a general overview of the field. As defined by Rowley and Slack (2004), systematic reviews aim to facilitate the definition, evaluation, and interpretation of studies in a specific field by examining the concepts, applications, and theories pertaining to it. These studies systematically review the literature to answer research questions to better understand and examine the key concepts in the field. Some of the previous studies on e-learning were conducted to provide insights into a specific area of e-learning, such as the Semantic Web for distance learning (Bashir & Warraich, 2020), virtual education (Fermín-González, 2019), educational data mining (Rodrigues et al., 2018), mobile learning in higher education (Krull & Duart, 2017), and machine-learning-based recommendation systems for e-learning (Khanal et al., 2020). Another group of studies were conducted on the implementation of e-learning in specific fields, such as e-learning for training work corporations (Kaizer et al., 2020), e-learning in undergraduate dentistry education (Zitzmann et al., 2020), implications of e-learning for universities (Kibuku et al., 2020), and e-learning for mathematics teaching (Klingenberg et al., 2020). There are only a limited number of systematic review studies addressing e-learning studies in general. Among these, a systematic review conducted on 99 e-learning articles published between 2010 and 2018 reported four main themes in the field: educational systems, learning issues, student behaviors, and online learning tools (Rodrigues et al., 2019). Valverde-Berrocoso et al. (2020) also conducted a systematic review analyzing 248 articles published between 2009 and 2018 and discovered the following: that online students, online teachers, and curriculum-interactive learning environments were the three main nodes of e-learning; that MOOCs were the most researched e-learning modality; that the community of inquiry and the technological acceptance model were the most used theories in the analyzed studies; and, finally, that case studies were the most frequently used methodology. As these systematic reviews require a lot of researcher effort, they are usually conducted with a limited number of articles.

Another group of studies attempting to provide a bigger picture of e-learning studies were undertaken as bibliometric analyses in scientific and research fields to examine the properties and recorded information based on a number of indicators (Abramo et al., 2009; Patra et al., 2006). As these studies considered certain indicators as the basis for analysis, they were conducted on larger data sets. For instance, Hung (2012) examined 689 articles published between 2000 and 2008 through a bibliometric analysis. Similarly, Asadzandi et al. (2017) descriptively analyzed 23,805 e-learning studies through the categories provided by the Scopus database, such as date of publication, type of documents, language of the documents, source of articles, subject areas, authors, and their affiliations, concluding that there was a steady growth in the number of articles on e-learning studies, which was parallel with its development. Similarly, Tibaná-Herrera et al. (2018a) categorized e-learning as an emerging discipline consisting of 64 descriptors and 219 journals and congresses indexed by Scopus between 2012 and 2014. Another bibliometric analysis was conducted by Tibaná-Herrera et al. (2018b) on 39,244 documents published between 2003 and 2016 that were indexed by Scopus and SCImago Institutional Rankings. They reported the following: the majority of these studies were published by authors from the United States; the University of Hong Kong was the most productive institution; and the National Taiwan University of Science and Technology had the greatest collaboration. Thus, bibliometric analyses were conducted on larger data sets and possibly provide a bigger picture of the field; however, as the analysis was based on a number of indicators, these bibliometric analyses missed out the details in the content of the published studies, which limits their contributions to the field.

All of these earlier studies are very valuable in providing a general perspective of the field of e-learning, despite limitations such as the limited number of articles, the narrow scope of the field, or limitations in the analysis methods (Çakiroğlu et al., 2019). As the number of articles in the field of e-learning is significantly increasing, it is becoming more difficult to conduct a manual analysis (Yang et al., 2016). Different methods are used for in-depth analysis of superficial description. In this context, various analyses can be performed using text/data mining methods with a large number of article sets. Today, different types of text analysis of a high volume of documents, such as word frequency analysis, text classification approaches, topic modeling analysis, and n-gram analysis, are being used extensively to gain a deeper understanding of specific domains and fields (Gurcan, 2019; Gurcan et al., 2021). For instance, in the field of distance education, Gurcan and Cagiltay (2020) recently conducted a text-mining-based review by analyzing 27,735 peer-reviewed journal articles published between 2008 and 2018 using n-grams, and they reported 10 main themes of the field. However, they applied a manual classification on the topics identified (Gurcan & Cagiltay, 2020). Recently, with improvements in machine learning and data mining techniques, significant developments have occurred in the areas of automatic topic determination, semantic information extraction from texts, and automatic analysis of very large data sets using text mining methodologies (Gürcan, 2009; Gurcan, 2018). These techniques open a wider window into understanding studies in the field and offer objective analysis methods. Accordingly, the study discussed in this article aimed to provide a wider perspective by analyzing 41,925 e-learning journal articles and reviews published between 2000 and 2019 using the latent Dirichlet allocation (LDA) algorithm (Blei et al., 2003). The methodology of the study was designed to investigate the following research questions (RQ):

RQ1. What have been the bibliometric characteristics of e-learning research during the period between 2000 and 2019?

RQ2. What have been the emerging topics in the e-learning field in the period between 2000 and 2019?

RQ3. How have the topics of interest in e-learning studies changed from 2000 to 2019?

RQ4. What are the future trends in the e-learning field?

Methods

The literature available on e-learning is very comprehensive. Since journal articles are subjected to a peer review process, this study considered only peer-reviewed journal articles. More specifically, only e-learning-oriented journal articles published in English in the last 20 years (between 2000 and 2019) were included in this study. Since e-learning is an interdisciplinary field covering a wide spectrum of topics, an iterative strategy was followed to determine the search string for the study. Namely, first, a wide literature review was carried out in order to determine the synonym equivalents of e-learning expression in the literature. Then, the opinions of field experts were obtained regarding the extracted terms. The final keywords were determined from the results of the examination by five field experts and the evaluation of the researchers. The search query that met the search string and other criteria determined as a result of these processes was created as follows:

> TITLE-ABS-KEY (("online learning" OR "e-learning" OR "distance learning" OR "mobile learning" OR "web-based learning" OR "online training" OR "e-training" OR "distance training" OR "mobile training" OR "web-based training" OR "online education" OR "e-education" OR "distance education" OR "mobile education" OR "web-based education" OR "online teaching" OR "e-teaching" OR "distance teaching" OR "mobile teaching" OR "web-based teaching" OR "MOOC" OR "online open course")) AND (PUBYEAR < 2020) AND (PUBYEAR > 1999) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "re")) AND (LIMIT-TO (LANGUAGE , "English"))

The Scopus database was used to obtain articles suitable for the scope of the study since it covers more than 5000 publishers worldwide—including Elsevier, Emerald, IEEE, Sage, Springer, Taylor & Francis, and Wiley Blackwell—and this number is increasing daily (Gurcan et al., 2021; Mongeon & Paul-Hus, 2016). The query given above was run on April 5, 2020, to access the relevant articles from the Scopus database. The search brought up a total of 41,925 articles (2619 review articles and 39,306 research articles). The title, abstract, and author keyword information of these articles were added to the data set.

To prepare the e-learning corpus for probabilistic topic modeling, preprocessing tasks such as tokenization; removing meaningless words, symbols, and stop words; and stemming were implemented (Gurcan et al., 2021). Then, an e-learning document term matrix was created, in which each row represented an article and each column represented a unique word in the e-learning corpus. Afterward, LDA, a probabilistic topic modeling approach (Blei et al., 2003), was used for creating and fitting a topic model to the e-learning corpus and analyzing this corpus.

LDA is a generative approach used to discover hidden semantic patterns in a large, relatively unstructured document corpus (Blei, 2012). Text documents contain hidden semantic patterns called “topics,” and each of these topics is defined by a probability distribution over a fixed set of words (Blei et al., 2003). Since LDA is an unsupervised method for topic modeling, it does not require any training set, tags, or metadata for learning, so large numbers of textual documents can be analyzed in a short time. The LDA model is frequently used in content analysis based on topic modeling (Blei et al., 2003; Blei & Lafferty, 2007). For these reasons, the LDA model was preferred over others and employed for topic modeling analysis of the e-learning corpus in this study.

This analysis revealed 16 topics at an optimal level. The top 20 words with the highest probability were identified for each topic and assigned to these topics. A suitable topic name was defined for each topic taking into account the first five words in the topics. Furthermore, the volumetric percentage rates and the temporal trends of the topics that modeled the entire e-learning corpus were revealed by calculating the distribution of topics per document and the word distributions per topic (Gurcan et al., 2021; Gurcan & Cagiltay, 2020).

Results

The results of the study are first presented descriptively by considering the number of yearly publications, the top subject areas and journals, and the top countries of the authors. Additionally, the top keywords found in these articles are also mentioned descriptively. Further, a detailed topic modeling analysis is presented to provide an overall picture of e-learning studies.

Descriptive Analysis

In order to describe the bibliometric characteristics of the e-learning field between 2000 and 2019 (RQ1), the descriptive analysis of the corpus is given below. The total number of articles published between 2000 and 2019 and their yearly distribution are given in Table 1, showing a total of 41,925 articles analyzed in the study. It should be noted that although there was a slight decrease in the number of articles in 2002 and 2010 compared to the other years, there was an overall linear increase in the number of publications each year.

Table 1

Yearly Distribution of the Articles

Year	n	%
2000	681	1.62
2001	861	2.05
2002	788	1.88
2003	993	2.37
2004	1133	2.70
2005	1179	2.81
2006	1325	3.16
2007	1508	3.60
2008	1632	3.89
2009	1962	4.68
2010	1927	4.60
2011	2244	5.35
2012	2330	5.56
2013	2494	5.95
2014	2847	6.79
2015	3017	7.20
2016	3224	7.69
2017	3357	8.01

2018	3823	9.12
2019	4600	10.97
Total	41,925	100

Figure 1 shows the top 10 subject areas addressed by the highest number of articles. The majority of the articles were published in the field of social sciences, including educational sciences (n = 23,150). As some studies were carried out in more than one discipline, they were classified under each of these subject areas by Scopus.

Figure 1

Top 10 Subject Areas With the Most Published Articles

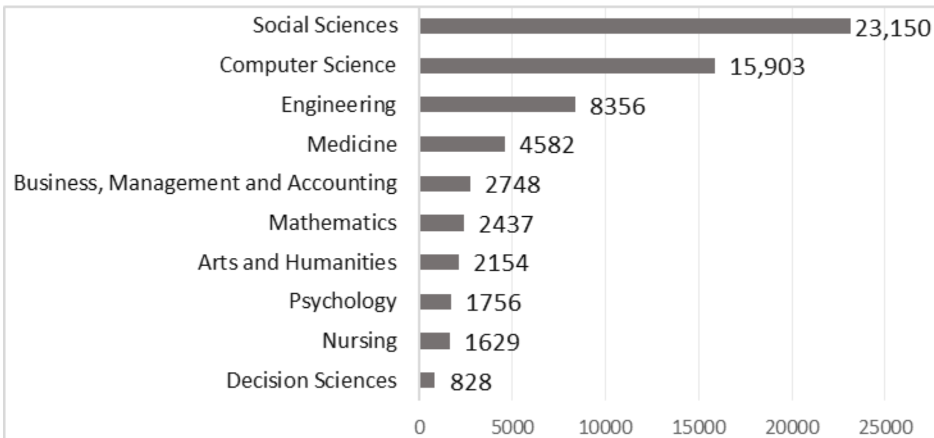


Figure 2 shows the top 10 journals with the highest number of published articles. The *Computers and Education* journal published the highest number of articles (n = 975), followed by the *International Review of Research in Open and Distance Education* journal (n = 723) and the *Turkish Online Journal of Distance Education* journal (n = 688).

Figure 2

Top 10 Journals With the Most Published Articles

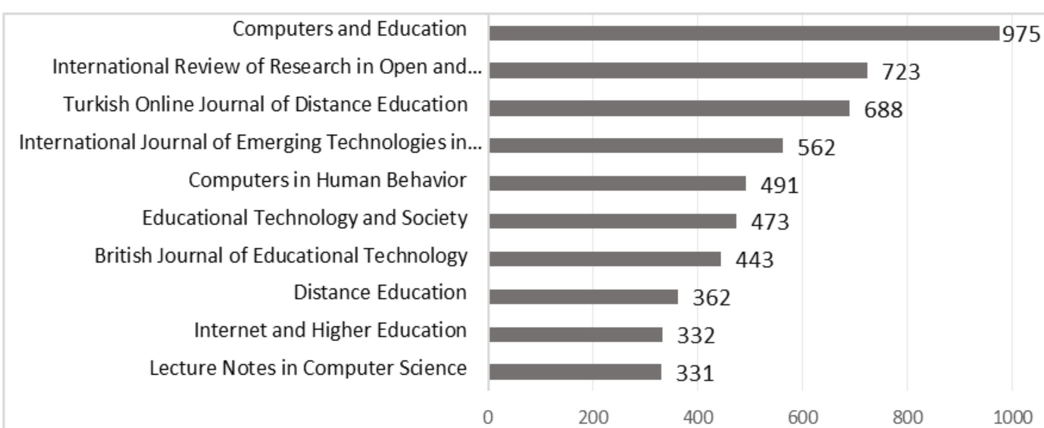
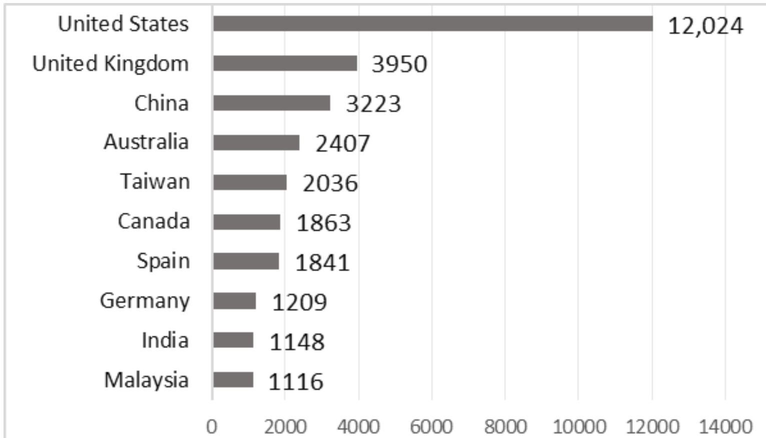


Figure 3 reveals that the highest number of articles originated from the United States of America (n = 12,024; f = 28.7%), followed by the United Kingdom (n = 3950) and China (n = 3223).

Figure 3

Top 10 Countries With the Most Published Articles



The top 20 keywords of the analyzed studies are listed in Table 2, with the top five keywords being "e-learning" (30.68%), "human" (27.35%), "education" (16.42%), "teaching" (12.88%), and "student" (12.01%).

Table 2

Top 20 Keywords Addressed by E-Learning Articles

Keyword	n	%
E-learning	12,861	30.68
Human	11,466	27.35
Education	6885	16.42
Teaching	5402	12.88
Student	5034	12.01
Distance education	4591	10.95
Online learning	4144	9.88
Internet	3935	9.39
Learning	3145	7.50
Learning systems	3111	7.42
Female	2573	6.14
Male	2423	5.78
Computer aided instruction	2196	5.24
Distance learning	2192	5.23
Adult	2098	5.00
Medical education	2010	4.79
Mobile learning	1692	4.04
Higher education	1560	3.72
Online systems	1546	3.69
Curriculum	1487	3.55

Topic Modeling Analysis

In order to reveal the emerging topics in the e-learning field (RQ2), the results of the topic modeling analysis achieved by the LDA are given in this section. Using a LDA-based topic modeling procedure, 16 topics were discovered (see Table 3). The rate (%) of each topic was calculated by their volume, referring to the number of articles published on each topic.

Table 3

Discovered Topics and Keywords of the Articles

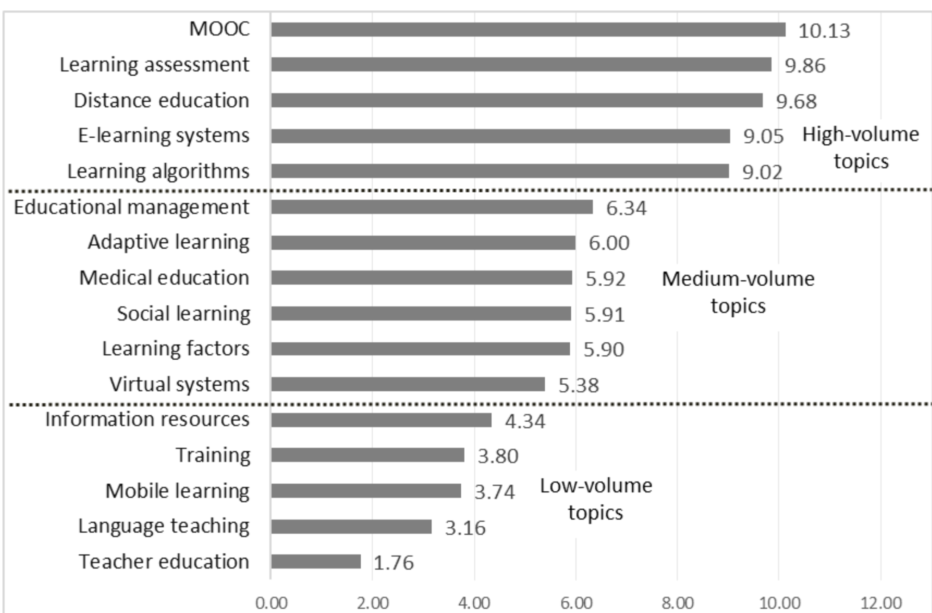
Topic name	Keywords	Rate %
MOOC	learn*, educ*, onlin*, design*, mooc*, develop*, practic*, approach*, teach*, cours*, learner*, technologi*, experi*, environ*, theori*, model*, support*, activ*, framework*, context*	10.13
Learning assessment	student*, learn*, cours*, onlin*, assess*, effect*, result*, teach*, instruct*, perform*, blend*, class*, feedback*, evalu*, tradit*, classroom*, compar*, method*, lectur*, test*	9.86
Distance education	educ*, distanc*, student*, univers*, program*, onlin*, cours*, learn*, faculti*, technologi*, develop*, institut*, teach*, academ*, support*, offer*, graduat*, experi*, access*, colleg*	9.68
E-learning systems	elearn*, system*, learn*, educ*, develop*, manag*, technologi*, evalu*, model*, process*, design*, tool*, qualiti*, inform*, implement*, applic*, support*, platform*, univers*, environ*	9.05
Learning algorithms	learn*, onlin*, algorithm*, model*, network*, control*, method*, data*, system*, perform*, neural*, predict*, adapt*, result*, optim*, train*, featur*, machin*, track*, dynam*	9.02
Educational management	train*, develop*, manag*, countri*, educ*, project*, polici*, cultur*, global*, busi*, knowledg*, chang*, organ*, inform*, market*, commun*, industri*, sustain*, intern*, employe*	6.34
Adaptive learning	learn*, system*, learner*, adapt*, data*, model*, user*, knowledg*, person*, intellig*, approach*, elearn*, recommend*, style*, object*, content*, environ*, mine*, semant*, result*	6.00
Medical education	health*, medic*, educ*, nurs*, care*, train*, clinic*, patient*, practic*, knowledg*, method*, profession*, program*, particip*, evalu*, develop*, improv*, skill*, modul*, assess*	5.92
Social learning	learn*, commun*, onlin*, social*, collabor*, interact*, discuss*, student*, environ*, particip*, network*, presenc*, support*, activ*, media*, share*, virtual*, knowledg*, forum*, asynchron*	5.91
Learning factors	factor*, learn*, student*, model*, perceiv*, motiv*, influenc*, result*, satisfact*, effect*, accept*, attitud*, learner*, analysi*, data*, intent*, affect*, technologi*, signific*, percept*	5.90
Virtual systems	virtual*, system*, engin*, laboratori*, comput*, simul*, environ*, remot*, experi*, design*, interact*, control*, develop*, applic*, cloud*, train*, realiti*, network*, educ*, technologi*	5.38
Information resources	inform*, video*, librari*, resourc*, web*, servic*, digit*, access*, internet*, content*, literaci*, materi*, user*, site*, websit*, search*, librarian*, educ*, lectur*, multimedia*	4.34
Training	train*, intervent*, effect*, control*, particip*, result*, improv*, trial*, children*, health*, program*, test*, assess*, patient*, increas*, measur*, outcom*, compar*, behavior*, prevent*	3.80

Mobile learning	mobil*, learn*, devic*, game*, technologi*, educ*, student*, mlearn*, applic*, app*, develop*, phone*, digit*, activ*, support*, design*, environ*, smart*, comput*, result*	3.74
Language teaching	languag*, teach*, learn*, english*, multimedia*, learner*, write*, effect*, student*, technologi*, read*, skill*, develop*, improv*, comput*, platform*, foreign*, design*, chines*, applic*	3.16
Teacher education	teacher*, school*, educ*, mathemat*, teach*, ict*, profession*, develop*, train*, secondari*, classroom*, pre-servic*, technologi*, compet*, scienc*, primari*, music*, elementari*, mentor*, digit*	1.76

The top 20 keywords classified under each topic are also given by considering their volume rates. Table 3 shows that the most intensively studied topic by researchers was "MOOC" (10.13%), while the least read topic was "teacher education" (1.76%). Figure 4 shows the volume of the topics among all the articles considered in this study. Accordingly, the topics can be classified as high-volume topics having a ratio higher than 9.0%, medium-volume topics having a ratio higher than 5.4% and less than 9.0%, and low-volume topics having a ratio less than 5.4%. The topics having the highest ratio were "MOOC" (10.13%), "learning assessment" (9.86%), "distance education" (9.68%), "e-learning systems" (9.05%), and "learning algorithms" (9.02%), while those with lower ratios were "teacher education" (1.76%), "language teaching" (3.16%), "mobile learning" (3.74%), "training" (3.80%), and "information resources" (4.34%). According to these ratio differences, the discovered topics could be classified under three groups. Changes in the volume ratios were taken into account while classifying the discovered topics. There were sharp decreases and clusters in volume ratios below 9 and below 5. These groups were labeled by the researchers as high-volume (n = 5), medium-volume (n = 6), and low-volume (n = 5) topics.

Figure 4

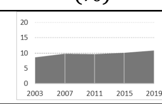
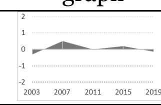
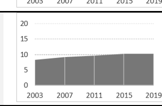
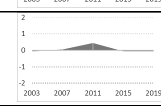
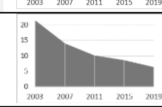
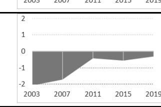
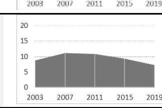
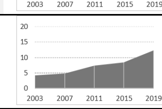
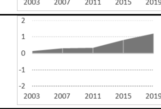
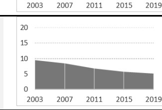
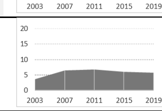
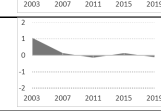
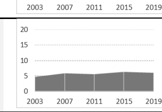
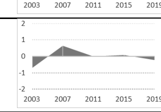
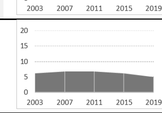
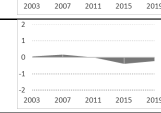
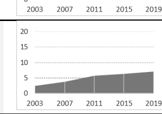
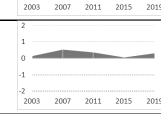
Percentage Rates of Articles From 2000 to 2019 for Each Topic

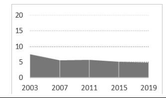
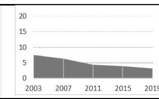
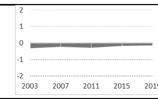
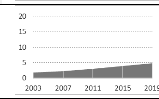
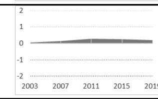
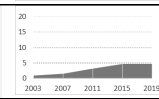
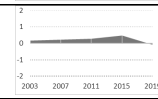
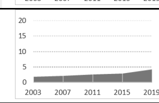
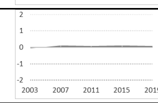
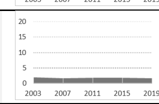
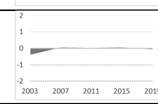


To better understand the temporal trends of e-learning topics between 2000 and 2019 (RQ3), the developmental stages of these topics were analyzed in four-year periods as shown in Table 4, with the average number of articles published under each topic (n) for each time period being evaluated. Their percentages according to the total number of articles published each year were calculated, and their average value for each period (%) is also given. Their accelerations were calculated by subtracting the average percentage of articles from that of the previous years. The average acceleration values (A) for each period were also calculated and are presented in Table 4. Finally, the trends of the articles for each topic are presented graphically, considering their volume according to the percentages of the number of articles (%) and the acceleration graph through the calculated acceleration values (A). Table 4 shows that among the top volume topics, "MOOC" and "learning assessment" showed more steady behavior; however, for some topics, such as "distance education," there was a decrease and for other topics, such as "learning algorithms," there was an increase in the percentages of the number of periodical articles. Similarly, even though "teacher education" had the lowest volume, it had a steady acceleration resulting in a similar number of articles compared to the other topics.

Table 4

Volume and Acceleration of Articles for Each Discovered Topic in Four-Year Periods

Topic name		Four-year periods 2000–2003	2004–2007	2008–2011	2012–2015	2016–2019	AVG	Trend line Volume graph (%)	Acceleration graph
MOOC	n	285	503	750	1092	1619	849.74		
	%	8.62	9.75	9.64	10.17	10.83	9.80		
	A	−0.31	0.50	0.00	0.19	−0.14	0.04		
Learning assessment	n	278	474	752	1093	1536	826.47		
	%	8.37	9.25	9.62	10.22	10.26	9.54		
	A	−0.05	0.05	0.44	−0.05	−0.05	0.07		
Distance education	n	708	707	779	908	955	811.30		
	%	21.59	13.96	10.07	8.58	6.40	12.12		
	A	−2.07	−1.70	−0.42	−0.56	−0.31	−1.01		
E-learning systems	n	298	579	842	990	1085	758.68		
	%	8.78	11.19	10.86	9.34	7.28	9.49		
	A	1.33	0.12	−0.38	−0.51	−0.33	0.05		
Learning algorithms	n	142	253	577	919	1893	756.74		
	%	4.23	4.86	7.44	8.50	12.36	7.48		
	A	0.14	0.32	0.34	0.83	1.21	0.57		
Educational management	n	319	438	521	613	767	531.80		
	%	9.47	8.49	6.75	5.77	5.12	7.12		
	A	0.96	−0.36	−0.68	−0.34	0.04	−0.08		
Adaptive learning	n	127	332	529	656	873	503.20		
	%	3.66	6.47	6.87	6.12	5.80	5.78		
	A	1.06	0.15	−0.14	0.15	−0.11	0.22		
Medical education	n	153	302	440	676	911	496.55		
	%	4.72	5.86	5.62	6.30	6.10	5.72		
	A	−0.69	0.64	0.01	0.09	−0.21	−0.04		
Social learning	n	204	348	524	656	746	495.68		
	%	6.13	6.75	6.74	6.19	5.04	6.17		
	A	0.05	0.16	−0.01	−0.40	−0.22	−0.08		
Learning factors	n	83	199	444	680	1066	494.38		
	%	2.47	3.81	5.68	6.36	7.05	5.07		
	A	0.15	0.53	0.37	0.07	0.30	0.28		
	n	252	288	439	550	728	451.48		

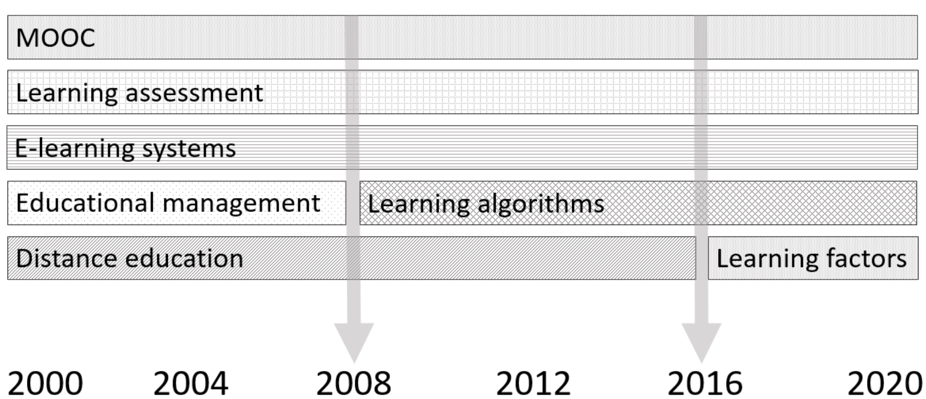
Virtual systems	%	7.59	5.60	5.67	5.16	4.90	5.79		
	A	−0.04	−0.69	0.12	−0.18	−0.18	−0.20		
Information resources	n	249	323	344	418	485	363.96		
	%	7.55	6.34	4.45	3.94	3.25	5.11		
	A	−0.31	−0.23	−0.29	−0.16	−0.13	−0.22		
Training	n	63	122	236	432	742	319.03		
	%	1.89	2.35	3.01	4.01	4.90	3.23		
	A	0.06	0.13	0.27	0.24	0.21	0.18		
Mobile learning	n	33	81	251	504	699	313.73		
	%	0.97	1.54	3.24	4.67	4.65	3.01		
	A	0.16	0.22	0.27	0.47	−0.09	0.21		
Language teaching	n	63	111	199	312	640	264.79		
	%	1.90	2.15	2.54	2.90	4.30	2.76		
	A	−0.05	0.12	0.08	0.11	0.07	0.07		
Teacher education	n	66	84	139	190	259	147.46		
	%	2.06	1.64	1.79	1.78	1.74	1.80		
	A	−0.38	0.06	0.04	0.06	−0.05	−0.06		

Note. A = acceleration; AVG = average.

When analyzed, the top topics considering their volumes in each period—“e-learning systems,” “MOOC,” and “learning assessment”—were in the top five from 2000 to 2020; then, “education management” was one of the top five topics between 2000 and 2008 (Figure 5). Similarly, the topic “distance education” was one of the top five topics starting from 2000 to 2016. The topics “learning algorithms” and “learning factors” appeared on the list starting from 2008 and 2016, respectively.

Figure 5

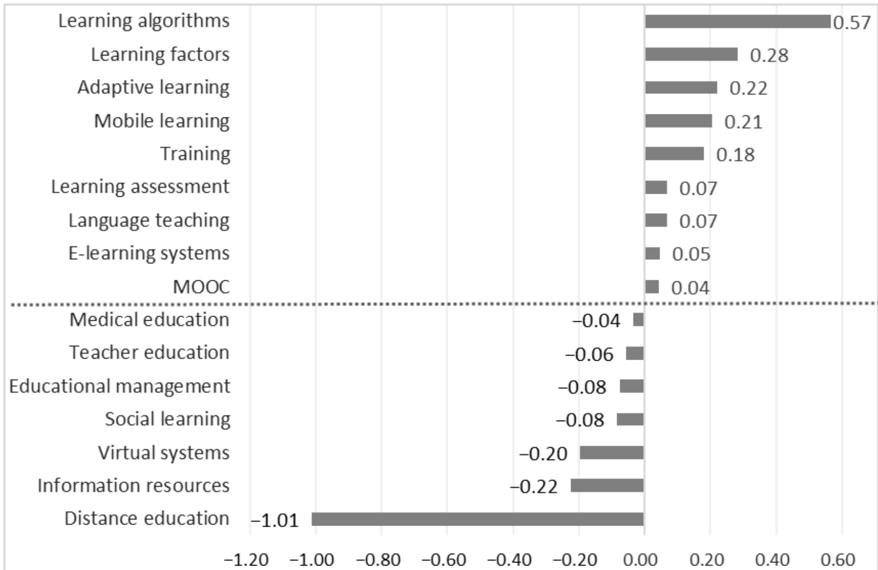
The Top Five Topics From 2000 to 2020



In order to reveal insights about future trends in e-learning (RQ4), the acceleration of the discovered topics in terms of their average acceleration for all years is given in Figure 6. “Learning algorithms” had the highest acceleration value (0.57) and “distance education” had a significantly lower acceleration value (−1.01) compared to the other topics.

Figure 6

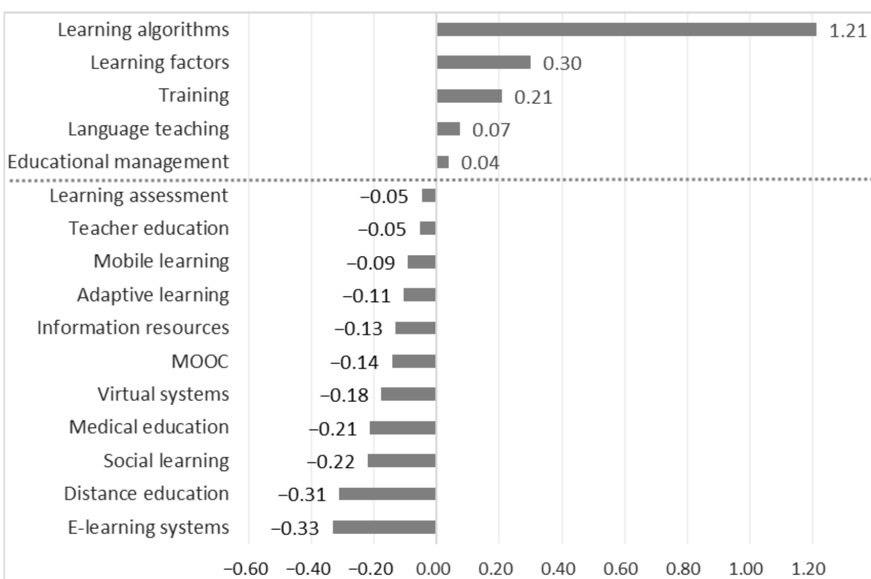
Acceleration of Topics From 2000 to 2020



The recent trends of the topics and their acceleration values during the last period (2016–2019) are given in Figure 7. "Learning algorithms" had a significantly higher acceleration (1.21), and during the same period, the acceleration of the topics "e-learning systems" (−0.33) and "distance education" (−0.31) was the lowest.

Figure 7

Acceleration of Topics From 2016 to 2020



Discussion

In this study, the main trends of e-learning during the last 20 years (between 2000 and 2019) were determined by analyzing articles published in the field using a topic modeling analysis, and 16 main topics were discovered through the LDA-based analysis. The number of articles in this field showed a linear increase over the years (see Table 1), a result parallel with earlier work reporting that studies in the field of e-learning have started to increase and become widespread especially since the early 2000s (Tibaná-Herrera et al., 2018a). The results revealed that the top five subject areas were social sciences, computer science, engineering, medicine and business, and management and accounting. Considering that educational science is also under social sciences, our results were aligned with those of Tibaná-Herrera et al. (2018a), indicating educational science as being the major subject area for e-learning studies. Additionally, by highlighting "medical education" as one of the discovered topics (see Table 3), the results of the current study support earlier work suggesting that in recent years, e-learning studies in the field of medicine are in first place (Barteit et al., 2020). According to the results, in the e-learning corpus, the majority of the articles (975 of them) were published in the *Computers & Education* journal, which indicates that this journal creates a larger space for e-learning studies (see Figure 2). An examination of the origins of the articles showed that the United States was in the lead (see Figure 3; 12,024 articles), which supports the findings of Tibaná-Herrera et al. (2018b). In addition to these contributions, the results of the current study offer insights into e-learning studies, which are summarized under three main headings as follows:

Emergence of New Topics

Table 4 reveals that during the early years (2000–2003) of the publication of e-learning studies, "distance education" (21.59%) had the highest volume ratio and can be considered as the main and oldest topic of e-learning studies. In contrast, during this period, "mobile learning" (0.97%) and "training" (1.89%) had a lower volume ratio in terms of the percentage of articles; thus, they can be classified as having been very young and newly emerging topics in those years. When the acceleration values of these topics were analyzed, as seen in Figure 6, "distance education" had the lowest acceleration value (−1.01), an indicator that the emergence of these younger topics, such as "mobile learning" and "training," decreases the volume percentages of the older topics like "distance education."

Major Topics

The results of this study indicate that "learning algorithms," "learning factors," and "adaptive learning" were the major topics having the highest overall acceleration values (0.57, 0.28, and 0.22, respectively; Figure 6). Additionally, Table 4 shows that the topic "MOOC" had the highest average volume (n = 849.74). These results seem to confirm the expectation of Graf et al. (2010) that MOOCs would occupy an important place in the future. In addition, Chiappe and Lee (2017) supported the view that MOOCs had an important place in e-learning, which is also consistent with the findings of Valverde-Berrocoso et al. (2020) that reported MOOCs as being the most researched e-learning modality.

Future of the Field

The analysis of the accelerations of the topics revealed that after 2008, "learning algorithms" and "learning factors" were also becoming dominating topics with higher overall (0.57 and 0.28, respectively; Figure 6) and recent (1.21 and 0.30, respectively; Figure 7) acceleration values. As in the current stage of e-learning systems a large amount of data is being collected from e-learning activities, studies on "learning algorithms" and "learning factors" will offer an understanding of the learning process, which will also create a baseline for its adaptation and individualization. As it is not easy to thoroughly create adaptive e-learning systems without developing appropriate learning algorithms and without a deeper understanding of the learning factors, the acceleration of the topic "adaptive learning" has recently dropped from an overall acceleration value of 0.22 (Figure 6) to −0.11 (Figure 7). However, after developments in topics such as "learning algorithms" and "learning factors," the acceleration of "adaptive learning" can be expected to show an increase in the following decades, with a similar trend for "mobile learning."

Conclusion

In this study, 16 main topics of e-learning studies were identified, and the results of the study are important in terms of determining the trends in the field of e-learning. Based on the results of this study, it can be concluded that "learning algorithms," "learning factors," "training," "language teaching," and "educational management" have been the highly accelerating topics during the last four years, and in the near future, they are expected to have an even greater impact on the field and create a baseline for more individualized and adaptive mobile platforms. Accordingly, it can be concluded that although the field is encompassing more adaptive e-learning systems, the developments for supporting adaptive e-learning platforms are not yet sufficiently mature, and during the next few years, the dominating topics will be those five topics. However, after these five topics reach a level of maturity, "adaptive learning" and "mobile" can be expected to have higher acceleration. The results of the current study can offer support to researchers working in this field, as well as to decision-makers and practitioners. In future studies, similar analyses can be conducted to determine the changes in this field and perform comparative studies. Furthermore, the results obtained from this work can lead to more comprehensive studies on sub-topics based on both high-volume and fast-accelerating issues.

In this study, LDA-based topic modeling technique was implemented on 41,925 peer-reviewed journal articles. Even though this technique provides an opportunity to analyze large data sets, currently, it is not possible to conduct deeper analyses like systematic reviews through LDA. In the future, with improvements in topic modeling algorithms, deeper analysis of large data sets can also be performed, which could be expected to provide very important insights for the researchers in this field.

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Trends and Patterns in Distance Education (2014–2019): A Synthesis of Scholarly Publications and a Visualization of the Intellectual Landscape

Aras Bozkurt[1] and Olaf Zawacki-Richter[2]
[1]Anadolu University & University of South Africa; [2]Carl von Ossietzky University of Oldenburg

Abstract

The field of distance education (DE) is dynamic and constantly evolving; it reflects and adapts according to changes in socio-cultural, demographic, political, and technological domains. Thus, there is a need to understand past and present activities in the field, in order to better inform future research. The main purpose of this study was to examine DE research through data mining and analytics approaches, using social network analysis (SNA) and text mining to conduct a bibliographic analysis. The findings highlighted three main strands of DE research: (a) issues related to open education; (b) the design, support, and quality assurance of online DE; and (c) the implementation and use of educational technology, media, and digital tools. SNA of the bibliometric data identified pivotal theoretical contributions, including that the fields of distance education and educational technology converge. The article concludes with recommendations for future research directions.

Keywords: distance education, open and distance learning, open education, online learning, research patterns and trends

Introduction

The field of distance education (DE) has long been dedicated to providing flexible ways for a wide diversity of learners to access knowledge and learning opportunities. In particular, for generations the field has benefited from the use of educational technologies (EdTech) to provide a variety of educational opportunities to learners beyond traditional paper-based study materials (Bozkurt, 2019; Moore & Kearsley, 2012; Zawacki-Richter & Naidu, 2016). Over time, DE has adapted and developed DE-specific curricula, educational strategies, and learning models that meet the needs of learners, by taking advantage of increased capacity and affordances of prevalent technologies. Following the advent of computers, online technologies, and online networks, as well as socio-cultural, demographic, political, and technological shifts all over the world, DE has metamorphosed as online learning and emerged as a mainstream educational model, rather than being peripheral or supplementary. Years of experience in the theory and practice of DE have provided a clear pathway for the transformation of higher education due to changing characteristics of teaching, learning, and educational institutions. DE proved its value during the interruption of education due to the COVID-19 pandemic; further, the field of DE has been a significant change agent in the digital transformation of higher education.

In the digital age, affected by the globalized knowledge-intensive economy, 21st-century learners demand ubiquitous, personalized, flexible, and socially collaborative educational experiences; DE has striven to meet these aims by merging theory and practice, and implementing educational technologies where appropriate and relevant. The dynamic nature of DE requires a broad, multidimensional understanding of the past and present evolution of the field, not only to understand past trends but also to anticipate future needs and opportunities. It is vital to gain deeper insights into the constantly changing characteristics of learners, learning, educational technology, and educational institutions. In order to embrace change, enable smooth transitions during the phases of transformation, and more importantly, to be resilient, agile, and adaptive, we need to know how the field of DE has framed and processed scholarly knowledge. This research study aimed to map and visualize the intellectual landscape of the DE field and synthesize the findings of scholarly publications by analyzing scientific networks.

Literature Review

Scholarship is based on the notion that to better predict the future of a field of study and navigate through it, one must first look at its past. In this way we can gain insights by tracking the growth and progress of a field in terms of scholarly publications and reflect on what makes these insights valuable. The following section describes some earlier works that sought to analyze the field and provide a base for future directions by distilling past and present aspects of DE research.

Zawacki-Richter and Naidu (2016) suggested that "online educational technologies will play a critical role in education broadly, and especially in relation to an education for all agenda" (p. 264). Similarly, different authors have claimed that EdTech (Sim, 2017) and instructional design for online learning have triggered the advancement of DE (Çakiroğlu et al., 2019) and moved online distance education from the periphery to the centre of higher education (HE) offerings (Xiao, 2018). Naidu (2019) further emphasized that it was not the mere contribution of technology, but learning methods, approaches, and strategies that were transforming distance education. Providing a base and justification for this area of research, Xiao (2018) highlighted DE's value, validity, and central role in HE, and argued that there was a need to "reflect seriously and constantly on what to do next" (p. 269).

Some studies have explored change and transformation in DE research. Highlighting that until the 2000s, DE research was criticized harshly for a lack of robust empirical research, Berge and Mrozowski (2001) reported that from 1990 to 1999, common concerns in DE publications were pedagogical topics such as "design issues, learner characteristics, and strategies for active learning and increased interactivity" (p. 17). The same authors also noted the importance of identifying research gaps and providing a research agenda in the DE field, which provided a rationale for the studies that followed. Lee et al. (2004) examined DE publications from 1997 to 2002 and recommended that "new research methodology and paradigms are needed to advance distance education research" (p. 17). They further noted that topics related to learning design were dominant at that time, which may be attributed to the changing characteristics of learning technologies and environments. Zawacki-Richter et al. (2009) investigated publications from 2000 to 2008 and showed that the focus of DE research had shifted toward "interaction and communication patterns in computer-mediated communication, instructional design issues, learner characteristics, and educational technology" (p. 20). Bozkurt et al. (2015) analyzed studies from 2009 to 2013 and found that online learning had gained great momentum, and openness in education was becoming an obvious research interest. They highlighted the finding that learner and learning-centered topics were the focal points in DE research at that time, and they noted further that dominant research areas were (a) educational technology, (b) interaction and communication in learning communities, (c) learner characteristics, and (d) instructional design. One thing these studies had in common was recognition of the increasing influence of digital or online technologies, which tended to open up education, and built an intertwined relationship between DE and EdTech.

Change is continuous, so it is necessary to examine trends and patterns, and build upon previous research. Thus, structural gaps and weak points in the area can be identified and buttressed. Such an approach is vital for improving the field on solid ground and navigating through uncertainty. Against this background, the main purpose of this research study was to explore and examine research trends and patterns in the field of DE between 2014 and 2019. This study sought to answer the following research questions:

1. What are the thematic patterns within the field of DE in terms of research topics covered in leading DE journals?

2. What have been the pivotal contributions to the DE literature and what kind of theoretical and technological shifts did they emphasize?

Methodology

Research Method and Design

This study applied data mining and analytic approaches (Fayyad, et al., 2002) such as text mining (Feldman & Sanger, 2007) and social network analysis (SNA; Hansen et al., 2010; Scott, 2017) to explore publication patterns and thematic trends in DE research between 2014 and 2019. We used text mining to analyze the titles and abstracts of 1,362 peer-reviewed publications, and SNA to analyze keywords and reference lists of the publications in this research corpus. For benchmarking and reliability purposes, the software tools Gephi and NodeXL were used to perform SNA, and Leximancer to conduct text mining. The purpose of using multiple analytic approaches is to triangulate the data to increase the reliability and validity of the research findings (Thurmond, 2001), and to explore different layers of the research corpus to reach a broader view in addressing the research questions.

Research Corpus and Inclusion Criteria

The journals for inclusion in the research corpus were selected based on the following three criteria: they were indexed in the Scopus database, were published in English, and had a strong focus on DE. Accordingly, the corpus consisted of the following six double-blind, peer reviewed journals: *International Review of Research in Open and Distributed Learning* (IRRODL), *Distance Education* (DE), *Open Learning: The Journal of Open, Distance and e-Learning* (OL), the *International Journal of Distance Education Technologies* (IJDET), the *Turkish Online Journal of Distance Education* (TOJDE), and the *American Journal of Distance Education* (AJDE). These journals were considered representative of the field and had been featured in earlier studies (Gomes & Barbosa, 2018; Zawacki-Richter & Anderson, 2011). In following up on Bozkurt et al. (2015), who reviewed the field from 2009 to 2013, we defined the year 2014 as a starting point. As a result, a total of 1,362 articles published between 2014 and 2019 in the six journals were selected for analysis (see Appendices A and B for details on these journals).

Analysis Process

After building the research corpus, four separate analyses were conducted. First, titles and abstracts of the selected articles were analyzed using t-distributed stochastic neighbor embedding (t-SNE) to visualize "high-dimensional data by giving each datapoint [words in titles and abstracts] a location in a two [*sic*] or three-dimensional map" (van der Maaten & Hinton, 2008, p. 2579). Second, social network analysis (Scott, 2017) of the keywords was performed to better identify thematic clusters and significant nodes with strategic positions in the keyword network. In this analysis, each keyword identified by the authors of the article was considered a node and their co-occurrences considered a relationship. Third, lexical analysis of the titles and abstracts was performed to visualize a thematic concept map and to identify major themes emerging from the research corpus. Lexical analysis "employs two stages of co-occurrence information extraction—semantic and relational—using a different algorithm for each stage" (Smith & Humphreys, 2006, p. 262). In the fourth and final stage, social network analysis was used to examine the references and citation patterns in the articles in the research corpus. Accordingly, "citing articles and cited articles are linked to each other through invisible ties, and they collaboratively and collectively build an intellectual community that can be referred to as a living network, structure, or an ecology" (Bozkurt, 2019, p. 498). Chen (2006) further argued that pivotal contributions in the scholarly landscape can be identified through their ability to answer critical and needed questions; their strategic position can be estimated in terms of impact which, in turn, can be measured by means of bibliometric metrics. In this regard, the final stage of analysis examined scholarly progress in the DE field by identifying pivotal contributions and turning points.

Strengths and Limitations

The strength of this study was in its methodology and scope. First, the research built a representative research corpus by including full data from six sampled DE journals. Second, the research used computer-based data visualization techniques to better interpret the large volume of research data collected. Third, triangulation of research data enabled the exploration of different dimensions of the DE field, thus yielding a broader view of the field. However, some limitations need to be acknowledged. First, despite the representative research corpus constructed, DE-related articles are also published in various other formats, and thus this study provided only a partial view. Second, the findings were based on the data extracted from six double-blind, peer reviewed journals and limited to publications written in English.

Findings and Discussion

The Thematic Structure of DE Research

To address the first research question, three types of complementary data analysis explored the thematic structure and research topics in the 1,362 articles that made up the bibliographic corpus of this study. The three analyses—t-SNE analysis of titles and abstracts to identify major research topics, SNA of keywords, and content and co-word analysis—are described in detail below.

t-SNE Analysis

In order to provide a first rough description of the focal points in DE research, t-SNE analysis was conducted based on titles and abstracts of the articles in the research corpus. t-SNE is an unsupervised “nonlinear dimensionality reduction technique that aims to preserve the local structure of data” (van der Maaten & Hinton, 2008, p. 2580), used for exploring and visualizing high dimensional data. The data set derived from the 1,362 articles produced 246,950 total words in 10,730 unique, singular word forms. From among these, the top 100 words with raw frequencies were included in the t-SNE analysis. The settings for t-SNE were adjusted as follows: cluster value: 3; dimension value: 2; and perplexity value (probability distribution): 75.

Figure 1

t-SNE Visualization of Article Titles and Abstracts

**Note*. The size of a circle indicates the frequencies of the nodes. See Appendix D for a larger version.

Figure 1 illustrates three major clusters identified in the research corpus, depicted, from right to left, as green, pink, and blue. The salient cluster that emerged with the highest raw frequencies (green cluster) indicates that—in the broadest sense—the focal points of authors publishing in DE journals were student learning in an open, online course environment (i.e., *student, learning, online, course, open, MOOC*), and using educational technology to design teaching and learning experiences.

The majority of research was undertaken in a higher education context (i.e., university in the green, and higher education, academic in the pink cluster), in contrast to DE and technology-enhanced learning in school settings (i.e., school in the blue cluster). This result is in line with findings by Zawacki-Richter and Naidu (2016), who carried out a content analysis of the journal *Distance Education* over 35 years. They also identified students and learning as the two major topics in 515 articles that were connected via the thematic region of interaction. "Learning is seen in these articles as a social process that is facilitated by interaction among participants" (Zawacki-Richter & Naidu, 2016, p. 249). The current findings showed that in order to facilitate interaction, technology was used in DE to design high-quality learning opportunities (i.e., technology, interaction, media, design, teaching, social, and engagement in the green, pink, and blue clusters).

Quality in open and distance learning is another important concern of researchers in the field. Student support systems, high-quality content, and interaction are important factors related to quality assurance and development (i.e., quality, support, content, and interaction in the pink cluster). Prerequisites for high-quality online learning and teaching include institutional strategies and policies for digital education, support, and resources to overcome the challenges of innovation and change. Professional training for faculty members and teachers is critical for them to develop the necessary skills to design and facilitate meaningful online learning experiences (i.e., institutions, strategies, challenges, professional, skills, and faculty in the blue cluster).

Social Network Analysis of Keywords

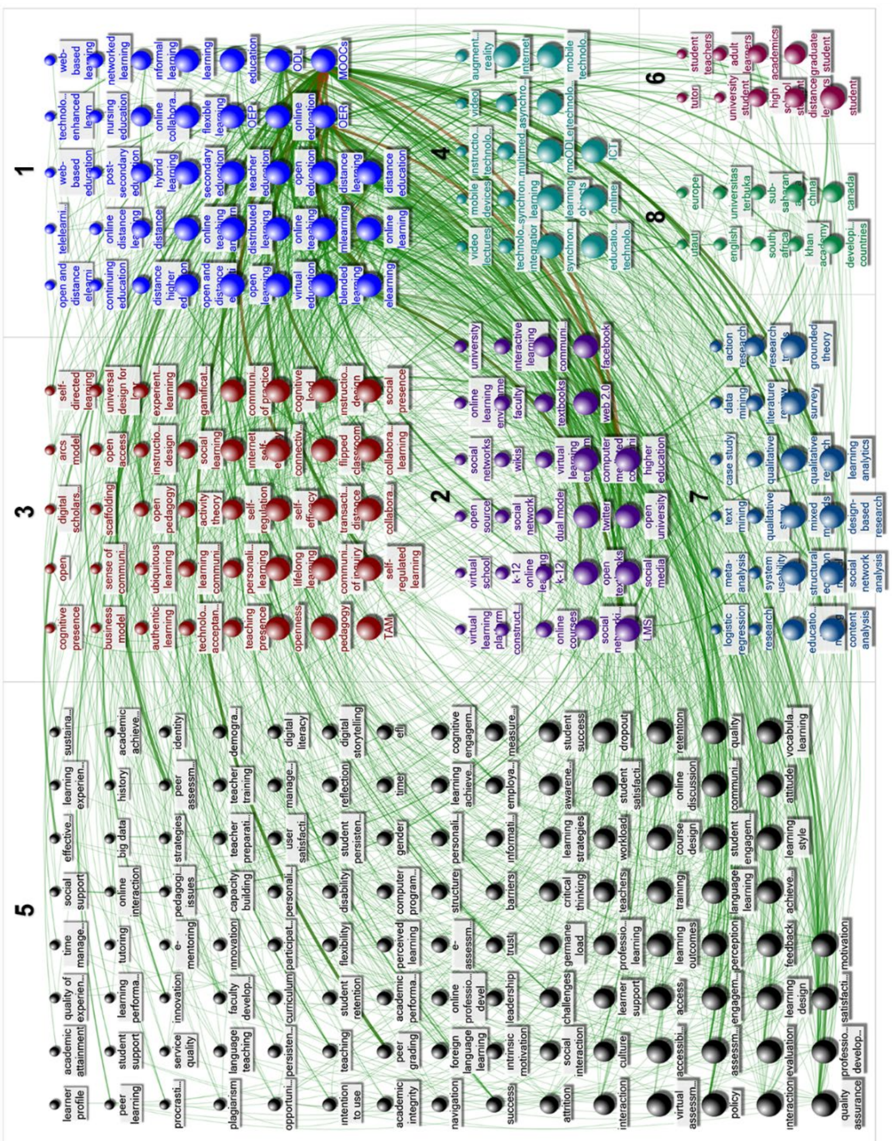
SNA provides insightful solutions to map, summarize, and visualize networks as well as identify key nodes that occupy strategic positions in these networks (Hansen et al., 2010). Keywords are representations of the articles at the granular level, highlighting their thematic scope. Of the 3,383 keywords in the 1,362 articles, those with a minimum occurrence of three were included in the analysis—a total of 282 keywords (see Appendix C for the top 40 keywords). Essentially, SNA examines nodes and their relationships—in this study, these were the keywords and their co-occurrence. The analysis revealed eight major clusters concerned with (a) delivery modes, (b) learning environments and contexts, (c) theories and concepts, (d) technology and media, (e) variables, (f) target groups, (g) research methods, and (h) miscellaneous territorial keywords. Figure 2 illustrates the SNA results; each cluster is discussed in more detail following Figure 2.

The first cluster of keywords describes various delivery modes depending on the degree of digitisation: (a) technology-enhanced learning; (b) e-learning; (c) mobile learning; (d) blended or flexible learning; and (e) online, distance learning. The analysis showed that the concepts of open education and open educational practice played an important role in the publications. This was not surprising, as open and distance learning have been closely related to each other throughout the history of DE (Zawacki-Richter et al., 2020).

Cluster two is related to DE settings, contexts and learning environments. The findings confirmed that the publications focussed mainly on the higher education context, with less emphasis on K–12 school settings. Articles in this area dealt with learning environments that can be formal (e.g., an institutional learning management system) and informal (e.g., social networks like Twitter, Facebook, or other Web 2.0 tools). Again, the concept of openness played a prominent role, with open access applications and open textbooks seen as important tools and resources for the design of learning environments and networks.

Figure 2

SNA of Keywords, Showing Eight Clusters



The third cluster provides an overview of the theories and concepts applied in DE studies. Perhaps the most influential theoretical framework for online learning has been that of Garrison at al. (2000), the community of inquiry (CoI) model with its core elements of social, teaching, and cognitive presences—all these were among the top keywords in this area. As distance education promotes independent and autonomous learning, self-directed and self-regulated learning theories formed the foundation of many articles. On the other hand, many researchers were concerned with questions about how distance learning can be made more interactive, and how to facilitate communication with students and teachers in order to build a sense of community. These ideas resonated with Lave and Wenger's (1991) community of practice or Moore's (1989) theory of transactional distance. Since distance education is facilitated by educational media and tools, technology acceptance model (TAM) was important concepts to measure their acceptance and usage by students and teachers.

The keywords in cluster four confirmed that DE was closely linked to educational technology, especially two-way media as a constituent element, as evident in Keegan's (1980) definition of DE. Learning and teaching in DE have been supported by various synchronous and asynchronous media and tools; in particular, video-based formats have gained importance in the years that were analyzed.

Cluster five includes a wide range of input or output variables that studies have measured to evaluate and investigate learning designs (e.g., students' attitudes and perceptions, their engagement and satisfaction, drop-out rates, or learning styles and strategies). Many of these keywords were related to issues dealing with student support and service quality, as well as students' skills and individual traits. The need for teacher training was highlighted, particularly in terms of providing academic support and guidance to students.

Cluster six includes keywords related to target groups within DE, mainly adult learners, but also high school students. However, the majority of keywords in this area showed again that research focused on the higher education context (e.g., university student, graduate students, academics) as opposed to the school context.

Whilst research into distance education in its early stages was criticized as being "atheoretical and predominantly descriptive" (Perraton, 2000, p. 1), the keywords in cluster three and cluster seven indicated that current research methods have applied a wide range of theories, as well as qualitative and quantitative research methods. SNA and learning analytics, as well as design-based methods, occurred as prominent research approaches over the range of years included in this study.

The eighth and last cluster is related to miscellaneous territorial keywords. What was prominent here was the mission of the DE field to widen access to educational opportunities, especially in developing countries. These efforts were supported, for example, by the Commonwealth of Learning in Canada, and the open education initiative of the Khan Academy.

The findings of the SNA of keywords resonated with the t-SNE analysis of titles and abstracts, provided more details of the plethora of research topics under investigation. We now proceed to discuss the third method of analysis—a text-mining approach for content and co-word analysis.

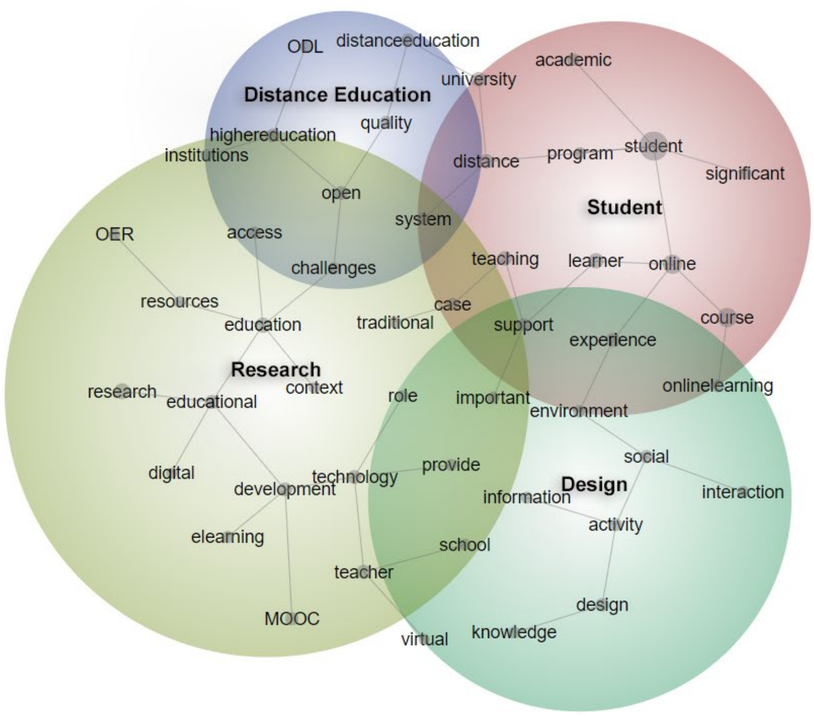
Content and Co-Word Analysis

Words gain their meanings in their context, and the implicit lexical relationship among words within texts can be revealed and visualized explicitly through text mining. For the purpose of the study, the titles and abstracts of 1,362 articles were analyzed and visualized through text mining using the Leximancer software tool. The software drew a concept map that revealed lexical patterns of concepts, grouped through relational co-word analysis in thematic regions (Figure 3). "The map is an indicative visualization that presents concept frequency (brightness), total concept connectedness (hierarchical order of appearance), direct inter-concept relative co-occurrence frequency (ray intensity), and total (direct and indirect) inter-concept co-occurrence (proximity)" (Smith & Humphreys, 2006, p. 264). Depending on the connectedness of concepts, a thematic region was formed (the colored bubbles) and named by the most frequent concept within this region.

Figure 3 depicts the overall concept map for the 1,362 articles in the corpus. The publications in the journals reported on four main themes, namely (a) research on the (b) design of (c) student online learning opportunities in (d) distance education in higher education academic settings.

Figure 3

Concept Map for 1,362 Articles Published in DE Journals Between 2014 and 2019



Openness and Access. Topics related to openness and open education were prevalent in the thematic regions of research and distance education (in Figure 3 see concept paths OER—resources—education—access, MOOC—development, and open—higher education—ODL). Meta-evaluations indicated that open educational resources (OER) promise a great deal in terms of multiple perspectives (e.g., transparency, communication, and engagement; Dalsgaard & Thestrup, 2015). However, challenges and quality issues were addressed by researchers in this thematic area—such as discoverability, sustainability, and remixing of learning materials (Luo et al., 2019); it has been further critically argued that we should first "remove the barriers from within" (Mishra, 2017, p. 378). Some authors argued that open educational practice (OEP) paves the way for OER, and openness should not be limited to OER issues only (Koseoglu et al., 2020). Similar to discussions on OER and OEP, MOOCs, for instance, emerged as an extension of openness in education. However, they have been highly criticized because of high dropout rates, motivational issues, and low instructional quality. Lambert (2020) argued that MOOCs and other practices rooted in openness in education should be praised for contributing to student equity, social inclusion, and widening participation. In fact, when we revisited the core values of DE, it was not quantified measures that defined its success, but rather quality and the degree of openness, flexibility, and learning opportunities through DE available for those who would not otherwise have access to education.

Digital Transformation of DE. DE and technology-enhanced learning have been evolving over time and closely related to innovations in the field of educational technology (see Zawacki-Richter & Latchem, 2018). Researchers paid attention to development, innovation, and change in the light of new and emerging digital tools and media to facilitate teaching and learning in DE (In Figure 3, see concept path technology—development—educational—digital). Globalization has challenged education in many ways, including the supply and demand chain in HE (Youssef, 2014). These changes have promoted online learning as a solution to meet expectations, and as reported by Allen and Seaman (2013), online learning has gained great momentum all around the world. The ongoing digital transformation in higher education has led to hybrid modes of DE. For instance, approaches such as blended learning (Garrison & Kanuka, 2004), flipped learning (Zainuddin & Halili, 2016), and MOOCs (by offering micro-credentials or nano degrees; Lemoine & Richardson, 2015) demonstrated how face-to-face and distance education have tended towards hybridization.

Social Learning Design in Online Learning Processes. The design of online learning environments was another important aspect (In Figure 3, see concept paths social—activity—design—knowledge, and interaction—social—environment—experience—online). Social interaction is a key factor in supporting learners and learning processes (Fisher & Baird, 2005), and changes in online networks require the application of innovative technological and pedagogical approaches to foster learning communities (Conley et al., 2017; O'Connell, 2016). For instance, Robinson et al. (2020) argued that maintenance of a *climate of care* was significant for online learning which highlighted a need to revisit emotional and affective domains in online learning environments.

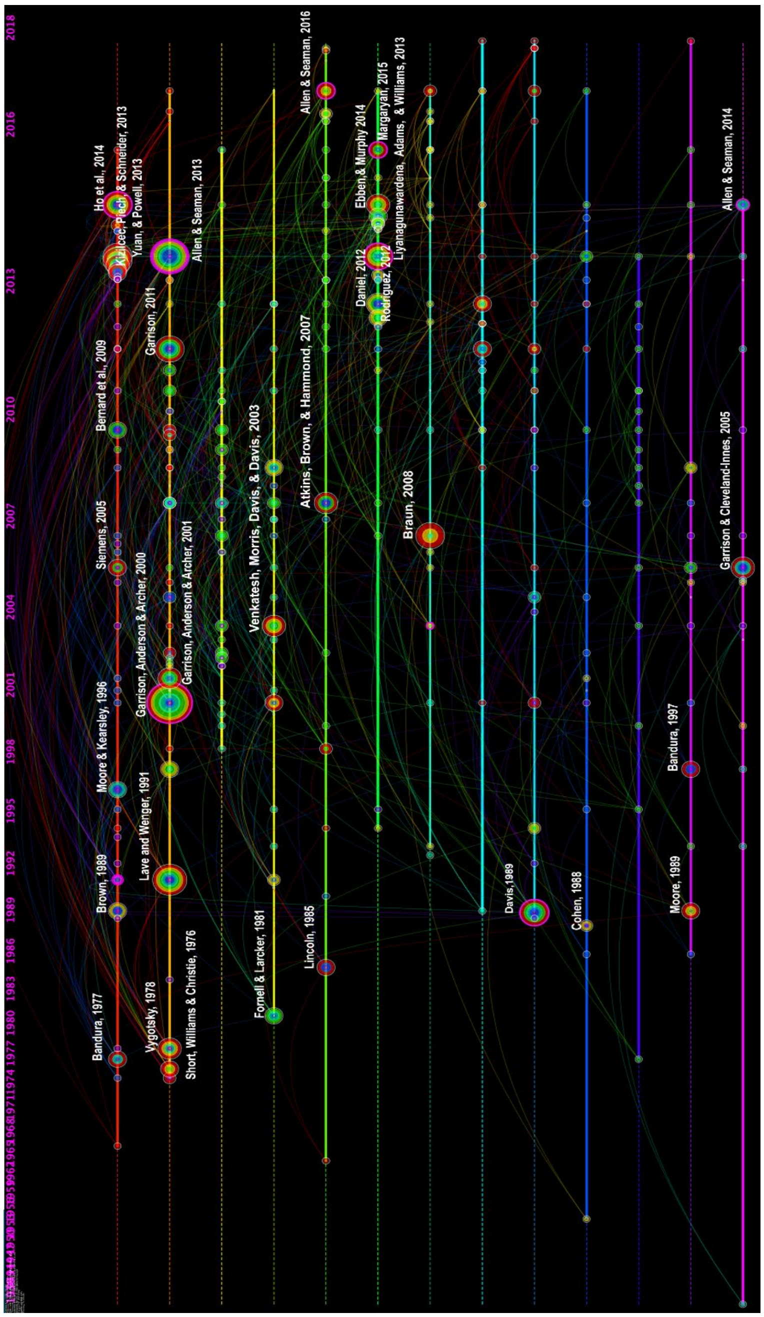
Pivotal Contributions and Turning Points

To investigate the second research question regarding pivotal contributions to the field of DE and theoretical and technological shifts, an SNA of the references in the selected articles was conducted to reveal the network of citing and cited articles as a scholarly *communication system* (Garfield, 1972). In this sense, a total of 43,318 valid processed distinct references (99.93%; captured by the software) and 27 invalid unprocessed distinct references (0.07%; illegible by the software) were collected from the 1,362 articles and examined through SNA. In this analysis, cited articles were the nodes in the network, while the citations (by one article to another) were considered as the ties between them.

To identify pivotal contributions to DE research and shifting intellectual attention from 2014 to 2019, the data corpus was visualized through timeline analysis (Figure 4). The analysis identified two major streams: (a) theoretical and conceptual growth of DE; and (b) theoretical and conceptual growth of educational technology (EdTech). These streams are explained below by referencing significant nodes in the timeline analysis, based on their impact in the scientific network.

Figure 4

Timeline Visualization of Pivotal Contributions

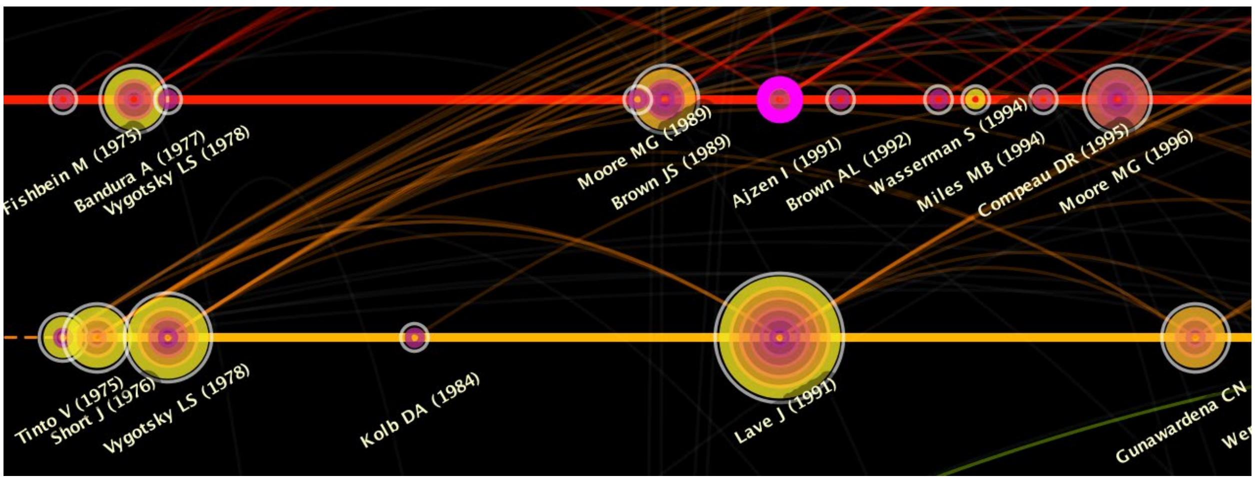


Theoretical and Conceptual Growth of DE

Timeline visualization enabled us to identify chronological meta-narratives by linking references and acknowledging their pivotal contributions (Figure 4). Referring to generic educational theories, it was Bandura (1977) and Vygotsky (1978) who proposed early explanations of social learning processes. Short et al.'s (1976) study on the social psychology of telecommunications was a significant pivotal contribution and provided a solid base from which to investigate DE communication processes. By the 1990s, when computer-mediated communication (CMC) came to the fore, DE-related theoretical or conceptual studies drew more attention. For instance, Lave and Wenger (1991), who introduced the community of practice concept, and Moore (1989) who proposed three types of interaction in DE, appeared to be early pivotal contributions in DE research (see Figure 4 and Figure 5).

Figure 5

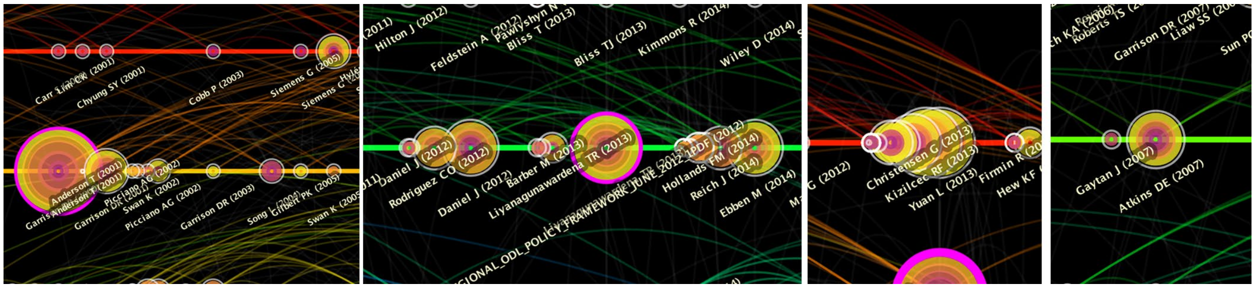
Snapshot of Timeline Visualization From 1970s to 1990s



However, in terms of the overall timeline analysis, the biggest impact has been that of Garrison et al. (2000) who introduced the community of inquiry model and its components, namely social, teaching, and cognitive presences. Another study by the same authors (Garrison et al., 2001) maintained the legacy of the CoI. In terms of theoretical contributions, Siemens' (2005) work on connectivism was another milestone, as it indicated a shift in attention to networked learning. Following these developments and capacity increase in delivery modes, MOOCs emerged as an evolved form of DE and online learning (see Daniel, 2012; Ho et al., 2014; Kizilcec et al., 2013; Liyanagunawardena et al., 2013; Yuan & Powell, 2013). Open educational resources have contributed to forging open practices and open pedagogy (Atkins et al., 2007; see Figure 4 and Figure 6).

Figure 6

Snapshots of Timeline Visualization From 2000 to 2020

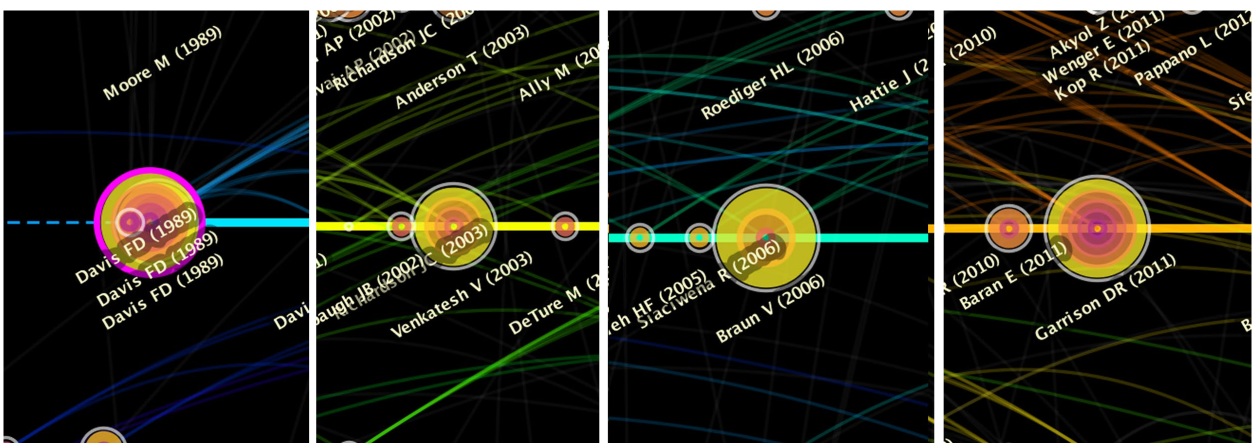


Theoretical and Conceptual Growth of Educational Technology (EdTech)

In parallel with the development of DE, we observed pivotal contributions related to EdTech. A pioneering theoretical contribution was by Davis (1989) who introduced the TAM, which was followed by pioneering theoretical contribution by Venkatesh et al. (2003). After the first decade of the 2000s, the focal point was online learning and online learners (Allen & Seaman, 2013; Braun, 2008), and e-learning became part of mainstream education (Garrison, 2011; see Figure 4 and Figure 7).

Figure 7

Snapshots of Timeline Visualization From 1990s to 2010s



To summarize, it can be argued that DE evolved by incorporating social learning theories and, starting in the 1990s, the field has focused on CMC (e.g., interaction and presence types, as well as online community formation). This focus was followed by the emergence of ubiquitous learning opportunities offered by distributed and networked online DE. Confirming the findings of Bozkurt (2020), it is noteworthy that since the 2000s, the fields of DE and EdTech have exhibited points of intersection and have advanced by triggering innovations in each other. The dawn of the 21st century witnessed a swift and dramatic transformation of DE, when online learning emerged as the “new face of distance education” (Zawacki-Richter & Naidu, 2016, p. 258). It should be noted that the emergence, rise, and success of online learning (with its relatively short history), is a consequence of the long and distilled theoretical and practical body of knowledge in the broader field of DE.

Conclusion and Recommendations

This study provides orientation and new insights into the scholarly structure of DE as an academic discipline. Our findings demonstrate that research in the period from 2014 to 2019 published in leading DE journals focused on three broad areas:

- Openness and open education extended the raison d'être of many distance teaching and open universities (see Tait, 2008), namely to provide access to learning opportunities for those who were previously excluded or unable to participate in educational programs and services.

- Learning design, academic and institutional support services, and quality assurance were major concerns of researchers in DE. Student support was the critical link in DE (Dillon et al., 1992, p. 29).

- The application and use of educational technology, media and tools provided a means to develop learning content in various presentation modes, and to facilitate synchronous and asynchronous interaction between students and teachers, as well as among students, in order to support collaborative learning.

Our findings show that published DE research has been clearly dominated by studies in the higher education context. Moving further into the mainstream of education—especially in times such as the global COVID-19 pandemic—we recommend that DE researchers should also turn their attention and transfer knowledge and experience to the K–12 school context. This would support teachers and parents, and prevent them having to re-invent the wheel when adopting remote teaching and homeschooling practices. Furthermore, the results of this study suggest there is very little research that considers learning with digital media in non-formal settings (see Latchem, 2018).

The field of online DE research has been developing dynamically in the era of digital transformation. With the need for emergency remote education (Bozkurt & Sharma, 2020a; Hodges et al., 2020) in the current COVID-19 pandemic, the roots of online learning and teaching (namely theory, practice, and empirical research in the broader field of DE) have gained added relevance. It is crucial to build on and relate to this theory, practical experiences, and knowledge, especially for researchers and practitioners who venture into the field of online distance education.

DE research is well-grounded in foundational theories such as adult learning theory, self-directed learning theory, as well as emerging theories. The discipline of DE (most prominently the CoI framework and the theory of connectivism) has not only spawned new theories, but has also borrowed theories from related fields, such as media theory, instructional design theory, and motivation theory (see an overview in Jung, 2019).

For generations, DE has skillfully served to balance inequity, address the knowledge gap, and democratize education. However, we are on the verge of a major transformation due to the COVID-19 pandemic, which has been called the great reset, and there is now a new/next normal and a new order all around the world (Bozkurt & Sharma, 2020b). In addition to the effects of the pandemic, the world is being decentralized, learners are coming from increasingly diverse backgrounds, learning is emerging as a liminal process, learning sources are being distributed across online and offline networks, and—most importantly—the nature of the learning ecology is evolving. We, therefore, need to redefine our roles, take on new responsibilities, and embrace them. As distance educators, we should ask ourselves how we envision the future and how well we are prepared for tomorrow's learning landscape. In this regard, it is more critical than ever to ask what our research agenda will be in the changing world. This study suggests that the role of DE is more significant than ever and there is a need to develop new policies and strategies; it is critical to identify a proactive research agenda to better respond to changes, to be resilient, and to meet ongoing and sometimes sudden challenges in terms of educational needs.

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Appendix A

Sampled Journals with 2018 Metrics in Scopus Database

Journal	Rank (Education)	Percentile	Site Score	SJR*	SNIP**
IRRODL	#74/1038	92	2.87	1202	1774
DE	#147/1038	85	2.19	0.972	1126
OL	#474/1038	54	1.01	0.492	0.976
IJDET	#503/1038	51	0.94	0.19	0.747
TOJDE	#599/1038	42	0.73	0.274	0.59
AJDE	#602/1038	41	0.72	0.272	0.509

Note: *SJR: SCImago journal rank. **SNIP: Source normalized impact per paper

Appendix B

Number of Analyzed Articles by Journal and Year

	IRRODL	DE	OL	IJDET	TOJDE	AJDE	TOTAL
2014	90	22	15	24	82	22	255
2015	81	28	16	23	48	21	217
2016	92	24	19	24	40	23	222
2017	102	24	19	21	56	19	241
2018	81	33	16	22	55	19	226
2019	68	30	25	20	31	27	201
TOTAL	514	161	110	134	312	131	1362

Appendix C

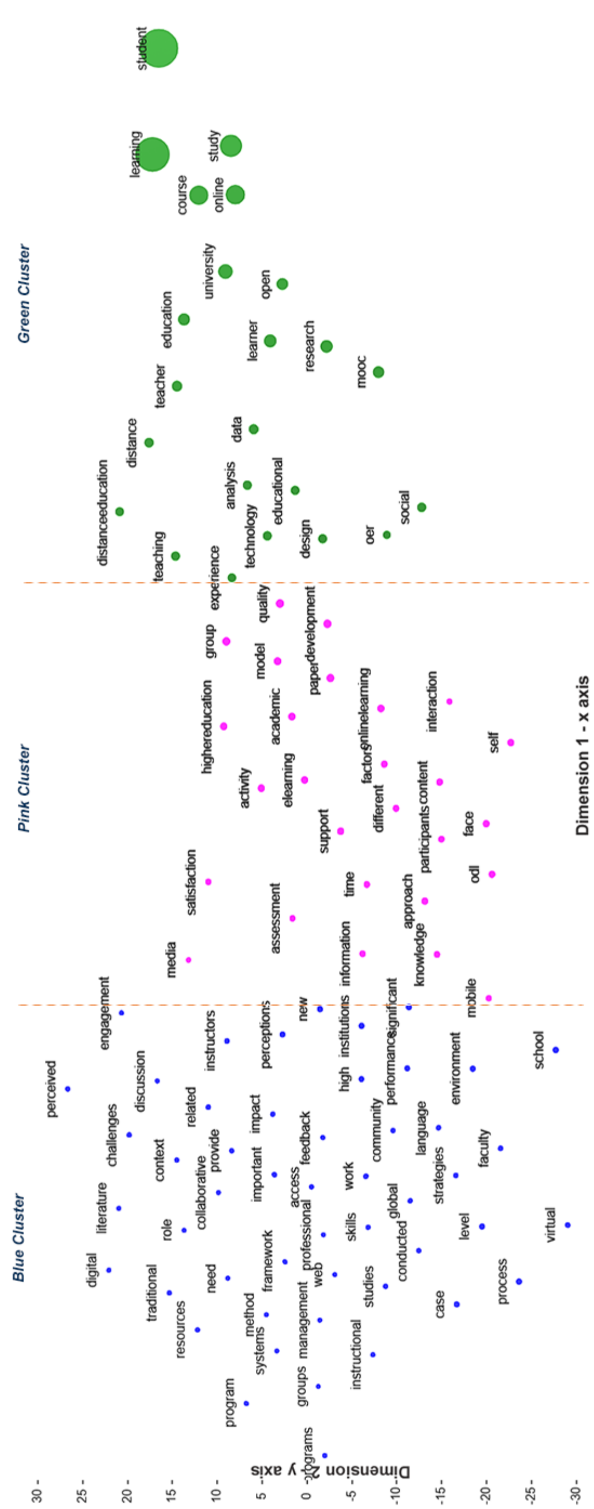
Top 40 Keywords Among Articles Analyzed

#	Node	Degree Centrality	Betweenness Centrality	Eigenvector Centrality	Page Rank
1	distance education	136	15710.771	0.023	9.457
2	online learning	124	11108.641	0.022	8.211
3	MOOCs	107	8041.012	0.020	7.016
4	higher education	105	7706.127	0.019	7.041
5	elearning	102	8940.382	0.018	7.012
6	OER	79	4680.240	0.015	5.263
7	distance learning	74	4087.552	0.014	4.890
8	blended learning	58	2473.849	0.013	3.872
9	ODL	50	1807.992	0.012	3.297
10	online education	48	1390.226	0.011	3.160
11	motivation	52	1766.106	0.011	3.460
12	mlearning	55	3353.626	0.011	3.804
13	learning analytics	44	1448.621	0.010	3.001
14	open education	43	1044.747	0.010	2.878
15	open university	34	842.669	0.009	2.292
16	social media	32	766.959	0.008	2.167
17	professional development	27	699.396	0.008	1.850
18	social presence	30	814.978	0.008	2.036
19	quality assurance	26	641.301	0.007	1.847
20	online teaching	29	901.245	0.007	2.050
21	LMS	29	516.654	0.007	1.924
22	education	25	449.619	0.007	1.703

23	satisfaction	32	879.897	0.007	2.243
24	communication	22	272.889	0.007	1.465
25	educational technology	21	302.016	0.007	1.462
26	feedback	22	302.529	0.007	1.537
27	achievement	26	327.588	0.007	1.761
28	collaborative learning	31	748.113	0.006	2.140
29	online	29	571.598	0.006	2.010
30	collaboration	27	649.821	0.006	1.916
31	open learning	19	151.781	0.006	1.307
32	ınstructional design	17	377.478	0.006	1.197
33	OEP	22	319.708	0.006	1.532
34	quality	21	277.756	0.006	1.470
35	qualitative research	14	107.668	0.006	1.002
36	flipped classroom	24	346.592	0.006	1.596
37	facebook	23	349.495	0.006	1.607
38	self-regulated learning	20	415.665	0.006	1.446
39	engagement	22	238.498	0.006	1.501
40	student engagement	18	261.412	0.006	1.300

Appendix D

t-SNE Visualization of Article Titles and Abstracts (Enlarged Version)



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Design Matters: Development and Validation of the Online Course Design Elements (OCDE) Instrument

Florence Martin, PhD[1], Doris U. Bolliger, EdD[2], and Claudia Flowers, PhD[3]
[1,3]University of North Carolina Charlotte, [2]Old Dominion University, Virginia

Abstract

Course design is critical to online student engagement and retention. This study focused on the development and validation of an online course design elements (OCDE) instrument with 38 Likert-type scale items in five subscales: (a) overview, (b) content presentation, (c) interaction and communication, (d) assessment and evaluation, and (e) learner support. The validation process included implementation with 222 online instructors and instructional designers in higher education. Three models were evaluated which included a one-factor model, five-factor model, and higher-order model. The five-factor and higher-order models aligned with the development of the OCDE. The frequency of use of OCDE items was rated above the mean 4.0 except for two items on collaboration and self-assessment. The overall OCDE score was related to self-reported levels of expertise but not with years of experience. The findings have implications for the use of this instrument with online instructors and instructional designers in the design of online courses.

Keywords: online course design, design elements, instrument validation, confirmatory factor analysis, structural equation model

Introduction

Higher education campus enrollment has decreased; however, the number of online courses and online enrollment has continued to increase (Allen & Seaman, 2017). Though online enrollment has increased, online student dropout and lack of engagement in distance education are still issues of concern. Dropout can be prevented through well-designed online courses (Dietz-Uhler et al., 2007). It is clear that high-quality course design is critical to the success of online courses. Several researchers have examined online course design in online learning. Jaggars and Xu (2016) examined the relationships among online course design features, course organization and presentation, learning objectives and assessment, and interpersonal interaction and technology. They found that design features influenced student performance, and interaction affected student grades. Swan (2001) found clarity of design, interaction with instructors, and active discussion influenced students' perceived learning and satisfaction. Laurillard et al. (2013) recommended effective pedagogy to foster individual and social processes and outcomes, promote active engagement, and support learning with a needs assessment.

Some higher education institutions have developed or adopted rubrics to not only provide guidance for instructors' course design efforts, but also to evaluate the design in online courses. Baldwin et al. (2018) reviewed six rubrics commonly used to evaluate the design of online courses. They identified 22 design standards that were included in several of the rubrics. We reviewed the research on five categories of design standards, namely (a) overview, (b) content presentation, (c) interaction and communication, (d) assessment and evaluation, and (e) learner support, and examined their impact on online learning.

Figure 1

Online Course Design Elements Framework

Overview

At the beginning of a course, it is critical to provide an overview or information for learners to get started in the online course (Bozarth et al., 2004; Jones, 2013). An overview or getting started module can include elements such as (a) a course orientation, (b) instructor contact information and instructor expectations, (c) course goals and objectives, and (d) course policies. An orientation must be designed to introduce the learners to the course intentionally and to guide them to the various aspects of the course. Bozarth et al. (2004) examined challenges faced by novice students in an online course and recommended creating an orientation to address these challenges. For example, they recommended clarifying the time commitment required in online courses. Jones (2013) found students felt better prepared for online learning after completing an orientation. At the beginning of the course, it is also essential to provide expectations regarding the quality of communication and participation in the online course (Stavredes & Herder, 2014).

Price et al. (2016) suggested that providing instructor contact information, with different ways to contact the instructor, is important in the online course; contact could be via e-mail, phone, or synchronous online communication tools. Instructor information can be presented as text or in an instructor's introduction video so that the students can get to know the instructor better (Martin et al., 2018). It is also important for the instructor to provide standard response times, specifically for questions via e-mail or in discussion forum, in addition to feedback on submitted assignments. Most instructional design models and rubrics have emphasized the importance of measurable course goals and objectives (Chen, 2007; Czerkawski & Lyman, 2016). In online courses it is also important to include these goals and objectives in an area where online students can easily locate them. Finally, it is critical to state course policies for behavior expectations. Policies pertaining to netiquette, academic integrity, and late work need to be provided to all learners. In addition, Waterhouse and Rogers (2004) listed specific policies for privacy, e-mail, discussions, software standards, assignments, and technical help.

Content Presentation

Online learning offers advantages in that content can be presented in various modalities. Some of the elements of content presentation include (a) providing a variety of instructional materials, (b) chunking content into manageable segments, (c) providing clear instructions, (d) aligning course content and activities with objectives, and (e) adapting content for learners with disabilities. Digital material can include (a) textbook readings, (b) instructor-created recorded video lectures, (c) content from experts in the form of audio or video, (d) Web resources, (e) animations or interactive games and simulations, and (f) scholarly articles (Stavredes & Herder, 2014). Learning management systems provide the functionality for embedding these varied instructional elements into the online course (Vai & Sosulski, 2016).

Ko and Rossen (2017) emphasized the importance of chunking content into manageable segments such as modules or units. Young (2006) found that students preferred courses that were structured and well organized. Instructions must be clearly written with sufficient detail. A critical aspect of content presentation includes instructional alignment—aligning instructional elements to both objectives and assessments. Czerkawski and Lyman (2016) emphasized the importance of aligning course content and activities in order to achieve objectives. In addition, it is imperative to include accommodations for learners with disabilities, such as providing (a) transcripts or closed captioning, (b) alternative text to accompany images, and (c) header information for tables. Dell et al. (2015) highlighted the importance of including information about the accessibility of all course technologies in the course.

Interaction and Communication

Interaction and communication are critical in online courses. Some of the strategies to enhance interaction and communication include (a) providing opportunities for student-to-student interaction, (b) using activities to build community, (c) including collaborative activities to support active learning, and (d) using technology in such a way as to promote learner engagement and facilitate learning. Moore (1989) proposed an interaction framework, and listed student-student interaction as essential for online courses, in addition to student-content and student-instructor interaction. Moore stated that adult learners might be self-motivated to interact with peers, whereas younger learners might need some stimulation and motivation. Luo et al. (2017) highlighted that interaction assists in building a sense of community. These authors describe a sense of community "as values students obtain from interactions" with the online community (p. 154). Hence it is essential to intentionally design activities that build and maintain community in online courses. Strategies to build community include humanizing online courses by using videos and designing collaborative assignments that provide learners with opportunities to interact with peers (Liu et al., 2007). Shackelford and Maxwell (2012) found using introductions, collaborative group projects, whole-class discussions, as well as sharing personal experiences and resources predicted a sense of community. Online collaboration supports active learning as it involves lateral thinking, social empathy, and extensive ideation (Rennstich, 2019). Salmon (2013) described the importance of designing e-tivities for online participation and providing learners with scaffolding to achieve learning outcomes. A variety of technology systems and tools have been used to promote online learner engagement. Some of these technologies are e-mail, learning management systems, wikis, blogs, videos, social media, and mobile technologies (Anderson, 2017; Fathema et al., 2015; Pimmer et al., 2016).

Assessment and Evaluation

Assessment and evaluation are essential in an online course to measure students' learning outcomes and determine overall course effectiveness. Some of the strategies for well-designed assessment and evaluation include (a) aligning assessments with learning objectives, (b) providing several assessments throughout the course, (c) including grading rubrics for each assessment, (d) providing self-assessment opportunities for learners, and (e) giving students opportunities to provide feedback for course improvement. Dick (1996) emphasized the importance of aligned assessments in the instructional design process. Instructional design models recommend that assessments be aligned with learning objectives and instructional events. In addition, Quality Matters (2020) considered alignment between objectives, materials, activities, technologies, and assessments in online courses as essential because it helps students to understand the purpose of activities and assessments in relation to the objectives and instructional material.

Researchers have pointed out the importance of administering a variety of assessments throughout the course so that students can gauge their learning progress (Gaytan & McEwen, 2007). Martin et al. (2019) reported that award-winning online instructors recommend using rubrics for all types of assessments. Rubrics not only save time in the grading process, but they can assist instructors in providing effective feedback and supporting student learning (Stevens & Levi, 2013). Self-assessments help learners identify their progress towards the course outcomes.

Evaluation is an important element in course improvement. Kumar et al. (2019) found that expert instructors used mid- and end-semester surveys and student evaluations. They also use data from learning management systems and institutional course evaluations to improve courses. These practices illustrate the importance of providing learners with opportunities to give feedback to instructors.

Learner Support

Support is essential for online learners to be successful. Some of the strategies for providing support to the online learner include providing (a) intuitive and consistent course navigation, (b) media that can be easily accessed and viewed, (c) details for minimum technology requirements, and (d) resources for accessing technology and institutional support services. Support can be offered at the course, program, and college or institution level. At the course level, it is essential to provide learner support for easy and consistent navigation (Graf et al., 2010); otherwise, students can become easily frustrated and dissatisfied. Because online learners come from different backgrounds and have access to different resources, they may use various devices and platforms to access courses. Therefore, it is important to specify technology requirements and to design the course with media and files that can be easily viewed and accessed with mobile devices (Han & Shin, 2016; Ssekakubo et al., 2013). Additionally, it is important for the institution to provide a variety of support services (e.g., academic, technical).

Experience and Expertise

Individuals with many years of experience in designing online courses tend to have a high level of expertise. Award-winning faculty who had designed and taught online courses were interviewed to identify important course design elements. These faculty members mentioned that they followed a systematic process. They chunked course content, aligned course elements using a backwards design approach, provided opportunities for learner interaction, and addressed the needs of diverse learners (Martin et al., 2019). Expert designers have “a rich and well-organized knowledge base in instructional design” (Le Maistre, 1998, p. 33). In general, compared to novice designers, they are more knowledgeable regarding design principles and are able to access a variety of resources (Perez et al., 1995).

Research Purpose

The purpose of this study was to develop the Online Course Design Elements (OCDE) instrument and establish its reliability and construct validity. Baldwin et a. (2018) reviewed some of the few rubrics focus on online course design, most of these instruments have not been validated. Some of these rubrics were created by universities or at the state level.

Building on design elements from across the six rubrics examined in Baldwin et al. (2018), the OCDE captured the most common design elements from these various rubrics. This instrument filled the gap by designing a valid and reliable instrument that instructors and designers of online courses may use at no cost for developing or maintaining online courses. In addition to designing the instrument, we also examined whether years of experience or expertise was related to instructors’ and instructional designers’ use of design elements.

More specifically, the objectives of this study were to (a) develop an instrument to identify design elements frequently used in online courses, (b) validate the instrument by verifying its factor structure, and (c) examine the relationships of the latent variables to years of experience and self-reported level of expertise. While the instrument was validated in higher education, it can also be adapted and used by researchers and practitioners to other instructional contexts including K-12 and corporate.

Method

This research was carried out in two phases. The first phase focused on the development of the OCDE instrument, and the second phase focused on validating the instrument. During the first phase, the research team developed the instrument, and the instrument was then reviewed by a panel who were experts in designing online courses and surveys. In the second phase, statistical analysis of reliability and validity of the instrument was conducted through a confirmatory factor analysis (CFA) and a multiple indicator multiple cause (MIMIC) model. CFA was used to test the conceptual measurement model implied in the design of the OCDE. The MIMIC was used to examine the relationships of the OCDE to participants' years of experience and self-reported levels of expertise.

Phase 1: Development of the OCDE Instrument

Development of the OCDE instrument was based on Baldwin et al. (2018) and their analysis of six online course rubrics: (a) Blackboard Exemplary Course Program Rubric (Blackboard, 2012); (b) Course Design Rubric (California Community Colleges Online Education Initiative, 2016); (c) QOLT Evaluation Instrument (California State University, 2015); (d) Quality Online Course Initiative (QOCI) Rubric (Illinois Online Network, 2015); (e) OSCQR Course Design Review (Online Learning Consortium, 2016); and (f) Specific Review Standards from the QM Higher Education Rubric (Quality Matters, 2020). Five of these rubrics are publicly available online, while one rubric is only available on a subscription basis or with permission. Baldwin et al. (2018) identified 22 standard online design components used in four of the six rubrics they analyzed.

After seeking the authors' permission (Baldwin et al., 2018) to build on the results of their study, the 22 elements were used as the foundation of the OCDE instrument. We added critical elements to the instrument based on existing research (Jones, 2013; Luo et al., 2017; Stavredes & Herder, 2014). These included (a) a course orientation, (b) a variety of instructional materials, (c) student-to-instructor interaction, and (d) consistent course structure. The instrument that was reviewed by experts for face validity had 37 items in five categories. All items prompted respondents to indicate how frequently they used the design elements on a Likert scale ranging from 1 (*Never*) to 5 (*Always*).

Four experts were provided with a digital copy of the instrument and instructions to evaluate the clarity and fit of all items, make changes, and add or delete relevant items. Once their review was completed, the experts returned the instrument with feedback by e-mail to the lead researcher. Experts were selected based on their expertise and experience in online or blended teaching in higher education and their expertise in survey research methodology. Two experts were research methodologists with expertise in teaching online, and two experts were online learning experts. The researchers discussed the expert feedback, and several items were revised based on the reviewers' feedback. Some of the changes recommended by the experts were to (a) provide examples for the items in parenthesis, (b) add an item regarding major course goals, (c) delete additional items on course objectives, and (d) modify the wording of some items. The final version of the instrument included 38 items with Likert scale responses (Table 1).

Table 1

Design Categories and Number of Items

Category	Number of items	
	Baldwin et al. (2018)	Current study
Overview	5	11
Content presentation	3	6
Interaction and communication	4	7
Assessment and evaluation	6	7
Learner support	4	7
Total	22	38

Phase 2: Validation of the OCDE Instrument

Procedure and Data Collection

Data were collected in the Spring 2020 semester with the use of an online Qualtrics survey that was housed on a protected server. All subscribers to e-mail distribution lists of two professional associations received an invitation to participate in the study. Members of these organizations work with information or instructional technologies in industry or higher education as instructors, instructional designers, or in different areas of instructional support. Therefore, these individuals have varied experience in designing and supporting online courses. Additionally, invitations to participate in the study were posted to groups of these organizations on one social networking site. In order to increase the response rate, one reminder was sent or posted after two weeks. All responses were voluntary and anonymous, and no incentives were provided to participants.

Participants

A total of 222 respondents completed the survey including 101 online instructors and 121 instructional designers who were involved with online course design. Most of the respondents identified as female (n = 158; 71%). The average age of respondents was 48 years (SD = 10.74) and the average years of experience was 10.54 (SD = 6.93). Nearly half of respondents (n = 107; 48%) rated their level of expertise as expert, 29% identified as proficient, 15% as competent, and 5% identified as advanced beginner. Only one individual was a novice.

Data Analysis

Descriptive statistics were reported at both the item level and the category level. After the data collection, three models were evaluated: (a) Model 1, a one-factor model; (b) Model 2, a five-factor model; and (c) Model 3, a five-factor higher-order model. The five-factor and higher-order models align with the development of the OCDE. Model 1 specified a unidimensional construct and endorsed the use of a total score instead of subscales. This model was examined to determine if the covariance among items was due to a single common factor. Model 2 specified a correlated five-factor model with eleven items loading on the overview factor (items 1– 1), six items loading on the content presentation factor (items 13–18), seven items loading on the remaining factors of interaction and communication (items 20–26), assessment and evaluation (items 28–34), and learner support (items 36–42). Model 3 specified the same factor structure as Model 2 but included a second-order factor of OCDE. Correlated error variances were used to modify the model if the re-specification agreed with theory. In order to determine the best model, both statistical criteria and information about the parameter estimates were used. Because the models are not nested and statistical tests of differences between models were not available using weighted least square mean and variance adjusted (WLSMV) estimations (e.g., DIFFTEST or Akaike's Information Criterion), no statistical tests of differences were conducted.

All models were tested with M*plus* 7.11 (Muthén & Muthén, 2012) using WLSMV estimator, which was designed for ordinal data (Li, 2016), and a polychoric correlation matrix.

The pattern coefficient for the first indicator of each latent variable was fixed to 1.00. Indices of model-data fit considered were chi-square test, root mean square error of approximation (RMSEA), standardized root mean squared residual (SRMR), and comparative fit index (CFI). For RMSEA, Browne and Cudeck (1992) suggested that values greater than .10 might indicate a lack of fit. CFI values greater than .90, which indicates that the proposed model is greater than 90% of than that of the baseline model, will serve as an indicator of adequate fit (Kline, 2016). Perfect model fit is indicated by SRMR = 0, and values greater than .10 may indicate poor fit (Kline, 2016). All models are overidentified indicating there is more than enough information in the data to estimate the model parameters.

After determining the best fitting model, a multiple indicators multiple cause model (MIMIC) was conducted to examine the a priori hypothesis that years of experience and level of expertise would have positive relationships with the latent variables of the OCDE. Specifically, we hypothesized years of experience and level of expertise to have a positive relationship to the latent variables.

Results

In this section we review the data screening process, the descriptive statistics from the OCDE implementation, the validation of OCDE, and examination of the relationship between OCDE and variables of years of experience and level of expertise.

Data Screening

Initially, 238 individuals responded to the survey invitation; however, 16 cases had one-third or more data missing, and these 16 cases were deleted from the data set. Missing values for all variables did not exceed 1.4% (i.e., three respondents). Little's (1988) Missing Completely at Random (MCAR) test was not statistically significant, $\chi^2 = 113.76$, $df = 142$, $p = .961$, suggesting that values could be treated as missing completely at random. These missing values were estimated using expectation-maximization algorithm (EM). All values were within range and no univariate or multivariate outliers were detected. Because the data were ordinal in nature, WLSMV estimations were used to estimate all parameters of the model. WLSMV is specifically designed for ordinal data (e.g., Likert-type data) and makes no distributional assumptions about the observed variables (Li, 2016). The variance inflation factor for all items were below 5.0, suggesting multicollinearity was not problematic.

Descriptive Statistics

The means and standard deviations for all items are reported in Table 2. All means exceeded 4.0 (on a 5-point scale; 1 = *Never*, 2 = *Rarely*, 3 = *Sometimes*, 4 = *Often*, and 5 = *Always*) except for two items. Reliability coefficients, as estimated using Cronbach's alpha, were (a) .91 for all 38 items; (b) .82 for overview; (c) .66 for content presentation; (d) .83 for interaction and communication; (e) .73 for assessment and evaluation; and (f) .76 for learner support. Reliability coefficients greater than .70 are generally acceptable, values greater than .80 are adequate, and values greater than .90 are good (Kline, 2016; Nunnally & Bernstein, 1994). Given the values of the reliability coefficients, making inferences about individual respondents' performance on the subdomains was not recommended. The correlation coefficients among the items ranged from .05 to .62. The correlation matrix for the items can be made available upon request.

Table 2

Means and Standard Deviations for Survey Items

Category and item	*M*	*SD*
Overview (Cronbach's alpha = .82)		
1. A student orientation (e.g., video overview of course elements)	4.22	1.125
2. Major course goals	4.82	0.579
3. Expectations regarding the quality of students' communication (e.g., netiquette)	4.50	0.886
4. Expectations regarding student participation (e.g., timing, frequency)	4.64	0.822
5. Expectations about the quality of students' assignments (e.g., good examples)	4.22	0.994
6. The instructor's contact information	4.86	0.573

7. The instructor's availability for office hours	4.50	1.084
8. A biography of the instructor	4.23	1.140
9. The instructor's response time to e-mails and/or phone calls	4.31	1.145
10. The instructor's turn-around time on feedback to submitted assignments	4.15	1.207
11. Policies about general expectations of students (e.g., late assignments, academic honesty)	4.77	0.697
Mean for overview category	4.47	0.582
Content presentation (Cronbach's alpha = .66)		
13. A variety of instructional materials (e.g., textbook readings, video recorded lectures, web resources)	4.68	0.524
14. Accommodations for learners with disabilities (e.g., transcripts, closed captioning)	4.22	1.096
15. Course information that is chunked into modules or units	4.84	0.527
16. Clearly written instructions	4.81	0.485
17. Course activities that promote achievement of objectives	4.77	0.589
18. Course objectives that are clearly defined (e.g., measurable)	4.73	0.650
Mean for content presentation category	4.67	0.413
Interaction and communication (Cronbach's alpha = .83)		
20. Opportunities for students to interact with the instructor	4.55	0.728
21. Required student-to-student interaction (e.g., graded activities)	4.15	0.981
22. Frequently occurring student-to-student interactions (e.g., weekly)	4.04	0.988
23. Activities that are used to build community (e.g., icebreaker activities, introduction activities)	4.08	1.024
24. Collaborative activities that support student learning (e.g., small group assignments)	3.73	1.025
25. Technology that is used to promote learner engagement (e.g., synchronous tools, discussion forums)	4.53	0.747
26. Technologies that facilitate active learning (e.g., student-created artifacts)	4.42	0.856

Mean for interaction and communication category	4.21	0.640
Assessment and evaluation (Cronbach's alpha = .73)		
28. Assessments that align with learning objectives	4.82	0.527
29. Formative assessments to provide feedback on learner progress (e.g., discussions, practice activities)	4.61	0.675
30. Summative assessments to measure student learning (e.g., final exam, final project)	4.64	0.690
31. Assessments occurring throughout the course	4.65	0.647
32. Rubrics for graded assignments	4.45	0.853
33. Self-assessment options for learners (e.g., self-check quizzes)	3.55	1.048
34. Opportunity for learners to give feedback on course improvement	4.37	0.867
Mean for assessment and evaluation category	4.44	0.480
Learner support (Cronbach's alpha = .76)		
36. Easy course navigation (e.g., menus)	4.77	0.589
37. Consistent course structure (e.g., design, look)	4.78	0.555
38. Easily viewable media (e.g., streamed videos, optimized graphics)	4.63	0.675
39. Media files accessible on different platforms and devices (e.g., tablets, smartphones)	4.27	0.920
40. Minimum technology requirements (e.g., operating systems)	4.25	1.148
41. Resources for accessing technology (e.g., guides, tutorials)	4.27	0.906
42. Links to institutional support services (e.g., help desk, library, tutors)	4.59	0.811
Mean for learner support category	4.51	0.545

**Note*. Q12, Q19, Q27, and Q35 were open-ended questions and were not included in Table 2.

Confirmatory Factor Analysis (CFA)

The results of the CFA are shown in Table 3. In all the of the analyses, the chi-square goodness-of-fit statistics were statistically significant. This suggest that none of the models fit perfectly. The other goodness-of-fit statistics suggested a reasonable fit for the models, except for Model 1. For Model 1, the Comparative Fit Index - CFI (.815), Tucker-Lewis Index -TLI (.815), Root Mean Square Error of Approximation - RMSEA (.082), and Standardized Root Mean Square Residual - SRMR (.129) exceeded the criteria, which suggest a one-factor model is not supported by the data. While Models 2 and 3 had reasonable fit, examinations of the residual correlation matrix suggested there was some local misfit, and both Models 2 and 3 were modified to improve the fit.

Models 2 and 3 modifications allowed for four correlated error variances between observed variables. Specifically, all of the correlated error variables were between items in the same factor. For the overview factor, the error variance for item 9 (instructor's response time to e-mails and/or phone calls) was allowed to correlate with item 10 (instructor's turnaround time for feedback on submitted assignments). The error variance for item 8 (a biography of the instructor) was correlated with item 9 (instructor's response time to e-mails and/or phone calls). The two items in the interaction and communication factor with correlated error variances were item 21 (required student-to-student interaction, such as graded activities) and item 22 (frequently occurring student-to-student interactions, such as weekly). In the learner support factor, the error variance for item 36 (easy course navigation, such as menus) correlated with item 37 (consistent course structure, such as design and look). The goodness-of-fit statistics are reported in Table 3. For both modified models, the chi-square goodness-of-fit statistics were statistically significant, but the other fit statistics suggested an acceptable fit of the observed covariance to the model-implied covariance.

Table 3

Goodness-of-Fit Statistics

Model	$\chi 2$	df	CFI	TLI	RMSEA	RMSEA 90%CI	SRMR
Model 1	1667.37	665	.825	.815	.082	[.077, .087]	.129
Model 2	1150.18	655	.914	.907	.058	[.053, .064]	.106
Model 3	1135.84	660	.917	.911	.057	[.051, .063]	.106
Modified							
Model 2-mod	1012.11	651	.940	.930	.050	[.044, .056]	.097
Model 3-mod	1002.85	656	.939	.935	.049	[.043, .055]	.098

**Note*. Model 1 = one factor; Model 2 = five factors; Model 3 = higher order factor; Model 2-mod = five factors with correlated error variances (items 8 with 9, 9 with 10, 21 with 22, and 36 with 37); Model 3-mod = Higher order with correlated error variances (items 8 with 9, 9 with 10, 21 with 22, and 36 with 37).

Modified Models

The correlation between the five factors (reported in Table 4) ranged between .48 to .85. This suggests shared variance among the factors. Given the size of the correlation coefficients and large degree of overlap among the factors, the modified Model 3 appears to be the best model and is discussed in greater detail.

Table 4

Correlation Coefficients Among the Five Factors of the OCDE

Factor	1	2	3	4
1. Overview				
2. Content presentation	.81			
3. Interaction and communication	.68	.68		
4. Assessment and evaluation	.85	.65	.65	
5. Learner support	.60	.68	.48	.60

The unstandardized and standardized pattern coefficients for Model 3 modified are reported in Table 5. All coefficients are statistically significant ($p < .001$). Several of the standardized coefficients fell below .70, indicating that over half of the variance is unaccounted for in the model. The path coefficients between the factors and the second order factor ranged from .67 to .93 and were statistically significant. The recommended model is shown in Figure 2. Note that the covariances among the factors are not included in the figure.

Table 5

Unstandardized, Standardized Pattern Coefficients, and Standard Error (SE) for the Higher-Order Model

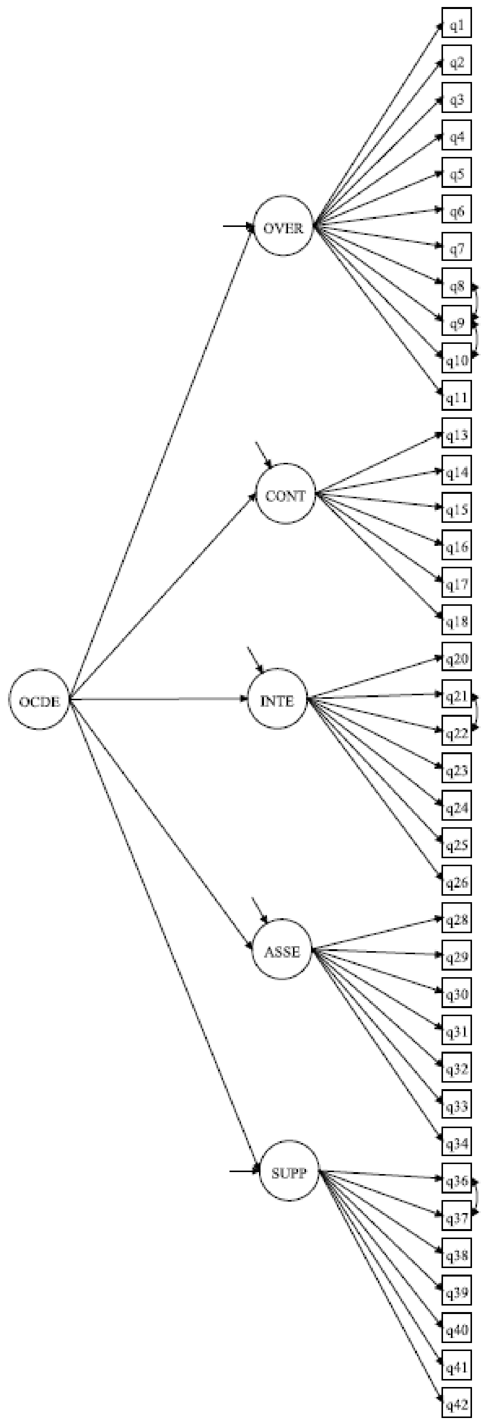
Factor	Item/Factor	Unstandardized		Standardized
		Coefficient	*SE*	Coefficient
Overview	Q1	1.00	.00	.47
	Q2	1.75	.28	.83
	Q3	1.60	.21	.75
	Q4	1.65	.22	.78
	Q5	1.29	.23	.61
	Q6	1.93	.29	.91
	Q7	1.34	.24	.63
	Q8	1.23	.20	.58
	Q9	1.45	.24	.69
	Q10	1.35	.22	.64
	Q11	1.78	.27	.84
Content presentation	Q13	1.00	.00	.51

	Q14	.88	.16	.45
	Q15	1.32	.18	.67
	Q16	1.47	.21	.75
	Q17	1.84	.27	.94
	Q18	1.62	.23	.83
Interaction and communication	Q20	1.00	.00	.79
	Q21	.95	.07	.75
	Q22	.75	.07	.60
	Q23	1.03	.08	.82
	Q24	.75	.09	.59
	Q25	.95	.08	.75
	Q26	.84	.08	.67
Assessment and evaluation	Q28	1.00	.00	.95
	Q29	.72	.06	.68
	Q30	.75	.06	.71
	Q31	.86	.06	.81
	Q32	.72	.05	.68
	Q33	.40	.06	.38
	Q34	.53	.07	.50
Learner support	Q36	1.00	.00	.85
	Q37	.78	.09	.66
	Q38	.97	.09	.82
	Q39	.77	.08	.65
	Q40	.86	.08	.73
	Q41	.78	.09	.66
	Q42	1.00	.10	.85
OCDE higher-order	OVER	1.00	.00	.90
	CONT	1.12	.20	.93
	INTE	1.35	.20	.73
	ASSE	2.06	.29	.93
	SUPP	1.34	.19	.67

**Note*. OVER = overview, CONT = content presentation, INTE = interaction and communication, ASSE = assessment and evaluation, and SUPP = learner support.

Figure 2

Best Fitting Higher-Order Model



Experience and Expertise on Design Strategies

A MIMIC model was conducted to examine the relationship between OCDE higher-order latent factor and the predictor variables of years of experience and level of expertise. The results suggested that level of expertise was a statistically significant predictor of OCDE (unstandardized coefficient = .09, *SE* = .04, standardized coefficient = .23), but years of experience was not statistically significant (unstandardized coefficient < .01, *SE* < .01, standardized coefficient <.01). This suggested for a one unit increase in the self-report level of expertise, there was about a .23 standard deviation increase in OCDE score.

Discussion

In this section, we discuss instructors' and instructional designers' frequency of use of the design elements, validation of the OCDE instrument, and the significance of expertise but not experience in course design.

Frequency of Use

In this implementation with 222 respondents, except for two items, the frequency of use of OCDE items was rated above a Mean of 4.0. With 36 items rated above 4.0, the various design elements in the OCDE are those frequently used in online courses. The two items that were rated below 4.0 were collaborative activities that support student learning (*M* = 3.73) and self-assessment options for learners (*M* = 3.55). This demonstrates that collaborative activities and self-assessment options may not be included as often in the online courses as compared to the rest of the items in the OCDE instrument. Based on research and existing literature, these items are important in student learning. Martin and Bolliger (2018) pointed out the importance of collaboration using online communication tools to engage learners in online learning environments. Capdeferro and Romero (2012) recognized that online learners were frustrated with collaborative learning experiences and provided a list of recommendations for distance education stakeholders in order to improve learners' experiences in computer-supported collaborative learning environments. Castle and McGuire (2010) discussed student-self assessment in online, blended, and face-to-face courses. Perhaps additional guidance or professional development needs to be provided for instructors on how to include these two aspects in the effective design and development of good quality online courses.

Validity of the OCDE Instrument

Evidence from Models 2 and 3 in this study supports inferences from OCDE. The total score demonstrates good reliability and factor structure. However, due to low reliability coefficients especially in the content presentation subscale where the reliability coefficient was at .66, caution needs to be taken if the factors or subscales are used individually. High correlation was found among the subscales, especially between overview and content presentation (.81), and overview and assessment and evaluation (.85). The OCDE instrument is recommended to be used as a whole, but due to low reliability coefficients, caution is advised if using individual subscales of overview, content presentation, interaction and communication, assessment, and evaluation and learner support.

Expertise and Years of Experience in the Design of Online Courses

The overall OCDE score is related to self-reported level of expertise. However, years of experience is not related to the OCDE. The perceived level of expertise was reported as expert, proficient, competent, advanced beginner, or novice. The level of expertise in online course design was a statistically significant predictor of the OCDE score, whereas years of experience was not. Perez et al. (1995) stated that compared to novice designers, expert designers use more design principles and access a variety of knowledge sources. A previous study suggested that experts are not just those with wealth of experience from their years teaching online (Martin et al., 2019) but also those who have the expertise and fluency.

While expertise can be developed with experience over time, this is not the only way to acquire it. Research on online learning strategies that focus on instructors' years of experience might help us understand whether online teaching experience obtained over time makes one an expert instructor. Shanteau (1992) recommended that instead of focusing on their years of teaching experience, experts should be identified based on peer recommendations. Some of the characteristics of expert online instructors identified by Kumar et al. (2019) include (a) possessing a wide range of strategies, (b) knowing how to adapt materials for an online format, (c) choosing content and activities carefully, (d) monitoring activities continuously, and (e) tweaking and evaluating a course.

Limitations

There were some limitations to this study. The elements included in this study are not an exhaustive list for the design and development of good quality online courses, though the OCDE was developed from the summary of six instruments, and from research and expert review. The reliability coefficients of some subscales were below .80, suggesting that rather than make decisions about individual subscales, the results of the study suggest that the research-based instrument can provide useful aggregated information to practitioners. As well, since the data are self-reported, social desirability may have been a factor in some of the participants' responses. In addition, the OCDE was implemented with a relatively small sample of instructors and instructional designers most of whom were based in the United States.

Conclusion

The goal of the study was to develop and validate an instrument to address critical elements in online course design. Results show that the OCDE with its five constructs—overview, content presentation, interaction and communication, assessment and evaluation, and learner support—is a valid and reliable instrument. When relationships of the latent variables to years of experiences and self-reported level of expertise were examined, results indicated that the level of expertise in online course design was a statistically significant predictor of the OCDE score. The OCDE instrument was implemented in higher education. However, practitioners and researchers may adapt and use the instrument for design and research in different settings.

Researchers should continue to examine design elements that are not included in the OCDE and implement them in different settings such as K-12, community colleges, and other instructional settings. This study may be replicated with a larger sample or with participants who teach or support faculty in a variety of disciplines. Using the instrument in other countries, particularly where online teaching and learning is still either a novelty or not as established as in the United States would be worthwhile.

The OCDE can be used to support online teaching and design professional development for instructors and instructional designers, particularly those who are novices or beginners. Instructional designers can offer training for instructors using the OCDE as a checklist. Instructors who are interested in teaching online may also use this rubric to guide their course design.

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Appendix

Online Course Design Elements (OCDE) Instrument

Please indicate the frequency with which you include the following design elements in your online courses.

(Scale: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always)

Overview

1. A student orientation (e.g., video overview of course elements).
2. Major course goals.
3. Expectations regarding the quality of students' communication (e.g., netiquette).
4. Expectations regarding student participation (e.g., timing, frequency).
5. Expectations about the quality of students' assignments (e.g., good examples).
6. The instructor's contact information.
7. The instructor's availability for office hours.
8. A biography of the instructor.
9. The instructor's response time to e-mails and/or phone calls.
10. The instructor's turnaround time for feedback on submitted assignments.
11. Policies about general expectations of students (e.g., late assignments, academic honesty).
12. In your opinion, what are the most important elements in this category? (please type in your answer). (*)

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Content Presentation

1. A variety of instructional materials (e.g., textbook readings, video recorded lectures, Web resources).
2. Accommodations for learners with disabilities (e.g., transcripts, closed captioning).
3. Course information that is chunked into modules or units.

4. Clearly written instructions.
5. Course activities that promote achievement of objectives.
6. Course objectives that are clearly defined (e.g., measurable).
7. In your opinion, what are the most important elements in this category? (please type in your answer). (*)

Interaction and Communication

1. Opportunities for students to interact with the instructor.
2. Required student-to-student interaction (e.g., graded activities).
3. Frequently occurring student-to-student interactions (e.g., weekly).
4. Activities that are used to build community (e.g., icebreaker activities, introduction activities).
5. Collaborative activities that support student learning (e.g., small group assignments).
6. Technology that is used to promote learner engagement (e.g., synchronous tools, discussion forums).
7. Technologies that facilitate active learning (e.g., student created artifacts).
8. In your opinion, what are the most important elements in this category? (please type in your answer). (*)

Assessment and Evaluation

1. Assessments that align with learning objectives.
2. Formative assessments to provide feedback on learner progress (e.g., discussions, practice activities).
3. Summative assessments to measure student learning (e.g., final exam, final project).
4. Assessments occurring throughout the course.
5. Rubrics for graded assignments.

6. Self-assessment options for learners (e.g., self-check quizzes).
7. Opportunity for learners to give feedback on course improvement.
8. In your opinion, what are the most important elements in this category? (please type in your answer). (*)

Learner Support

1. Easy course navigation (e.g., menus).
2. Consistent course structure (e.g., design, look).
3. Easily viewable media (e.g., streamed videos, optimized graphics).
4. Media files accessible on different platforms and devices (e.g., tablets, smartphones).
5. Minimum technology requirements (e.g., operating systems).
6. Resources for accessing technology (e.g., guides, tutorials).
7. Links to institutional support services (e.g., help desk, library, tutors).
8. In your opinion, what are the most important elements in this category? (please type in your answer). (*)

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1. Are there any other design elements that you think are important and are not included in this survey? (please type in your answer). (*)

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Evaluation of Open Educational Resources for an Introductory Exercise Science Course

Angela R. Hillman[1], Anna R. Brooks[1], Marcus Barr[1], and Jesse Strycker[2]
[1]Applied Health Sciences and Wellness, Division of Exercise Physiology, Ohio University, Ohio; [2]The Gladys W. and David H. Patton College of Education, Ohio University, Ohio

Abstract

While open educational resources (OER) have gained popularity, nearly three quarters of faculty are not aware they are available for use. However, when used, they are well received and do not negatively impact quality of learning. OER can be used within a variety of platforms, including software that aims to be more interactive and engage students in active learning and assessment. One such platform is Top Hat, which was used by the authors of this study to develop a textbook for an introductory exercise science course. We assessed student's perceptions of Top Hat and barriers to use for reading their textbook and for class assessments over the course of two years. A total of 486 students were registered for this course. Although two thirds of students had previous experience with Top Hat and half of those used the textbook feature, students (n = 39, 38%) were apprehensive about reading their textbook online via Top Hat. However, these feelings resolved as students became comfortable with the platform's features. Nearly 80% of students have sometimes or never acquired their textbooks before the start of the semester, despite 96% who expressed the importance of having their materials accessible online and available on or before the first day of the course. This indicated that students understood the importance of having their materials for the start of the semester, however they perceived the barriers of purchasing books to be greater. Therefore, using OER and Top Hat removed student learning barriers and had potential to increase course participation and success.

*Keywords***:** open educational resources, Top Hat, student perceptions, learning management systems

Introduction

Open educational resources (OER) are defined as "teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others" (Hewlett Foundation, 2013, p. 1). Such OER include things like "full courses, course materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge" (Hewlett Foundation, 2013, p. 1). Unfortunately, as many as 75% of higher education faculty were not aware of OER and although they indicated they would try them, they often cited barriers to adopting OER, such as difficulty finding appropriate or enough resources for their needs, and time and effort needed to evaluate the resources (I. E. Allen & Seaman, 2014). Locating resources and the time to evaluate them might be the most critical, as faculty indicated that quality and proven efficacy of materials were the most important criteria for adopting resources for a course. Interestingly, things like cost, currency, and being rated highly by other faculty were very low in importance (I. E. Allen & Seaman, 2014). Although these barriers are real, OER have been well accepted by both faculty and students. Bliss, Hilton, et al. (2013) found that 55% of faculty believed the quality of the OER they were using was equivalent to the material they had used previously, while 33% felt the quality was better. Greater still, 90% of students perceived OER to be as good as or better than traditional textbooks (Bliss, Robinson, et al., 2013). Similarly, Feldstein et al., (2012) reported 72% of students perceived the OER to be better than a traditional text. Perhaps most importantly, quality of learning did not appear to be impacted negatively by using OER (G. Allen et al., 2015; Feldstein et al., 2012; J. L. Hilton et al., 2013; Lovett et al., 2008; Nusbaum et al., 2020) or may have been improved (J. Hilton & Laman, 2012; Pawlyshyn et al., 2013).

OER materials can take several forms, including images, videos, e-books, existing course materials like quizzes or assignments, or entire courses. Additionally, there are many platforms available for hosting OER content, such as OER Commons or OpenStax. OER can also be accessed from within many learning management systems (LMS). Another option is Top Hat, educational software designed to blend in-person and virtual learning. The software allows instructors to use it for (a) in-class presentation and clicker-type functionality; (b) hosting a course textbook and interactive material; and (c) providing assessments including assignments, quizzes, and exams. The advantages of the textbook feature in Top Hat are that it (a) can host any OER content, (b) is completely customizable by the instructor, and (c) follows the strategic goal for OER that "educators have the legal rights to retain, reuse, revise, remix, and redistribute educational resources as they determine—without having to ask permission" (N. Allen et al., 2015, p. 2). Top Hat also allows authors to update content and material easily and quickly both during and between semesters. For example, if an instructor would like to add additional study materials or practice quizzes, they can either create new material or look for an available OER to upload to the platform. This also makes it easier to determine the effectiveness of materials—questions and real-time grades, showing how well material is being understood and by whom, can be viewed student-by-student or as a whole class. However, while students may be familiar with using an LMS for coursework, many are not familiar with online educational software hosting sites, and there are barriers to students' use of e-books (Pierard et al., 2020). It is imperative that we understand how students perceive these sites and if they have a role to play in the future of OER adoption.

In 2015 our institution established the Textbook Initiative Taskforce (Ohio University, 2016) to find ways to lower or eliminate the high cost of course materials. One of the main foci of the taskforce was the Alt-

Textbook program, to promote the use of OER in place of traditional textbooks. In 2017, the University became a member of the Open Text Network and implemented incentive programs to encourage faculty members to learn about and implement such resources. In fall 2017, the University formed a partnership with Top Hat, and since then increasing numbers of faculty have joined the program. Savings to students in the first academic year (2017-2018) exceeded $1 million (Business Wire, 2018). The instructors in this study were new participants in the Alt-Textbook program and selected Top Hat as their delivery platform. In addition to saving money for students, this approach also ensured that they had the material on the first day of the course, and made the textbook and assessments more interactive. Therefore, the purpose of this study was to investigate student perceptions pre- and post-semester regarding the use of Top Hat for reading their textbook and for class assessments.

Methods

This study was conducted at a large, research institution located in Appalachian Ohio where approximately 26% of the students were considered low income. Prior to the fall semester 2018, three instructors wrote a textbook for *Introduction to Exercise Science* and made it available via Top Hat. The course was a major requirement, typically completed by freshmen and sophomore students studying exercise science. It was also a required course for one minor in a different college, and an elective course for two other minors, one in the same school and the other in a different college. The instructors had been teaching the course for one to six years, having previously adopted a traditional textbook. However, following the partnership between Ohio University and Top Hat, aimed at fostering OER adoption, the instructors opted to author their own textbook to better fit the course objectives and to make it free for enrolled students (approximately 240 per academic year). The book consisted of 12 chapters, six of which were adapted from OER materials and six written by the instructors. Each chapter contained text, videos, and images to support learning. The resource also contained a highlighting feature, note-taking feature, in-chapter review questions, and end-of-chapter quizzes.

Data Collection Procedure

Two anonymous online-based surveys (available at doi.org/10.7303/syn24195429) were e-mailed to all students enrolled in *Introduction to Exercise Science* during fall and spring semesters from 2018 to 2020, for a total of four semesters. The course was offered with two face-to-face and one online section in the fall and one face-to-face and one online section in the spring. A pre-semester survey was e-mailed to students once during the first two weeks of the semester, with a post-semester version e-mailed during the final two weeks of the semester.

In the pre-semester survey, the first set of questions pertained to basic demographics (e.g., age, gender) and academic history (e.g., college level, course delivery format, previous experience with this course, previous online course experience). The next set of questions asked students about their comfort level with using technology (e.g., cellphones, laptops, e-books, Websites, word-processing software) both in their personal and their academic life. Students were then asked about their familiarity with Top Hat including previous experience (i.e., other courses using it) and were also asked open-ended questions regarding opinions or feelings about using the software. Next, students were asked about their textbook buying habits and barriers to purchasing books for courses. Finally, students were asked to respond to questions regarding the importance of course materials, including quality and reliability, availability (e.g., online, for free, available first day of class), and the credibility of their instructors as authors.

In the post-semester survey, students were asked the same demographic questions as during the pre-survey followed by questions related to their experience. First the students were asked to look back at their pre-course opinions on using e-books to see if they had changed, and if they did or did not like using Top Hat to read their textbook. They were also asked if they used Top Hat's optional highlighting and note-taking features and if so, how often and if not, why not. Next, they were asked if they felt Top Hat was user friendly, and if in future they would drop or avoid taking a class that used it. Students were again asked to respond to questions regarding the importance of course materials, including quality and reliability, availability (e.g., online, for free, available first day of class), and the credibility of their instructors as authors. Finally, students were asked how well they felt the Top Hat textbook and their instructor helped them achieve the course objectives, which were explicitly listed.

Data Analysis

Multiple-choice and multiple-select survey items were analyzed quantitatively. Where it was not possible to qualitatively compare data, a descriptive analysis of results was conducted instead. Open-ended items were analyzed using thematic analysis (Braun & Clarke, 2006).

Results

Over the four semesters examined for this study, a total of 486 students were registered for the course; 323 students were registered for in-person sections, while 163 were registered for online sections. The pre-semester surveys had a 49% completion rate (n = 240), while the post-semester completion rate was 33% (n = 150; based on course completion numbers). Demographics for participants are presented in Table 1. Approximately 50% of the students had previous experience with an online course; 44 (36%) stated that they preferred online courses, while 78 (64%) preferred in-person courses.

Table 1

Participants' Demographic and Academic History Data

Factor	Results
Age (years)	
Pre-Semester	19 ± 4
Post-Semester	20 ± 4
Gender	
Pre-Semester	143 female (60%), 97 male (40%)
Post-Semester	96 female (64%), 54 male (36%)
Class level	
Freshmen	154 (64%)
Sophomore	54 (23%)
Junior	22 (9%)

Senior	10 (4%)
Reason for taking course	
Major requirement	204 (85%)
Minor requirement	3 (1%)
Elective	33 (14%)

Pre-Semester Survey

Of the 153 participants (64%) who had previously used Top Hat in a course, 72 (51%) said their textbook was based in Top Hat, 95 (67%) said they used it for quizzes or in-class clicker functionality, 106 (75%) said it was used for in-class presentation, and 86 (61%) said it was used for homework, including quizzes.

When asked what they thought or felt about using Top Hat for a course (e.g., excited, curious, apprehensive), 174 (73%) said they had no such response before taking the course, while 66 (27%) did. Among those who did have feelings regarding Top Hat and had previously used it (n = 39), respondents reported feeling excited (44%), unsure (41%), apprehensive (38%), and/or confident (36%). Of those who had not previously used Top Hat (n = 27), respondents reported feeling unsure (59%), apprehensive (33%), excited (33%), and/or confident (22%). Reasons for apprehensive feelings included Top Hat being used poorly in previous courses and because "I can never trust technology." Reasons for excited feelings were because "I've never been in a class that uses Top Hat for anything other than attendance" and because Top Hat is a "great program" and will "keep me organized." Reasons for confidence included "I am familiar with Top Hat and enjoy using it to learn. I like seeing what I miss, and what questions I may get correct, as this helps me learn what I need to study more" and "I love using Top Hat. I think it's a great way to get an idea of what is really getting picked up on by the students and to identify what needs more reviewing, as well as engaging students." Students who reported being unsure said they "didn't know what to expect," were "unsure of what exactly it would be like," felt "every class is set up differently in Top Hat," and "don't like using online materials."

Responses to questions about their comfort using technology in their personal versus academic lives can be seen in Table 2. A Wilcoxon rank test revealed that there was a significant difference in comfort between personal and academic use of cellphones (W = 350, p < 0.001), but there were no statistically significant differences in use of any other technologies between personal and academic use.

Table 2

Comfort Level Using Technology for Personal Versus Learning Purposes

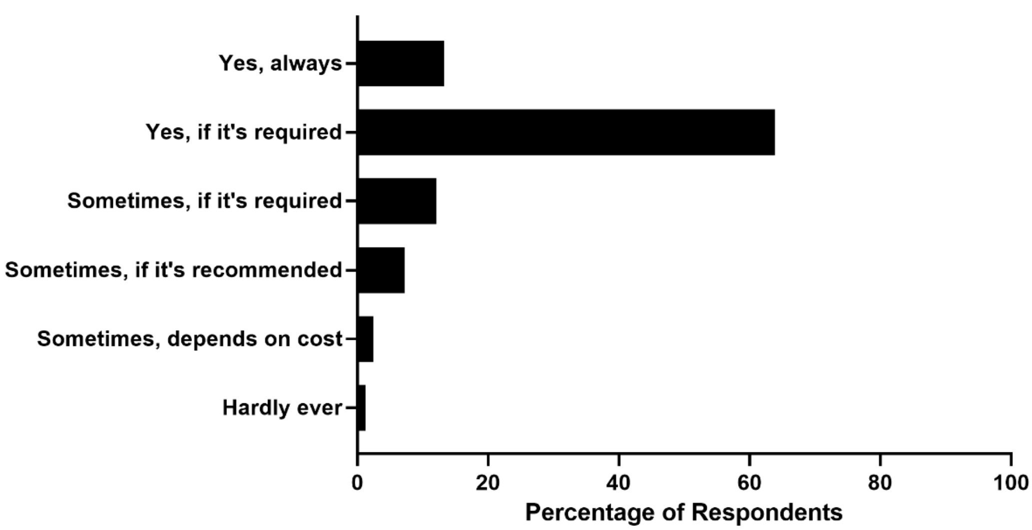
Technology Purpose	Extremely comfortable	Moderately comfortable	Neither comfortable nor uncomfortable	Slightly uncomfortable	Extremely uncomfortable
Cellphone					
Personal	92%	3%	0%	0%	5%
Learning	58%	32%	4%	1%	4%
Computer					
Personal	73%	21%	1%	0%	5%
Learning	74%	18%	4%	0%	4%

Tablet					
Personal	48%	32%	14%	1%	5%
Learning	41%	32%	23%	1%	3%
e-Book					
Personal	32%	40%	13%	14%	1%
Learning	36%	32%	19%	11%	1%
Websites					
Personal	60%	30%	1%	3%	5%
Learning	60%	28%	6%	6%	1%
Online documents (e.g., Google docs)					
Personal	61%	26%	4%	4%	4%
Learning	65%	22%	7%	3%	3%
Computer software (e.g., Microsoft Office)					
Personal	47%	32%	15%	5%	1%
Learning	50%	33%	10%	4%	3%

When asked about their textbook buying habits, 77% of students said they always bought the book or bought if it was required. Of the remainder, 21% said they sometimes bought the book if it was required, recommended, or their decision depended on the cost of the book. Only 1% said they hardly ever purchased their books (Figure 1).

Figure 1

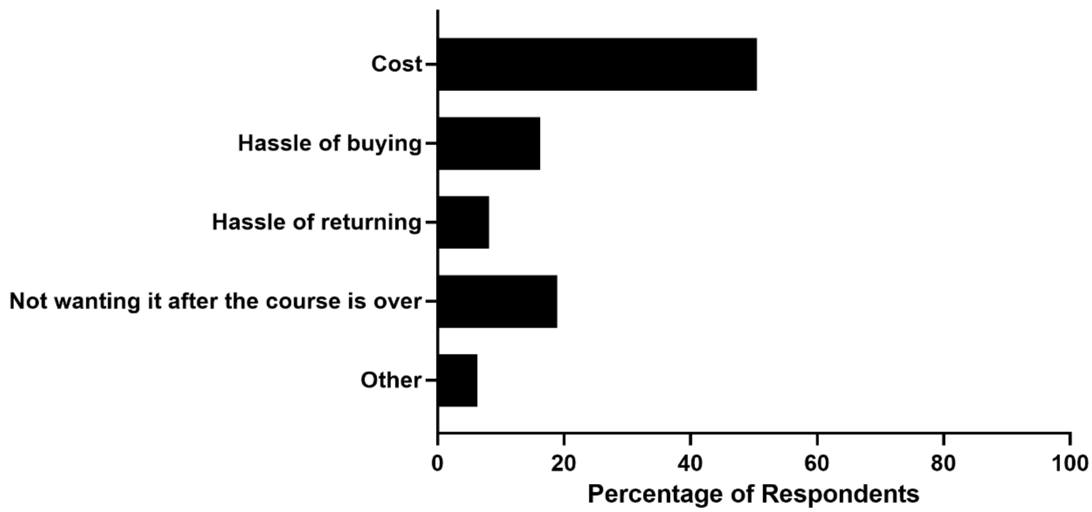
Students' Textbook Buying Habits



When asked about the barriers to purchasing a textbook, 50% stated the biggest barrier was cost. Other barriers included not wanting the book once the course was finished (19%), the hassle of buying (16%), and the hassle of returning (8%). Other reasons (6%) given were that "professors rarely used them" and "I don't need it" (Figure 2).

Figure 2

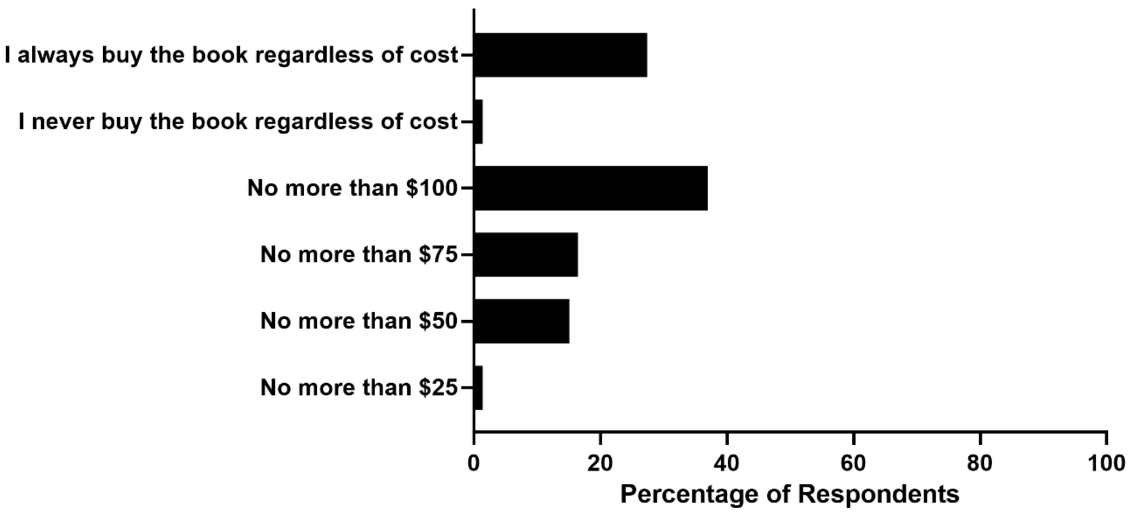
Barriers to Purchasing Books for Courses



When asked how often they had their textbooks for the first day of class, 37% said never, 25% said sometimes, 16% said half the time, and 22% said always or almost always. When asked about the maximum amount they would pay for their textbook, 32% said they would pay no more than $75, while 37% said they would pay no more than $100. Interestingly, 27% said they would purchase the book regardless of the cost (Figure 3).

Figure 3

Theoretical Cost Students Were Willing to Pay for Textbooks



Finally, students were asked how important it was to know their instructors were the authors versus someone else in the field.; 89% felt it was extremely to moderately important that instructors authored the textbook, while 11% felt it was slightly or not at all important. Students were also asked the importance that class materials be free, available on or before the first day of the course, and accessible online. Nearly all (99%) believed it was moderately to extremely important that the materials were free, 97% felt it was moderately to extremely important that the materials were available on or before the first day of the course, and 96% felt it was moderately to extremely important that the materials were accessible online. Finally, when asked about the importance of the reliability and quality of the materials, all students reported that it was moderately to extremely important that the materials were reliable and of good quality.

Post-Semester Survey

When asked to reflect on whether their use of Top Hat changed their pre-course feelings on using e-books, 75 (50%) said yes and 75 (50%) said no. Of those who did change their mind, a common theme was that of user-friendliness, including "my mind changed because I did not realize the text would be so user friendly," "it's easy to use," "it turned out better than expected," and "I really enjoyed using the tools Top Hat offered that were unique." Additional comments included those on convenience such as "at the beginning I hated it, but it was nice not to have to lug around a textbook" and "it changed a bunch, I didn't realize how convenient Top Hat was." Further comments suggested it had impacted their learning including "Top Hat was as key part of my learning," "it has helped me improve my study skills and I noticed a huge change in my grades from beginning to now," and "it was much easier to retain information." The vast majority of individuals who did not change their mind simply stated this, but others opined "I still feel that I'd prefer to use pencil and paper since I learn better that way than reading online," "the textbook was sometimes hard to navigate," and "I did not like the Website as a whole." Interestingly, one student noted they are "less likely to do in-depth reading with e-books" and approximately 20% of students would have liked to have a physical book because they do not like reading e-books.

Students were asked if they used Top Hat's special features of highlighting or note-taking within the online textbook; only 44% reported they used highlighting and 14% used note-taking. Of those who used the highlighting feature, 51% used it for most or all chapters, while 49% used it for a few chapters. Of those who used the note-taking feature, 40% used it for most or all chapters, while 60% used it for a few chapters. When prompted as to why they did not use these features, the most common response was "didn't know it existed" or they did not see it as useful and preferred to take their own notes.

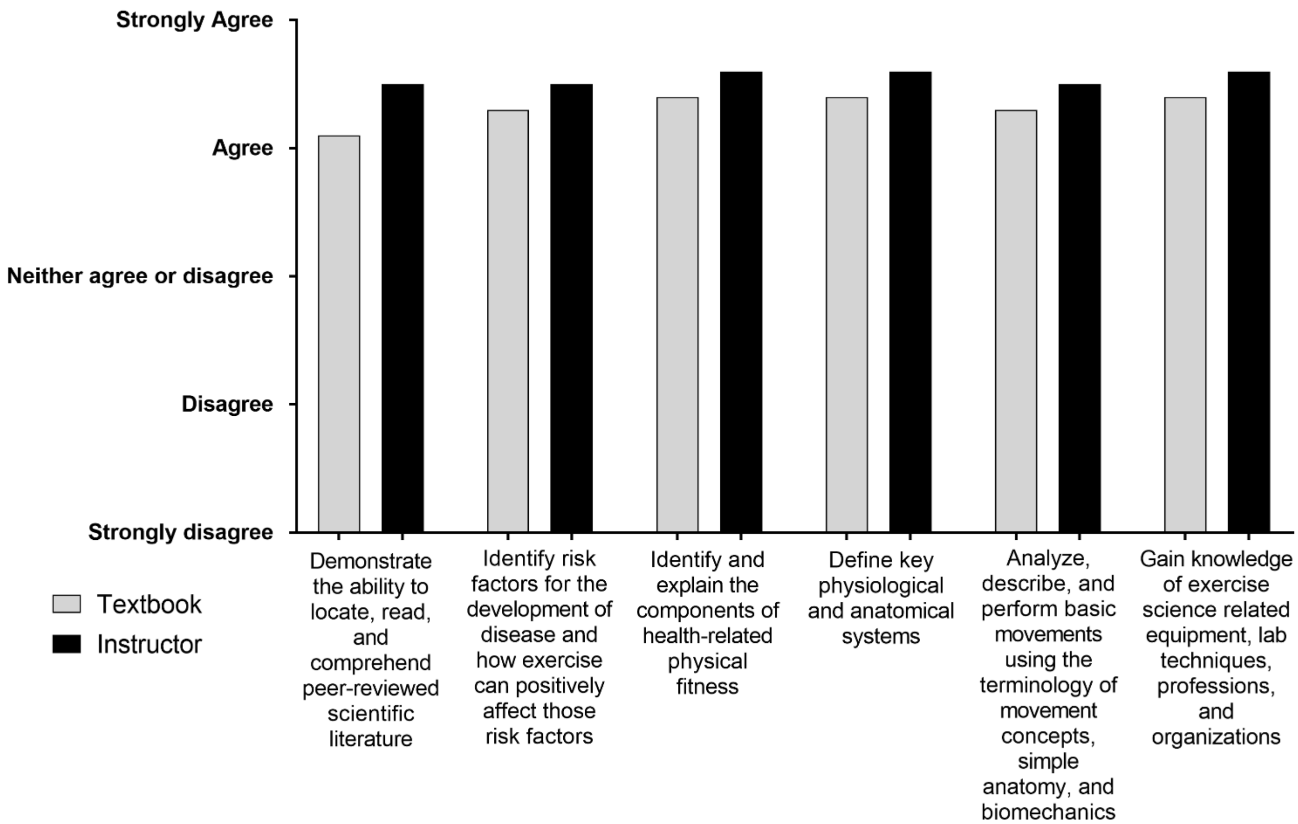
When asked if they felt Top Hat was user-friendly, 96% of students said yes, 92% said they would not avoid taking a class that used it in the future, and 99% said they would not drop a course that used it. The reasons for avoiding or dropping a course that used Top Hat was "didn't like it" and "didn't understand the requirements within."

When reflecting on the questions regarding the authoring and availability of the materials that they were asked pre-semester, students still reported that it was extremely to moderately important that the materials were reliable (99%) and of good quality (98%); 97% believed it was moderately to extremely important that the materials were free, and 96% felt it was moderately to extremely important that the materials were accessible online and that the materials were available on or before the first day of the course. In the post-semester survey, the importance of knowing that the instructors were the authors dropped to 81% who said this was either extremely to moderately important.

Finally, students were asked how well they felt the textbook and instructor helped them achieve the learning objectives for this course, which were explicitly listed. Figure 4 reports results of a Wilcoxon rank test that found scores for the instructor were significantly higher than for the textbook in terms of all objectives except one, namely "define key physiological and anatomical systems," likely because there was a chapter in the book titled "Anatomical Key Terms."

Figure 4

Student Opinion on How Well the Textbook and Instructor Helped Them Achieve Course Objectives



Discussion

Some faculty, like some parts of society, tend to think of modern students as being technology savvy. This may be the result of perceiving that students, born into an environment with increasing exposure to technology, are no doubt highly skilled technology users (Howe & Strauss, 2009; Oblinger & Oblinger, 2005; Tapscott, 2008). Each subsequent generation has the potential for exposure to more technologies and more opportunities to use them. However, the claims that each generation increases their technical skill and expertise, especially educational application of technology, have been heavily critiqued (Bennett et al., 2008; Helsper & Eynon, 2010; Kirschner & De Bruyckere, 2017). In our study, 92% of the students reported being extremely comfortable using cellphones for their personal lives versus only 58% in their academic lives, which is statistically significant. Even so, students are frequently asked to use their phones for academic purposes, and faculty may assume students feel comfortable doing so. Indeed, nearly the same number (60%) reported feeling that smartphones are important for their learning needs (Galanek et al., 2018). This appears to be an important disparity and may exist because many instructors ban the use of personal devices in the classroom, though students have reported that they want their instructors to use more technology in the classroom and would like to see more use of OER (Brooks & Pomerantz, 2017).

It may be important to explain expectations for technology use in the classroom, as students have reported feeling more comfortable with technology the more it is used (Margaryan et al., 2011). This was clearly evident in our study, as students frequently reported being apprehensive or not liking the online textbook at the start of the semester, though their feelings had changed by the end. There were some common themes in the comments from students when they were asked to reflect on the use of the textbook in Top Hat, including interaction, navigation and ease of use, and convenience. Most students appeared to enjoy using the textbook, in particular the fact that it was interactive and included quizzes, stating that "I liked how you had to engage with the textbook on Top Hat" and "I like seeing what I miss, and what questions I may get correct, as this helps me learn what I need to study more." While some noted that initial use and learning was a challenge, they "felt it was easy to navigate and helpful." Additionally, some remarked that "I really enjoyed that it was broken down by section," and "it was easy to use and find information." Many students remarked that the textbook in this format was convenient, that it was online and free, and they appreciated not having to have a physical book; even so, there were many who also remarked that they would still have preferred a hard copy version.

Students recognized the ease of use and convenience in the online textbook, including highlighting and note-taking features, as well as being able to have the book open while in lecture but not having to carry a textbook with them. They felt that it helped them improve their learning, though we did not assess how this compared to a traditional textbook. However, nearly half of those surveyed did not use some of the interactive features within the textbook, such as highlighting (yes: n = 66, 44%; no: n = 84, 56%) and note-taking (yes: n = 21, 14%; no: n = 128, 86%). This is despite instructors providing in-class demonstrations of the features at the start of the semester. Many of the students noted that they preferred to take handwritten notes, which should be encouraged as it is well documented that this leads to better learning (Mueller & Oppenheimer, 2014).

A major advantage of using an online textbook is the availability of the materials, not only in terms of cost but to ensure students are ready for the start of their courses. When surveyed pre-semester, 97% of students believed it was extremely or very important that their textbooks were free, however interestingly, only 3% of respondents reported they did not purchase or hardly ever purchased their textbooks. About a quarter of students stated they would purchase their books regardless of cost while a third would pay up to $75. The upper limit for cost for a textbook appeared to be $100 and 37% said they would buy a book at up to this price; however, many science-based courses require books that are double or triple this cost (Vitez, 2018). Adopting OER materials can save students hundreds of dollars per course, which would undoubtedly add up to thousands over the span of their education. Indeed, the partnership between Ohio University and Top Hat has saved students an estimated $1 million in textbook costs, based on publisher prices (Business Wire, 2018).

It is important to ensure that students have materials at the start of the semester. When surveyed pre-semester, 37% of students said they never have their textbook before the first day of class, 41% sometimes do, while only 22% always or almost always have their materials. This is despite federal regulations requiring textbook information be posted in time for registration (Higher Education Opportunity Act, 2008), some five months in advance of the start of the semester. When asked how important it was to them that the course materials were accessible online and available on or before the first day of the course, 96%

felt it was moderately to extremely important. This indicates that students understand the importance of having their materials for the start of the semester, however they perceive the barriers of purchasing books (such as cost and effort) to be greater. Additionally, retention rates are higher when students have their materials earlier in the semester (Bliss, Robinson, et al., 2013; Ozdemir & Hendricks, 2017). Therefore, if we remove the barriers of having to purchase a textbook and ensure its arrival before the start of term, students are more likely to be prepared. This is a main advantage that an OER can provide, whether it is through an LMS or a stand-alone course option.

We assessed student opinion on how successful the textbook and instructors were in helping students achieve the course objectives. Instructor ratings were significantly higher versus the textbook in all but one objective, however, it is not clear whether this result is meaningful. Bliss, Hilton, et al. (2013) stated that using OER should be done if it does not disrupt learning outcomes. Clearly the use of OER in our courses has not disrupted the achievement of the learning outcomes, and it should be noted that the students felt the instructors were more important, but that the textbook was complementary to their learning.

This study is not without limitations. For example, sample sizes were dictated by student response rates, which were relatively high pre-semester (49%) but lower post-semester (33%). Additionally, there was likely sample bias due a non-random sample (i.e., sampling a population of students in a course) and potential for response-bias based on how the students felt about Top Hat (i.e., responses might be primarily from students who either really liked or really disliked Top Hat). Even so, we saw low ratings combined with positive comments, so this issue may not be major concern.

Conclusions

Most importantly, the use of Top Hat was well received by students. It removed the barriers of cost and access to course materials before courses began, ensuring students were better prepared, which may improve outcomes. This may also provide a benefit to the university as a whole by improving student satisfaction and retention rates.

In addition, as OER gain increased acceptance and systems like Top Hat are used by more faculty across institutions like our own, there may be a greater need to orient students to the use of these resources and systems and make each instructors' expectations as clear as possible. Many of our participants noted they had used Top Hat and some OER in a variety of ways in past classes. During this transition it will be important that we support students through this change and remind instructors that there is no one-size-fits-all approach with Top Hat or use of OER.

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Impact of Changes in Teaching Methods During the COVID-19 Pandemic: The Effect of Integrative E-Learning on Readiness for Change and Interest in Learning Among Indonesian University Students

Anggun Resdasari Prasetyo, Harlina Nurtjahjanti, and Lusi Nur Ardhiani
Faculty of Psychology, Universitas Diponegoro, Indonesia

Abstract

The COVID-19 pandemic has forced universities to conduct online learning, requiring lecturers to create innovative e-learning methods and students to be ready to adapt and show high interest in learning. This study aimed to examine the effect of an integrative e-learning method on students' readiness and interest in learning at Universitas Diponegoro, Indonesia. This research was experimental, designed with one group pretest and posttest, and no control group. As many as 190 students participated, selected using clustered random sampling. Two measurement scales were used: the *readiness for change* scale and the *interest in learning* scale. The statistical analysis technique used was a paired sample *t*-test. The results of paired sample *t*-test analysis on readiness for change ($p = 0.000$; $p < 0.05$) and interest in learning ($p = 0.000$; $p < 0.05$) showed significant differences between the pretest and posttest data. The findings indicated that students who participate in integrative e-learning show significant change in the level of readiness and interest in learning.

Keywords: integrative e-learning, change readiness, interest in learning, university student

Introduction

An organization should be able to adapt to any changes, including challenges and competitions, that occur in its environment. The ability to adapt is essential for an organization to survive and expand. An organization's readiness for change is considered an essential factor in the ability to adapt. One challenge, however, is the unexpected external factor that requires an immediate organizational response. COVID-19 is one of those external factors that has demanded change and adaptation across all fields in Indonesia.

The COVID-19 pandemic began in the first quarter of 2020. The spread of the virus has led to an acute health crisis, causing governments, including Indonesia's, to issue social distancing policies. Such restrictions have affected the implementation of learning in tertiary institutions in Indonesia. The Circular of the Minister of Education and Culture (number 3 of 2020, dated 3 March 2020), concerning the prevention of the spread of COVID-19 in education units, requires all lecture activities to be conducted online. Online learning is defined as a form of learning where physical interaction between teachers and students is absent, and face-to-face meetings occur virtually (Shopova, 2014).

The COVID-19 pandemic conditions resulted in extraordinary changes. In the field of education in Indonesia, all levels immediately adopted online learning (Kotera et al., 2020). This was quite challenging, considering that the COVID-19 situation arose very abruptly, and no one had been prepared for it. Both university educators and students were among those who felt the heavy impact of those changes (Kotera et al., 2020). People reported feeling physical and psychological pressure. As an organizational unit, both lecturers and college students had to adapt to new social, health, and economic conditions (Kotler & Keller, 2009).

COVID-19 can also be seen as an opportunity to expand the use of technology in education, in line with the notion of the *fifth industrial revolution* in which there is expected to be a huge shift in the interaction between people and machines (George & George, 2020). It is predicted that during and after the COVID-19 pandemic, people will grow accustomed to the current e-learning method, and it will become the new learning culture in education (Rada, 2001). This adaptation is viewed positively because readiness for change is one requirement an organization needs to find effective problem-solving methods (Hamel & Valikangas, 2003). Thus, readiness for change at the individual and organizational level has a vital role to play in responding to uncertainties and evolving environmental changes. Readiness for change describes the beliefs, attitudes, and goals of an organization's members regarding the extent of change needed and how capable the organization might be in successfully implementing those changes (Rafferty et al., 2013). This is a cognitive tendency regarding the behavior observed, whether rejecting or supporting the change effort.

This current study focuses on students at Universitas Diponegoro, where the researchers are employed as teaching staff. The researchers wished to explore the effectiveness of the integrative e-learning method which replaced face-to-face learning due to the pandemic. The second reason for this research is to examine the implementation of work from home (WFH) at Universitas Diponegoro. WFH is a government program aimed at limiting the spread of COVID-19. This WFH program applies to almost all workplaces, including educational institutions. WFH entails that education institutions suspend and replace all offline teaching and learning activities with online teaching and learning activities. Students and lecturers continue to learn and teach, but from their respective houses. At first glance, the e-learning program seemed relatively simple to implement, due to the availability of gadgets (e.g., laptop, cellphone, computer) and network data. However, a preliminary study on 30 psychology students at Universitas Diponegoro revealed that students started to face obstacles a week before the implementation of the new learning regime. Among them, not all students had access to a good Internet connection or enough network data. Additionally, these students worried about changes in the learning method because so much depended on the method and technology.

Universitas Diponegoro created an online learning method called *integrative e-learning*, a form of a learning management method. It is a software that virtualizes the conventional teaching and learning process to aid with administration, documentation, and reporting. It also provides a platform to share content in online classrooms, events, e-learning programs, and training. For example, all features related to the management of the teaching and learning process (e.g., managing classes, teaching materials, discussion forums, scoring, and the online exam) are accessible online. This integrated method is considered an efficient and suitable application of distance learning (Dahiya et al., 2016). In distance learning, lecturers and students do not meet face to face directly, but rather while they are in different places and perhaps at different times, using the e-learning method chosen to achieve educational goals. At Universitas Diponegoro, it involves the use of Microsoft Teams, which has been integrated into the LMS and the website used to access it SIAP UNDIP (must be accessed at https://siap.undip.ac.id). Implementing an integrative e-learning program at Universitas Diponegoro is not merely an attempt to adhere to the WFH policy, but also a step towards adapting to a digital era. The online learning method will, therefore, become a primary learning method at Universitas Diponegoro.

Universitas Diponegoro considered several critical elements when designing its integrative e-learning program. The platform allows students to upgrade their skills, read learning materials, look for information, and conduct group discussions with team members. At the same time, lecturers can be present to review the material. Additionally, it provides a method for students to track their learning progress, access supplementary material, and participate in examinations. There are two main approaches to learning: asynchronous and synchronous. Asynchronous learning refers to interactions that occur sometimes with long delays, where the speed depends on the responses of lecturers and students. Synchronous learning is real-time online learning, meaning that student-lecturer interaction coincides (Van Brakel & Chisenga, 2003).

Based on the above explanation, students' readiness for change is related to lecture material, psychological skills, and digital skills. Digital skills are needed because face-to-face interaction in class is replaced by virtual face-to-face interaction using digital technology (Keskin et al., 2015). Digital skill is the ability to use and manage technology, information, and communication systems (Keskin et al., 2015). The advancement of information and communication technology in learning is considered an external factor that influences the learning process (Alqahtani & Mohammad, 2015; Babiker, 2015; Mohammad et al., 2015). Therefore, students should be active, creative, and innovative in order to develop themselves.

As in face-to-face learning in class, positive or negative attitudes and experiences in online learning are influenced by several factors such as the presentation of the materials (e.g., exciting animations), the number of activities, and the opportunity for students to share and collaborate with lecturers and classmates. The learning strategy could also provide opportunities to develop students' critical thinking skills and support self-directed learners. Similar to organizations, students should possess readiness for change. Holt et al. (2007) stated that individuals who are ready for change have a positive attitude towards organizational change and a desire to implement organizational change. Conversely, if individuals are not ready to change, then they will not be able to keep up and will feel overwhelmed by the speed of change happening in their organization.

Another aspect that determines learning other than readiness for change is the interest in learning. Without an interest in learning, students have difficulties following each learning process. Students' interest in learning supports student learning outcomes (Nemeth & Long, 2012). Interest has a positive influence on academic learning, knowledge domains, and specific fields of study (Ainley et al., 2002). Hidi and Renninger believed that interest affects three essential aspects of a person's knowledge: attention, goals, and learning (2011, as cited in Wang & Adesope, 2016).

In contrast to motivation as a driving factor for knowledge, interest is a driving factor for knowledge and attitude (Hidi, 2006). Furthermore, the notion of interest in learning is the attitude of obedience to learning activities, both regarding planning a study schedule and taking the learning effort seriously (Krapp, 2002). There are two kinds of interests, namely personal (individual) and situational. Personal interest in learning is more durable. In contrast, situational interest in learning is usually shown by seeking new information and having a positive attitude towards the learning environment (Woolfolk, 2010).

Interest is a sense of preferability and connection to knowledge or an activity. Djaali (2013) further stated that interest is accepting a relationship between oneself and something outside of oneself. The stronger or closer the relationship, the greater the interest. Sardiman (2009) suggested that interest focuses on a particular object, response to an object, or desire for something. In the context of learning, Hamalik (2003) stated that students have different levels of learning interests. Some students exhibit high interest in learning, characterized by their creativity, curiosity, perseverance, strong will, always trying to meet their needs, and having high ideals. Students with low interest in learning have the opposite characteristics: less creative, apathetic, always wanting to be served, and resistant to change. Based on the description of interest, it can be concluded that students' interest is their willingness to participate in learning activities consistently to understand a concept in achieving learning objectives based on these indicators: interests, pleasure, desires, and attention.

Aim and Hypotheses

This study aimed to determine the effect of the integrative e-learning method used at the Universitas Diponegoro on students' readiness for change and interest in learning. This research hypothesis proposed that there would be a difference in university students' readiness for change and interest in learning after implementing the integrative e-learning method.

Methodology

Research Design

The research design was experimental; there was only one group pretest and posttest. The intervention (integrative e-learning) was observed, pretest and posttest, for its effectiveness on the experimental group without comparison to a control group. This study did not allow for a control group because all classes at the Faculty of Psychology, Universitas Diponegoro were delivered with the integrative e-learning method due to government requirements related to the pandemic.

Participants

A total of 193 students (155 female and 38 male) from the Faculty of Psychology, Universitas Diponegoro were selected to participate in this study using cluster random sampling. The sampling method was conducted by randomly selecting groups of students from batch 2017 (n = 72 students), batch 2018 (n = 56 students), and batch 2019 (n = 65 students), but in the implementation of this research there were three students who did not take part in the learning process, so they could not be measured. In the absence of these three students, the research subjects became 190 students (153 female and 37 male), namely in details, batch 2017 (n = 71 students), batch 2018 (n = 55 students), and batch 2019 (n = 64 students).

Procedure

The intervention in this research was the integrative e-learning program, a learning method at the Universitas Diponegoro that employs information technology in the teaching-learning process. The method is a e-learning method that combines learning principles and technology to reduce face-to-face interaction. The learning processes at Universitas Diponegoro are integrated into SIAP, an application available at Google PlayStore. This application allows students to record their attendance.

Scheduling integrative e-learning is more flexible because it can be adjusted to the agreement between lecturers and students. The lecturer must develop e-learning modules, fill and upload in forms at SIAP UNDIP about lesson plans and prepare lecture material such as PowerPoint/video presentations, discussion forums, and quizzes/assignments, following the guidelines for implementing e-learning lectures.

Discussions in e-learning can be arranged in groups or with individuals all responding to a single question or comment. Group presentations or discussions can be done by streaming. Once students have downloaded the material, they can take part in discussions and complete quizzes/assignments. Students must attend at least 16 online meetings. The SIAP application is also used when students take the mid-term and the final test. The final score for each student is displayed in the SIAP application.

Measurement

Two measurement tools were used in this study: the *readiness for change* scale and the *interest in learning* scale. Both scales were distributed to students before and after they had taken a course using the integrative e-learning method. There were 16 meetings during the course.

The readiness for change scale was based on the dimensions for change constructed by Holt et al. (2007). The scale consisted of 32 items, with a range of five responses for favorable items (1 = *strongly disagree* to 5 = *strongly agree*) and five responses for unfavorable items (1 = *strongly agree* to 5 = *strongly disagree*). Aspects of the readiness for change scale included: (a) appropriateness, (b) change efficacy, (c) management support, and (d) personal valence. The blueprint for the readiness for change scale is shown in Table 1.

Appropriateness

This aspect looks at whether individuals believe a proposed change is appropriate for an organization. Individuals believe that there are logical reasons for change and understand the needs in planning the proposed change, focusing on the benefits of change for the organization, the efficiency gained from implementing changes, and the congruence between organizational goals and change objectives.

Change Efficacy

Individuals have beliefs about implementing change, where they acknowledge their skills and ability to carry out their duties/obligations related to change. This dimension measures how confident individuals and groups are that they will be able to implement the changes well. Research conducted by Bandura shows that, in general, individuals avoid activities that are considered beyond their abilities. Therefore, individuals must believe that they can perform the new behavior demanded by change. Otherwise, the results may be less optimal.

Management Support

This aspect considers individual perceptions regarding whether the organization (i.e., university and faculty management) is committed and supportive of the change implementation. This dimension examines whether students perceive that they received support from campus management in making the change successful. Individuals or recipients of change will consider the integrity of the leaders of the organization. If individuals perceive that support for change is inadequate, acceptance of these changes may be hampered.

Personal Valence

This aspect looks at personal feelings concerning individual advantages and disadvantages of a proposed change. Personal benefits suppress the positive and negative results of a change, intrinsic and extrinsic benefits, and a sense of justice. This dimension explains the benefits felt by individuals when they implement changes proposed by an organization such as campus management.

Table 1

Blueprint of Change Readiness Scale

Dimension	Indicator	Item		Total
		F	UF	
Appropriateness	Individual knowledge about the reasons for change	1, 3	14, 30	4
	Understand the purpose of the change	31, 9	2, 20	4
Change efficacy	Individual ability to carry out tasks	23, 29	18, 10	4
	Individual's confidence in personal competencies to carry out the task	15, 27	32, 4	4

Management support	Individuals observe that the organization is committed to change	5, 21	26, 16	4
	Individuals feel the support from the organization to successfully implement changes	19, 11	6, 22	4
Personal valence	Individuals are aware that the changes provide improvements in material circumstances	25, 7	12, 28	4
	Individuals perceive that the work environment is better if changes are made	17, 13	24, 8	4
Total				32

Note. The number of items on this scale was 32 at the time of the try-out implementation. F = favorable or positive items; UF = unfavorable or negative items.

The scale was tested on 30 students in the Faculty of Psychology, Universitas Diponegoro. This scale has the value of internal consistency α = 0.919, and only four items were dropped after tested: items 2, 15, 31, and 32. One example of an item on the readiness to change scale is: "I am not worried about changes in the teaching and learning process during the work from home period due to the updates I receive from the faculty."

The second scale was the interest in learning scale. The interest in learning scale was based on aspects constructed by Djaali (2003). This scale consisted of 15 items, with a range of five responses for favorable item (1 = *strongly disagree* to 5 = *strongly agree*). The aspects of the learning interest scale used in this study were: (a) feelings of pleasure: individuals interested in a lesson have an interest in the learning; (b) attention in learning: attention is the concentration or direction of one's passion towards observation, understanding, or others, putting aside other things; (c) knowledge: individuals interested in a lesson have extensive knowledge about the lesson and the benefits of learning in everyday life; and (d) awareness: an effort made consciously to learn and realize directed behavior to achieve expected goals in learning interactions. One example of the items on the scale of interest in learning is: "I am happy to study all psychology courses this semester." Table 2 shows the blueprint for the scale of interest in learning.

Table 2

Blueprint of Scale of Interest in Learning

Aspect	Item	Total
Interest in learning	1, 2, 3, 4	4
Focused on the learning process	5, 6, 7, 8	4
Extensive knowledge	9, 10, 11, 12	4
High awareness of learning	13, 14, 15	3

Note. The number of items on this scale was 15 at the time of the try-out implementation.

This learning interest scale was tested on 30 students in the Faculty of Psychology, Universitas Diponegoro. The scale was analyzed using Cronbach's alpha and resulted in an internal consistency $\alpha = 0.882$. Only one item was eliminated, which was item 6.

The effect of implementing the integrative e-learning method was measured using paired sample *t*-tests to examine differences before and after in the research group. Data were analyzed using the software SPSS 21. In addition to the primary analysis, which measured the impact of implementing integrative e-learning on student academic achievement, a descriptive analysis was conducted to explore students' satisfaction with integrative e-learning.

Results

The level of readiness for change and interest in learning before and after implementation of the integrative e-learning method can be viewed in Table 3.

Table 3

Paired Sample t-Tests for Pretest and Posttest Scores in Change Readiness and Interest in Learning

Aspect	Pretest		Posttest		*t*	*df*	*p*
	M	*SD*	*M*	*SD*			
Change readiness	93.40	13.52	105.75	13.448	-15.666	189	**.000***
Interest in learning	46.92	7.862	56.15	5.050	18.785	189	**.000***

Note. Statistically significant differences for change readiness and interest in learning between before and after implementing integrative e-learning are in bold. $p = 0.000$; $p < 0.05$.

The results of the paired sample *t*-test on the data of change readiness show a significant difference between the pretest and posttest data (mean pretest = 93.40; mean posttest = 105.75; $df = 189$ $p = 0.000$; $p < 0.05$). The results of the paired sample *t*-test on the data on interest in learning also show a significant difference between pretest and posttest data (mean pretest = 46.92; mean posttest = 52.16;

df = 189; *p* = 0.000; *p* <0.05). Furthermore, effect size shows that integrative e-learning had a large impact on readiness for change (*d* = .76) and interest in learning (*d* = 1.39). This suggests the research hypothesis is accepted. The implementation of integrative e-learning at Universitas Diponegoro has had a positive impact or a significant outcome on change readiness and interest in learning. Thus, integrative e-learning is recommended as an ongoing program.

Researchers also analyzed data on learning achievement before and after applying this learning method. This analysis was added because the success or failure of an e-learning program must also be measured by its impact on academic achievement. Achievement is a real ability resulting from the interaction among various internal and external factors in learning (Sardiman, 2009). Achievement is derived from work persistence, where each person pursues his or her respective fields and abilities. The achievement also acts as proof of the effort that a student has made. Based on achievement, self-achievement includes both learning achievement (often called academic achievement) and non-academic achievement. Academic achievement is a learning process that students experience, producing knowledge, understanding, application, analytical power, synthesis, and evaluation. Bloom (1956, as cited in Sardiman, 2009) stated that student academic achievement is a process carried out by students to obtain desired goals (e.g., academic grades). The results of data analysis using the paired sample *t*-test are shown in Table 4.

Table 4

Paired Samples Statistics for Student Achievement

Aspect	Pretest		Posttest		*t*	*df*	*p*
	M	*SD*	*M*	*SD*			
Student achievement	75.88	3.355	83.74	3.117	-26.573	189	**.000***

Note. Statistically significant differences for student achievement before and after implementing integrative e-learning are highlighted in bold (*p* = .000, *p* < .05).

Student achievement data were taken from quiz scores before and after the implementation of integrative e-learning. The results of a paired sample *t*-test show a significant difference in student achievement pretest and posttest (mean pretest = 75.88; mean posttest = 83.74; *df* = 189; *p* = 0.000; *p* <0.05). This result shows that student achievement significantly increased after implementation of the integrative e-learning method.

The researchers in this research also conducted a descriptive analysis of student satisfaction after the implementation of integrative e-learning method. The concept of satisfaction applies in all working situations, as in companies, governments, schools, and universities. In this case, satisfaction related to the application of integrative e-learning was analyzed. The level of student satisfaction with integrative e-learning is important to assess in order to determine whether the program runs well. Students will feel satisfied if there is a match between their abilities, skills, and expectations and the integrative e-learning they received. Satisfaction influences motivation and provides optimum output.

Student satisfaction is measured from two aspects, namely satisfaction towards lecturers' online teaching capability as well as toward the e-learning method. The researchers conducted a descriptive analysis of student satisfaction because, as Bolton and Drew (1991) explained, satisfaction and dissatisfaction could indicate disconfirmation between past expectations and current performance. Likewise, Kotler (2003) stated that satisfaction refers to how content a person feels after comparing his or her perception of a performance or service with his or her initial expectation. Table 5 describes student satisfaction with the integrative e-learning application.

Table 5

Description of Student Satisfaction With the Integrative E-Learning Application

Number	Aspect	Description	Very satisfied	Satisfied	Dissatisfied	Very dissatisfied
1	Reliability	The number of meetings per semester reached the maximum target (16 times)	100	65	25	0
		Quality of lecturers in lecture management	85	70	15	20
2	Satisfaction	The application of e-learning enhanced the student experience	70	120	0	0
		E-learning management provided student satisfaction	145	45	0	0

Note. The total number of respondents per aspect was 190.

Based on these results, it can be concluded that students were satisfied with the integrative e-learning implementation, and thus, the institution's implementation of this e-learning method has been a success.

Discussion

This analysis shows that students in the Faculty of Psychology, Universitas Diponegoro, have a high readiness for change and interest in learning when using the integrative e-learning method. Additionally, data suggest an increase in student achievement following implementation of the e-learning method. This finding is supported by a previous study that claimed student achievement could be influenced by students' readiness for learning and interest in learning (Abrantes et al., 2007). In this study, the increase in student achievement could be attributed to students who were ready to learn. To provide the correct answers to quizzes and other testing, students must have read and understood the course material. With greater readiness of learning, students are more motivated to optimize their learning outcomes.

This study's results are also in line with a study by Hamalik (2003), who explained that students' readiness for learning, which consists of aspects such as physical, mental, emotional, needs, and knowledge, also determines learning achievement outcomes. The more ready a student is, the easier it will be to accept the lecturer's material and achieve good results.

Additionally, a high interest in learning has a positive impact, especially on student achievement. Integrative e-learning has been proven to increase student achievement, evident through the paired sample *t*-test result. Katz et al. (2006) explained that a person interested in a particular subject tends to pay more attention. High interest and attention will have a positive impact on learning achievement. According to Katz et al. (2006), an interesting activity is continuously watched with pleasure to obtain satisfaction. Furthermore, interest plays an essential role in learning. If a subject does not meet students' expectations, students will be reluctant to study, and, as a result, their achievements will not be satisfactory.

Conversely, if the subject attracts interest, it will be more easily learned and understood. Tremendous interest in learning tends to produce high achievement; conversely, less interest in learning results in low achievement. According to Serin (2017), interest can be defined as a tendency, high enthusiasm, or great desire for something. A student who studies material with great interest will get better results than one who has less or no interest in similar material.

Turning to the integrative e-learning model used as the primary teaching method in university or college, this study offers several insights. First, students in this study showed significant positive results, partly because most university students now are part of *Generation Z* (born between the mid- to late nineties and the early 2010s), who are able to adapt faster and be more in tune with e-learning. Flew (2008) stated that Generation Z's characteristics were formed by the convergent era of social media, in which anyone can control the media to produce various messages. The production and reproduction of messages are delivered cheaply and massively and are driven by participation. Moreover, Generation Z has mastered this technology.

The application of e-learning has many advantages. It can shorten learning time and facilitate interaction between students and lecturers, and among fellow students. Also, students can share information and access teaching materials at any time and continuously. In these ways, e-learning is a more student-oriented learning process. Under such conditions, students can strengthen their mastery of learning materials.

E-learning strategies emphasize students' learning activities. Teaching is no longer understood as a process of transferring information, but as a vehicle to facilitate a better understanding of the process to achieve that knowledge (Arbaugh, 2005; Bolliger & Wasilik, 2009). Teachers become facilitators and students become researchers and analysts. In addition to receiving class materials, they deepen their understanding by searching for relevant literature and analyzing how it would be translated practically.

One aspect of e-learning that universities must develop in order to implement this method successfully is e-learning readiness. Chapnick (2000, as cited in Aydin & Tasci, 2005) described eight components of e-learning readiness. First, *psychological readiness* considers the perspective of e-learning initiatives. This factor is essential to successful implementation. Second, *socio-psychological readiness* considers the interpersonal aspects of the environment where the program is being implemented. Third, *environmental readiness* considers the need for greater power in stakeholders, both inside and outside the organization. Fourth, *human resources readiness* considers and assesses the human resource support methods. Fifth, *financial readiness* considers budget estimates and allocations. Sixth, the *readiness to apply technological skills* is considered and tested. Seventh, *equipment readiness* concerns ownership of appropriate equipment. Lastly, *content readiness* considers the learning content and learning objectives.

Aside from the readiness aspect, the success of an e-learning method can also be determined by how closely the method meets the technology acceptance model (TAM). The TAM has five primary constructs (Davis, 1989): (a) perceived usefulness, (b) perceived ease of use, (c) attitude toward using technology, (d) behavioral intention to use, and (e) actual technology use. The descriptive results of student satisfaction at Universitas Diponegoro (see Table 5) reflect elements of the TAM.

Conclusion and Implications

This research suggests that implementation of the integrative e-learning method at Universitas Diponegoro was positive. The method can be applied to other universities, although some improvements are still required pending further investigations. The COVID-19 situation has forced conventional learning models to be replaced with e-learning. We predict that this method will continue to be a primary learning method in various education sectors because it complements the current trend to promote education and information technology integration in this era of the fifth industrial revolution.

In an e-learning model, learning resources are easily accessible through the Internet by both lecturers and students. Teaching materials can then be saved in the e-learning method. Lecturers could benefit from the ease that the method offers, particularly during the examination period, when the method could automatically grade some exams. Lecturers need not worry that some students might not have accessed the learning materials because these would have been directly distributed to students through the e-learning method. This efficiency allows lecturers to spend more time with students.

The integrative e-learning model has the potential to streamline the teaching and learning process. Therefore, universities should offer lecturers the necessary facilities (i.e., a good internet network) and infrastructure to support e-learning implementation so as to have a positive effect on education in Indonesia.

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An Analysis of Digital Education in Canada in 2017-2019

Dr. George Veletsianos[1], Dr. Charlene A. VanLeeuwen[1,2], Olga Belikov[1], and Dr. Nicole Johnson[1,3]
[1]Royal Roads University; [2]University of Prince Edward Island; [3]Canadian Digital Learning Research Association

Abstract

Digital education refers to in-person, blended, and fully online learning efforts, as well as attempts to capture a wide range of teaching and learning contexts which make use of digital technology. While digital education is pervasive in Canada, pan-Canadian data on digital education are relatively scarce. The Canadian Digital Learning Research Association/Association Canadienne de Recherche sur la Formation en Ligne conducted pan-Canadian surveys of higher education institutions (2017-2019), collecting data on the digital education landscape and publishing annual reports of its results. Previous analyses of the data have used quantitative approaches. However, the surveys also collected responses to open-ended questions. In this study, we report a systematic analysis of qualitative data exploring the digital education landscape in Canada and its changes over time. Findings shed light on the growth of digital education, the situated and multidimensional nature of digital education, the adoption of openness, quality, and rigour, and the development of alternative credentials.

Keywords: digital education, higher education, university, college, Canada, qualitative analysis

Introduction

The demand for digital learning in Canada has expanded substantially over the last decade (e.g., Bates et al., 2017; Donovan et al., 2018; Johnson, 2019), with online and blended courses currently being offered by the majority of Canadian institutions of higher education (Agbra, 2018; Bates, 2018). A similar trend is reflected in the U.S., where online enrolments have been increasing for more than a decade (Seaman et al., 2018). Nevertheless, pan-Canadian data that illuminate digital learning in the Canadian postsecondary education sector are minimal. The annual surveys conducted by the Canadian Digital Learning Research Association/Association Canadienne de Recherche sur la Formation en Ligne (hereafter CDLRA) provide much-needed information and analysis. However, the published reports that result from these annual surveys focus on analyses of quantitative data. The purpose of this study was to conduct a systematic analysis of the qualitative data that were gathered in the 2017, 2018, and 2019 CDLRA pan-Canadian surveys in order to explore patterns in these data that may inform digital education practice in Canada.

Rationale and Research Context

Digital education refers to in-person, blended, and fully online learning efforts, as well as attempts to capture a wide range of teaching and learning contexts which make use of digital technology. While Canada has a long history of distance education use, researchers lack pan-Canadian data tracking use of digital learning, making it difficult to gauge comparative progress with respect to digital education, identify emerging topics of interest in the Canadian higher education sector, or identify future demands for digital education (Bates, 2018). Researchers and policymakers, therefore, often rely on proxy data to inform decisions pertaining to digital education. The absence of federal regulatory authority means that there is great variance across the country, as many education-related efforts are provincially- or institutionally-focused (McGreal & Anderson, 2007). As digital learning in Canada has grown over time, training and support for faculty have also become increasingly necessary (Mohr & Shelton, 2017; VanLeeuwen et al., 2020).

Guided by a need to address these gaps, the CDLRA began conducting surveys of Canadian higher education institutions (HEIs) in 2017, publishing annual reports of results and findings. While the surveys gather both quantitative and qualitative data, the annual reports focus on the quantitative results and use select comments to provide some richness to the findings (Bates et al., 2017; Donovan et al., 2018; Johnson, 2019). The insights provided by the little qualitative data shared in these reports motivated us to inquire further into the collected data to explore whether qualitative data collected could offer additional insights into both digital education in Canada as well as into trends across the life of the survey. Therefore, we sought to conduct a systematic analysis of the narrative comments from the 2017, 2018, and 2019 datasets, anticipating that this analysis could deepen our understanding of the Canadian digital education landscape.

There are 234 publicly-funded postsecondary institutions in Canada, located throughout the ten provinces and three territories, with total student enrolment of approximately 2.11 million in the 2017-2018 academic year (Statistics Canada, 2020). Within Canada's devolved governance system, education is a provincial/territorial responsibility. In this environment, a national approach to digital education faces a number of foundational challenges when it comes to jurisdiction, without even starting to examine the issues that a national digital education strategy would consider addressing. For instance, the postsecondary system in the province of Québec includes two distinct college designations—*Collège d'enseignement général et professionnel* (CEGEP) and private subsidized colleges—that other provinces do not have.

Results from the three pan-Canadian surveys conducted between 2017 and 2019 related to definitions of digital education, tracking enrolment data, technologies used, and the importance of digital education to the future of responding institutions (Bates et al., 2017; Donovan et al., 2018; Johnson, 2019). Reports reveal that digital education is evolving, as are the definitions used for online and blended/hybrid learning, reflecting changing practices. Challenges in tracking online enrolment data that arise from the different provincial/territorial reporting standards were also highlighted, noting that internal tracking processes used by HEIs to monitor progress are generally at the program or department level, making provincial/territorial and pan-Canadian comparisons difficult. Nearly all HEIs reported using a learning management system (LMS) and using it as the primary tool to deliver digital education, with video-based systems coming in second. The reports also drew attention to paradoxical findings in relation to institutions' long-term plans and strategies for digital education. While every year approximately two thirds of Canadian HEIs reported that online learning was very or extremely important to their future plans, the overall number of institutions with a fully implemented strategic plan for digital learning was small (e.g., 12% in 2019). Each year, HEIs reported that they anticipated continued growth in digital and online learning, including fully online courses and blended/hybrid course offerings. In 2017, almost three quarters of HEIs reported that they offered blended/hybrid courses. By 2019, this number had increased to 89%. Nonetheless, the 2018 report cautioned that fewer than one in five institutions had a significant number of blended/hybrid courses. Growth was also evident in fully online course offerings, with 10% growth reported in the 2019 report, even though overall course registrations remained stable. Finally, the survey results revealed emerging topics of interest in association with faculty development and training to use technology in teaching, advances in the development of alternative credentials, and adoption of open educational resources and practices.

Objectives and Research Questions

The aim of this study was to conduct a systematic analysis of the responses to open-ended questions from the annual surveys in order to provide a richer and multi-year view of digital education in Canada. The research questions were the following:

- What themes are present in open-ended comments with regard to digital education in the 2017-2019 CDLRA survey responses?
- Are there discernible patterns in these themes that change over time?

Method

Participants

The CDLRA national survey was conducted in 2017, 2018, and 2019. The 2020 survey was cancelled due to the COVID-19 pandemic. The survey was sent to all publicly-funded postsecondary institutions in Canada, including universities, colleges, polytechnics, CEGEPs, and, starting in 2018, all private subsidized colleges in Québec. The number of institutions invited to participate, response rates, and the proportion of the total Canadian student population base represented is shown in Table 1.

Table 1

Responses to the CDLRA National Survey 2017-2019

Year	*N* of HEIs invited to participate	Response rate		% of the Canadian student population base represented by responding institutions
		n	%	
2017	203	140	69	78
2018	234	187	80	92
2019	234	164	70	90

Note. HEI = higher education institution.

Each year, the CDLRA sent the survey via email to institutional leaders (e.g., provost/VP academic) at every institution on the survey roster. In many cases, the results for each institution reflect the responses of multiple individuals.

Data Collection

Data for this study include all of the open-ended comments to the CDLRA national surveys from 2017 to 2019. At the time of writing, upon request by third-party researchers, the CDLRA made available de-identified and anonymized data it collected for secondary use. Prior to our analysis, the raw datasets were reviewed by the CDLRA and de-identified. The surveys included a total of 36 open-ended questions (9 for 2017; 16 for 2018; and 11 for 2019). The open-ended questions were optional and, in many cases, respondents left one or more of these questions blank. The open-ended responses analyzed for this study totalled 110,106 words (26,366 words for 2017; 61,977 for 2018; and 21,763 for 2019). Minor edits were made to the data for readability and spelling, without changing the intent or meaning of the data. French comments were translated into English and edited for accuracy, clarity, and completeness for analysis.

Data Analysis

Data was analyzed in both a deductive and inductive manner, guided by the research questions and sensitizing concepts. Analysis included constant comparison of codes, identification of emergent themes, memo-writing about category and theme development, and iterative analysis. The open-coding process began with two researchers independently reading the data to become familiar with it; first, through an unstructured reading of the narrative data before a second reading, where they wrote open codes. This process allowed for emerging phenomena to arise from the raw data and was guided by Glaser and Strauss' (1967) constant comparative approach. During this process, researchers had access to the narrative data, the survey questions, and the three national reports. The questions and reports, while not original data, drew researchers' attention to contextual issues, important findings, and background ideas which informed the data analysis. These materials served as sensitizing concepts, offering researchers a sense of direction while making sense of the data (Patton, 2015). Through a series of iterative discussions with the entire research team, broad categories with codes and sub-codes were identified and defined for each individual year of survey responses. Next, the researchers refined the categories and developed a codebook with definitions for each category, code, and sub-code. The final codebook consisted of 8 categories and 84 codes, which were eventually collapsed into the themes presented below. To systematically analyze the data for this publication, a further round of focused and selective coding (Bogdan & Biklen, 2007; Charmaz, 2006) was conducted independently by the same two researchers who conducted the initial coding. As data analysis continued, reports and tables were generated to organize, synthesize, differentiate, and compare patterns in the data. Where appropriate, themes were compared code by code in order to reach consensus between coders.

Qualitative Rigour

Careful consideration was given to procedures which would enhance the rigour and trustworthiness of findings by addressing accepted standards in the design, data analysis, and reporting of results (Patton, 2015). First, the data are available via CDLRA, enabling others to use and confirm the analysis reported herein. Second, authors ensured an audit trail by systematically documenting processes and materials (Freeman et al., 2007; Patton, 2015). Third, sensitizing concepts were used during the data analysis to organize the data and make informed decisions about the significance and importance of findings (Blumer, 1969). Fourth, to reduce bias in data analysis, team members analyzed data independently before collaborating in order to reduce the possibility of imposing individual biases and influence on other team members' interpretations. Fifth, reliability was addressed through constant comparison of findings at multiple points during data analysis and through discussions between researchers regarding the plausibility of findings (Merriam, 1995). Finally, findings are presented using thick descriptions to allow readers to determine whether findings from this study are applicable to their own contexts (Patton 2015).

Limitations

This study faces some limitations. First, the individuals submitting responses on behalf of participating HEIs could change from one year to the next, limiting not only the generalizability of findings between institutions but potentially the year-to-year comparison within the same institution. Second, the necessary process of de-identification eliminated contextual details, contextual indicators, and opportunities for member checking that could have aided in gaining a richer understanding of respondent comments. Finally, changes in survey items between years, in an effort to address emerging concerns and ensure the relevancy of the survey, limited a more detailed exploration of changes over time.

Findings

We identified six themes and describe these below.

Growth of Digital Education

Findings related to the growth of digital education draw from 185 comments across all three years of the survey. Several respondents noted areas where they see the potential for growth in either online courses or programs, such as in the trades. Many respondents also alluded to increasing interest in digital education among all students, regardless of whether they were studying on campus or at a distance, such as in the case of Respondent 56 (2019), who noted that "about one of every three students at our institution participates in an online course." Respondents also indicated that fully online programs were offered at multiple levels including undergraduate, graduate, and continuing education, in credit and non-credit programs. For example, Respondent 89 commented that their "institution offers fully online courses and programs including for-credit certificate programs" (2019). Institutions deliver their online programs along a continuum of a/synchronicity as evidenced in comments such as this: "Our courses are primarily delivered online in an asynchronous format" (Respondent 91, 2018). We also noted how, for some respondents, online program offerings are a priority, with comments such as these two: "We have committed to strategic investment in online and hybrid course development over the coming three years" (Respondent 126, 2017), and "Our institution will focus heavily on the development of fully online programs for the next three years" (Respondent 59, 2019).

Many respondents shared comments reflecting their intentions to be adaptable, responsive, and relevant to the needs of society, students, and potential employers by offering diverse course and program offerings which employ digital technology with effective pedagogical practices. For example, one institution stated that "online and blended fits with a larger strategy around flexible and authentic learning that dovetails into [our] experiential learning initiative" (Respondent 53, 2019). Another respondent noted that "online learning is particularly important in providing sustainable regional programming" (Respondent 13, 2019).

Numerous comments related to providing access to courses and programs for current and future students. Some were focused on the flexibility and growth opportunities that digital education can offer: "We see blended/hybrid learning as a key strategy that will allow for more flexibility for students and growth of our programs" (Respondent 9, 2019). Other remarks were about how online courses can enable students enrolled in programs in specific geographic locations to have access to courses or programs that might not otherwise be available to them. "The issue of accessibility of training is very important, and online training is likely to make learning accessible to remote communities that could not otherwise access it" (Respondent 241, 2017).

Finally, responses to questions asking about changes to the ways institutions offer digital education included comments around growth in course enrolments or increases in the types of courses and programs offered in online or blended/hybrid formats. For example, a typical comment was: "The number of students enrolled exclusively in distance learning courses is growing rapidly, as are students who combine classroom and distance learning courses to reconcile education, work and personal life" (Respondent 13, 2017). Some respondents elaborated with details on local circumstance: "As we continue to develop new online courses, our registrations continue to increase. However, we anticipate a leveling off to maintain a balance of online and face-to-face options for our students" (Respondent 112, 2017). Respondents also indicated future directions, as in "our institution will focus heavily on the development of fully online programs for the next three years" (Respondent 59, 2019) and shared explanations of how digital education was allowing them to address particular mandates (Respondent 104, 2019). In some instances, while institutions described having interest and experiencing growth in digital learning, they also noted that few of their offerings were in this modality. For instance, Respondent 92 noted that their institution "has considerable interest and growth in hybrid learning [but] when expressed as a percentage of our overall offerings, the portion is still less than 1%" (2019).

Adoption of OER and OE Practice in Canada is Supported Through Various Means

Adoption of open education resources (OER) and practices (OEP) at Canadian institutions is present and supported at both the individual and institutional level. The majority of comments focusing on open education centered on open textbooks and OER. Most comments in these two categories simply mentioned use of OER at an institution without elaborating on such use (e.g., "Due to their open nature, OER exist in our institution in different forms and on different platforms." [Respondent 31, 2018]). Some respondents' comments provided further insight into how their institutions were implementing OER. One individual, for example, noted: "Our learning design process clearly articulates OER materials be considered at the course planning stage" (Respondent 26, 2017), suggesting that the OER adoption process at that institution is supported by broader structures and not solely reliant on faculty interests, desires, or passions. The clear picture that emerged from these comments was that OER use was uneven: while some institutions, for instance, featured OER champions (Respondent 76, 2019), in other instances, "the vast majority of faculty choose to use publisher resources" (Respondent 57, 2019).

From 2017 and 2018, we identified more comments indicating that institutions were in the early stages of OER use or that they were currently not using or pursuing OER. We noted some comments indicating low interest in OER (Respondent 125, 2017). In contrast, we coded a number of comments describing implementations, especially those of larger scale in 2019. A typical example of comments related to implementations was shared by Respondent 8 (2019) who stated: "There is significant interest amongst faculty. Many are exploring OER, and some are actively using OER."

Comments revealed that there are a variety of ways that institutions champion OER, including through instructional design support, library services, funding, policy making, training and workshops, and work-release from duties to free up time for adoption and creation of OER. The most frequently mentioned supports revealed that HEIs provide assistance and encouragement through policy making, funding, and library support for instructors. Many colleges and universities have institutional policies in place that include OER in some way. Respondent 5 (2019) indicated how their institution is "committed to developing an OER Strategy and embedding it within the Teaching and Learning Framework." A few participants remarked on policy-adjacent supports, such as Respondent 85 (2019) who noted that their "institution does not currently have a formal policy around OER. However, they do have a strategy that is elaborated in a guide for faculty."

In addition to policy and funding, libraries and centres for teaching and learning appear to be important sources of aid, advocacy, and overall institutional OER support. Nonetheless, despite some institutions developing OER policy and offering faculty support, OER use often appears to arise out of individual efforts and from a bottom-up approach. For example: "We are currently working with a handful of instructors who are independently using OER or have expressed interest in working with students to identify appropriate resources" (Respondent 141, 2019). There are also small groups bringing OER to the institution, with a handful of respondents sharing comments similar to Respondent 93 (2017), who noted "OER and open textbooks are currently being implemented on a small scale/pilot level," and another institution that described the adoption of these resources as "OER via grassroots efforts" (Respondent 77, 2019).

Multidimensional Innovation in the Development of Digital Education

The open-ended comments shared by respondents with regard to innovation in digital education at their institutions suggest that advances are occurring in various ways.

Guided, Collaborative Approaches for Development of High-Quality Digital Education

Across all years of the survey, 37 comments described how team approaches to course development were promoted at institutions. Respondent comments suggest that in many universities and colleges, professionals have shared responsibility for course design, development, and delivery. Collaborative approaches such as these bring together the expertise of subject matter experts, instructional designers, website developers, faculty, librarians, and educational media specialists. We noted that while reflecting on these team approaches, many respondents highlighted the shared expertise of professionals involved in course development processes in the 2018 and 2019 responses to the survey. A typical example is the following:

> Faculty can work with an instructional design team who can provide out-of-the-box thinking on pedagogically relevant technology, content, graded and ungraded activities, and collaboration in a mode of delivery that students may feel more comfortable operating in (Respondent 17, 2018).

The collaborative course design processes described also included varied technological and non-technological supports, such as in the case of Respondent 68 (2017) who mentioned that each online course developed "involves a four-person team—an instructional designer, graphic designer, front-end web developer, and a faculty expert" and is supported by LMS tools, HTML5, and various "third party tools, including Adobe products, Videoscribe, animation software, and other open source software."

Respondents also described a continuum in the autonomy accorded to those developing digital education experiences in HEIs across the country. In some cases, the course development process was directed with rubrics and other guidelines, such as the practices described here: "Faculty are guided by a blended learning reference document, which was developed following a two-year pilot of blended learning by a faculty member" (Respondent 25, 2018). Similarly, Respondent 16 shared that guidance was provided by a Centre for Teaching and Learning and that practices guiding course design included "frameworks, rubrics, and standards … [as well as] instructional design principles" (2018). At the other end of this continuum, a handful of comments from respondents indicated that instructors were being left to their own devices to design online, blended/hybrid courses with minimal or no support or oversight. For example, Respondent 32 noted that, at their institution, "instructors often make their own choices regarding what technologies are used in their courses with some exceptions where the department determines what technologies are used" (2019) and Respondent 74 noted that "most courses were designed by individual faculty members" (2017).

Innovations Remain Focused on Good Practices

Survey responses appear to reflect thoughtful consideration being given to good practices in implementing new pedagogy or technology. Good practices in digital education extend beyond simply employing the newest educational technology or offering a different modality, to include practices which foster "student success and engagement and the adoption of universal design principles [which] are at the forefront of all of our teaching and learning experiences, including our online and hybrid offerings" (Respondent 66, 2019). There were many comments in all three years of the survey to support this perspective. For example, one respondent indicated that at the crux of these efforts are thoughtful considerations. They stated: "We have begun the process of encouraging faculty to integrate newly available technologies into their courses in a way that keeps teaching and learning best practices in mind" (Respondent 15, 2017). Another respondent indicated that their "libraries have introduced a new technology lending program for students and faculty, including virtual reality headsets [and] creative software application/invention kits … encourag[ing] experimentation and creativity in curricular enhancements in simulation, labs, learning spaces, and course assignments (Respondent 126, 2017). Respondents also shared comments reflecting an awareness of the intersections between pedagogy and technology in the course design and development processes. For instance, sensitivity toward course design was expressed in many comments, such as in the case below:

> Preparing an online course forces faculty to think carefully about course design and its connection to assessment that often leads to better in-person design as well. Digital affordances of online teaching have inspired greater interdisciplinarity, a wider range of perspectives in a course, and more pedagogical innovation in regards to student contact (Respondent 2, 2018).

Institutional Strategies to Embrace New Technologies

In every year of the survey, respondents described institutional strategies such as strategic, academic, or digital plans which encouraged faculty and staff to adopt new technologies. Although many institutions identified aspects of digital education as a priority at their institution, we noted few comments which reflected substantial progress in implementing these strategies, even though this may have been one of their institution's priorities for multiple years. A typical comment illustrating this from 2017 was the following: "We have committed to strategic investment in online and hybrid course development over the coming three years" (Respondent 126, 2017). In all three years of the survey, we identified similar comments around investing in new technologies, such as this one from Respondent 66: "Our current strategic plan (2018-2023) is very much focused on increasing how and when we integrate technologies into the curriculum and classroom experiences" (2019). This may reflect the fact that HEIs are in different stages of adoption, but may also reflect some digital chasms between institutions.

Emergent Digital Education Modalities and Technologies

A variety of course delivery approaches were mentioned by respondents. While the vast majority were variations on blended/hybrid course delivery approaches, multi-access or hyflex (hybrid flexible) options, which offer a variety of educational choices and delivery methods, emerged in a handful of responses, with respondents noting that increased multi-access modalities might "better meet the needs of our students, whether they are here on-campus or living on the other side of the world" (Respondent 192, 2018). Adaptive models were another emergent modality mentioned by respondents as platforms that allow institutions to "build online courses that are more adaptive in nature, where students can enjoy a self-paced experience based on the mastery of learning outcomes and objectives" (Respondent 68, 2017). In addition to these emergent delivery models, respondents relayed details about the technologies their institutions have recently explored, are currently exploring, or are interested in exploring in the near future. Three technologies were mentioned: virtual, augmented, or extended reality (VR/AR/XR), mobile applications, and artificial intelligence (AI).

The most frequently mentioned emerging educational technology (60 coded responses) was virtual, augmented, or extended reality (VR/AR/XR). Respondents identified these platforms as useful in their near-future plans with comments such as: "We're looking more into XR [extended reality] applications for simulated labs" (Respondent 41, 2019) and "Our institution is developing Augmented and Virtual Reality initiatives" (Respondent 75, 2019). Nonetheless, institutions appear to be in the initial stages of incorporating these forms of technology into their digital education offerings, as evidenced by a number of comments that described exploring this technology. A second emergent technology noted by 23 respondents was mobile learning. Respondents noted that "students use mobile technology, even if courses or the LMS is not designed for such use" (Respondent 6, 2019). In response, some HEIs indicated that they have started looking for ways to respond or capitalize on this through their LMS, as evidenced in this comment from Respondent 14: "The Brightspace platform allows for the reformatting of material to accommodate the use of iPads and iPhones" (2019). Finally, AI was a prominent technology, mentioned by thirteen respondents. In doing so, respondents often noted some of the different purposes or functions they hoped AI could serve. For example, one respondent stated, "Our institution is developing a framework for assessing prior learning, identifying gaps, and using AI training modules to address the gaps" (Respondent 2, 2019). Other respondents commented on the potential for AI to provide technical support "to help support students (and perhaps faculty) in the use of online technologies" (Respondent 6, 2019) or academic support for student learning by "exploring the use of AI Tutor" (Respondent 82, 2019).

Innovative Teaching in Digital Education in Canada is Situated

While our analysis revealed numerous innovative digital practices, it also showed that such practices are situated within institutional contexts, and that there are substantial variations in the ways that respondents describe innovation. Significantly, what may be considered innovative in one context may not necessarily be innovative in another (cf. Veletsianos, 2016). We coded 180 responses over all three years focusing on innovative teaching practices in digital education.

Typical innovative teaching practices described by respondents across all years of the survey focused on the intersections of technology and pedagogy, pedagogical methods, course delivery formats, and student learning needs. Specific practices were, at times, mentioned, such as: "Using online simulations to provide students with opportunities to apply learning; Using online interactive case studies; Conducting presentations and seminars through synchronous and asynchronous tools" (Respondent 96, 2017); and "integrating active learning, creating gaming opportunities, using badging, producing video segments, building opportunities for reflections, etc." (Respondent 64, 2018). Further, one individual noted that the institution employed:

> crowd-sourced marking generally, introducing more video conferencing with synchronous meetings for both instructors and students, working to allow more seamless integration of video and audio resources (especially for students) into course work (Respondent 97, 2019).

Respondents generally affirmed the important role of pedagogy in the innovative digital education approaches being developed. Technology was often described as a tool to support and facilitate these new practices, as in "Technology supports innovation when pedagogical considerations drive the use of the technology" (Respondent 6, 2018). Such thinking is also reflected in a number of respondents emphatically stating that "modality does not guarantee superiority" (Respondent 91, 2018). Statements like this revealed that respondents believed that no one course delivery modality was inherently better or worse, and that innovation could not be inferred strictly through the use of educational technology.

Recognition of Quality and Rigour Concerns in the Broad Range of Digital Education Options Offered by HEIs

There were 78 open-ended comments that mentioned *quality* across the three years of the survey. In responses, we noted that HEIs were looking to make effective use of evidence-based resources to guide the course development process and address quality standards.

Respondents commented on technology and pedagogical decisions and a desire to make the best choices in terms of quality and rigour. This could mean sharing which digital education choices they feel to be the best, concerns with their current choices, re-evaluations, and future digital education plans and considerations. One of the most frequent types of comments that we coded for this theme was one that made mention of technology choices and the rationale for these decisions. This was articulated by Respondent 110 who wrote: "Our institution has been increasingly moving towards offering more courses using its LMS (Brightspace) to increase accessibility for remote communities, reduce the burden on physical space, provide more flexibility in delivery options, and make training available internationally" (2018). A second category of comments was associated with techno-pedagogical choices to improve rigour, such as the use of learning analytics to improve outcomes (e.g., Respondent 110, 2018). Finally, the third category of responses focused on how various pedagogical approaches that HEIs have identified contributed to the rigour of their digital courses. Respondent 97, for example, wrote:

> It's true that some employers may value on-campus education more than online education, and it may be true that online education does not reach the standards of on-campus education at some institutions, but that is not our reality; we understand that the courses we deliver online are just as rigourous as the ones we deliver on-campus .... Our student persistence (or retention) rates are remarkably high, [and] both our new and experienced instructors have access to our [Centre for Teaching & Learning] where they can get help (Respondent 97, 2018).

HEIs are Developing a Broad Range of Alternative Credentials to Serve a Variety of Purposes

Seventy-six comments in the dataset mentioned some form of alternative or micro credential, revealing that Canadian HEIs are exploring a broad variety of credentials which serve various functions. Badges were mentioned 23 times and were the most frequently mentioned alternative credential. While badges were described as being used in both individual courses (e.g., as incentives, Respondent 32, 2019) and as part of a program of study (Respondent 12, 2018), respondents indicated that alternative credentials served many purposes. These included using them as a dual credit with high schools; laddering options to other courses/programs; stackable credentials as a way to reflect updated skills and competencies; and as signifiers of co-curricular options for community-based or service learning experiences. Finally, some respondents noted that alternative credentials are means to other goals. For example, one respondent explained that their institution "is interested in exploring micro-credentialing as a strategy for curricular renewal and enhancing access to higher education" (Respondent 79, 2019). Thirteen respondents also described alternative credentials as a means to advance, pursue, or otherwise enable competency-based education efforts.

Discussion and Implications

These findings reveal common and typical practices and experiences in the Canadian higher education sector that shed additional light on the quantitative results reported by the Canadian Digital Learning Research Association over the years. As such, the implications of these results are broader than those offered by findings during a particular year of study.

Complexity

The increasingly complex nature of higher education is evident in respondent comments from all three years of the survey. Elements of complexity are not confined to technological advances (e.g., AI), but reach into other areas such as institutional and pedagogical processes. For instance, the use of OER and alternative credentials expands not only the number of activities that institutions engage in but also the nature of content and credentialing, and raises a variety of questions around data ownership, privacy, training needs, integration support, quality assurance, and evaluation methods. Further, such activities may include the disaggregation of higher education teaching, learning, and credentialing activities into various smaller components (e.g., course design and development or student support), further complicating higher education. Disaggregation appears to be common in digital education efforts (Czerniewicz, 2018) and is visible in some of the activities described above.

Such developments may speak to a broader willingness amongst HEIs to question established practices. Despite the likelihood of digital education initiatives raising various concerns, many HEIs appear willing to question institutional and pedagogical practices such as the use of traditionally published textbooks or the focus on typical credentials.

As digital education options grow at the institutional level, HEIs need to consider not just course design and support, but also student support. This may mean evaluating training needs, providing support for adoption, employing learning design and digital learning experts, and verbalizing the role that digital learning plays for the institution. Due to varying contexts, it is difficult to make recommendations for specific actions, but some of these may include the development of institutional policies around data ownership and privacy issues, the establishment of course design teams, the acknowledgement that such efforts may require more resourcing and different kinds of workloads for staff, administrators, and faculty, and so on.

Contextual Innovations and Affirmation of the Important Role of Pedagogy

HEIs reported a number of innovative teaching practices. While there were some commonalities among these, there were also variations. In some cases, what a HEI reported as a highly innovative practice in its setting may no longer be the case in another. Such variations in digital teaching practices may reflect disparities between institutions (e.g., access to pedagogical expertise), faculty training supports across sectors or regions, or even differences in mandate or institutional priorities. Innovations, therefore, need to be seen in context: what may be innovative at one institution may not be innovative in another. One significant implication of this finding is that innovations need to account for local conditions, implying that adopting innovations that other HEIs found worthwhile may not guarantee success. One finding appears to defy this implication. Specifically, as respondents at Canadian colleges and universities appear to affirm the important role of pedagogy in making decisions around the use of technology in their courses, it becomes clear that paying attention to pedagogy is significant across contexts. Pedagogical principles can guide adoption, innovation, and design, and this area offers much room for scholarly investigation.

Contrasts in OER and OEP Support

Respondents made frequent comments relating to OER adoption and the inclusion of OER in institutional policy. In addition to saving students money, OER are often offered as a vehicle to aid faculty in reimagining their courses and potentially impacting the teaching practices of those courses (Hegarty, 2015; Weller et al., 2015). Nonetheless, while participants described supports for OER, there was little to no mention of open educational practices (OEP) and supports provided to foster them. Cronin and MacLaren (2018, p. 137) contend that "expansive conceptualisations of OEP acknowledge the complex, actual and situated practices of teaching and learning," indicating that support for OEP may be necessary given its complicating nature and newness. One approach that HEIs may consider is to assess how OEP are being implemented and supported at their institutions. Again, this is a ripe area for future research.

Variations, Unevenness, and Collaboration

Findings suggest that there are variations and unevenness in digital education practice across Canada. Variations can be a sign of specialization, such as, for example, when institutions offer blended learning options for working professionals in their region compared to those institutions that employ online learning to reach out-of-region students. Unevenness may reflect a variety of issues, such as inequities in the higher education system (e.g., resourcing, digital literacies, etc.). Regardless of the reasons for the existence of variations and unevenness in the system, what institutional experience with COVID-19 has made clear is that the whole system can benefit from greater collaboration, synergies, and sharing of expertise. Between March and August of 2020, numerous faculty and institutions in Canada engaged in large-scale professional development efforts to support colleagues, both at their institutions and at institutions elsewhere, to design and develop remote courses. Such knowledge-sharing was significant and may have addressed some of the gaps and unevenness between institutions in terms of digital learning know-how. We hope that such efforts persist beyond the pandemic, and that they contribute to a higher education ecosystem that is more willing to share and collaborate.

Conclusion

The uptake of digital education in Canadian HEIs—partly arising from the COVID-19 pandemic, partly a result of ongoing efforts aimed specifically at online learning—makes the findings of this study timely and important. Based on the findings of this study, we recommend that approaches to digital learning in Canadian institutions be informed by contexts, including local, provincial, and pan-Canadian. Nuanced research of this nature, focused on Canadian HEIs at a time of widespread engagement with digital learning due to COVID-19, can provide evidence that researchers, faculty, and administrators interested in digital learning efforts need.

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Ready to Do OpenCourseWare? A Comparative Study of Taiwan College Faculty

Huei-Chuan Wei[1,2] and Chien Chou[3,4]

[1]Center for Institutional Research and Data Analytics, National Yang Ming Chiao Tung University, Taiwan; [2]Center for Institutional Research and Data Analytics, National Chiao Tung University, Taiwan; [3]Institute of Education, National Yang Ming Chiao Tung University, Taiwan; [4]Institute of Education, National Chiao Tung University, Taiwan

Abstract

This study aimed to address the teaching readiness issues of OpenCourseWare (OCW). Specifically, the research goal was to examine Taiwanese college faculty members' level of teaching readiness for OCW via a questionnaire named "Teaching Readiness Scale for OCW" (TRS-OCW). A total of 142 Taiwanese college faculty members both with and without OCW teaching experience participated in this study. The results showed that faculty members with OCW teaching experience had significantly higher readiness levels in the factors of perception of administrative support, personal characteristics, and OCW recognition when compared to faculty members without OCW teaching experience. Male faculty members with OCW teaching experience had higher readiness than female faculty members with OCW teaching experience in the OCW recognition factor. Moreover, the job position of OCW-experienced faculty did not make a difference in any readiness factor. Finally, perceived administrative support was the only significant predictor of the willingness of college faculty without OCW teaching experience to provide OCW in the future.

Keywords: teaching readiness; OpenCourseWare (OCW); college faculty; comparative study

Introduction

With the increase in Internet use worldwide, many higher education institutions have come to view online learning as an alternative means to extending educational classrooms beyond their physical campuses (Barrett et al., 2009; Keramati et al., 2011; Lin & Wang, 2018); particularly, to reduce the risk of COVID-19 infection, many schools have turned to distance education. Open education and its impact on the learning process have become remarkable and important, especially in higher education and adult education (Dhawan, 2020; Nahhas et al., 2018). Open education, such as open educational resources (OER), OpenCourseWare (OCW), and massive online open courses (MOOCs), allows people to access and participate in courses regardless of their time, physical and geographical barriers, and constraints. OCW is an important force in the global movement of open education (Sheu & Shih, 2017). OCW is defined as "a free and open digital publication of high-quality educational materials, organized as a course" (Carson, 2009, p. 27). Since the Massachusetts Institute of Technology (MIT) initiated its OCW project in 2001 and inspired others to follow suit, more than 275 institutions around the world have joined the Open Education Consortium (OEC) to share their common values of openness, equity, collaboration, and multiculturalism (Open Education Consortium, n.d.). Of course, as in every educational movement, institutional OCW platforms differ from one another due to the unique educational settings and expectations of each institution.

While OCW has attracted millions of users around the world since its inauguration (MITOpenCourseWare, 2018), the major issue behind all institutional OCW is how to provide and maintain quality learning materials from educators to engage self-learners in continuous learning activities (Jaggars & Xu, 2016; Paskevicius et al., 2018; Piedra et al., 2015; Rolfe, 2012). Past research has shown that teaching staff are the key to provide quality assurance in learning resources and learner support in OCW (Downes, 2007; Lowenthal et al., 2019; Paskevicius et al., 2018). Similarly, Wang et al. (2013) have pointed out that the degree of active participation of faculty in curriculum development could impact the success of OCW. If college faculty are to play such a critical role in OCW, as indeed they have up to now, it is essential to understand faculty members' teaching readiness for or abilities within OCW. By reaching such an understanding, we can identify strategies for training and provide support for faculty to engage in OCW.

However, only a small number of studies have explored whether college faculty are ready to participate in OCW. To better understand how to encourage college faculty to participate in OCW, it is necessary to identify the factors of OCW teaching readiness that faculty with past success have possessed. In undertaking this task, the present study aimed to examine the concepts and underlying factors of college faculty teaching readiness for OCW. By extending the previous study design and results, the present study also took related background factors and experience factors into consideration.

Literature Review

Teaching in Open Education

Why do we need to discuss the instructors' teaching readiness in the open education context, especially in OCW? Are open education instructors' teaching methods different from traditional face-to-face teaching methods? Past researchers (e.g., Lowenthal et al., 2018; Paskevicius et al., 2018) have indicated that open pedagogies not only engage students with open culture literacies in the context of teaching and learning but also promote the production of knowledge and often integrate both formal and informal learning environments. Similarly, Hegarty (2015) pointed out that attributes of open teaching often include the use of participatory technologies, the encouragement of trust, the support of innovation and creativity, a greater sharing of ideas and resources, and reflective practice. In Zheng et al.'s (2016) study, the instructors further pointed out that participating in open education and sharing their pedagogies might have potential impacts on students, increase instructors' professional teaching growth, provide more research opportunities for instructors, and even further enhance instructors' reputations in education. Martin et al. (2019) stated that if online instructors were to teach successfully, additional competencies such as ICT competence or online instruction knowledge should be required. Besides online teaching competency, motivation should be another important issue in faculty's open teaching. Orr et al. (2009) proposed that the motivational factors influencing faculty members' participation in online teaching might relate to tenure, scholarship, promotion, etc. For example, in Orr et al.'s (2009) study, the interviewees indicated that the workload for designing learning materials and activities was a main concern. Moreover, these interviewees mentioned that if institutions could provide additional compensation for teaching an online course, they might consider teaching online or developing an online course. As noted in some of the aforementioned works, instructors' willingness and readiness are essential factors in the promotion and development of open education/classrooms in higher education.

Teaching Readiness for OCW

As OCW has become one of the most important types of open education, it is worthwhile discussing whether instructors or teachers are ready or have intentions to provide OCW. However, surprisingly few studies have been conducted on faculty readiness in OCW/MOOCs. For instance, Chou et al. (2011) interviewed eight Taiwanese college faculty members about their thoughts on and concepts of OCW and proposed eight possible factors influencing their participation in such a setting. The eight factors are (a) acceptance of the OCW concept, (b) the teacher's personal characteristics, (c) perceptions of self-ICT competency, (d) course materials, teaching methods, and styles, (e) effects on teaching and research, (f) administrative support and incentives, (g) intellectual property rights-related issues, and (h) interaction with OCW web users. Similarly, Wang et al. (2013) interviewed nine instructors who participated in the OCW and found that the key factors influencing them to participate included personal internal and external factors, organizational and administrative factors, and strategies for encouraging teachers to participate. This study further proposed that if teachers have more positive beliefs about OCW, they are more willing to participate in OCW and provide good quality teaching materials for students. Furthermore, Zheng et al. (2016) interviewed 14 MOOC instructors and proposed five key factors that instructors perceived might influence their willingness to teach MOOCs. These factors included: (a) struggling with managing collaborative work; (b) balancing the amount of time spent teaching the course; (c) maintaining realistic expectations; (d) dealing with critical students; and (e) having insufficient support. This study concluded that instructors should open their pedagogy and instructional approach and should offer new ways to conceptualize their practice of teaching and learning.

Lessons Learned from Past Studies, Research Questions, and Significance of the Present Study

The aforementioned small-scale interview studies serve a basis for large-scale investigations. In other words, the results of previous studies offer valuable insights, but more empirical evidence is needed. By scrutinizing all of the above studies, we tentatively identified some common factors of OCW teaching readiness: (a) personal characteristics (e.g., the perception of challenges in opening teaching); (b) perceived ICT self-efficacy (e.g., perception of personal technical competency); (c) perceived administrative or organizational support (e.g., the support from the teaching environment/instructional experts); and (d) perceived benefits of OCW (e.g., anticipated quality of OCW and general beliefs about OCW).

Moreover, since college faculty are definitely not a homogeneous group—there are differences in background as well as seniority—the present study considered Taiwan's higher education context and took two major factors, gender and position, into account in the investigation.

The research questions were as follows:

1. What are the differences in the OCW teaching readiness of college faculty members with different OCW experience?
2. Does the gender of college faculty members make any difference in their teaching readiness for OCW?
3. Does the position of college faculty members make any difference in their teaching readiness for OCW?
4. What is the relationship between college faculty members' OCW teaching readiness and their willingness to offer OCW?

There are three significant aspects of this study. First, this study developed a college faculty teaching readiness scale for OCW (TRS-OCW) to conduct a large-sample survey and further identify the factors influencing faculty members' teaching readiness for OCW, especially in the Taiwanese context, as OCW is one of the major and popular types of open education in that country (Taiwan Open Course and Education Consortium, n.d.). Second, this study used different and appropriate statistical methods to analyze the collected data based on the research questions. Finally, by understanding college faculty members' teaching readiness for OCW, not only can instructional designers and faculty provide better OCW, but administrators and organizations can both help faculty enhance their OCW experiences and provide assistance to faculty willing to participate in OCW.

Method

Research Participants and Distribution Process

The participants in this study were Taiwanese college faculty who had provided OCW in the Taiwan Open Course and Education Consortium (TOCEC) and faculty who had not provided any OCW in the past. A total of 253 paper-and-pencil questionnaires were collected through two methods.

For college faculty who had provided OCW in the past, we collected the list of instructor members from the TOCEC website and mailed questionnaires to all of them (293). There were 120 questionnaires returned by mail, 49 of which had a substantial amount of missing data. As a result, only 71 valid surveys were completed.

For college faculty who had not provided any OCW in the past, we used purposive sampling and snowball sampling and mailed 176 questionnaires to them. There were 133 questionnaires returned by mail from faculty who had not provided any OCW in the past, with 62 having a substantial amount of missing data. Thus, there were 71 valid surveys completed.

The 142 valid questionnaires were examined for further 3-group comparisons. The effective respondent rate for this collection method was approximately 54%. The response rate was somewhat low because participation was voluntarily, without enforcement or incentive.

As shown in Table 1, among the 142 participants, 94 (66.2%) were men and 48 (33.8%) were women; 71 (50.0%) were from the OCW-experienced faculty group, 45 (31.7%) were from the OCW-unexperienced-Yes faculty group (faculty with no experience providing OCW but willing to provide OCW in the future), and 26 (18.3%) were from the OCW-unexperienced-No faculty group (faculty with no experience providing OCW and not willing to provide OCW in the future). The average length of their teaching careers was 17.18 years, with 8.4 years as the standard deviation (*SD*). Regarding faculty members' position, 61 (43.0%) were professors, 45 (31.7%) were associate professors, and 36 (25.4%) were assistant professors/lecturers.

Table 1

Demographic Characteristics of Participants

	OCW-experienced (*n*=71)		OCW-unexperienced-Yes (*n*=45)		OCW-unexperienced-No (*n*=26)	
	n	%	*n*	%	*n*	%
Gender						
Men	48	67.6	29	64.4	17	65.4
Women	23	32.4	16	35.6	9	34.6
Position						
Professor	35	49.3	18	40.0	8	30.8
Associate professor	23	32.4	14	31.1	8	30.8
Assistant professor/Lecturer	13	18.3	13	28.9	10	38.4

Note. *N* = 142. OCW = OpenCourseWare.

Instrument

This survey was mainly composed of two sections. The first section investigated faculty members' demographic characteristics, including gender, position, teaching level, and past OCW experience. The second section measured the degree of faculty members' teaching readiness for OCW. To develop the self-report questionnaires, the studies of Chou et al. (2011) and Wang et al. (2013) were reviewed, and other related studies (e.g., Paskevicius et al., 2018; Zheng et al., 2016) were taken into account to construct the item set.

Consequently, we developed a college faculty teaching readiness scale for OCW (TRS-OCW) containing 35 items for the second section. Among these 35 items, we categorized individual items into seven tentative factors, each designed to capture one construct: (a) acceptance of the OCW concept, (b) teachers' personal characteristics and perceptions of their own ICT competency, (c) course materials and teaching methods, (d) effects on teaching and research, (e) administrative support and incentives, (f) intellectual property rights-related issues, and (g) interaction with OCW web users. We deliberately removed the neutral level by using a four-point Likert scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*), thus requiring faculty to take a stance. A higher summed score indicated that faculty exhibited higher levels of teaching readiness for OCW.

Results

Exploratory Factor Analysis

We used exploratory factor analysis (EFA) to recategorize these items into distinct factors and to ensure TRS-OCW construct validity (i.e., the deletion of invalid items). We performed the principal components of factor analysis with promax rotation to explore the underlying structure. If the value of the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is less than 0.5, factor analysis should not be applied. In this study, the value of the KMO measure of sampling adequacy was 0.90, suggesting that applying factor analysis was appropriate.

Moreover, it was necessary for the chi-square of Bartlett's Test of Sphericity to be statistically significant in order to use factor analysis. In this study, the *p*-value of Bartlett's Test of Sphericity was 0.00 (χ^2 = 4,957.832). In the promax rotated factors, four factors were extracted with an eigenvalue greater than one, and they effectively explained 65.33% of the total variance. Eight items were deleted from the original 35 items owing to their low validity.

Thus, the final version of the TRS-OCW consisted of 27 items. The four factors were exactly interpreted as personal characteristics (PC), perception of administrative support (PAS), OCW recognition (OCWR), and competency in digital teaching material development (CDTMD).

Additionally, Cronbach's alpha reliability analysis was used to check the consistency of the scale items. Cronbach's alpha coefficient regarding the 27 items constituting the TRS-OCW was calculated as 0.94. Cronbach's alpha coefficient for personal characteristics, perception of administrative support, OCW recognition, and competency in digital teaching material development were calculated as 0.94, 0.95, 0.89 and 0.79, respectively. All variables had an alpha greater than 0.7, and thus we concluded that the questionnaire was reliable (Cortina, 1993; Taber, 2018). Table 2 presents the values of each item in terms of mean, standard deviation, subscale reliability, and factor loading.

Table 2

Items and Factor Loadings of Four Factors on the TRS-OCW

Item no.	Factor/items	*M*	*SD*	Factor loading
Personal characteristics (PC) (Cronbach's α = 0.94)				
PC1	Since my speaking is not fluent enough, I'm not willing to have my teaching recorded and published on the	3.21	0.56	0.98

Item no.	Factor/items	*M*	*SD*	Factor loading
	OCW website.			
PC2	Since I have stiff body language while I lecture, I'm not willing to have my teaching recorded and published on the OCW website.	3.22	0.53	0.97
PC3	Because I am not good looking, I'm not willing to have my teaching recorded and published on the OCW website.	3.18	0.58	0.85
PC4	Because my teaching includes various strategies, I think my teaching is not suitable to be recorded and published on the OCW website.	3.04	0.66	0.73
PC5	Because I do not want other colleagues to observe my teaching, I'm not willing to offer an OCW.	3.21	0.63	0.71
PC6	Because the content of my teaching materials is sensitive, I think my lectures are not suitable to be published on the OCW website.	3.15	0.62	0.70
PC7	Because my blackboard-writing is not good enough, I'm not willing to have my teaching recorded and published on the OCW website.	3.04	0.67	0.68
PC8	Because I significantly revise my teaching materials every semester or every academic year, I think my teaching materials are not suitable to be published on the OCW website.	2.95	0.67	0.67
PC9	Because I feel uncomfortable with having an open class, I'm not willing to have my teaching recorded and published on the OCW website.	3.05	0.70	0.64
PC10	I think I would need to spend more time to prepare	2.88	0.78	0.58

Item no.	Factor/items	*M*	*SD*	Factor loading
	OCW materials, so I'm not willing to provide an OCW.			
PC11	I think my teaching methods (i.e., group discussion or seminar) are not suitable to be recorded and published on the OCW website.	2.92	0.72	0.56
Perception of administrative support (PAS) (Cronbach's α = 0.95)				
PAS1	If the school provides enough human resources to support my OCW development, I'm willing to provide an OCW.	3.27	0.63	0.93
PAS2	If the school provides enough equipment and necessary skills, I'm willing to provide an OCW.	3.25	0.67	0.91
PAS3	If the school provides additional incentives (e.g., bonuses) for me, I'm willing to provide an OCW.	3.15	0.73	0.88
PAS4	If the school actively promotes the OCW, I'm willing to provide an OCW.	3.17	0.66	0.85
PAS5	If the school provides training courses (e.g., workshops) for me, I'm willing to provide an OCW.	3.13	0.72	0.83
PAS6	If the school provides sufficient funding for me, I'm willing to provide an OCW.	3.11	0.71	0.82
PAS7	Since there are significant benefits for my teaching performance if I work on OCW development, I'm willing to provide an OCW.	3.14	0.80	0.78
PAS8	If my workload is reduced (i.e., reduction of teaching hours) or the time spent developing an OCW can be deducted from my teaching hours, I'm willing to	3.40	0.66	0.67

Item no.	Factor/items	*M*	*SD*	Factor loading
	provide an OCW.			
OCW recognition (OCWR) (Cronbach's α = 0.89)				
OCWR1	I agree with the OCW principle of free education. All courses should be provided to the public for free.	3.37	0.80	0.94
OCWR2	I agree with the concept of open authorization provided by OCW course material developers. All users should be asked for nothing in return.	3.23	0.85	0.88
OCWR3	I agree with the OCW principle of openness. Anyone should be able to use the course materials freely.	3.48	0.67	0.75
OCWR4	I agree with the delivery method of OCW. All courses should be spread out and delivered via the Web.	3.31	0.80	0.67
OCWR5	Because my knowledge and teaching materials are valuable, I think they should not be free for all users.	2.74	0.83	0.57
Competency in digital teaching material development (CDTMD) (Cronbach's α = 0.79)				
CDTMD1	I think I can learn how to produce digital teaching materials by myself.	2.90	0.73	0.76
CDTMD2	I think it is easy for me to produce digital teaching materials by myself.	2.44	0.84	0.70
CDTMD3	I am confident of my ability to produce digital teaching materials.	3.05	0.71	0.70

Note. TRS-OCW = teaching readiness scale for OpenCourseWare; OCW = OpenCourseWare; PC = personal characteristics; PAS = perception of administrative support; OCWR = OpenCourseWare recognition; CDTMD = competency in digital teaching material development.

Differences Among College Faculty Members' Readiness for OCW

The first research question explored how college faculty members' teaching readiness for OCW varied across three different samples and stemmed from different levels of OCW experience/willingness. Table 3 presents the three groups' mean scores and *SD* for the four factors. As shown in Table 3, whether faculty members in OCW-experienced group or OCW-unexperienced group, the average scores for each factor was higher than 2.5 point of a 4-point Likert scale.

Table 3

Results of a Multivariate Repeated One-Way ANOVA and Post Hoc Test of the TRS-OCW Regarding the Three Faculty Groups

Group	Factor	*M*	Range	*SD*	*F*	Post hoc
OCW-experienced	PC	3.24	3.11-3.37	0.55	16.04***	PC, PAS, OCWR > CDTMD; PAS > PC
	PAS	3.39	3.25-3.53	0.58		
	OCWR	3.37	3.22-3.52	0.63		
	CDTMD	2.88	2.72-3.04	0.67		
OCW-unexperienced-Yes	PC	3.01	2.89-3.14	0.41	11.39***	PC, PAS, OCWR > CDTMD; PAS > PC
	PAS	3.22	3.08-3.37	0.48		
	OCWR	3.14	2.95-3.33	0.64		
	CDTMD	2.76	2.59-2.94	0.58		
OCW-unexperienced-No	PC	2.75	2.60-2.90	0.38	2.76*	OCWR > PAS, CDTMD
	PAS	2.66	2.43-2.90	0.58		
	OCWR	2.98	2.71-3.24	0.66		
	CDTMD	2.63	2.38-2.88	0.62		

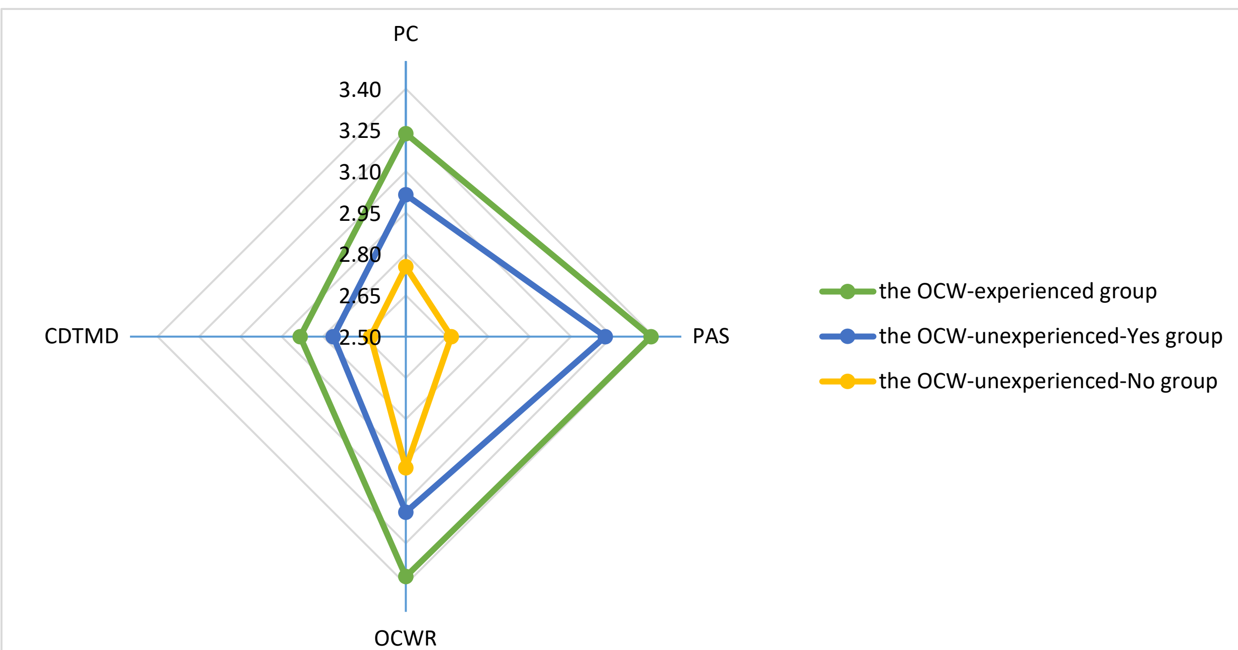
Note. N = 142. ANOVA = analysis of variance; TRS-OCW = teaching readiness scale for OpenCourseWare; OCW = OpenCourseWare; PC = personal characteristics; PAS = perception of administrative support; OCWR = OpenCourseWare recognition; CDTMD = competency in digital teaching material development.
*$p < .05$. ***$p < .001$.

To investigate the differences among the four factors of the scale, we conducted a one-way repeated analysis of variance (ANOVA). It is noted that the higher the mean score, the greater the weight or, in the case of this research, a higher mean indicated faculty members' perception of greater teaching readiness toward OCW. The results showed that in the OCW-experienced group and in the OCW-unexperienced-Yes group, the mean scores were significant (F = 16.04, p < .001; F = 11.39, p < .001, respectively). A post hoc test further revealed that the mean scores of PC, PAS, and OCWR were greater than the mean score of CDTMD, and that the mean score of PAS was greater than the mean score of PC in both groups. In addition, in the OCW-unexperienced-No group, the mean score was significant (F = 2.76, p < .05). A post hoc test further revealed that the mean score of OCWR was greater than the mean scores of PAS and CDTMD, respectively.

Further demonstration of the results is shown in Figure 1. The radar graphs for two faculty groups (OCW-experienced and OCW-unexperienced-Yes) have similar shapes but to different degrees across the four factors. On the other hand, the OCW-unexperienced-No group has a slightly different diamond shape and significantly lower degrees in all four factors.

Figure 1

Radar Chart for the Mean Comparison of the Four Factors for the Three Faculty Groups



Note. OCW = OpenCourseWare; PC = personal characteristics; PAS = perception of administrative support; OCWR = OpenCourseWare recognition; CDTMD = competency in digital teaching material development.

Moreover, to investigate the differences among the three groups in their TRS-OCW constructs, we conducted a one-way multivariate analysis of variance (MANOVA). As shown in Table 4, the results revealed that faculty members' experience with OCW made significant differences in the TRS-OCW (F = 5.03, p < .001; Wilks' λ = 0.76; η^2 = 0.13). A follow-up analysis showed that in the factors of PC, PAS, and OCWR, the OCW-experienced group and the OCW-unexperienced-Yes group rated significantly higher than the OCW-unexperienced-No group. Only in the CDTMD factor, there were no significant difference among the three faculty groups with different OCW experience.

Table 4

Descriptive Statistics and One-Way MANOVA Results for Different Groups on TRS-OCW Factors

	Group 1 OCW-experienced (*n*=71)		Group 2 OCW-unexperienced-Yes (*n*=45)		Group 3 OCW-unexperienced-No (*n*=26)		F	η^2	Groups post hoc
	M	*SD*	*M*	*SD*	*M*	*SD*			
PC	3.24	.55	3.01	.41	2.75	.38	10.33***	0.13	1>2>3
PAS	3.39	.58	3.22	.48	2.66	.58	16.72***	0.19	1, 2>3
OCWR	3.37	.63	3.14	.64	2.98	.66	4.24*	0.06	1>3
CDTMD	2.88	.67	2.76	.58	2.63	.62	1.65	0.02	

Note: N = 142. MANOVA = multivariate analysis of variance; TRS-OCW = teaching readiness scale for OpenCourseWare; OCW = OpenCourseWare; PC = personal characteristics; PAS = perception of administrative support; OCWR = OpenCourseWare recognition; CDTMD = competency in digital teaching material development.
*p < .05. ***p < .001.

Gender Differences in College Faculty Members' Teaching Readiness for OCW

For the second research question, we conducted an independent samples t-test to explore the differences between male and female faculty members across two different samples stemming from two groups with different OCW experience regarding the four measured factors of the TRS-OCW. In the OCW-experienced faculty group, the results revealed statistically significant gender differences in mean scores of OCWR (t = 2.05, p < .05). As shown in Table 5, male faculty members assigned a heavier weight to OCWR than did female faculty members. However, no significant gender differences were found in terms of the other three readiness factors.

Moreover, in the OCW-unexperienced faculty group, we merged the OCW-unexperienced-Yes group and OCW-unexperienced-No group to discuss the gender differences in each factor of the TRS-OCW. The results revealed statistically significant gender differences in the CDTMD mean scores (t = 3.38, p < .01). As shown in Table 5, male faculty members assigned a heavier weight to CDTMD than did female faculty members. However, no significant gender differences were found in terms of the other three readiness factors.

Table 5

Descriptive Statistics and t-Test of Gender on TRS-OCW Factors

Factor	OCW-experienced faculty (*n*=71)				*t*	Cohen's *d*
	Men (*n*=48)		Women (*n*=23)			
	M	*SD*	*M*	*SD*		
PC	3.30	0.58	3.11	0.45	1.40	0.37
PAS	3.45	0.57	3.27	0.59	1.19	0.31
OCWR	3.49	0.54	3.13	0.75	2.05*	0.55
CDTMD	2.95	0.75	2.74	0.46	1.47	0.34
	OCW-unexperienced faculty (*n*=71)					
	Men (*n*=46)		Women (*n*=25)			
	M	*SD*	*M*	*SD*		
PC	2.97	0.48	2.83	0.25	1.58	0.37
PAS	3.07	0.58	2.93	0.57	0.94	0.24
OCWR	3.17	0.58	2.91	0.74	1.62	0.39
CDTMD	2.88	0.52	2.41	0.60	3.38**	0.84

Note. N = 142. TRS-OCW = teaching readiness scale for OpenCourseWare; OCW = OpenCourseWare; PC = personal characteristics; PAS = perception of administrative support; OCWR = OpenCourseWare

recognition; CDTMD = competency in digital teaching material development.
*p < .05. **p < .01.

Position Differences in College Faculty's Readiness for OCW

For the third research question, we conducted a one-way ANOVA to determine whether the position held by an OCW-experienced faculty member had a statistically significant effect on the mean scores of the four factors of the TRS-OCW. As shown in Table 6, OCW-experienced faculty members' position in universities did not change the ratings of the four factors in the TRS-OCW.

Table 6

Descriptive Statistics and One-Way ANOVA of OCW-Experienced Faculty Position Relative to TRS-OCW Factors

Factor	Professor (n=35)	Associate Professor (n=23)	Assistant Professor/Lecturer (n=13)	F
	M (SD)	M (SD)	M (SD)	
PC	3.39 (0.47)	3.09 (0.62)	3.06 (0.51)	3.08
PAS	3.33 (0.65)	3.48 (0.46)	3.38 (0.59)	0.44
OCWR	3.55 (0.53)	3.21 (0.66)	3.17 (0.74)	3.05
CDTMD	2.93 (0.73)	2.83 (0.61)	2.85 (0.65)	0.20

Note. n = 71. ANOVA = analysis of variance; TRS-OCW = teaching readiness scale for OpenCourseWare; OCW = OpenCourseWare; PC = personal characteristics; PAS = perception of administrative support; OCWR = OpenCourseWare recognition; CDTMD = competency in digital teaching material development.

In addition, as shown in Table 7, the OCW-unexperienced faculty members' position varied in the CDTMD factor (F = 4.39, p < .05) of TRS-OCW. A post hoc test further showed that faculty members with professor position rated CDTMD significantly higher than did faculty members with assistant professor/lecturer position. However, faculty members in different position did not express any significant differences regarding readiness in the factors of PAS, PC, and OCWR.

Table 7

Descriptive Statistics and One-Way ANOVA of Position of OCW-Unexperienced Faculty Relative to TRS-OCW Factors

Factor	Professor (*n*=26)	Associate Professor (*n*=22)	Assistant Professor/Lecturer (*n*=23)	*F*	Post hoc
	M (*SD*)	*M* (*SD*)	*M* (*SD*)		
PC	3.06 (0.51)	2.86 (0.37)	2.82 (0.29)	2.36	
PAS	3.10 (0.67)	3.09 (0.48)	2.85 (0.54)	1.39	
OCWR	3.08 (0.57)	3.15 (0.66)	3.01 (0.73)	0.28	
CDTMD	2.96 (0.52)	2.65 (0.47)	2.49 (0.69)	4.39*	Professor > Assistant Professor/Lecturer

Note. n = 71. ANOVA = analysis of variance; TRS-OCW = teaching readiness scale for OpenCourseWare; OCW = OpenCourseWare; PC = personal characteristics; PAS = perception of administrative support; OCWR = OpenCourseWare recognition; CDTMD = competency in digital teaching material development.
*p < .05.

OCW-Unexperienced College Faculty Members' Willingness to Offer OCW in the Future

For the fourth research question on the relationship between college faculty members' teaching readiness and their willingness to offer OCW courses, we conducted a logistic regression analysis to determine which readiness factors could predict OCW-unexperienced faculty members' decision to provide OCW courses in the future. The sample of logistic regression analysis consisted of 71 faculty with no OCW experience, drawn from the main sample. Table 8 presents the predictability of the proposed model. The results show that the model correctly classified 93.3% of the faculty who are willing to provide OCW in the future and 57.7% of the faculty who are not willing to do so, with an overall accuracy of 80.3%. This rate is acceptable for predicting faculty members' decision to provide OCW in the future ($\chi^2[4, 71] = 20.276$, $p < .001$, Nagelkerke $R^2 = 0.34$).

Table 8

Accuracy of a Model to Predict Willingness to Provide OCW in Future

	Proposed model	Actual	Accuracy of model (%)
Willing to provide OCW	42	45	93.3
Not willing to provide OCW	15	26	57.7
Average accuracy		71	80.3

Note. n = 71. OCW = OpenCourseWare.

Table 9 presents the logistic regression coefficient (B), standard error (*SE*), Wald test, and odds ratio for each of the predictors. The results show that the PAS is a significant predictor. Based on the results obtained here, it could be concluded that the perceived administrative support of OCW-unexperienced faculty members is a significant predictor of their willingness to provide OCW in the future. It could be interpreted that OCW-unexperienced faculty members' decision about providing OCW would be related to their perception of the administrative support provided.

Table 9

Logit Coefficients and Wald Statistics of the Proposed Logistic Regression Model

Factor	Choice of providing OCW in the future					
	B	*SE*	*Odds ratio*	95% CI	Wald	*P* value
PC	-1.063	.998	.345	[0.490, 2.440]	1.136	.287
PAS	-2.387	.779	.092	[0.020, 0.423]	9.380	.002**
OCWR	.571	.520	1.770	[0.638, 4.908]	1.202	.273
CDTMD	.534	.581	1.705	[0.546, 5.322]	.844	.358

Note. n = 71. OCW = OpenCourseWare; PC = personal characteristics; PAS = perception of administrative support; OCWR = OpenCourseWare recognition; CDTMD = competency in digital teaching material development.

$^{**}p < .01$.

Discussion

Factors of College Faculty Teaching Readiness for OCW

This study examined college faculty members' teaching readiness for OCW by using a college faculty teaching readiness scale for OCW (TRS-OCW) built on previous research and instruments. The EFA showed that the 27-item TRS-OCW included four factors of faculty teaching readiness: personal characteristics (PC), perception of administrative support (PAS), OCW recognition (OCWR), and competency in digital teaching material development (CDTMD).

Upon examining faculty members' mean scores for the TRS-OCW factors, both OCW-experienced faculty and OCW-unexperienced-Yes faculty exhibited the greatest weight in the readiness factors of administrative support and OCW recognition, followed by the factors of personal characteristics and competency in digital teaching material development. This result is consistent with Wang et al. (2013), whose results indicated that both organizational/administrative support and teachers' education approaches are crucial factors influencing teachers' willingness to participate in OCW. In sum, the faculty participants in this study, regardless of whether they had provided OCW before or were willing to provide it in the future, indicated their recognition of OCW and the importance of administrative support, and identified their personal characteristics. Moreover, whether or not faculty participants had OCW experience, they showed similar, relatively lower degrees of confidence in their ability to develop digital teaching materials.

In addition to the abovementioned findings, this study further examined the differences among three groups (OCW-experienced, OCW-unexperienced-Yes, OCW-unexperienced-No) in all factors of TRS-OCW. The findings revealed that OCW-experienced faculty rated higher in the factors of personal characteristics, administrative support, and OCW recognition than did OCW-unexperienced-Yes faculty and OCW-unexperienced-No faculty. The reason might be that faculty who have OCW experience have confidence in their own teaching and more willingness to share their teaching/instruction with more online learners. In addition, the OCW-experienced faculty were fully aware of the benefits provided by administrations and organizations, such as reducing the number of teaching hours and providing teaching assistants. Furthermore, we found that OCW-unexperienced-Yes faculty rated higher in the readiness factors of personal characteristics and perception of administrative support than did OCW-unexperienced-No faculty. It may be that although these faculty members had no experience providing OCW, they were more confident about facing a camera and opening their minds to sharing their teaching with online learners. Additionally, the OCW-unexperienced-Yes faculty might have considered administrative support as helping and encouraging them to provide OCW. It is worth noting that no significant difference was found among the three faculty groups in the factor of competency in digital teaching material development. In order words, whether or not faculty members had OCW experience, they had equal perception of their competence and ability to develop digital teaching material for OCW.

Gender Differences in College Faculty Members' Teaching Readiness for OCW

The second research question asked whether faculty members' gender made any difference in teaching readiness for OCW. The current study found that male faculty members with OCW experience exhibited statistically significantly greater teaching readiness in the factor of OCW recognition than did female faculty members with OCW experience. A possible explanation may be that male faculty members with OCW experience might agree more with OCW's model of openness, lack of cost to learners, and shared course materials and instruction in courses. Moreover, male faculty members lacking OCW experience exhibited statistically significantly greater readiness in the factor of competency in digital teaching material development than did female faculty members with OCW experience. This finding is consistent with the findings of previous studies (e.g., Broos, 2005; Wu & Tsai, 2006) that men have better Internet self-efficacy than women. In other words, in this study, male faculty in general, and those with no OCW experience in particular, may be more confident in their ability to develop digital teaching materials than female faculty are. However, this significant difference between men and women disappeared in the OCW-experienced group. Both male and female faculty members in this study who had experience in providing OCW had equal competence levels in developing digital teaching materials for OCW.

Position Differences in College Faculty Teaching Readiness for OCW

Job position seemed to be associated with differences in college faculty teaching readiness for OCW. In the current study, we conducted a series of post hoc tests and found that OCW-experienced faculty with different position in universities did not have differences in any factors for OCW. In other words, no matter which position these experienced faculty members held, they were equally ready to teach OCW across the four measurement factors. In contrast, we found that OCW-unexperienced faculty with professor position exhibited a higher degree of competency in digital teaching material development than did those with assistant professor/lecturer position. The reason for this might be that when compared to junior faculty, professors with tenure-track position have less pressure to conduct research or seek promotions; they might have more time to explore different teaching methods or strategies and demonstrate more confidence in developing digital teaching materials. However, competence in digital material development, especially for professors, did not necessarily transfer to their possible development of OCW.

OCW-Unexperienced College Faculty Willingness to Offer OCW in the Future

Research question 4 concerns the relationship between faculty members' willingness to offer OCW in the future and their readiness factors. We conducted a logistic regression analysis and found that the administrative support factor was a statistically significant predictor of OCW-unexperienced faculty members' willingness to provide OCW in the future. In other words, the perception of administrative support is the only single readiness factor that contributes to OCW-unexperienced faculty members' decision-making process in providing future OCW. The result implies that OCW-unexperienced faculty are more likely to provide OCW in the future once they perceive administrative support from their universities.

Conclusions, Limitations, and Future Research

In conclusion, this study makes a contribution to both the OCW literature and to the practice of OCW promotion. The findings of this study have important implications for understanding factors that determine the OCW teaching readiness of college faculty. To encourage college faculty members, especially those without any OCW experience, to participate in OCW in the future, the most important factor is sufficient administrative support from higher educational institutions and OCW administrators. Possible strategies include increasing course development subsidies and decreasing regular teaching hours. Other strategies, such as enhancing faculty familiarity with OCW by sharing the concept of OCW and helping faculty solve ICT-related problems by providing assistants to prepare digital course materials or professional teams to help with postproduction, may also help.

Although this study provided relevant data and sought to answer research questions previously outlined by other studies (e.g., factors which affect instructor's participation in OCW), there were several limitations that prevented the study from being more generalizable. One main limitation of this study is the low response rate. We tried our best to solicit participation from all faculty members who have provided OCW in the TOCEC and then solicit matching response rates from faculty without OCW experience. Although the number of participants was sufficient for the present study's statistical analysis, more participants may be needed for future studies using different analysis methods.

Since MOOCs are getting more attention around the world, another recommendation is to expand this study to involve instructors or college faculty who have provided MOOCs and those who have not. Including the perspectives of both full-time faculty members and other instructors allows researchers to conduct a gap analysis to determine if there are overlaps with this study's findings.

The economic recession, layoffs, lockdown measures, and the risk of illness caused by COVID-19 mean self-employment, remote jobs, and online learning have become very popular (Law, 2021). Schools need to shift face-to-face teaching to online teaching during the COVID-19 outbreak; faculty who have abilities or readiness to teach online become important, especially in higher education. According to the findings of this study, the administration should provide enough supports, such as incentives or technicians, when instructors prepare their online teaching. Information gathered from this research would allow a holistic view of OCW and MOOCs from the perspective of both OCW-experienced faculty and OCW-unexperienced faculty that could provide important breakthrough ideas for enhancing and promoting OCW and MOOCs in higher education.

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Investigation of the Factors Affecting Open and Distance Education Learners' Intentions to Use a Virtual Laboratory[i]

Hanife Çivril[1] and Ali Ekrem Özkul[2]
[1]Isparta University of Applied Sciences, Turkey; [2]Alanya Hamdullah Emin Paşa University, Turkey

Abstract

Laboratories, which are an integral part of education in disciplines that require hands-on training and application, can now be presented using new technologies, and application activities can be realized at a distance. In this study, virtual laboratories (VLs) are discussed, and factors affecting the students' intention to use VLs are investigated. The study was conducted within laboratory applications of circuit analysis within an associate degree program of a distance teaching university in Turkey. In this study, which used exploratory sequential design approach, the learners' intentions to use a VL were examined within the framework of the technology acceptance model (TAM). Content analysis was used for the analysis of qualitative data, and the partial least squares structural equation model was used for the analysis of quantitative data. As a result of the study, the developed TAM-based research model is a useful conceptual framework towards understanding and explaining the intentions of learners' virtual laboratory usage. The results of this study will guide institutions to integrate VLs effectively into the education process and to increase and disseminate the use of VLs by learners.

Keywords: virtual laboratories, open learning, distance education, technology acceptance

Introduction

Laboratory practices, which are defined as learning experiences in which the learners interact with the material to observe theoretically taught events (Hofstein & Lunetta, 1982), are considered an integral part of education in various disciplines. They aim to develop learners' application skills such as observation, measurement, estimation, planning, hypothesis building, problem solving, collaboration, data acquisition, interpretation of results, and time management (Kennepohl, 2013; Meester & Kirschner, 1995). In addition, learners are taught the skills they should possess in their business life after they graduate.

While the effective design of laboratories in a traditional way and their presentation to students is not an easy undertaking, institutions that offer open learning and distance education experience more difficulties (Kennepohl, 2013) due to learners' obvious geographical distance from the laboratory facilities. In open and distance learning, which gained more popularity with the establishment of the Open University in the United Kingdom in 1969, various methods, such as face-to-face laboratories, home study kits, remote laboratories, virtual laboratories, and fieldwork and clinics, are employed to provide high-quality laboratory experiences to distance learners, as exemplified by Kennepohl (2017).

Virtual laboratories (VLs) are one of the solutions put forward in the digital age for flexible and accessible laboratory applications. VLs simulate a real laboratory environment by way of a variety of softwares. They allow learners to conduct experiments independent of time and place. Thus, learners can be more comfortable in designing experiments and analyzing and interpreting results (Stefanovic, 2013). Learners explore knowledge by interacting with the virtual environment (Dalgarno, 2002).

A number of studies show that VLs make important contributions to learning and teaching (e.g., Hung & Tsai, 2020; Wolski & Jagodzinski, 2019). Although the effectiveness of VLs is often stated, the fact that they are not adopted and used by all learners will prevent the success of this laboratory practice. It is therefore important for institutions to know the factors that affect learners' intentions to use or not use a VL. Understanding these factors will guide institutions in ensuring that VLs are adopted and used by more learners and will enable them to take steps in this direction.

This study aims to discover the factors affecting open and distance learning (ODL) learners' intentions to use VLs in terms of their opinions of VL experiences.

Theoretical Foundation and Literature Review

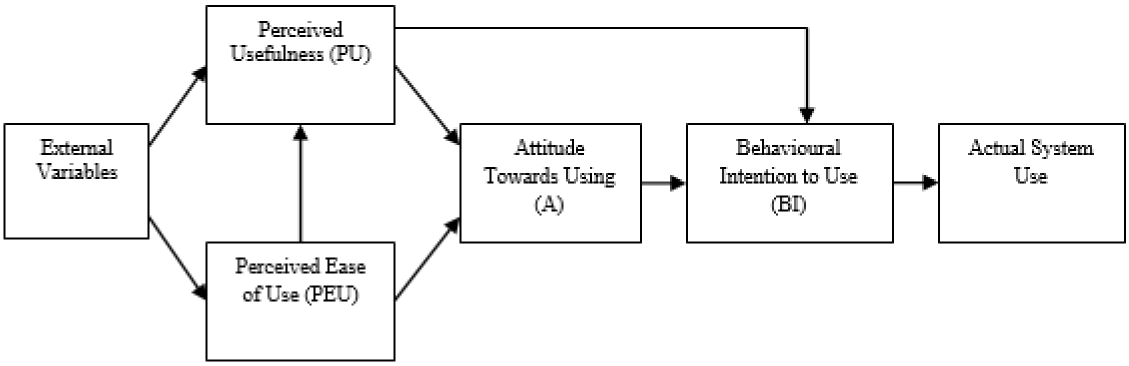
Technology Acceptance Model

Technology acceptance can be defined as the process of people accepting and using a technology or their intent to use it. The acceptance of technology has become an important field of study as information technologies have begun to be implemented in almost every field. Many technological or psychological factors affect people's decisions to use and/or their behaviours in using technological systems. Various theories have emerged to reveal and understand these factors. One of these theories is the technology acceptance model (TAM). Proposed by Davis et al. (1989), the TAM, as shown in Figure 1, has two important factors: perceived usefulness (PU) and perceived ease of use (PEU). These factors directly influence attitudes (A) towards technology use. PU is defined as the perception that the use of a certain technological system increases the work performance of a person (Davis et al., 1989). In other words, people tend to use technology (or not) to the extent to which they believe it helps them to do their jobs better. On the other hand, some people may not accept technology unless it is easy to use, even if it is perceived as useful. PEU is the belief that individuals can use a system without too much effort; PEU directly affects PU. Finally, these two beliefs are assumed to be directly influenced by external variables (Davis et al., 1989).

In this model, a system's use is determined directly by the behavioural intention (BI), which is influenced by both human attitudes towards the system and PU. The relationship between attitude and BI is described as follows: People are intent on realizing the behaviors that they feel positively towards (Davis et al., 1989) . The relationship between PU and BI is based on the idea that people are willing to perform the actions they believe will improve their business performances regardless of their positive or negative feelings toward the action (Davis et al., 1989).

Figure 1

Technology Acceptance Model



**Note*. From "User acceptance of computer technology: A comparison of two theoretical models," by F. D. Davis, R. P. Bagozzi, and P. R Warshaw, *Management Science*, *35*(8), p. 985 (http://www.jstor.org/stable/2632151). Copyright 1989 by The Institute of Management Sciences.

Initial Research Model

The TAM is widely used to predict the extent to which new technologies will be adopted in ODL practices, as in many areas. In the studies about technology adoption in the literature, various technologies were discussed in terms of both students and teachers. Learning management systems (e.g., Fathema et al., 2015), mobile learning (e.g., Iqbal & Bhatti, 2015), synchronous learning (e.g., Kang & Shin, 2015), Web-based learning tools (e.g., Khor, 2014), and online forums (e.g., Camarero et al., 2012) are examples of these technologies.

In order to determine the factors that affect learners' intentions to use VL, a research model has been developed based on the basic structures of the TAM (PU, PEU, A, BI) in this study.

PU and PEU

In this study, PU refers to the benefits that learners perceive they will obtain from a VL. PEU, on the other hand, expresses the learners' impressions of their efforts in using or constructing the VLs.

In studies investigating the acceptance of various ODL systems, PEU has been found to be the most important determinant of learners' acceptance of the systems. In some of these studies, it has been observed that PU and PEU affect BI through attitudes, and at the same time, PU directly affects BI (e.g., Fathema et al., 2015; Khor, 2014). In addition, it has been observed that PEU affects PU. As a result, the following hypotheses have been developed:

H1: PU is significantly and positively related to attitude.

H2: PU is significantly and positively related to BI.

H3: PEU is significantly and positively related to PU.

H4: PEU is significantly and positively related to attitude.

Attitude

Attitude in this study refers to learners' general attitudes towards VL. Attitude is considered to be an important component in predicting behaviours. The following hypothesis has been developed:

H5: There is a significant and positive relationship between attitude and learners' intentions.

BI and Perceived Usage (U)

BI refers to a person's future intention and willingness to act. In this study, BI was expressed in terms of the intentions of learners to use VLs in other lessons and to recommend VLs to fellow students. Perceived usage (U) is the belief to what extent learners used VL. Because this study aims to discover the factors that affect learners' intentions to use VL, BI was considered as an output variable.

In contrast to the original TAMs, for which actual use is predicted by intention, this study was added to the research model as a potential predictor of intentions to use VL. The following hypothesis was developed:

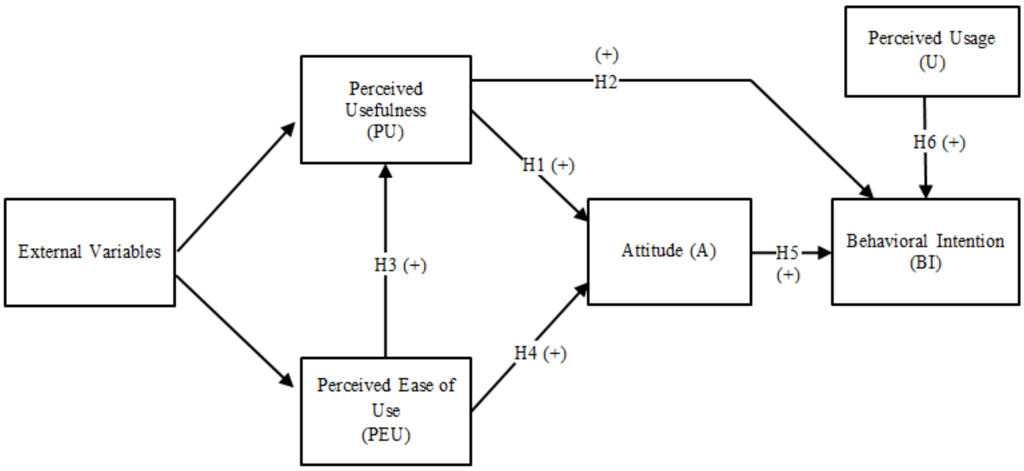
H6: U is significantly and positively related to BI.

External Variables of the Research Model

Davis et al. also suggest that external factors may be important determinants of the PU and PEU of TAM. Numerous studies suggest various external variables for TAM (e.g., Abdullah & Ward, 2016). The initial research model is shown in Figure 2.

Figure 2

Initial Research Model



**Note*. Adapted from "User acceptance of computer technology: A comparison of two theoretical models," by F. D. Davis, R. P. Bagozzi, and P. R Warshaw, *Management Science, 35*(8), p. 985 (http://www.jstor.org/stable/2632151). Copyright 1989 by The Institute of Management Sciences.

This study uses an exploratory sequential mixed methods design. In the qualitative phase of the study, semi-structured interviews were conducted with 15 students who performed experiments in a VL in order to find the important factors affecting students' VL usage behaviour and views about the VL.

Based on qualitative findings, to increase the model's predictive power, various external variables that can affect PU and PEU were added to this initial research model, and a final research model was established. The quantitative phase of the study was then conducted to verify causal relationships.

Methodology

Research Design

In this study, an exploratory sequential mixed method design was used. Exploratory sequential design consists of two stages in which researchers qualitatively explore a subject and conduct quantitative research to generalize these qualitative findings to larger samples (Creswell, 2012). In this study, first, a qualitative case study was carried out, and then the quantitative phase was conducted. These two consecutive phases can be described as content analysis and survey.

Context of the Study

In the Open Education Faculty at Anadolu University, for applied courses, learners come to campus for a certain period in the summer and practise in a real laboratory environment under instructors' supervision. One of those courses is Circuit Analysis. Learners are invited from various provinces of Turkey to the campus for face-to-face laboratory practices for a duration time. They are provided with an application guide and also experimental videos to prepare for laboratory applications. In this study, circuit analysis virtual laboratories (CAVL), which enable learners to carry out virtual applications, were presented to learners through e-learning environments in the scope of the Circuit Analysis Laboratory course.

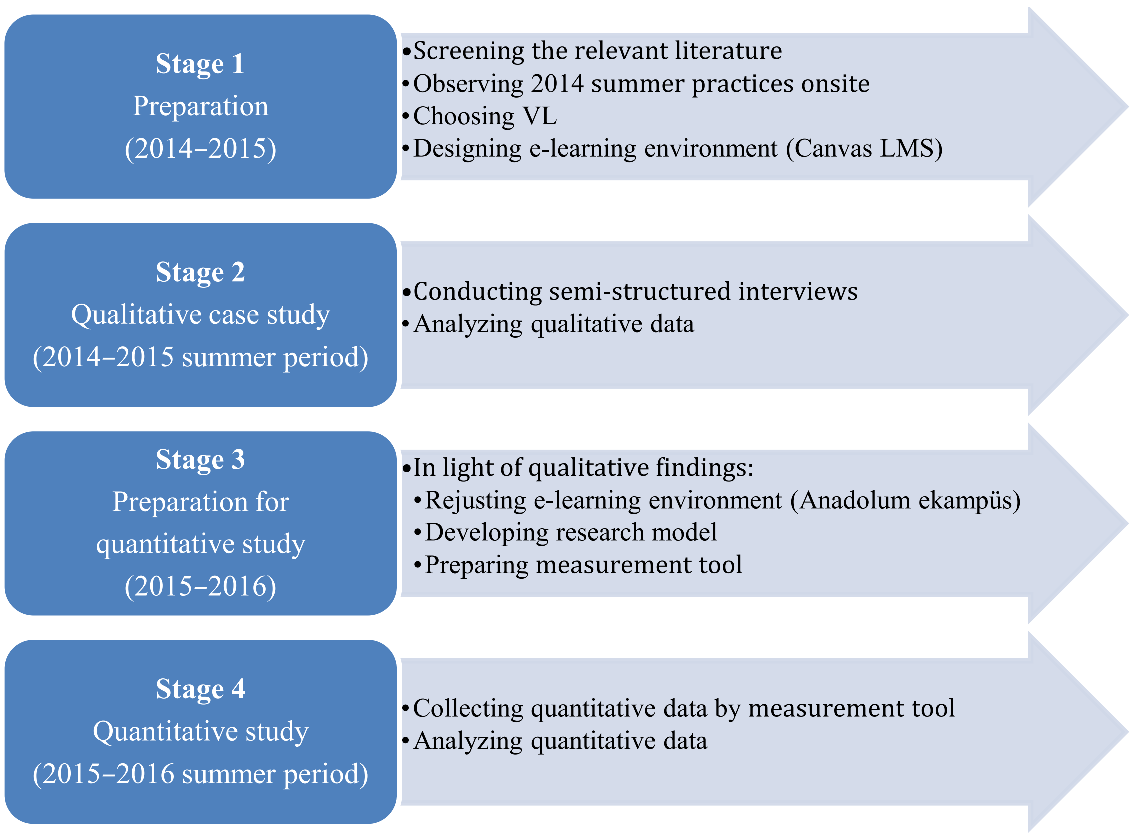
Research Process/Stages of Research

This study consists of a four-stage process. The first stage concerns the design of the course's e-learning environment. An e-learning environment has been developed by screening the relevant literature, examining sample lessons and VLs, and taking expert opinions, and it has been made available to learners through an open source learning management system (LMS). In this stage, the use of an open source, two-dimensional (2D) PhET circuit construction kit was deemed appropriate to enable laboratory applications to be carried out in a virtual environment.

In the second stage, the qualitative data was collected and analyzed. In the third stage, a research model was developed in light of qualitative findings, and a measurement tool was developed. In addition, readjustments were made in the e-learning environment, taking the students' recommondations into account. During this stage, a three-dimensional (3D) VL with a realistic representation of the materials and processes used in circuit analysis experiments, as well as 2D VL, was shared with the learners. In the fourth stage, quantitative data was collected, analyzed, and interpreted. The stages of the research process is shown in Figure 3.

Figure 3

Stages of the Research Application Process



**Note*. VL = virtual laboratory; LMS = learning management system.

Participants

The research was conducted with two different groups for the qualitative case study and quantitative research phases of the study.

Qualitative Case Study Participants

The qualitative case study phase of the study was planned for 1,062 learners who had enrolled in the summer semester of the 2014–2015 academic year. The e-learning environment (Canvas LMS) was introduced to the learners before their session appointments. LMS records show that 296 learners used this environment, but only 60 of those learners performed experiments in CAVL.

In this study, the criterion sampling, which is a purposeful sampling method, was used to gather the opinions of learners about the VL. The basic criterion was to include only learners who had conducted at least one experiment in CAVL. In accordance with this basic criterion, the qualitative case study participants constituted 15 learners who voluntarily performed experiments in the CAVL (Table 1).

Table 1

Qualitative Case Study Participants

Date	Participant	Age	Gender	Working status	Education level
June 22–26, 2015	P1	40	Male	Working	Undergraduate
	P2	50	Male	Working	Undergraduate
	P3	32	Male	Working	Undergraduate
July 6–10, 2015	P4	36	Male	Working	High school
	P5	33	Male	Working	Undergraduate
	P6	44	Female	Working	Undergraduate
July 20–24, 2015	P7	26	Male	Working	High school
	P8	23	Female	Working	High school
	P9	28	Male	Working	High school
July 27–31, 2015	P10	27	Male	Working	High school
	P11	21	Female	Student	High school
	P12	42	Male	Working	Undergraduate
	P13	29	Male	Working	Associate degree
	P14	25	Male	Student	Undergraduate
August 3–7, 2015	P15	52	Female	Not working	Undergraduate

Quantitative Research Participants

The quantitative phase of the work was planned for 1,370 learners who had registered for the summer session of the 2015–2016 academic year. The prepared e-learning platform (Anadolum ekampüs) was introduced to these learners before their appointment date. During the summer period, the survey tool was shared online with learners. A total of 49 responded to the survey (Table 2).

Table 2

Quantitative Research Participants

Demographic characteristics		Frequency	%
Gender	Male	45	91.84
	Female	4	8.16
Age	20–29	19	38.76
	30–39	19	38.76
	40–49	10	20.41
	50+	1	2.04
Education level	High school	17	34.69
	Associate degree	5	10.20
	Undergraduate	24	48.98
	Postgraduate	3	6.21
Working status	Working	40	81.63
	Not working	9	18.37

Data Collection Tools

Data Collection Tools for the Qualitative Case Study

Qualitative data was collected using a semi-structured interview technique. The interview form was used as a data collection tool. This form was prepared based on the constructs important for understanding the VL's ease of use, usefulness, participants' behavioural intention to use, and participants' general views of the VL. This interview form was presented to experts for their opinions, and the questions were examined in terms of their clarity and language. Necessary adjustments were made in line with the experts' recommendations.

Data Collection Tools for Quantitative Research

To determine the factors that affect CAVL users' intentions, the researchers developed a research model in the light of qualitative case study findings and created a measurement tool within this model. In the first part of the scale, demographic information was collected from learners. In the second part, the learners' experiences about CAVL were investigated within the framework of the research model. The developed scale consists of 11 variables and 29 items in total. The scale items were prepared to cover all of the subthemes obtained as a result of semi-structured interviews. While some scale items were adapted from previous studies in the literature, others were developed by the researchers. A seven-point Likert scale was used to assess the items in the measurement tools.

Analysis of Data

Data Analysis for the Qualitative Case Study

Individual interview data with learners were analyzed using the content analysis method. The recorded interviews were first transcribed to writing and saved on a computer. The researchers and an area specialist later coded this recorded data and determined the subthemes and main themes related to these codes. Content analysis results were tabulated and given as frequency and percentage values.

Data Analysis for the Quantitative Phase

Partial least squares (PLS) structural equation modelling (SEM) was used to analyze the quantitative data. The SmartPLS 3.0 (student edition) program (Ringle et al., 2015) was used for PLS-SEM. PLS-SEM was used in this study for reasons such as a low number of samples and its strong prediction accuracy of PLS. According to Hair et al. (2011), the minimum sample size for testing PLS-SEM models is 10 times the largest number of structural paths directed at a particular latent construct in the structural model.

Because there are at most four structural paths for a latent structure in the developed research model, 40 samples were sufficient for this study. There are 49 samples in this study, so the minimum sampling requirement of PLS analysis was met.

Findings

Qualitative Case Study Findings

In this study, where a semi-structured interview technique was used to determine the learners' opinions about their experiences with the VL, the results obtained were analyzed in-depth, and themes and subthemes were created. Table 3 shows the frequency and percentage distribution of learners' views according to these themes.

Table 3

Themes and Subthemes

Theme	Subtheme	Frequency	%
Technological factors	Installation	7	26.92
	Usage	8	30.77
	Functionality	5	19.23
	Visuality	6	23.01
TOTAL		26	100.00
Educational factors	Preparation	13	35.13
	Preparation time	5	13.51
	Theoretical knowledge development	10	27.03
	Relative advantage	7	18.92
	Academic support	2	5.41
TOTAL		37	100.00
Affective factors	Satisfaction	10	62.50
	Motivation	4	25.00
	Self-efficacy	2	12.50
TOTAL		16	100.00

Technological Factors

Installation.

It was determined that learners evaluated CAVL differently from the standpoint of installation. While some indicated that they did not have any problems with installation, others did report having difficulties. Installing CAVL requires basic computer skills. Although some of the learners had difficulties, all of them were able to conduct experiments by setting up the CAVL. This can be explained by short training videos and documentation on CAVL setup that are available in the LMS. In addition, one learner said that CAVL would be more accessible if it were presented directly online in the absence of third-party software.

Usage.

Learners stated that they were able to carry out experiments in CAVL without any major problems. This can be explained by the fact that the CAVL is user-friendly and has a simple interface and detailed guidelines for experiments. The learners also said that the guidelines for the experiments were explanatory, and it was easy to carry out experiments.

Functionality and Visuality.

When the CAVL was selected, the circuits and equipment used in circuit analysis were taken into consideration. The purpose of CAVL is not to provide a visually realistic experimental environment but rather to help learners understand the electrical behaviours underlying the circuits established. However, learners have stated that there is a visual and functional difference between the environment and equipment used in the CAVL and those in the actual laboratory and that the CAVL should be further developed.

Educational Factors

Preparation. Most learners in this study stated that they became more conscious of the face-to-face laboratory environment with CAVL, and it allowed them to better prepare for a face-to-face laboratory setting, experiment materials, and correct use of materials. This was an advantage for those who used CAVL compared with those who did not use CAVL.

Preparation Time. Learners stated that they could not benefit from the CAVL as much as possible and could not finish the experiments on time, indicating that there was not enough time between the announcement date and the face-to-face laboratory session dates or that they could not spare time from their work.

Theoretical Knowledge Development. Most learners stated that CAVL helped improve their theoretical knowledge by providing visual learning opportunities. They stated that they had found the opportunity to learn by doing in CAVL, which made it easier for them to structure their knowledge in this regard and make it more permanent.

Relative Advantage. Some learners pointed out that using CAVL together with the application books and videos provided by the institution was more productive than using these environments alone.

Academic Support. In interviews, some learners requested the development of an interactive system in order to receive immediate support for problems and errors encountered during the execution of experiments.

Affective Factors

Satisfaction. Most learners stated that they perceived CAVL as a positive experience, were satisfied with the environment, and found the system successful. Some learners also hoped to have such a system for other laboratory courses.

Motivation. In the interviews, some learners stated that they were motivated by the the institution's encouragement in using CAVL and the extra scores they received after conducting experiments in CAVL. The learners who expressed their views on this issue requested that the use of CAVL be made compulsory and that it would always contribute to scores; thus, other learners would be more likely to be willing to use CAVL.

Self-Efficacy. Some learners' self-efficacy within the scope of the circuit analysis subject was influential to their perceptions of using CAVL. One learner stated that he felt the need to use CAVL because he had been seeing himself as inadequate in circuit analysis. On the other hand, a learner with high self-efficacy for circuit analysis said that it was easy to use CAVL. The familiarity of the materials used in circuit analysis allowed the experiments to be carried out more conveniently in CAVL.

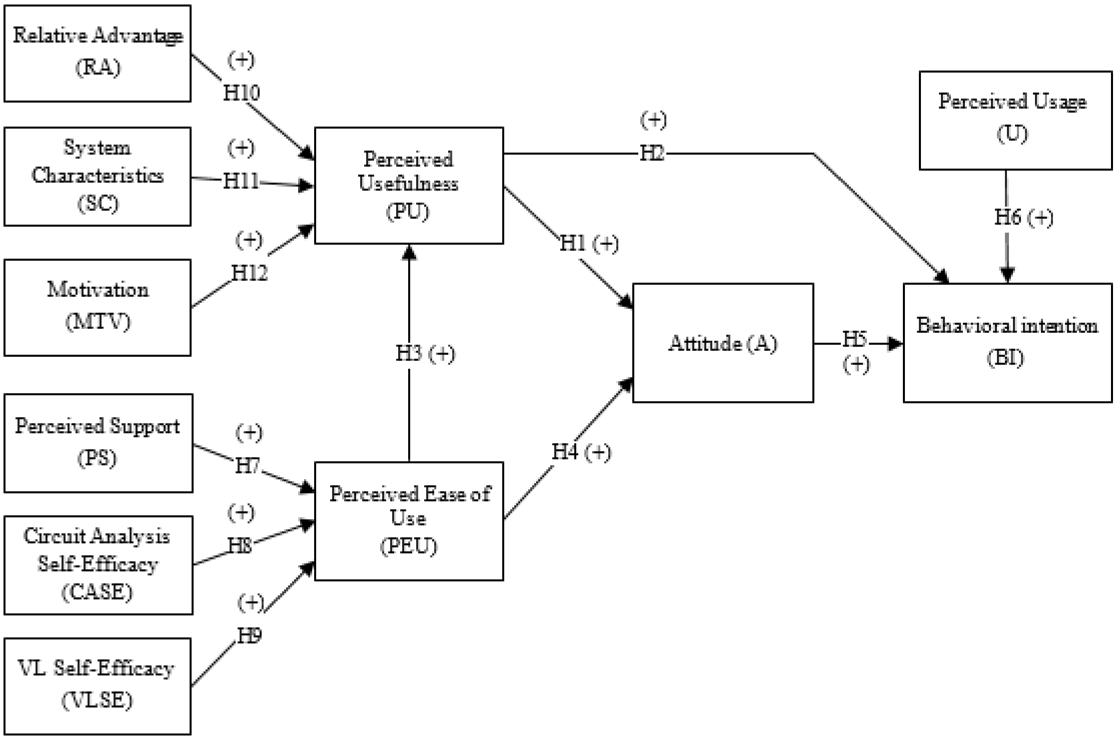
Interviews with the learners highlighted the need for improvements regarding an LMS and VLs. Canvas LMS, which was used for this study, is a platform independent from the Open Education Faculty's official system. The existence of these two platforms is observed as the cause of the troubles since students have to log in to these platforms located at different web addresses with a different username and password. The prepared environment has been moved to the official e-campus platform. It was shared at the beginning of the semester so that learners could find more time to prepare for the face-to-face laboratory environment. In addition, during the quantitative research phase, a 3D CAVL containing a realistic representation of the equipment and processes was also shared with the learners. Unlike the 2D CAVL, the 3D CAVL works online via a browser. A telephone hotline was also shared so learners could get immediate help and support in academic and technical matters.

Final Research Model

To determine the factors that affect learners' intentions to use a VL, a final research model has been developed as a result of qualitative case study findings and a literature review. The model is based on the basic structures of the TAM. Qualitative findings have been helpful in determining the factors that influence learners' intentions to use a VL. With semi-structured interviews, the important factors in using a VL have been identified. For example, learners often find VLs useful in a variety of ways, and their experience with installation and use is often mentioned. This confirms that PU and PEU are important factors affecting learners' attitudes and intentions to use technology, as noted in other technology adoption studies (Fathema et al., 2015; Khor, 2014). Other factors that emerged as a result of the interviews are relative advantage, motivation, support, self-efficacy, and visuality/functionality. The self-efficacy factor in the research model proposed in this study is addressed in two ways. The first is circuit analysis self-efficacy (CASE) and the second is VL self-efficacy (VLSE). While CASE emerged as a factor affecting learners' use of VL as a result of the interviews, VLSE was modelled by the researchers by considering the difficulties that learners experienced in installing and using CAVL. The visuality/functionality factor was considered within system characteristics (SC) in the model. The final research model is shown in Figure 4.

Figure 4

Final Research Model



Research Model's External Variables

Perceived Support (PS). In this study, PS refers to the perceptions of learners about the availability of the resources they need during their VL use. As a result of the qualitative case study, it has been found that learners need support.

H7: PS is significantly and positively related to PEU.

Self-Efficacy Perception. In this study, self-efficacy perception was approached from two viewpoints. The first is self-efficacy perceptions for learners using VL (VLSE), and the other is self-efficacy perceptions about being able to perform experiments in the real-time circuit analysis laboratory (CASE). The following hypotheses have been developed as a result of the qualitative case study findings and literature review:

H8: CASE is significantly and positively related to PEU.

H9: VLSE is significantly and positively related to PEU.

Relative Advantage (RA). In this study, RA is considered as a reflection of the advantages of using VLs together with other existing materials (books, videos, etc.).

H10: RA is significantly and positively related to PU.

System Characteristics (SC). SC can be defined as features that enable a system to perform its task in the best way in accordance with the desired purposes (Venkatesh & Davis, 2000). In this study, SC was defined as learners' perception that a VL is similar to a real laboratory environment and the extent to which they can perform experiments that would be done in the real laboratory environment in a VL. In this study, a VL was used as a supportive material to prepare for the face-to-face laboratory environment. Therefore, SC is thought to only affect PU.

H11: SC is significantly and positively related to PU.

Motivation (MTV). In this study, motivation refers to the use of VL by learners to achieve their goals or as a result of the instruction of the teaching institution. Motivation is thought to affect only PU.

H12: MTV is significantly and positively related to PU.

Quantitative Research Findings

Quantitative analysis was performed in two steps. First, the measurement model was evaluated. Then, the hypothesis was tested and the structural model was estimated.

Measurement Model

Prior to analyzing the structural model, the validity and reliability of the measurement model must be analyzed. For this purpose, indicator reliability, internal consistency, convergent validity, and discriminant validity were examined in order.

The item loadings are shown in Table 4. If these values are 0.7 or higher, they are considered satisfactory, and if higher than 0.5, they are considered acceptable (Chin, 1998). In this study, the threshold value for item loadings was 0.5, and indicators below this value were deleted. As shown in Table 4, the loads of all the items in the measurement model are between 0.600 and 0.966, which indicates sufficient item reliability.

Table 4

Partial Least Squares Results of the Measurement Model

Variable	Indicator	Item loading	*M*	*SD*	Composite reliability	AVE
PEU	peu1	0.853	4.939	1.8530	0.872	0.774
	peu2	0.906	5.184	1.6030		
PU	pu1	0.802	5.347	1.7506	0.893	0.737
	pu2	0.881	5.612	1.6178		
	pu3	0.889	4.816	1.9650		
PS	ps1	0.767	5.388	1.8576	0.841	0.571
	ps2	0.652	4.367	1.9968		
	ps3	0.804	4.102	2.0941		
	ps4	0.788	4.061	2.1056		

SC	sc1	0.855	5.122	1.5361	0.843	0.643
	sc2	0.813	4.980	1.4360		
	sc3	0.733	5.143	1.6708		
RA	ra1	0.873	5.429	1.7795	0.894	0.808
	ra2	0.925	5.857	1.4142		
MTV	mtv1	0.958	5.041	1.9035	0.873	0.705
	mtv2	0.914	4.980	1.9737		
	mtv3	0.600	5.143	1.7200		
CASE	case1	0.958	5.408	1.6447	0.947	0.857
	case2	0.966	5.408	1.6320		
	case3	0.848	5.571	1.5138		
VLSE	vlse1	0.765	6.163	1.3126	0.840	0.727
	vlse2	0.932	4.918	1.7776		
U	u	1.000	3.306	1.7225	1.000	1.000
A	a1	0.831	5.245	1.7384	0.754	0.607
	a2	0.723	5.755	1.8204		
BI	bi1	0.914	5.510	1.6089	0.911	0.836
	bi2	0.914	5.490	1.5562		

**Note*. AVE = average variance extracted; PEU = perceived ease of use; PU = perceived usefulness; PS = perceived support; SC = system characteristics; RA = relative advantage; MTV = motivation; CASE = circuit analysis self-efficacy; VLSE = virtual laboratories self-efficacy; U = percieved usage; A = attitude; BI = behavioural intention.

Composite reliability was calculated for internal consistency. Hair et al. (2012) indicate that the composite reliability value should be 0.70 or higher, but values of 0.60 or higher are acceptable values for an exploratory study. Table 4 shows the composite reliability values of the variables. These values are higher than the threshold value of 0.70 for all variables. This means that the variables have high internal consistency.

The average variance extracted (AVE) value of each variable was calculated for convergent validity. Fornell and Larcker (1981) state that the acceptable value of AVE should be 0.50 or higher. In Table 4, it is shown that the AVE values obtained for each of the variables are higher than the 0.50 threshold value, which shows the appropriate convergence validity.

The square root of the AVE value of each variable is highly correlated with the other latent variables, which indicate the discriminant validity of the model (Fornell & Larcker, 1981). The square root of the AVE values calculated from each variable are larger than the correlation values with the other variables and this criterion is satisfied, as seen in Table 5.

Table 5

Discriminant Validity

	PS	PU	U	PEU	CASE	BI	RA	MTV	SC	VLSE	A
PS	**0.755**										

PU	0.627	**0.858**									
U	0.264	0.237	**Single Item**								
PEU	0.527	0.596	0.209	**0.880**							
CASE	0.346	0.381	0.147	0.585	**0.926**						
BI	0.531	0.839	0.212	0.516	0.377	**0.914**					
RA	0.478	0.838	0.212	0.351	0.312	0.812	**0.899**				
MTV	0.505	0.838	0.258	0.416	0.385	0.705	0.796	**0.839**			
SC	0.710	0.769	0.184	0.740	0.512	0.715	0.610	0.567	**0.802**		
VLSE	0.388	0.367	0.356	0.661	0.575	0.170	0.170	0.357	0.438	**0.852**	
A	0.417	0.762	0.350	0.523	0.427	0.758	0.629	0.654	0.680	0.381	**0.779**

**Note*. PS = perceived support; PU = perceived usefulness; U = percieved usage; PEU = perceived ease of use; CASE = circuit analysis self-efficacy; BI = behavioural intention; RA = relative advantage; MTV = motivation; SC = system characteristics; VLSE = virtual laboratories self-efficacy; A = attitude.

The square roots of the AVE values are presented diagonally.

The results in Table 5 show the validity and reliability of the measurement model, which are prerequisites for evaluating the structural model and hypothesis testing.

Structural Model

Following the evaluation of the measurement model, the structural model was tested, and the causal links identified in the proposed research model were examined. The coefficient of determination (r^2) for each dependent variable (endogenous variables) and path coefficients (β) were obtained in the model using the PLS-SEM method.

The coefficient of determination (r^2) indicates the percentage of the model's dependent structure is exposed by independent (exogenous) structures. In the PLS method, values of 0.67, 0.33, and 0.19 r^2 are defined as strong, moderate, and weak, respectively (Chin, 1998). Table 6 gives the r^2 values of the endogenous variables. In the proposed model, 86.9% of learners' beliefs that VLs are useful (PU), 56.5% of learners' beliefs that they can easily carry out their experiments in VLs without effort (PEU), 74% of learners' future intentions to use VLs (BI), and 58.8% of learners' attitudes towards VL (A) are explained by other variables affecting these variables. The r^2 values obtained for PU and BI are strong, and the r^2 values obtained for PEU and A have moderate values. This suggests that the proposed model is quite successful at explaining learners' intentions to use a VL.

Table 6

Variance Explanation Results

Variable	r^2
PU	0.869
PEU	0.565
BI	0.740

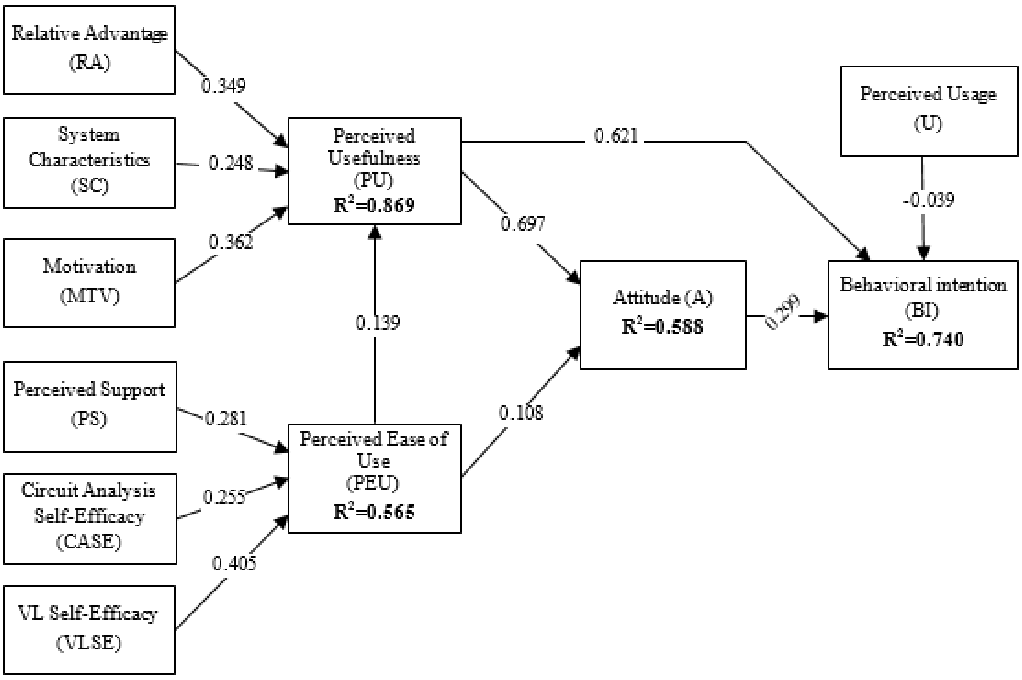
A	0.588

Note. r^2 = coefficient of determination; PU = perceived usefulness; PEU = perceived ease of use; BI = behavioural intention; A = attitude.

The path coefficients (β) indicate the magnitude of the causal relation between the constructs, that is, the magnitude of effect of one variable on the other. For the model proposed, the path coefficients (between the arrows) and the r^2 values (in the boxes) are shown in Figure 5. For example, it can be said that the effect of PU on BI (β = 0.621) is strong, A (β = 0.299) is moderate, and U (β = −0.039) is very weak. The path coefficients in the model are found to be positive except for the path coefficient between U and BI. A negative path coefficient indicates that the causal relation is negative.

Figure 5

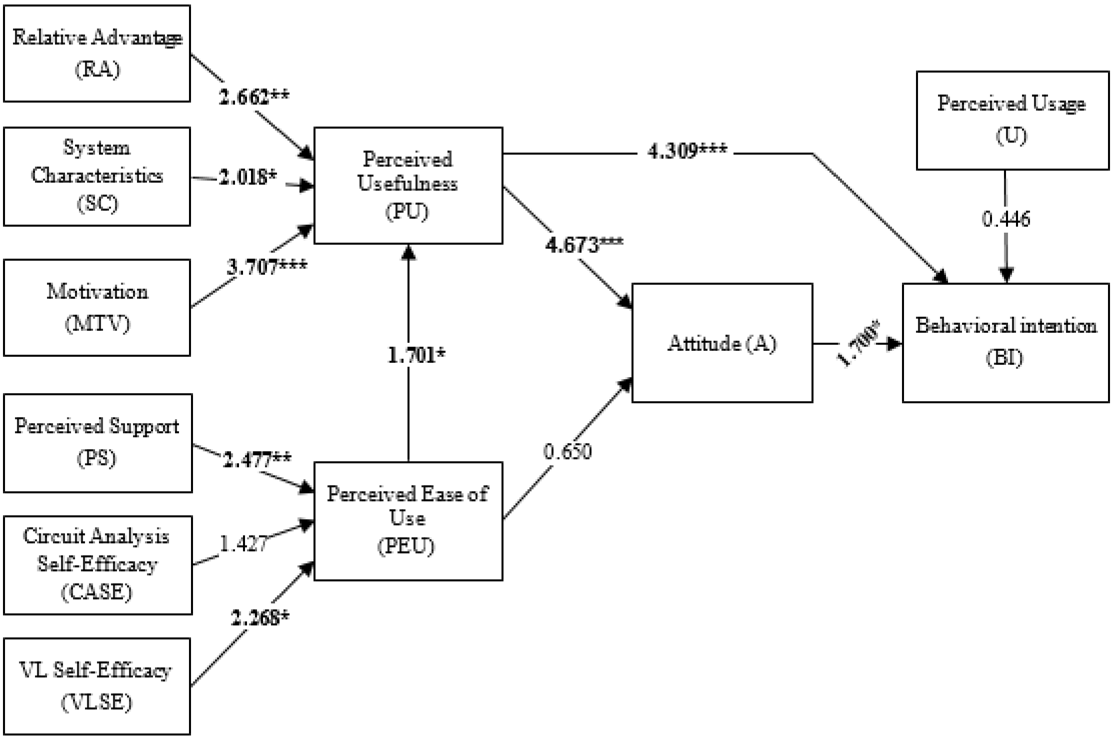
Partial Least Squares Analysis Results



The bootstrap method was used to estimate the statistical significance of the path coefficients in the model, and *t* statistics and standard errors were produced. Hypotheses were tested using the *t* values. In this study, the bootstrap analysis was performed with 500 subsamples. Figure 6 displays a graphical representation of the bootstrap output along with the *t* values.

Figure 6

Bootstrap Output With t Values



Note. One-tailed *$p < .05$. **$p < .01$. ***$p < .001$.

Table 7 summarizes the hypothesis results; 9 of the 12 hypotheses are supported. All hypotheses related to TAM variables (H1, H2, H3, H5) were supported except for the causal relation between PEU and A (H4). In addition, the effect of U on BI was not significant (H6) ($t = 0.446$; $p > .05$).

Table 7

Summary of Hypotheses Results

Hypothesis		Path coefficients	*t*	Result
H1	PU → A	0.697	4.673***	Supported
H2	PU → BI	0.621	4.309***	Supported
H3	PEU → PU	0.139	1.701*	Supported
H4	PEU → A	0.108	0.650	Not supported
H5	A → BI	0.299	1.700*	Supported
H6	U → BI	−0.039	0.446	Not supported
H7	PS → PEU	0.281	2.477**	Supported
H8	CASE → PEU	0.255	1.427	Not supported
H9	VLSE → PEU	0.405	2.268*	Supported
H10	RA → PU	0.349	2.662**	Supported
H11	SC → PU	0.248	2.018*	Supported
H12	MTV → PU	0.362	3.707***	Supported

Note. PU = perceived usefulness; A = attitude; BI = behavioural intention; PEU = perceived ease of use; U = percieved usage; PS = perceived support; CASE = circuit analysis self-efficacy; VLSE = virtual laboratories self-efficacy; RA = relative advantage; SC = system characteristics; MTV = motivation.

One-tailed *$p < .05$. **$p < .01$. ***$p < .001$.

The effect size (f^2) measures how the value of r^2 changes when a variable is subtracted from the model. In other words, the subtracted exogenous variable is used to evaluate whether it has an effect on the r^2 value of the endogenous structure. Effect sizes of 0.02, 0.15, and 0.35 mean small, medium, and large influences, respectively (Cohen, 1988). Table 8 shows the effect size results for each variable. In the production of the r^2 value of the BI variable, it is seen that the effect of PU is large, A is small, and PEU is small. In the production t^2 value of the PU variable, the effects of learners' motivation to use the virtual lab (MTV), the advantages of using VLs together with other existing materials (RA), and learners' perceptions of virtual labs to resemble real lab environments (SC) are moderate, and PEU is small. In the production r^2 value of the PEU variable, self-efficacy perceptions (VLSE) for learners using VL (VLSE) and perceptions of learners about the availability of the resources they need during their VL use (PS) has a moderate effect, and self-efficacy perceptions about being able to perform experiments in the real-time VL (CASE) has a small effect. If r^2 of the variable A is produced, the PU has a large effect, while the PEU has a small effect.

Table 8

Effect Size Results

	f^2
Behavioural intention	
PU	0.621
U	0.005
A	0.133
Perceived usefulness	
PEU	0.062
RA	0.287
MTV	0.345
SC	0.147
Perceived ease of use	
PS	0.150
CASE	0.097
VLSE	0.237
Attitude	
PU	0.761
PEU	0.018

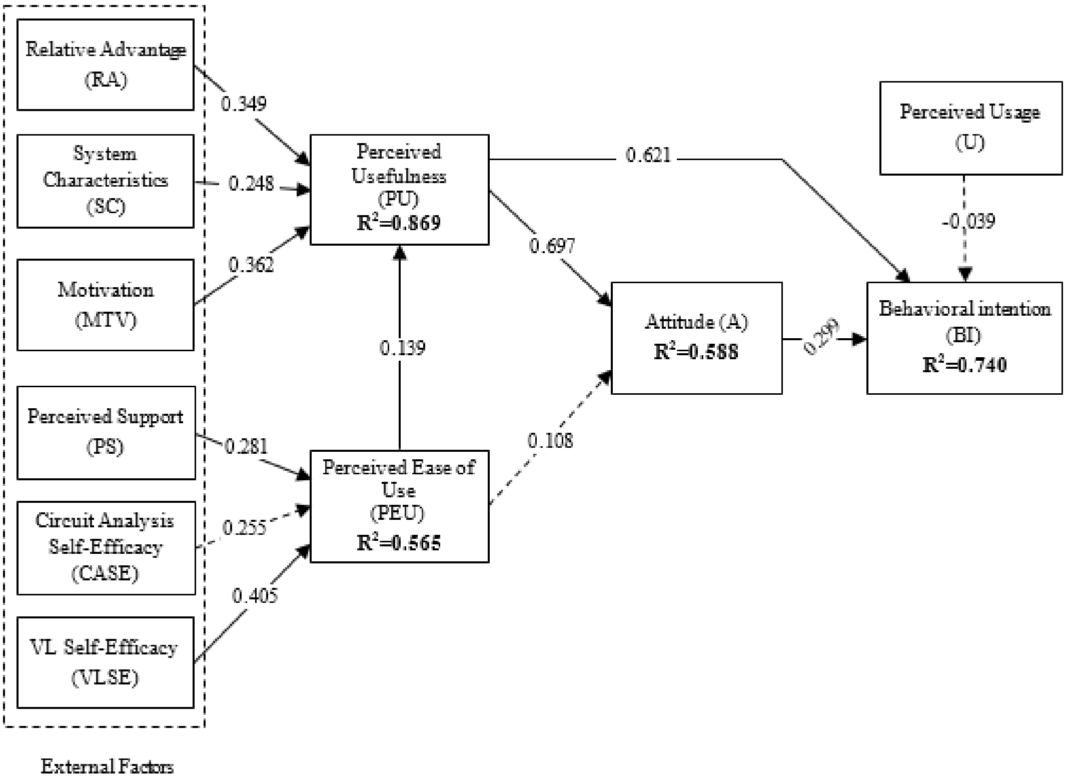
Note. PU = perceived usefulness; U = percieved usage; A = attitude; PEU = perceived ease of use; RA = relative advantage; MTV = motivation; SC = system characteristics; PS = perceived support; CASE = circuit analysis self-efficacy; VLSE = virtual laboratories self-efficacy.

Conclusions

Factors affecting learners' intention to use a VL in this study were determined within the framework of the research model built on the basic components of the TAM as a result of qualitative case study findings and literature review. Most of the causal relations between the developed model variables were supported. The results of the study confirmed 9 out of 12 hypotheses (Figure 7). Therefore, it can be said that the model is a useful theoretical model in terms of helping understand and explain learners' intentions of using a VL.

Figure 7

Results of Research Model



**Note.* Straight arrows indicate supported hypotheses and dashed arrows indicate unsupported hypotheses.

The strongest direct influence on learners' intention to use a VL was the variable PU. Learners will use a VL more often if they think that it is useful in situations such as preparing for a face-to-face lab environment, getting to know circuit components, or improving performance in experiments conducted in face-to-face labs. The results also show that learners' attitudes have a positive influence on BI. That is, learners are more likely to use a VL when they have positive feelings towards VL use. Finally, the U variable apparently has no significant effect on learners' attitudes.

Only PU had a significant effect in determining the attitudes of learners in this study. Although PEU is one of the main building blocks of the TAM, it does not have an observable direct influence on learners' attitudes. Thus, we can conclude that benefits of VLs are important in learners' attitudes towards VLs but that perceptions of how easy or difficult VLs are to use are not important. Despite the fact that the relationship between PEU and A is not significant in this study contradicts the TAM; other studies have found similar results (e.g., Camarero et al., 2012; Sun & Cheng, 2009; Tan, 2015).

In this study, PU and PEU mediate the relationship between external factors and learners' attitudes towards a VL and their intentions to use it.

A significant and positive correlation was found between the PEU, RA, MTV, and SC variables and PU, and 86.9% of the variance in PU could be explained by these variables. As a result, learners with high motivation who think that the use of VL is clear, easy, and understandable; that experiments can be performed like in a real laboratory; and that VL is complementary to existing learning materials will have a positive conception on the gains of VL. Therefore, their attitudes towards using VL will be positive, and their intent to use it will increase. This finding guides developers, designers, and institutions in carefully assessing the needs of learners so that they, in turn, can be effectively met by a VL.

Finally, PS, VLSE, and CASE variables account for 56.5% of the variance in PEU. Support provided to learners on technical and academic matters will influence their belief that they can easily carry out experiments in a VL without effort. Learners may think that a VL is a difficult and complicated technology because of the problems they are experiencing because they lack a theoretical guide in setting it up. Designers and institutions therefore must offer more help and support services so that learners can solve their potential problems with VLs. In this way, learners will learn more about VLs and experiments through support, and the perception of the ease of use of VLs will be positive.

On the other hand, VLSE seems to have a strong influence on PEU. Learners with self-efficacy in the use of a VL will find the VL easier to use than other learners, as their tendency to resolve problems with the VL by themselves via their own efforts will be higher. However, learners' self-efficacy on the subject of circuit analysis seems to have no effect on PEU. The hypothesis that there would be a positive correlation between PEU and CASE, which emerged as a result of qualitative interviews and which resulted in the tendency of learners with self-efficacy in circuit analysis to perceive the use of VL more easily, was not confirmed.

It is important for institutions, developers, and designers to investigate the factors that affect the use of VLs. This study demonstrates that the proposed model can be used as a useful theoretical framework to predict and understand the factors that affect learners' intentions to use a VL.

A model was developed in this study to understand the intentions of learners in using a VL. Undoubtedly, creating a conceptual framework on this subject with a single study is difficult. Therefore, in future studies, this model can be evaluated by various users in similar or different contexts. Studies can be done to increase the explanatory rate by exploring different variables that may have an effect on learners' VL use and adding them to the model. In addition, the influence of demographic characteristics such as age, gender, and experience on learners' VL acceptance can be examined.

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IDEAS for Transforming Higher Education: An Overview of Ongoing Trends and Challenges

Lourdes Guàrdia[1], Derek Clougher[1], Terry Anderson[2], and Marcelo Maina[1]
[1]Universitat Oberta de Catalunya, [2]Athabasca University

Abstract

The recent unexpected impact of the global pandemic on higher education has caused universities, governments, students, and teachers to reexamine all components of existing systems, including how to become more effective and efficient in using technologies for education. We have seen that moving classes online—either blended or fully online—can be done rapidly, but early reports show huge variations in quality, acceptance, completion, and learning. Thus, it is important to examine the existing research literature on pedagogical innovations and practices that use technologies. To understand this complex situation, the present study examines the current technological, organisational, and pedagogical trends and challenges using an exploratory design carried out in three stages. In stage one, a literature review of the academic and grey literature was conducted, identifying 14 trends of interest. These trends were used in a workshop and interview discussion between leading experts in the higher education field. Stage two focused on identifying 108 initiatives that represent these trends. Finally, 30 of these were selected as cases for further exploration in stage three. Using thematic analysis, the 30 cases were condensed into 12 main themes that represent the innovative practices that led to development of the IDEAS framework as a signpost on the roadmap of next-generation pedagogy for transforming higher education. IDEAS is presented in the discussion alongside examples and ways to apply it in higher education contexts.

Keywords: higher education, educational technology, trends and challenges in higher education, higher education transformation, next-generation pedagogy, strategic and organisational planning

Introduction

In a progressively networked society, educators are faced with countless possibilities for strategic and opportunistic expansion (Henderikx & Jansen, 2018). While benefiting our society with increased access to education (Baldwin & Ching, 2019) and innovative teaching methods (Walder, 2017), this highly interconnected world also presents many challenges, given the societal expectations put on institutions (Posselt et al., 2018). The government, students, and society expect universities to be innovative, affordable, and cost-effective to remain relevant and provide quality education (Damewood, 2016), highlighting an ongoing transformation that signals an "increased convergence of many concerns: pedagogy, professional training, [and] the transfer of knowledge" in higher education institutions (Ruano-Borbalan, 2019, p. 493). Managing the transformation presents challenges for educators and education administrators as new pedagogies and technologies continue to materialize, driving the need for effective strategic planning and decision-making processes that guide their implementation (Bennett et al., 2018).

Advances in technology drive the emergence of innovative pedagogies and practice that in turn generate a "digital disruption of education" (De Wit et al., 2015, p. 77), acting as a catalyst for the main developments in higher education (Haywood et al., 2015). These effects are found at institutions delivering distance and online education and traditional face-to-face-only universities that move towards greater use of technology and interactive methodologies, providing a combination of classroom experience with the convenience and flexibility of online provision, increasing student interaction and engagement (Phoong et al., 2019). Thus, technology supports traditional models of higher education as a transformative complementary tool (Goh et al., 2020).

However, what are the most effective pedagogical innovations implemented in digital learning environments? To respond, it is necessary to understand the core trends and challenges in higher education that could transform decision making about the future of education (DeVries, 2019) and identify practices that can be adopted in urgent and unprecedented situations, such as the COVID-19 pandemic, allowing universities to continue providing high-quality education (Bates, 2020). The COVID-19 pandemic highlights that disruptive pedagogical practices are implemented to respond immediately (Rapanta et al., 2020), but reports from early studies provide a mixed review of the effectiveness of emergency remote education (Bozkurt et al., 2020), which differs from the usual practices of distance and online education that benefit from extensive a priori strategic planning and organisation, thus impacting the quality of course design, development, and delivery (O'Keefe et al., 2020). Additionally, many teachers have little or no experience teaching in an online environment, and the rapid transition revealed a lack of expertise as an area in great need of further support going forward in the new normality (Johnson et al., 2020).

Trends in Higher Education

Trends provide a unique insight into the approaches that universities are taking to differentiate themselves in the fast-evolving educational environment, giving an overview of the state of the art of higher education (Westine et al., 2019). We operationalize trends as broad predominant directions in which higher education is developing and transforming.

Various reports identified in our study detail the current trends in higher education related to technology-enhanced teaching and learning, such as "The Changing Pedagogical Landscapes Study" (Henderikx & Jansen, 2018), which cites technology as a means to "solve problems higher education is facing today and … offer new opportunities for teaching and learning" (p. 3). The main trends reported include leadership and institutional strategy, gradual innovation at the course and curriculum levels, incentives for digital education, increased (scalable) continuous education and continuous professional development offerings, massive open online courses (MOOCs) as enablers for innovation, increasing internationalization of higher education, and the important role of governments. Moreover, institutions' capacity and resistance to implement technology were investigated, revealing that a lack of digital and media competences, absence of necessary institutional policies, and infrastructural limitations were the principal difficulties facing pedagogical innovation. The report suggests that blended learning methods are a trend driven by students' and teachers' digital skills, coupled with increased capability and reduced costs of the technology itself. Furthermore, the use of blended methods is recommended to complement, rather than replace, existing methods, as they improve quality while reaching a larger, more diverse population. Therefore, institutional policies and trends must adjust to the demand and be student-focused rather than teacher-focused forms of active learning.

Similarly, the Internationalization in Higher Education for Society publication (Brandenburg et al., 2020) addresses the crucial role that digital learning plays as a catalyst for the internationalization and mobility of both instructors and students. Its study references collaborative online international learning via technology-enabled virtual mobility as a key trend. Technological transformation is a vital factor in bridging the gap between universities and society, making the institutions more accessible to the wider public, including vulnerable communities, and it can extend education within the local society and beyond to national and international levels. Internationalization in higher education should focus on economic developmental models as well as taking into account factors such as economic growth, technology transfer and innovation (Brandenburg et al., 2020), reinforcing the importance of internationalization of digital learning, which in itself is considered a strategic issue in higher education development (De Wit et al., 2015).

The 2020 EDUCAUSE Horizon Report (Brown et al., 2020) focuses on five categories of trends: social, technological, economic, higher education, and political. Technological trends include advancements in artificial intelligence (AI), next-generation digital learning, and analytics and privacy questions. The authors discuss the economic impact of the trends, stating that institutions "will need to adjust their courses, curricula, and degree programmes to meet learners' needs as well as the demands of new industries and an evolving workforce" (p. 10). Technological advances respond to students' needs as they increasingly seek nontraditional routes to education, underlining that "higher education institutions are moving to new models for online programmes, such as assessment (competency) and crediting (micro-credentials and digital badging)" methods (p. 11).

Finally, it is necessary to reiterate that the COVID-19 pandemic has revealed a new major trend in that it has increased higher education's dependency on the use of technology for teaching and learning as emergency online courses have been implemented without the necessary time frame to prepare for this move (Hodges et al., 2020). Nonetheless, merely moving traditional-style classrooms online is not enough to deliver a consistent quality of education (Gasevic, 2020). The aforementioned trend reports argue that technology provides a viable solution to designing and supporting more flexible educational models, which are adaptable to educational, social, and economic needs as they arise. As such, the current debate on the future of the university system questions the foundations of the institution as it is compelled to adapt to a social context where technology plays a predominant role. This does not mean that existing teaching models should be replaced but rather that universities use technological advances to enhance traditional forms of pedagogy expanding the pedagogical possibilities thanks to the affordances of technology (Wick & Lumpe, 2015).

Challenges

Despite the advantages associated with pedagogical innovations supported by technology, challenges exist. Technology has been implemented slower than expected (Marshall, 2018). Although universities strive to remain innovative, the use of technologies, societal digitalization, and societal and economic limitations highlight the difficulties they face (Posselt et al., 2018). These impact teachers, learners, and decision making in terms of structural and content design (Ponomarenko et al., 2019).

Barriers to technology implementation include how the role of the teacher changes once it is introduced (Bates, 2019). Understanding this role may explain the differences in technology use between novice and experienced teachers. In a 10-year longitudinal study, novice teachers in Sweden were more likely than their experienced counterparts to implement new technologies in their educational practices (Englund et al., 2017). Similarly, teachers' attitudes towards and beliefs about technology implementation were the strongest influences in its implementation at Dutch universities (Farjon et al., 2019). This represents an ongoing challenge as it is vital that all members of the institution adopt a pro-change attitude to drive innovative pedagogical practices at the level of strategy and organisational planning (Bates, 2019). However, these attitudes are not always easily adopted: 93% of interviewed teachers in Australian universities have identified teacher resistance to technology implementation as a core barrier (Watty et al., 2016).

Moreover, choosing the most appropriate tools and learning activities for teachers' and learners' needs is a time-consuming process (Bates, 2019). The rapid pace at which technological innovations are introduced often eclipse teachers' capacity to gain successful competence prior to use (Sutton & DeSantis, 2017). Academic staff must acquire an advanced level of digital and technological competency (Gillett-Swan, 2017). Therefore, collaborative learning via e-learning platforms and social networks, as well as online virtual collaboration between teachers, is needed (Romero-Moreno, 2019). Nevertheless, teachers differ in their opinions as to how technology can and should be used. Jääskelä et al. (2017) identify the following teachers' belief groups about digital learning: "[It is] a pivotal tool for self-paced learning, an additional tool for active and interactive learning, a tool designed for the integration and assessment of learning, and a tool for changing the learning culture" (p. 202). Moreover, a growing need for teachers' digital competence (DC) in higher education requires ongoing support in digital teaching methods (Amhag et al., 2019).

Further challenges upon implementation of the technology are seen in credentialization as the use of digital badge programmes includes usability issues, increased faculty workload, and a lack of information about their introduction (Stefaniak & Carey, 2019). Both learning analytics and AI face challenges due to the lack of theoretical background and evidence-based business models promoting their use (Renz & Hilbig, 2020). These limitations are linked to challenges that institutions face related to technological infrastructure, hardware, and software (Ponomarenko et al., 2019), as teachers require information to implement organisational and strategic developments with innovative pedagogies.

Finally, from the learner perspective, the digital divide remains in terms of access to technology (De Wit et al., 2015). At the international and internal levels, the digital divide is a cause for concern in Europe in those countries considered to be digital leaders (Cruz-Jesus et al., 2016). Consequently, equal emphasis on digital skills and infrastructure development of digital platforms is required to help institutions meet their students' needs in relation to the digital divide (Chetty et al., 2018).

Purpose of the Present Study

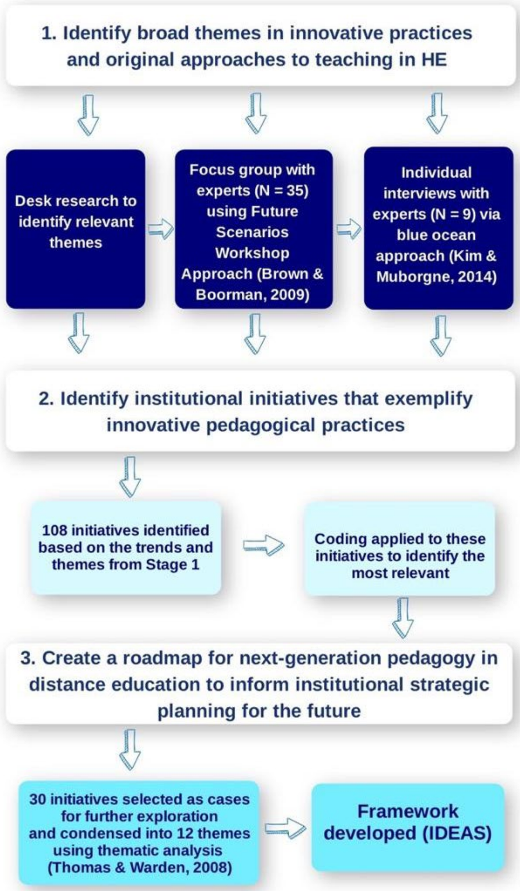
Based on a prior study by Guàrdia and Maina (2018), our research explores technology use as a driver of innovative change in higher education and its associated trends, challenges, and pedagogical practices facing the new, uncertain pandemic scenario. We aim to identify broad themes in innovative practices and the institutional initiatives that exemplify sound educational practices. The results are organised into a structured framework that will offer insight to universities that want to modernize and benefit from technologies and that will aid policy makers and university directors in their decision-making strategies in relation to innovation in higher education. Finally, we hope to spark debate about the future of universities given that in these unprecedented times, the future is now.

Research Design

Our study unfolds in three consequent phases as per the thematic synthesis guidelines of Thomas and Harden (2008). Adopting this approach facilitates the coding of findings, as well as the selection of descriptive themes, which in turn supports the development of the presented framework by providing a clearer understanding of the identified themes and initiatives (Vryonides et al., 2014). An overview of the research phases of this article is provided in Figure 1.

Figure 1

Overview of Research Stages



Stage one involved desk research of the academic and grey literature related to broad themes in innovative practices and original approaches (see Table 1) to teaching in higher education from 2015 to 2020. Prior to the search, the key themes were identified based on relevant academic reports, documented practices, and the researchers' professional expertise in innovative practices using information and communications technology. Projects financed in competitive calls were used as a reference to indicate the trends prioritized in education. We began our search using the term innovative practices, chosen for its specificity to the objective of this research. Using the Boolean operator AND, the innovative practices search term was linked to search terms related to higher education and technology, including higher education OR technology OR original approaches OR educational practices. Backward snowballing was used to expand the number of sources found within the reference lists of the reviewed literature to identify additional papers (Wohlin, 2014). The citation chaining option in Google Scholar was then used to further the literature search as it offers suitable coverage for systematic reviews (Gehanno et al., 2013) and is scholarly in terms of accuracy, authority, objectivity, currency, inclusion, and relevance (Howland et al., 2008).

A focus group of leading experts from the field of online education and technology (n = 35) was then held using the Future Scenarios workshop approach (Brown & Boorman, 2009). Working in small groups, participants brainstormed different scenarios for the future of universities, which contributed to the ongoing discussion about future possibilities, opportunities, and challenges in the sector. Finally, nine experts chosen for their expertise and research in online education and learning technologies in different geographic areas of the world were interviewed individually based on the results of the focus group, using the blue ocean approach to strategic planning (Kim & Mauborgne, 2014), which helps organisations discover their own unique selling point to differentiate themselves from similar competitors, thus offering more innovative and sustainable products. The interviews focused on questions regarding which kind of educational model could be devised to help the the experts create their own blue ocean for learning and teaching for institutions, both now and in the future, in terms of pedagogical innovations that do not imitate competitors, which were included in the experts' list of recommendations, highlighting different examples of the suggested innovations.

In stage two, examples of the trends and themes from the first phase were explored. A total of 108 initiatives in online, blended, and lifelong learning from institutions in Europe, the United States, Canada, and Australia were identified. The consulted reports, articles, and various sources discovered in the stage one literature search helped to identify, prioritize, and categorize many of the initiatives chosen. Coding was applied to these initiatives by two external researchers. The first researcher coded all 108 initiatives, and the second reviewed the 30 most relevant initiatives named by the first coder. One point was allocated to any initiative representing an example of either an educational current practice (max. points: 14); a challenge, concern, or area of interest for higher education (max. points: 12); or an innovative or original approach to teaching in higher education (max. points: 34). Initiatives that could not be transferred to an online environment were excluded; those remaining were captured in a spreadsheet, mapping the initiatives with their descriptions, country or region of impact, the main source of information, notes, and rating in relation to the coding criteria (see Table 2).

In stage three, 30 of the 108 initiatives with the highest ratings in the coding framework were chosen as cases for further in-depth exploration based on their transferability, key aspects, probability of bringing about significant change in higher education, and present innovations and trends identified in the literature. The main objective was to propose significant attributes to consider for next-generation pedagogy to inform institutional strategic planning for the future (see Tables 3 and 4).

The output of trends and themes were reorganised into a comprehensive set of attributes of next-generation pedagogy using the technology, organisation, and pedagogy model's rationale for data reduction (Sangrà et al., 2009), which matches technology, organisation, and pedagogy in e-learning.

Results and Discussion

A total of 14 trends (Table 1) emerged from stage one and were classified according to the three broad themes of interest: online learning and teaching, blended learning and teaching, and lifelong learning.

Table 1

Trends Identified in Desk Research

Online learning and teaching	Blended learning and teaching	Lifelong learning
Collaboration between higher education institutions Internationalization Digital literacy Learning analytics Massive open online courses Open educational resources	Flipped classrooms Bring your own device Teacher development Flexible and personalised learning Increased assessment-related activities	Vocational and educational training Collaboration between universities and employers Informal learning

In the stage two workshop, participants devised a list of 34 innovative approaches to teaching in higher education (Table 2), which influenced the selection of cases for further exploration, informed the final selection of cases, and oriented the content to interview the experts.

Table 2

Innovative Approaches to Teaching in Higher Education

Number	Innovative approach
1.	Adaptive learning technologies
2.	Artificial intelligence
3.	Augmented reality
4.	Authenticity
5.	Event-based learning
6.	Community of inquiry
7.	Community of interest
8.	Community of practice
9.	Competency-oriented education
10.	Connectivism
11.	Data portability
12.	Disaggregated services
13.	Digital badges
14.	E-portfolios
15.	Gamification
16.	Inquiry-based learning
17.	Internet of things
18.	Learning and performance support systems
19.	Meta-cognitive learning approach
20.	Modularity
21.	Personal learning environment
22.	Problem-based learning
23.	Project- and problem-based learning
24.	Recognition of open nonformal learning
25.	Rhizomatic learning

26.	Robotics applied to education
27.	Self-regulated learning
28.	Serious games
29.	Smart learning environment
30.	Social networking for education
31.	Structure opposed to flexibility
32.	Virtual mobility
33.	Virtual reality
34.	Virtual worlds

A thematic analysis—a qualitative method credited as being accessible and theoretically flexible (Braun & Clarke, 2006)—was applied to the 30 cases selected for further exploration. Twelve overarching themes in innovative practices and original approaches to teaching emerged from the selected institutional initiatives (Table 3).

Table 3

Themes of Innovative Practices and Original Approaches to Teaching in Higher Education

Theme	Key aspect
Active learning	Learner-generated content Gamification Problem-based learning
Beyond the institutional learning management system	Remote labs Personalised learning pathways Educational applications Software architecture integration
Collaboration between higher education institutions	Sharing and joint development of resources and courses Benchmarking practices Increasing offer of staff development opportunities Enhancing student exchanges
Digital literacy (digital competences)	Training programmes for teachers and students to support digital literacy Incorporation of learning technologies into teachers' practices
Employability and collaboration between higher education institutions and employers	Digital badges Placements/internships Nanodegrees
Flexibility and personalisation	Use of learning analytics Adaptive learning technologies Stackable degrees Free credits between institutions
Innovation as a curriculum topic	Massive open online courses Innovation projects directed by students and external stakeholders
Internationalization	Networking between institutions from different countries Enrolment of international learners

	Student and staff outbound/inbound mobility Foreign language learning Globally focused curricula Transnational delivery of courses
Learning analytics	Educational use of Web analytics and other student activity data Automatic e-mails to students veering offtrack from their studies Increasing communication between institutional representatives and students Allowing students to understand their progress in comparison to the overall cohort Live updates for checking students' progress Adaptive learning platforms
Nonformal and open learning	Recognizing nontraditional learning Open educational resources Massive open online courses Micro-credentials as recognition for learning achievements
Recognition of prior learning	Acknowledgement of learning outside of formal credit award training and educational programmes References from experienced referees List of past achievements Monographs, journal articles, speech notes

Based on the interviews and investigation of innovative approaches and thematic analysis, the data set was reduced to reveal the IDEAS framework, developed as a signpost on the roadmap of next-generation pedagogy, alongside the landmark practices for each one (Table 4). The acronym comprises the five key characteristics of innovative, next-generation pedagogy: Intelligent, Distributed, Engaging, Agile, and Situated.

Table 4

IDEAS Next-Generation Pedagogy Framework for Transforming Higher Education

Characteristic	Landmark practices
Intelligent (I)	Informing educational decisions using learning analytics Teaching digital competences Taking learning and teaching beyond the institutional learning platform Creative use of emerging technologies
Distributed (D)	Making the most of partnerships with other institutions, employers, or professional bodies Disaggregating teaching, content provision, assessment, academic support, and other services Involving a wider community of interest in research and teaching activities

Engaging (E)	Designing for active learning: encouraging problem solving and knowledge construction by learners Reducing the focus on content and increasing the focus on learning
Agile (A)	Facilitating personalisation and flexibility of learning pathways Expanding options for recognition of prior learning Widening participation in higher education Fostering internationalization and student mobility
Situated (S)	Contextualising learning and assessment activities in the real world Expanding work-related learning opportunities Focusing on society's big issues

Intelligent pedagogy involves the use of technology such as learning analytics to enhance the learning experience. Learning analytics helps to identify students who are offtrack with their studies, update them with live progress reports, identify popular learning materials and methods to adapt coursework according to individual learners needs, and replace the learning management system with student data management, human resources management, and/or financial management. Teaching DC is another landmark practice to consider as a student learning outcome, as well as providing DC training and development for staff, and establishing a DC institutional culture. Also, taking learning and teaching beyond the institutional learning platform is vital and can be achieved by encouraging students to be curators/creators of online platforms relevant to the course content, creation, and/or participation in virtual/collaborative project work platforms for students and staff—so they can work with professionals and community members outside of the institution—and by ensuring that software architecture incorporates a range of educational applications (tools, systems, content). These practices encourage active learning by increasing student autonomy and the creative use of emerging technologies such as remote labs or augmented and virtual reality that enhance learners' educational experiences. Additionally, the use of mobile device apps that support learning via student input and collaboration could be implemented.

Distributed pedagogy is related to the shared ownership of aspects of the learner's journey by various stakeholders in the process. It includes collaborative alliances between institutions and a deliberate disaggregation of services to let learners choose their learning experience from a competitive marketplace, demonstrating that a university education no longer depends on institutions to provide learning materials, teaching, and accreditation, as they have more freedom in the services they provide. Thus, increasing focus on strategic partnerships through collaboration, building curricula and credentials with employers/employer bodies, tailoring programmes to enhance students' employability and support innovation in the industry, and partnering with agencies that can provide specific services for more flexibility such as 24-hour academic support for students is needed. Further elements of this practice include open access to courses and course materials alongside assessment and formal credits for successful demonstration of learning outcomes, institutional collaboration to recognize credits obtained via open/nonformal learning, offers of challenge exams and recognition of prior learning, and learners' empowerment to receive formal credit for learning from a variety of formal and informal sources. Finally, involving a wider community of interest in research and teaching activities such as projects that students can work on with professionals and interested members of the public to address problems of wider interest to society is recommended.

Engaging pedagogy encompasses students' desires to be engaged by what they are learning. Examples of effective practices for this characteristic include strategic design for active learning—which implies learners having a more active role in content generation—active use of technology for learning, learner-built portfolios, appropriate use of gamification, and learners' encouragement to proactively seek and use teacher, peer, and wider academic community feedback. Both a reduced focus on content and an increased focus on learning are also needed. Reducing the course content and replacing it with learner-focused content—that is, learners find and evaluate information and apply it to real-life contexts and approaches to learning that include problem solving and project work in teams—are recommended. It is crucial to support teaching staff in creating engaging pedagogy by encouraging them to find, select, reflect on, and participate in learning activities that match their levels of expertise; offering teaching enhancement programmes that fit easily into their workload; and ensuring recognition for continuing professional development (e.g., digital badges/micro-credentials).

Agile pedagogy addresses the need for flexibility and responsiveness to learners' needs. Facilitating personalisation and flexibility can be achieved by modularizing degree programmes as stand-alone blocks to be studied at home or at partner institutions, providing different entry points to degree programmes, eliminating preset deadlines and maintaining fixed schedules for assessment of learning, providing self-assessment tools so students can decide if a flexible programme suits them, proposing optimal course plans (learning pathway) with grade requirements and milestones, offering a variety of personalised assistance services such as online tutoring to support students, and tailoring communications and rapid responses to individual students' and teachers' needs, as well as tailoring access to learning resources, activities, and support to users.

Expanding the options for recognition of prior learning involves issuing micro-credentials—for example, nanodegrees, digital badges, or skill certificates endorsed by employers based on successful completion of assessment; showcasing digital badges/credits on students' online profiles; integrating e-portfolios into students' personal learning environments; and awarding academic credits for evidence of prior learning. Moreover, the following actions are also recommended: widening participation by recruiting lifelong learners as opposed to traditional undergraduates; offering students money-saving and time-saving options or a subscription-based fee whereby students pay less based on the time taken to complete the programme or free online courses; offering resources as transition points/credits towards formal degree programmes; and encouraging sponsorship to support free access to personalised support, academic credits, and certificates of achievement to online employment-focused MOOCs.

Another aspect of agile pedagogy refers to promoting internationalization and student mobility through partnerships with other universities, inviting students to experience different pedagogies and perspectives by taking a course or a number of free credits to use on MOOCs or distance courses offered by other institutions.

Situated pedagogy refers to the real-world relevance of the curriculum and the contextualisation of the learning process in terms of learners' personal/professional goals. To contextualise learning activities, educators should ensure that teaching and assessment reflect authentic contexts, giving learners the opportunity to apply the knowledge they have learnt and partner with companies, community organisations, government institutions, and nongovernmental organisations to identify key job-related competencies and integrate career development opportunities into the curriculum. They can then create an online platform to facilitate the coordination, development, and documentation of real-world projects. Further practices include expanding work-related learning opportunities via virtual mobility and placements; providing internships and research projects for industry clients; integration of assessments that simulate on-the-job work into programmes, emphasising feedback over grades; incentivising student participation in business projects by paying for successful solutions; offering online access to job vacancies, employer lectures, international opportunities, networking events, career profiles, and CV building resources; enabling students to demonstrate their knowledge and capabilities to prospective employers via a video platform; encouraging alumni to share work-related experiences with current students; and providing mentoring and/or internships and embedding innovation and entrepreneurship knowledge and skills in the course content.

Finally, big issues in society should be addressed. Practices aimed at achieving this goal include the following: student-led entrepreneurial activities or research projects using input from the public/community partners on custom-built platforms; collaborations with nonprofit organisations that widen participation in higher education—for example, programmes targeted at the refugee community; and engagement in local and regional initiatives for environmental protection and sustainability.

Conclusions

Higher education is being pushed to undergo rapid change and transformation. All higher education institutions, educational leaders, and administrators are expected to remain up to date with technological trends and societal demands, while continuing to provide high-quality education. The aim of this study was to detect the key themes, concerns, and examples of pedagogical innovative practices that drive transformation in higher education. A review of the extant literature alongside experts' opinions and thematic analysis revealed the most crucial areas for discussion in terms of technology, organisation, and pedagogy, as captured by the IDEAS framework. Focusing on the core framed characteristics here identified could encourage innovation in curriculum design and permit institutions to demonstrate their strengths and unique pedagogical approaches that differentiate them in the context of globalized education.

Our research focused on pedagogical innovation supported by technology as a catalyst for next-generation pedagogy supported by studies that highlight the key role of technology in both development and change in higher education (Goh et al., 2020; Haywood et al., 2015; Westine et al., 2019). A prime example is learning analytics: research shows that they influence student outcomes, and in organizational terms are useful for student assessment (Marshall, 2018), and can improve learning practices in the learning process (Viberg et al., 2018).

Another relevant outcome from our research is the emphasis on the need to ensure DC for both staff and students. It is essential that staff are digitally competent in order not only to implement and adopt innovative pedagogical practices but also to promote pro-change attitudes. Research has suggested that negative attitudes to change in teaching methods can limit advances in their implementation (Bates, 2019; Englund et al., 2017; Watty et al., 2016). Therefore, the need to include DC as a core objective in institutional and organisational planning is emphasised as it can complement the implementation of the necessary pedagogical and technological changes detected in our study. For students, DC is linked to the increased focus on active learning and students as autonomous actors in choosing and defining their learning trajectory. A major factor behind this is the student who no longer depends solely on traditional learning resources to continue their personal and professional development (Henderikx & Jansen, 2018; Wick et al., 2015).

Furthermore, our study creates a space for debate and reflection with regard to the COVID-19 pandemic. The IDEAS framework proposes a set of key strategic points regarding challenges and trends in the field and highlights the most urgent aspects that need to be addressed. The pandemic has demonstrated that many higher education institutions remain strategically unprepared to provide quality education in times of crisis, as seen in the difficulties reported globally when educators were forced to move their classes online (Gasevic, 2020). IDEAS provides a response that can help in a priori strategic and organisational planning as a robust method to prepare for the near future of higher education.

In summary, this article provides an overview of the current changes, trends, and challenges at the centre of higher education's transformation, highlighting pedagogical innovation supported by technology as a core aspect. The IDEAS framework is intended to be indicative rather than comprehensive and descriptive rather than prescriptive. It is proposed as a guide to identify crucial issues and to support decision making, organisational planning, and structural design, thus developing strategies for institutions to remain at the cutting edge of transformational higher education while addressing challenges and concerns. It can be used to spark reflective thinking, brainstorming, debate, and imaginative planning for future policies at the institutional and cross-institutional levels. Finally, it can be applied to further research in the various associated themes being investigated by providing focal points to develop and explore hypotheses.

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What Is Open Pedagogy? Identifying Commonalities

Phil Tietjen[1] and Tutaleni I. Asino[2]
[1]Davidson-Davie Community College, [2]Oklahoma State University

Abstract

Open pedagogy has been touted by advocates as a promising expansion of open educational resources because it involves shifting from making resources accessible to impacting the practice of teaching. The allure of the term coupled with its promise to bring greater innovation to pedagogy has led to its widespread use at conferences and publications. However, as the concept has gained increasing levels of popularity, it has also sparked considerable debate as to what it means. For example, how is open pedagogy distinct from other forms of pedagogy such as critical or cultural? What does it mean to practice open pedagogy? Without a clear understanding of its meaning, establishing a solid research foundation on which to make claims about the impact of open pedagogy approaches is difficult. Accordingly, this article argues that the current debate signals the need for the development of robust analytical frameworks in order to construct a cohesive body of research that can be used to advance it as a field of study. To do this, the authors review the literature and identify common characteristics within it. The authors then propose a five-part framework that encourages the long-term sustainability of open pedagogy.

Keywords: open educational resources, open pedagogy, open educational practices, framework

Introduction

The field of open education has been steadily growing since the Cape Town Declaration of 2002. Research has included issues pertaining to adoption of open educational resources (OER) and evaluation and impact at the student, faculty, and institutional levels (Braddlee & VanScoy, 2019; Colvard et al., 2018). Griffiths et al.'s (2020) recent study examining the impact of Achieving the Dream's OER degree initiative shows an explosion of OER courses, particularly on community college campuses. As OER has gained momentum, some of its ardent supporters have argued that it should consist of more than free books or resources. They state that it offers compelling implications for pedagogy, such as increasing the level of student engagement and pedagogical innovation (Andrade et al., 2011; Orr et al., 2015). Advocates for this view often use the general umbrella term: open pedagogy (OP) (DeRosa & Robison, 2017; Hegarty, 2015; Wiley, 2013). But for those who are interested in practicing OP, what exactly does that mean? What processes, steps, and/or benefits does that entail? How do they make it happen? More broadly, what exactly does it mean to practice or do OP?

On the surface, OP seems attractive, as the term itself evokes a very optimistic and uplifting imagery of teachers openly sharing ideas related to teaching and partnering with students in the education process. However, a review of the literature quickly reveals that there is no agreed-upon definition of what the term OP means; indeed, quite a broad spectrum of proposed definitions exists. Some argue that OP is distinguished by the use of open licenses that enable learning materials to be freely accessed, reused, and remixed (Wiley, 2013). Others assert that it is less about resources and more about pedagogical practices where, for example, students become participants in a broader ecosystem of public knowledge (DeRosa & Robison, 2017; Luke, 2017; Morgan, 2016). As a complement to pedagogical practice, others advocate that it should be strongly connected to matters of social justice (Bali, 2016; Koseoglu, 2017). While the term OP has generated popular appeal, Jhangiani cautions that such popularity can also undermine its meaningfulness: "I am concerned about using the term 'open' so broadly and in so many ways that it becomes essentially meaningless" (Open Education Consortium, 2017, "What is Open Pedagogy?", para. 4). Similarly, Hilton (2017) argues that the need for greater clarity and coherence is central to making research-based claims about the impact of OP:

> Open pedagogy is frequently touted at conferences, yet little research has been done on its efficacy, how teachers/students perceive it, and so forth. … Will widespread adoption of open pedagogy spark dramatic improvements in learning? Those who study this question *need to carefully consider what they mean by open pedagogy, an increasingly contested term* [emphasis added], and the metrics they use when determining whether open pedagogy leads to increased learning outcomes. (p. iv)

Hilton's critique underscores the point that to make claims about the efficacy of OP and thereby establish a sustainable foundation of research, it is essential that we bring clarity and cohesion to how we conceptualize OP. With this in mind, we argue that it is time to bring a greater sense of cohesion to the concept of OP by identifying commonalities. Our purpose in this article is twofold: (a) to make sense of the OP concept as it has been discussed in the literature, and (b) to identify commonalities that can be used for building a flexible, responsive framework.

Two Clarifications Regarding the Focus of This Article

Before proceeding further, two important clarifications need to be made. First, part of the confusion around the definition of OP may be due to ambiguous use of terms. In our research, we often found this ambiguity to manifest itself in one of two ways: either (a) the term OP was used interchangeably with the term open educational practices, or (b) OP was presented as another branch of open education. Our primary interest centers on the adjective that links them both: open. Accordingly, since the purpose of this article is to make sense of this debate, our discussion and analysis will incorporate research that has used the terms OP and/or open educational practices (OEP).

The second clarification pertains to the history of the term OP. Morgan (2016), Jordan (2017), Rolfe (2016), and others have pointed out that the term OP has been around since at least the 1970s. While we recognize that the term is not new, for the purposes of this essay, we are focusing on the debate that has resurfaced since the introduction of social Web technologies as tools for expanding the impact of open education (Brown & Adler, 2008) and especially since the publication of the 2011 Open Educational Quality Initiative (OPAL) report (Andrade et al., 2011), which called for OER to impact pedagogical practice as well as provide access. With this in mind, our discussion pertains to research that has occurred within the general time frame of the 2010s to the present.

Method

In reviewing the literature, we focused on sources that specifically address the challenge of developing a definition or conceptualization of OP. In addition, because we found that the term OP was often used interchangeably with the term open education, we included that term as well.

We used a university library database that simultaneously searches major databases (e.g., EBSCO, PsycINFO). As inclusion criteria, we included the following source types: articles, book chapters, conference proceedings, and books published between 2011 and 2020. We employed Boolean search parameters to ensure that only materials that contained the exact words were returned. This process yielded a total of 938 articles (Table 1).

Table 1

Search Results—Articles

Term	Source type	No. articles found
Open education	Articles, book chapters, conference proceedings, and books	273
Open education	Peer-reviewed articles only	181
Open pedagogy (title only)	Articles, book chapters, conference proceedings, and books	10
Open pedagogy (any field)	Articles, book chapters, conference proceedings, and books	95

Open pedagogy (any field)	Peer-reviewed articles only	63
Open educational practices (any field)	Articles, book chapters, conference proceedings, and books	272
Open educational practices (title only)	Articles, book chapters, conference proceedings, and books	44
Total articles found		938

In reviewing of these results, we found that many were duplicate entries; eliminating those narrowed the results to 127 citations. We further analyzed these and found that 87 discussed the issue of definition in more than superficial detail (i.e., more than 1–2 sentences). Similarly, 24 of those 87 discussed it in substantive detail and were considered to have met the relevant criteria.

In addition to research databases, we also consulted blog posts from 2017 that were written by authors interested in OP. We chose to focus on blog posts from 2017 for three reasons. First, Open Education Global (formerly the Open Education Consortium) organized a yearlong celebration of various phenomena related to openness where the month of March was specifically dedicated to OP. Second, the Association for Learning Technology (ALT, 2017) dedicated the theme of its annual conference that year to issues pertinent to open education. Third, one of the more visible voices in OP, Maha Bali, compiled a list of blog posts from various educational technologists, teachers, and researchers who had used the ALT conference as material for writing their own thoughts concerning open education. Our review of this list found that 15 bloggers presented a definition of OP (Table 2).

Table 2

Blog Posts, 2017: Year of Open

Author	Title	OP definition
Atenas	Open education in Palestine: A tool for liberation	No
Bell (1)	Preparing for OER17	No
Bell (2)	Ground zero approaches to open #YearofOpen	No
Campbell	Open pedagogy—A view from a distance	No
Cangialosi	More questions than answers (about open ped)	Yes
Cronin (1)	OER17: Personal and political	No
Cronin (2)	Opening up open pedagogy	No
DeRosa	Open pedagogy: Quick reflection for #YearOfOpen	Yes
Fraser	Waves not ripples: Reflections on #OER17	Yes

Groom	I don’t need permission to be open	Yes
Jhangiani	Definitions vs. foundational values	Yes
Kalir	Marginal syllabus as OER and OEP	Yes
Koseoglu	Open pedagogy: A response to David Wiley	Yes
LaLonde	Does open pedagogy require OER?	Yes
Luke	What’s open? Are OER necessary?	Yes
Morgan (1)	Open pedagogy and a very brief history of the concept	Yes
Morgan (2)	Reflections on #OER17—From beyond content to open pedagogy	Yes
Smith	Feature: Open is as open does	Yes
Veneruso	Convergence: Open pedagogy and complexity	Yes
Weller	My definition is this	Yes
Wiley	When opens collide	Yes

**Note*. OP = open pedagogy; OER = open educational resources; OEP = open educational practices.

In general, we found our first source of data (i.e., journal articles) provided more depth and detail, and so most of our discussion relies on that work.

Analysis and Findings

We organize our findings into two phases: (a) phase 1, 2011–2016, where 2011 marks the publication of the 2011 OPAL report; and (b) phase 2, 2017 and beyond, which corresponds to the occurrence of two key events, namely, the Year of Open (2017), which compiled different definitions of OP, and the OER17 conference, which generated a considerable number of blog posts. In addition, we classified the definitions into two categories: (a) based on characteristics and (b) based on policy. Table 3 presents a sample of the definitions.

Table 3

Definitions of Open Pedagogy and Open Educational Practice

Citation	Definition	Purpose
Bali et al. (2020)	Propose OEP definition based on a three-part typology ranging from (a) content-centric to process-centric, to (b) teacher-centric to learner-centric, to (c) pedagogical to primarily social justice focused	DBC
Bloom (2019)	OP refers to the broader practice of leveraging the permissions of open content to redesign educational experience to be more meaningful and engaging to students	DBC
Conole & De Cicco (2012)	Defines OEP on four dimensions: (a) strategies and policies, (b) barriers and success factors, (c) tools and tool practices, and (d) skills development and support	DBC
Cronin (2017)	OEP are collaborative and pedagogical practices that involve the creation, use, and reuse of OER as well as participatory technologies and social networks to interact, learn, create knowledge, and empower learners	DBC
Czerniewicz et al. (2017)	Views OP in terms of four aspects: (a) legal openness, (b) pedagogic openness and learning in networks, (c) encouraging others to teach and learn in open networks, and (d) reusing content in teaching and other contexts	DBC
Ehlers (2011)	OEP are defined as practices that support the (re)use and production of OER through institutional policies, promote innovative pedagogical models, and respect and empower learners as coproducers on their lifelong learning path (p. 4)	DBP
Franco et al. (2014)	OEP are practices that include the creation, use/reuse, and repurposing of OEP in order to innovate and improve education (OPAL, 2011a)	DBP
Hodgkinson-Williams (2014)	Defines OEP based on a proposed five-part framework regarding openness: (a) technical openness, (b) legal openness, (c) cultural openness, (d) pedagogical openness, and (e) financial openness	DBC
Koseoglu & Bozkurt (2018)	Defines OEP as "a broad range of practices that are informed by open education initiatives and movements and that embody the values and visions of openness" (p. 455)	DBP
Murphy (2013)	OEP refers to "policies and practices implemented by higher education institutions that support the development, use and management of OER, and the formal assessment and accreditation of informal learning undertaken using OERs" (p. 202)	DBP
Nascimbeni & Burgos (2016)	OEP are "practices 'based on a competency-focused, constructivist paradigm of learning [that] promote a creative and collaborative engagement of learners with digital content, tools and services in the learning process'" (p. 1)	DBC
Paskevicius et al. (2018)	OP "focuses on the literacies and approaches to teaching and learning that take advantage of the unique affordances of OER" (p. 118)	DBC

**Note*. OEP = open educational practices; DBC = definition based on characteristics; OP = open pedagogy; DPB = definition based on policy.

Phase 1: 2011–2016

A pivotal document in facilitating the shift from an emphasis on resources (i.e., OER) to pedagogical practice (e.g., OP, OEP) was the 2011 report by OPAL (Andrade et al., 2011). Ehlers (2011) builds on the OPAL report by proposing a framework that educational organizations can use to determine the degree to which they have shifted to practice. He defines OEP as "practices which support the (re)use and production of OER through institutional policies, promote innovative pedagogical models, and respect and empower learners as co-producers on their lifelong learning path" (p. 4). Nascimbeni and Burgos (2016) conceptualize OEP as a continuum on which the focus is more directly on the individual educator who may be unaware of OER and its implications for pedagogy. They argue that more attention needs to be given to the social change processes that inevitably need to happen if instructors are to adopt the identity of an open educator. Conole (2012) uses OEP as a way to emphasize the social processes that can facilitate a transition from resources to practice:

> The vision of open educational practices includes a move from resource-based learning and outcome-based assessment to a learning process in which social processes, validation and reflection are at the heart of education, and learners become experts in judging, reflecting, innovating and navigating through domain knowledge. (p. 250)

Her definition highlights the liberatory dimensions of context as learners are no longer restricted to the boundaries of a proprietary textbook but are presented with pathways for participating in an open learning ecosystem. Hodgkinson-Williams (2014) proposes a framework that specifies five types of openness: technical, legal, cultural, pedagogical, and financial. She argues that successful implementation of OEP requires understanding different types of openness and how overcoming obstacles related to these different levels can vary depending on the geographic region of the world in which the implementation is being attempted. Schreurs et al. (2014) argue that the social learning dynamics that occur in contexts such as OEP are complex and involve shifting levels of membership and activity, therefore necessitating a different framework than more common, established social learning frameworks such as Communities of Practice. They propose conceptualizing OEPs as containing four "dimensions of social configuration": practice, domain, collective identity, and organization (p. 5).

As noted previously, other scholars have used the term OP. One of the most visible conceptualizations of OP is Wiley's (2013) 5Rs. First conceived in 2013, Wiley's definition identifies five specific rights enabled by using an open licensing system:

- *Retain*—"the right to make, own, and control copies of the content"
- *Reuse*—"the right to use the content in a wide range of ways (e.g., in a class, in a study group, on a website, in a video)"
- *Revise*—"the right to adapt, adjust, modify, or alter the content itself (e.g., translate the content into another language)"
- *Remix*—"the right to combine the original or revised content with other open content to create something new (e.g., incorporate the content into a mashup)"

- *Redistribute*—"the right to share copies of the original content, your revisions, or your remixes with others (e.g., give a copy of the content to a friend)" (Wiley, 2014)

One of the underlying forces driving Wiley's conceptualization of OP is to combat the problem of the disposable assignment. In a traditional classroom, the student spends numerous hours working on an assignment that the professor then grades and returns; however, its purpose and usefulness generally end there. Wiley argues that the unfortunate consequence of this traditional academic transaction is that it treats the assignment as a disposable thing. He therefore proposes that students and teachers extend the value of this work by sharing it with the broader outside world. Such an emphasis connects to Scardamalia and Bereiter's (2014) knowledge-building framework, which is well known in the learning sciences community: "In Knowledge Building theory, pedagogy and technology, students' work is *primarily valued for what it contributes to the community* [emphasis added] and secondarily for what it reveals about individual students' knowledge" (pp. 397–398). In Wiley's 5Rs framework, having the right to freely distribute materials and therefore without the constraint of copyright is the key element that distinguishes OP from other forms of teaching practice.

From another perspective, Bali calls for greater semantic scrutiny of the word open: "When we call anything 'open' we need to clarify: What are we opening, how are we opening it, for whom, and why?" (Open Education Consortium, 2017, "What is Open Pedagogy Anyway?", para. 1). These important framing questions extend the work of an earlier blog post titled "Reproducing Marginality?" (2016), where Bali looks at OP through a prism of power dynamics and questions that critically examine assumptions regarding how it manifests in practice. She argues that despite good intentions, open communities can still unwittingly create boundaries that marginalize certain voices; therefore, "opening doors is not enough," since a genuinely open space requires that participants "listen and care and support marginal voices. Whether or not they wish to speak. Whether or not they wish to be present. Whether or not they like what we do" (Bali, 2016, para. 16).

In a similar vein, Bayne et al. (2015) argue that open is all too often viewed with an uncritical eye and framed in exclusively optimistic terms that downplay the different forms and levels of impacts created by implementations of openness: "Much less common is the acknowledgement that openness reconfigures or maintains particular notions of learning, teaching, and human being" (p. 248). They urge researchers and practitioners to view openness in a more nuanced way because without a more critical view, there is a tendency to oversimplify the organizational, political, economic, and other obstacles associated with pursuing educational models characterized as open. Another important contribution comes from Hegarty (2015), who conceptualizes OP as comprising eight attributes (e.g., participatory technologies, connected community). Central to Hegarty's model is how OP enables individuals to share, modify, and repurpose learning materials with a broader community of learners and educators. Voices such as Hegarty's represent an important first phase of contributions toward defining OP and OEP. Next, we turn to the second key phase of the definitional debate.

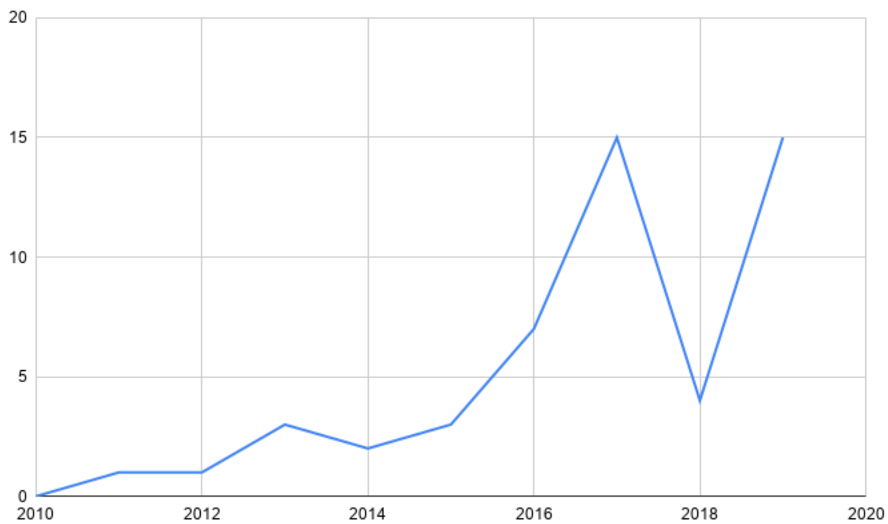
Phase 2: 2017 and Beyond

As noted, 2017 marked a significant moment in the various conversations and debates regarding how to define OP. First, there was a dramatic uptick in the number of articles published on the topic of OP (Figure

1). Second, 2017 was established as the Year of Open, with March dedicated to sharing different perspectives on OP. Third, the ALT organized its 2017 conference around discussing issues pertaining to open education, which in turn inspired many blog posts.

Figure 1

Research Articles on Open Pedagogy: Articles Using Open Pedagogy



Much of the literature on OP points to attributes such as open licenses and reusable assignments. For example, Jhangiani's vision of OP centers on three key elements (Open Education Consortuim, 2017). The first is that open licenses are central to promoting the growth of innovative teaching and learning practices. Second, OP is primarily demonstrated through renewable course assignments. Third, OP actively encourages educators to openly share their course design and development practices. For DeRosa and Robison (2017), one of the most exciting benefits of OP is that students become active participants in knowledge-building communities that live beyond the immediate confines of their own classrooms.

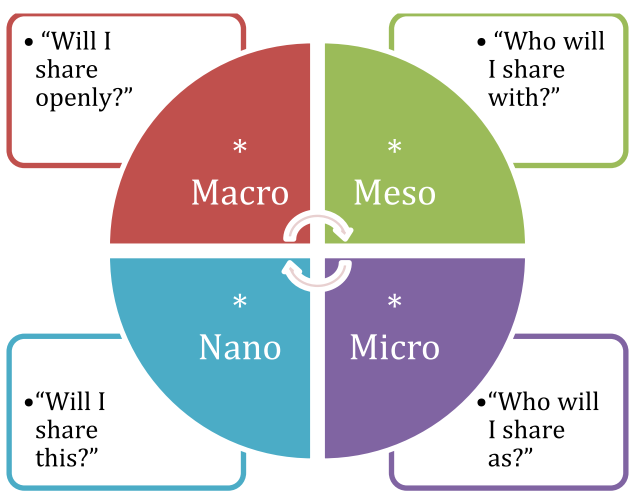
Their conceptualization of OP draws inspiration from Stommel's (2014) "critical digital pedagogy," which, among other distinguishing practices, "centers its practice on community and collaboration" and its "application outside traditional institutions of education" (para. 3). Bloom (2019) explores OP within a community college setting and asserts that research studies of OP follow too limited a vision when they confine themselves to simple comparisons between learning contexts that use OER materials and those that do not. One of the distinctive advantages of OP is the way it uses the flexibility of open licenses to address the problem of disposable assignments, thereby enhancing the meaningfulness of the student's learning experience. Nizami and Shambaugh (2019) see OP as a way to eliminate information barriers between universities and the broader community within which they are situated. They propose that OP should emphasize a holistic approach where open practices are not something that happen only within academic silos but include local community partners such as public libraries that can bring learning materials to marginalized constituents. Thus, social justice represents an important component of Nizami and Shambaugh's vision of OP.

This second phase of 2017 also witnessed further conceptualizations of the related term OEP. Bali et al. (2020) present a three-dimensional framework that includes (a) content-centric to process-centric and (b) teacher-centric to learner-centric and (c) pedagogy-centric to social justice-centric (p. 2). They argue that successful OEP should actively support and encourage connections to a diverse range of voices. In addition, social justice represents a central component to their framework. They explain that projects such as Equity Unbound and the Open Pedagogy Notebook offer learners ways to channel the learning artifacts they create through OER as a means of ameliorating inequities that exist in the broader world.

Cronin (2017) proposes a definition of OEP that considers instructors' attitudes toward openness and how they shape their willingness to practice their teaching in more open ways: "collaborative practices that include the creation, use and reuse of OER, as well as pedagogical practices employing participatory technologies and social networks for interaction, peer learning, knowledge creation and empowerment of learners" (p. 18). Her definition is developed within the larger context of a study investigating the rationale and extent for why academic staff employ OEP. Cronin found that educators' open practices could be expressed in terms of four dimensions: (a) balancing privacy and openness, (b) developing digital literacies, (d) valuing social learning, and (d) challenging traditional teaching role expectations (p. 23). Most prominent among these four dimensions was (a) balancing privacy and openness. Similarly, further data analysis suggests that the decision making related to this tension between privacy and openness could be expressed as four levels of consideration: macro, micro, meso, and nano (Figure 2).

Figure 2

Adaptation of Cronin's Privacy and Openness Model



Adapted from "Openness and praxis: Exploring the use of open educational practices in higher education." By C. Cronin, 2017, *The International Review of Research in Open and Distributed Learning, 18*(5). CC-BY.

This four-part consideration model underscores the need for greater awareness, connectedness, and recognition of the complexities of openness.

Karunanayaka and Naidu (2017) agree with many other OEP advocates who argue for the need to move beyond the accessibility of OER content and focus more on the way they can impact practice and cultivate creativity. But they extend that argument by asserting that the likelihood for success can be significantly enhanced by using a design-based research approach where OEP evangelists partner with those who are less familiar or enthusiastic. Doing this improves the chances for realizing a successful form of OEP that is more organic and compatible with the local context. Similarly, in a 2019 report for the European Union Joint Research Center, dos Santos and Punie see OEP as a way to shift the emphasis from availability of content (i.e., OER) to pedagogical practice. Echoing this emphasis on practice, Harrison and DeVries (2019) define OEP as including any, or all, of the following practices: creating or incorporating OER materials into learning contexts, using free and open-source software, and open sharing of research and scholarly practice. Koseoglu and Bozkurt (2018) propose that OEP should take an expansive approach, where interested educators and learners have multiple points of entry. These entry points can include practicing open scholarship, open assessments, and open teaching, as well as the creation, use, or adoption of OER materials. Paskevicius (2017) directs attention to how OEP can be aligned with specific phases of instructional practice (e.g., learning objectives, assessment).

A helpful complement to the work that appeared in journal articles was the array of contributions that appeared in educational blogs. Morgan (2017), for example, finds a lot to like in Wiley's 5Rs but expresses reservations regarding its preoccupation with content: "Is content what defines open pedagogy?" (para. 5). Her vision of OP rests more on the practices and activities—that is, the means of how OP happens—than on the static content. For Cangialosi (2017), OP is about students and educators taking a more active role on the Web by claiming their own domains and digital identities. Practicing OP means making a political statement about individuals' rights to establish and manage their own digital identities on the Web so they can use that freedom to create, customize, and contribute to learning experiences that are not bound by rules stipulated by commercial interests. Fraser (2017) is critical of the distinction between OP and open practice. She reasons that if OP is all about bringing educational and teaching practices out into the open, then why not use the word practice? She wonders if the word pedagogy is simply being used as "shorthand for educational practice" (para 5). Koseoglu (2017) resists seeing OP through a singular lens. With specific focus on Wiley's 5Rs model, she asserts that the debate is less about definition than method. Luke (2017) asserts that Wiley's 5Rs attach too much emphasis on resources, which is problematic because an undue emphasis on resources runs the risk of reducing pedagogy to a commodity or property. He argues that the distinguishing element of pedagogy is process and that this process plays out through traversing six dimensions of openness (e.g., isolation vs. connectedness), where each presents a tension between freedom and authority embedded in pedagogical processes. Overall, 2017 and beyond represents a period of significant volume of activity regarding the challenge of defining OP and OEP. Next, we identify some commonalities among this range of perspectives as a means toward building a framework for analyzing this phenomenon across contexts.

Perhaps aware of the considerable debate generated by the many attempts to define OP, Wiley and Hilton (2018) argue that the attempt to reach agreement on a "common definition" of OP is "essentially impossible" (p. 135). Accordingly, they propose that a more productive path is to avoid pursuing such a goal and instead propose a new term: OER-enabled pedagogy. The authors define *OER-enabled pedagogy* as a "set of teaching and learning practices that are only possible or practical in the context of the 5R permissions which are characteristic of OER" (p. 135). By moving away from the debate around the word open, they redirect the focus to the material artifacts of OER and the open licensing system that suggests its potential for bringing measurable impacts on teaching and learning. Their proposed new term tightens the link between OER and pedagogy. In this view, open is implicitly defined by the licenses because it is that which allows the artifact to move from something that is an academic classroom object to a community one.

The Five-Circle Framework

After reflecting on the work above, we conceptualize OP as comprising five elements.

1. First, OP recognizes the diversity and culture of the learners by welcoming them as design partners in the conversation.

2. Second, OP is a participatory pedagogy for multiple stakeholders.

3. Third, open licenses are central to OP's ability to thrive and grow because they allow for vital practices such as modifying, reusing, and remixing. (We do, however, acknowledge the inherent conflicts in open licenses and agree that they may not be cross-culturally informed.)

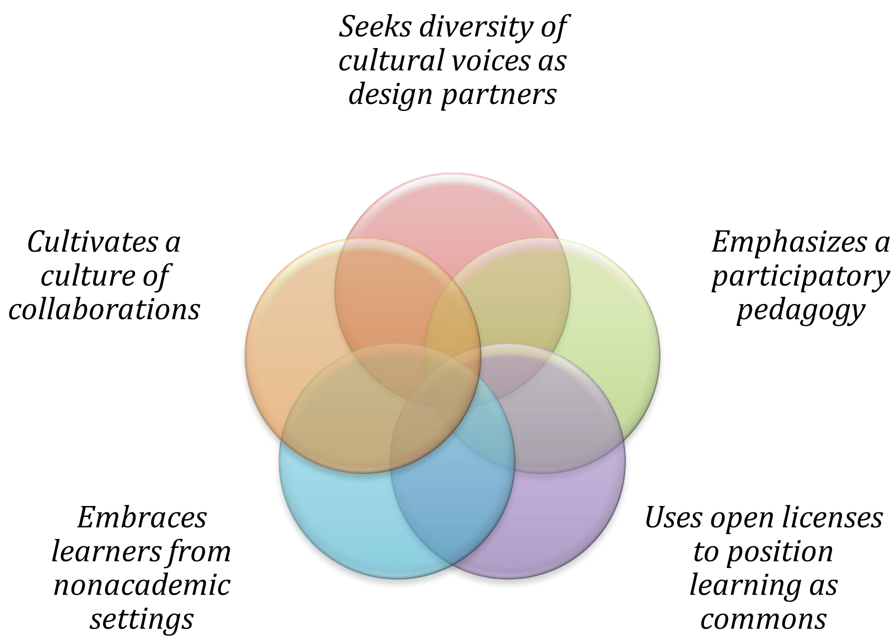
4. Fourth, OP actively encourages learners, both inside and outside school settings, to share, review, edit, and contribute resources and, as a result, promote the development of a knowledge-building community.

5. Fifth, OP fosters a culture of collaboration through practices of sharing, reviewing, and editing.

We graphically present these five elements with overlapping circles to emphasize interconnectedness and expand on each (Figure 3).

Figure 3

The Five-Circle Framework



First, we see OP as poly-vocal and thriving on a diverse spectrum of voices. As an Internet-enabled, knowledge-building collective, OP welcomes participation and contributions from around the globe. OP recognizes the vital role that international organizations such as the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Council for Open and Distance Education (ICDE) have played in promoting the benefits and wider implementation of OP (e.g., OPAL Initiative, 2011). Efforts such as theirs establish the diversity of voices and representation as a distinguishing feature of OP.

Second, OP is a participatory pedagogy. Rather than seeing pedagogy in terms of a traditional instructor–student hierarchy, where the learner is the passive recipient of knowledge, it conceptualizes the learner as a peer contributor to a broader community that extends beyond the boundaries of a specific academic cohort. This is enabled through social Web technologies such as wikis, tagging, open messaging platforms, and similar tools.

Third, another important feature is the role of open licenses: without these, people cannot openly share, reuse, revise, and remix materials. This element draws its inspiration from open-source software and, more broadly, the notion of the commons, where a community openly shares and manages resources to respond to a particular need (Benkler, 2005; Ostrom, 1990). As an educational commons, the goal of students and teachers is to extend the value of their work by inviting the commons to build on it.

Fourth, OP also actively encourages participation from those outside traditional academic contexts. Educational research has long recognized the value of informal learning (Marsick & Watkins, 2001; Rogoff

& Lave, 1984). Similarly, social Web technologies have dramatically enabled the growth of informal online learning communities (Greenhow et al., 2015; Thomas & Brown, 2011). OP builds on this existing precedent by welcoming and supporting the interests of learners whose style is more self-directed and not driven by academic credit.

Last, the opportunities to revise, remix, and openly share foster a culture of collaboration that enables opportunities for growth and innovation, especially as they relate to pedagogy, teaching, and learning practices. Practices in OP give wider exposure to a diversity of approaches, and as this diversity disperses outward across a wider network of learners and educators, it accelerates the pace of change and innovation in the field. For example, the COVID-19 pandemic has required many faculty members to move their face-to-face classes to exclusively online contexts, but since many have had little experience with teaching online, they have been eager for ideas and resources related to online teaching. A community of OP practitioners can help educators better cope with crisis situations such as this.

Conclusions

As OER and OP mature as areas of educational practice, we believe it is important to make sense of these different perspectives and identify areas of commonality and divergence. In addition, given that OER and OP aim to reach a global audience, it is important to consider perspectives and related issues from researchers and practitioners around the world. One key takeaway from this exploration is that the concept of OP is difficult to reduce to a static, single-sentence definition. This is supported by the journal articles we reviewed, which show that researchers have chosen more often to focus on defining OEP instead of OP. One has to wonder if part of the problem is a refusal to question other fundamentals and ignore other questions, terms, or words that we have not yet settled, such as education or pedagogy.

Question We Refuse to Ask: What Is Pedagogy?

The use of the word pedagogy is similar to that of education. The word education itself has gone largely overlooked in this debate. Its concept is often accepted at face value without asking what it is, what its purpose is, and whose education is being promoted. Brock-Utne (2002) has brought this question to bear in “Whose Education for All?” by suggesting that although “education for all” sounds nice, we must ask whose education is being promoted. Such an omission should not be overlooked as trivial or unnecessary. Latour (2005), for example, developed the analytical approach of Actor–Network Theory to, in part, call attention to how terms such as sociology become so firmly established in a disciplinary lexicon that they can obscure the debates and negotiations that lead to its firm position. He argues that especially when new developments or ideas emerge in a given field, it becomes important to reexamine or trace the contested lineage behind terms previously seen as immutable.

The conversation around the term pedagogy as it relates to the OP literature is also ominously mute. This is rather odd, given that the term pedagogy has been around for centuries. In the literature, it has often been contested, misread (Stommel, 2014), and at times blurred in translation (Hamilton, 2009); moreover, open is not the only modifier to append itself to the word pedagogy. Examples of others include cultural pedagogy (Ladson-Billings, 1995), second language pedagogy (Prabhu, 1987), feminist pedagogy

(Shrewsbury, 1987), pedagogy of the oppressed (Freire, 2018), and critical pedagogies (Darder et al., 2009), among many others. The focus on the modifier "open" is especially odd because what is important before debating a concept is to ensure a shared understanding of that very concept exists. In the literature, the term *pedagogy* is broadly explained as the art of teaching. However, as Alexander (2004) has aptly noted, "the spectrum of available definitions ranges from the societally broad to the procedurally narrow" (p. 9). Part of this variance is due to teaching being a practice that is contextually and culturally based; as such, if pedagogy is indeed the art of teaching, such a large spectrum of understanding of the term is to be expected. While the interrogation of the word pedagogy is beyond the scope of this article, we raise the omission to point out a rather massive gap in our literature. While we have had numerous debates on what open is, we have not done the same with the term pedagogy and what it specifically means within the context of the debate on the meaning of OP and related terms. This can mean either that we all share the same meaning and understanding of the concept or that we are engaged in a vigorous debate while having different meanings.

More broadly, the challenge that these definitional issues or questions raise is the need for a robust set of theoretical frameworks. Building theoretical perspectives enables us to think about how these different definitions can be linked to broader philosophical foundations and thereby conceptualize the phenomena of interest in more nuanced, richer ways. Indeed, this need for a set of robust theoretical frameworks is a challenge identified by Knox (2013).

Defining terms is an important aspect of any scholarly pursuits. Definitions help bound and guide conversations. They ensure agreement on the nature of a thing and provide a point of departure for discussions, debates, or agreement. Essentially, a definition acts as a calibrating lens to look at a phenomenon. In terms of the importance of a definition of OP, we agree with Wiley and Hilton (2018) that "the dearth of agreement on a common definition makes evaluating the impacts of open pedagogy on student learning, student engagement, and other metrics of interest essentially impossible since we cannot specify what we are evaluating" (p. 135). If OP advocates agree on and advocate for its value, as many of the authors described in our literature review certainly have, then it seems logical and appropriate to investigate its impact on teaching and learning. Doing this requires building a solid research foundation of theoretical frameworks and methods. Similarly, it also means that we, as a community, need to develop a coherent vocabulary so that as we build a corpus of research, there is a clear understanding of how specific terms, frameworks, and methods are being defined. We see this article as a step toward realizing that goal.

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Analysis of Success Indicators in Online Learning

Ermira Idrizi, Sonja Filiposka, and Vladimir Trajkovik
Faculty of Computer Science and Engineering, Ss. Cyril and Methodius University, Skopje, Republic of North Macedonia

Abstract

This article examines the impact of personality traits, learning styles, gender, and online course factors (course difficulty, group affiliation, provided materials, etc.) in the academic success of students taking online courses and their overall success rate through traditional classes. Students' performance in the online learning environment is still a new perception, and a fair numbers of details are still unknown, in stark contrast to the details known in regard to traditional learning methods. Different types of learners respond differently to online and traditional courses. A case study was performed in which students were asked to attend two online courses, with different difficulty levels, during one semester. One-way analysis of variance was used to determine which factors are significant for the academic performance of students taking online courses, as well as for their overall academic success. Findings from the case study indicate that female students score slightly better, course difficulty has impact on test results, emotional students are more susceptible to online environments, and learning styles are more difficult to identify in online classes.

Keywords: online education, character traits, learning styles, academic success, gender

Introduction

Online learning is compelling as it demonstrates individuals' and organizations' commitment to improving education and to exchanging knowledge and skills on a larger scale. The online learning trend continues to expand, mostly driven by technology and increased demand for enrolment in higher education institutions. Educational gains are elevated by e-learning, but one cannot overlook its social benefits, bearing in mind its use during the COVID-19 pandemic.

Since the outbreak of the COVID-19 pandemic, distance learning has become the new cornerstone of education. Educational institutions across the world have been forced to halt physical classes, which only accelerated the development of online learning environments to hinder any further interruptions to the learning process. The shift to online learning can trigger the development of a modern, more successful way of educating students. What has been made clear by this pandemic is the relevance of transferring information across borders, companies, and all segments of society. With this sudden shift away from the traditional classroom, the growth of online learning will continue to increase in the post–COVID-19 world and affect the global education sector as a whole.

Based on these additions to teaching and learning, numerous studies have been done, where researchers compare conventional forms of learning with online learning for student outcomes. It is of note that these studies seem to have difficulties in drawing accurate conclusions. While demand for online learning remains high (Allen & Seaman, 2017), higher education professionals need to discover new methods of creating an environment that promotes efficient learning by taking into account student preferences (Bonk et al., 2015). Furthermore, in this shift to online education, additional disciplines will be added and curricula modification will be needed to provide a workforce capable of meeting the ever-growing technological needs of society. Additionally, students gain invaluable practical skills through their respective distance education courses, such as problem solving, quick information analysis, and conclusion forming; additionally, overall creativity and innovation are stimulated (Simonson et al., 2019). More importantly, students learn how to work together by participating in group learning sessions and develop habits that prepare them for the collaborative workplace of the future (Essien, 2015). The evolution of online learning has mirrored changes in technology and society in recent history, and it will presumably continue to do so in the foreseeable future (Rice et al., 2020).

In our previous work, we studied the implications of students' character traits and learning styles separately; we also analyzed students' satisfaction with quality of service (Idrizi & Filiposka, 2018). This study offers students a unique environment; they attend courses fully online, choose types of materials, and are not influenced or obliged to participate until the end, which creates for them a better environment to study.

This article focuses on how different input variables—character traits, learning styles, gender, course difficulty level, and delivered materials and how they vary between online and traditional classes—influence students' academic achievements. Its scope is the provision of a deeper understanding of how different types of learners react to online courses. This can prove useful in better designing, evaluating, and marketing online courses. The article starts with an introduction of the importance of online learning and the differences between online and traditional learning. Then it reviews the related work that has been researched until the time of writing, regarding how personality, learning styles, and gender are related to students' academic success and other factors of significance in students' success rates in online courses contrary to traditional learning ("Related Work"). Next, it describes the methodology of the case study used and how participants were chosen and separated into groups for courses with different levels of difficulty and materials delivered ("Methodology"). The section titled "ANOVA Analysis" displays the analyses, which are executed on the given variables to gain insight into which of said variables have positive or negative impacts in academic results. The different roles such variables play in online courses in contrast to traditional learning are reviewed. Finally, discussions and conclusions are outlined in the final two sections via a showcase of how different variables impact the results of online and traditional classes. The article concludes with insights regarding advancing the conception of online courses in a more individualized manner.

Related Work

A recognized advantage of online and blended courses is that they provide both the teacher and the student greater convenience and accessibility. These are valuable assets for courses to effectively facilitate learning materials to students. Several meta-analyses have addressed this matter, generally concluding that well-structured online courses make learning easier for students (Siemens et al., 2015).

Discussions on the advantages and disadvantages of online learning opposed to traditional education have been based on a variety of parameters. Talebian et al. (2014) indicate that face-to-face education depends on time and place. Coincidentally, enrolment in online courses has been growing more rapidly in recent years (Seaman et al., 2018) due to an expanded environment that enables individual users to retain control over time, speed, location, and interactions with teachers and other participants. According to Kara et al., (2019), there are still factors challenging students to participate in distance education properly. Simonson et al. (2019) discuss the equivalency theory, which helps instructors provide learners with materials equivalent to, instead of identical to, materials handed out in traditional classrooms. Tseng and Chu (2010) have analyzed the relationship between the methods of learning and the outcomes of economics courses. They found that the online platform is vital for better learning and, therefore, preferable to the conventional way of learning. Also, McCarty et al. (2013) have examined the performance of students in microeconomics introductory classes. They found that students in online classes had an average final grade slightly higher than the average class grades. Clark (2020) states that in the near future, use of portable devices will expand learning using virtual and augmented reality, which will offer a more robust studying environment.

Nevertheless, there are also conflicting findings, with some research reports indicating that academic achievements are higher in traditional classrooms (e.g., Figlio et al., 2010; Page et al., 2017). Some other studies report no significant difference in student performance between online and traditional classes (e.g., Davies & West, 2018).

Results for a variety of methodological limitations must be evaluated with heightened attention. Students who choose online classes willingly may have different traits and purposes than students who choose conventional, in-person classes. For instance, students who opt for online classes may be older, have children, and be employed full-time (Ilgaz & Gulbahar, 2017). During the COVID-19 pandemic, while shifting all courses online, educational organizations were confronted with significant problems in their methods of planning, execution, and evaluation. On a minor note, however, the global pandemic uncovered possibilities for the nation to update its provision of education and to turn its focus to new technology.

The research looking at this abrupt transition to online learning is very narrow, and time is needed to evaluate the possible outcomes of this unexcepted shift to distance learning. Nevertheless, higher education organizations must improve their evidence-based policies, offer affordable mental health care, and adapt to the demands of evolving times (Toquero, 2020). According to Bao (2020), five standards of high-impact instructional practice for the successful implementation of large-scale online education have been observed: (a) sufficient significance—the quality, complexity, and duration of the instructional material must be adapted to electronic learning behavior; (b) efficient distribution—the pace of teaching has to be slower due to the low concentration of students in online learning; (c) adequate assistance—faculty and teaching assistants need to offer rapid support; (d) high-quality engagement—this is needed to boost the degree and scope of student engagement; and (e) a backup plan in consideration of the incredibly broad size of online education—preparation measures must be developed in advance to tackle future concerns such as the network traffic congestion problem. Moreover, while this online learning migration has been applied rapidly due to the COVID-19 pandemic, students' anxieties must be resolved in a number of ways to ensure that they can successfully and efficiently participate in electronic learning.

Another study (Crawford et al., 2020) highlights the response of a series of universities across 20 countries, where almost all universities switched to online education. Some were partly equipped for this initiative, providing several blended or entirely online offerings. Others had more issues offering all courses online, which depended also on the status of the country as having developed or developing economies. Although several higher education institutions initially concentrated on the shift to the online environment, the emphasis is now on online pedagogy (Crawford et al., 2020).

It is essential for educational institutions to adapt a pedagogy system that encapsulates the different aspects of online learning, which differ greatly from aspects of traditional, in-person education. Traditional learning theories such as behaviorism, cognitivism, and constructivism (Tawfik et al., 2017) have influenced traditional learning and teaching methodology heavily. *Behaviorism* assumes that learning is tangible and real, as merely a computational mechanism of accumulated practice. In contrast to behaviorism, *cognitivism* emphasizes internal learning mechanisms. It suggests that learners use knowledge to understand and that knowledge can be processed and retrieved as appropriate. *Constructivism* puts emphasis on learning as a reaction to behaviorism and cognitivism, arguing that learners create awareness from their own interactions. The digital age requires new concepts about how learning happens. The theory of *connectivism* argues that knowledge is spread through a network of connections; thus, learning consists of the ability to construct and navigate those networks (Downes, 2020). Although connectivism focuses on where information is obtained and how learners communicate on the Internet, rhizomatic learning focuses on how learners access the network and seek knowledge as an innovative search for understanding.

Rhizomatic learning (Cronje, 2018) is based on the premise that knowledge is robust, nonlinear, and unpredictable and extends these concepts to the learning process. From a theoretical viewpoint, it is found that online learning is of an interdisciplinary type and is subject to continuous transition. Therefore, rather than sticking to a predetermined theoretical framework, we can take advantage of various theoretical approaches to broaden our perspectives and improve our educational environment. In this regard, we have been motivated by a theory of diversity in many respects (Bozkurt, 2019; Geng et al., 2019).

There has never been a greater need for a concerted, inclusive, and mutual global approach to best practice guidelines for online education. This article focuses on different indicators in online and traditional learning. Where according to Wu and Cheng (2019), gender has no significance in online classes, other studies come to the conclusion that success in online classes is more individual, with results demonstrating that students' average performance differs based on the particular mixture of course modalities and demographic variables (e.g., Glazier et al., 2020). Other indicators such as personality traits have been positively linked with student engagement (Zhang et al., 2020), and learning styles are likely not linked with students' performance (Mirza & Khurshid, 2020). In a time of global uncertainty, there is a collective need for mutual assets and knowledge to ensure that the schooling of our students will succeed in the face of COVID-19. Nevertheless, more research is necessary to understand fully why these differences exist and if they are due to course design, curriculum content, faculty involvement, or other factors that need to be considered.

Personality, Learning Styles, and Gender in Online Learning

Educational researchers have concentrated intensively on many variables that contribute to learners' academic achievement. Efforts are focused on identifying how personality traits and teaching styles contribute to academic accomplishments during distance learning. Another factor that was found important was gender—how male and female students differ in character traits and preferred learning styles, and how they succeed in online classes (Allen & Seaman, 2011). Traits are defined as coherent patterns of ideas, emotions, motives, and behaviors that an individual displays across circumstances (Komarraju et al., 2011). Character traits in our case have been explained using the model generated by Costa and McCrae (1992)—the so called Big Five, which consists of a range of five different personality traits:

- *Conscientiousness*—characterized by being disciplined, organized, and achievement-oriented.
- *Agreeableness*—refers to being helpful, cooperative, and sympathetic towards others.
- *Neuroticism*—refers to a degree of Neuroticism instability, impulse control, and anxiety.
- *Openness*—reflected in an intense intellectual curiosity and a preference for novelty and variety.
- *Extraversion*—shown through a higher degree of sociability, assertiveness, and talkativeness.

The Big Five framework has become a worldwide reliable method used to investigate the relationship between personality and different academic activities (Poropat, 2009). Personality is as important as, if not more than, intelligence in educational contexts. Different educational results have been effectively predicted by the related variations of the Big Five personality traits. Research has revealed that conscientiousness is the most reliable predictor of a person's online course experiences, and conscientiousness and openness both continue to be reliable predictors of academic success (Sandu, 2019). Opposing the positive influence of conscientiousness and openness, the Neuroticism trait appears to work as an inhibitor (Keller & Karau, 2013). Overall, outcomes from studies on personality and education have indicated that personality can play an important part in learning and academic success. It is also notable that the outcomes are similar for traditional learning and online learning (Köseoglu, 2016).

Learning styles make up another dimension of how a person learns and adapts to their educational environment (Diseth, 2013). One model commonly used to identify learning styles is Neil Fleming's VARK model, created in 1987 (Fleming, 1987). Fleming's model identifies four primary types of learning styles—visual, auditory, read/write, and kinesthetics—the initials of which are used to name the VARK model (Fleming & Baume, 2006):

- *Visual* learners like to be provided with demonstrations and can learn through descriptions.
- *Aural* learners learn by listening. They like to be provided with aural instructions appreciate aural discussions.
- *Read/write* learners take notes. They often draw things to remember them.
- *Kinaesthetic* learners learn best by doing. Their preference is for hands-on experiences. They prefer not to watch or listen and generally do not do well in the classroom. (Gašević et al., 2015)

Students are able to use all these sensory learning methods; however, each student has a distinct preference or set of preferences in which one mode is often dominant. Learners with a single learning style preference are referred to as unimodal, while others who prefer a range of styles are referred to as multimodal (Nakayama et al., 2017). We suppose that in an online course, the set of teaching styles is distributed differently than in a face-to-face course. Online learning systems typically include fewer auditory or verbal sections than traditional face-to-face lessons. They have a more exceptional ability to read and write parts of a task. Students with visual learning styles and read/write learning styles may do better in online courses than their complements in face-to-face courses (Howie, 2011).

Regarding gender differences in online learning, scarce empirical evidence calls for the pretense that personality traits and learning styles differ by gender or that they impact general academic achievement. Results are conflicting on how male and female students interact in online learning environments. A prior study by Beer et al. (2010) indicates that male students perform better in online learning. In contrast, Harvey et al. (2017) indicate higher grades for female students in online classes. Cuadrado-García et al.'s (2010) study shows little differences in how male and female students interact in online environments. Overall, the results generally indicate that no significant differences exist on average between male and female students in online class participation, grades, motivation, or satisfaction (Henderikx et al., 2019).

Research Questions

We looked at different indicators for academic achievements in traditional and online learning, with a main focus on character traits, learning styles, and gender. Therefore, we put forward following research questions:

R1: Which character trait is most significant in traditional and/or online learning?

R2: Does gender impact test results and academic achievements?

R3: Which learning style is noteworthy for traditional and/or online learning?

R4: How does course difficulty and group affiliation affect achievements?

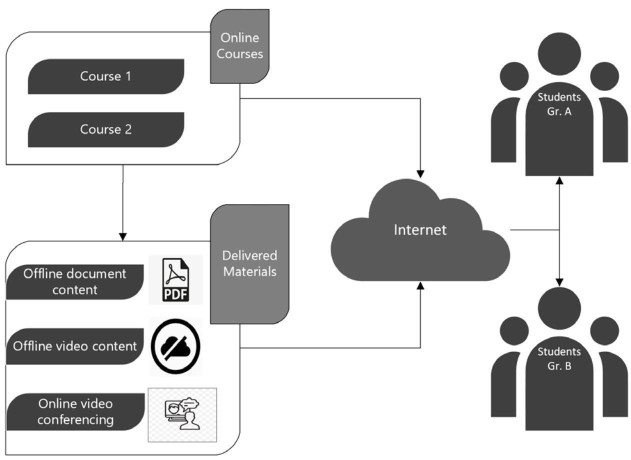
Methodology

Data were evaluated based on a case study, where participants were students who were part of two separate online courses that had different levels of difficulty. All participants were assessed using the revised NEO personality inventory (NEO PI-R; Uliaszek et al., 2019) and the VARK online questionnaire. Questioners were briefed on how they experienced the two online courses. This case study was conducted at the Faculty of Computer Science and Engineering, Ss. Cyril and Methodius University in Skopje, North Macedonia. The Moodle interactive interface was used for the management of student content during the experiment, as well as for the teachers' interaction with the content.

All participants attended two online courses during one semester: (a) Search Engines (C1 course), with a lower level of difficulty, and (b) Dynamic Websites (C2 course), with a higher level of difficulty (Idrizi & Filiposka, 2018). The initial number of students who started in the case study was 155, with 61 female and 94 male participating students. Of all participating students, 97 students filled out the VARK questionnaire, and 96 performed the Big Five questionnaire. The number of students who did not finish the case study was 101 in total: 74 male and 27 female students. Altogether, 54 students completed the case study and took the final test (34 female and 20 male students). Different presentation types were used for delivering the educational content of each course: offline document content (PDF documents), offline video content (recorded video presentations), and online videoconferencing (live videoconferences; Idrizi et. al, 2018). Students were split into two groups, A and B, with an equal number of participants—27 students each (see Figure 1). Group A students attending the C1 course were asked to pick their preferred type of learning materials; meanwhile, the C1 course instructor assigned the type of delivered materials to group B. For the C2 course, the opposite practice was implemented—that is, group B students picked their learning materials, and group A students were assigned the delivered materials by the instructor.

Figure 1

Case Scenarios for the Online Courses



One-way analysis of variance (ANOVA) is used to compare means of two or more samples. We thus could determine which of the variables had any significance in test results for the online courses and the overall grade point average (GPA) calculated from traditional classes taken by students who attended the two online courses. ANOVA was chosen due to the nature of the variables, having more than two levels in the cases of type of material delivered, VARK, and Big Five. Other methods for statistical analysis can deal with only continuous variables and/or two-level variables.

ANOVA Analysis

The one-way ANOVA method was used to determine whether any statistically significant differences existed between our variables for test results and GPA. ANOVA gives an approximation of how much variance in the dependent variable can be interpreted by the independent variable. It divides the results into inputs from various sources and then decides whether substantial variations exist between the sources of variance and provides a measure that represents the amount of the variability (see Tables 1 and 2).

In Tables 1 and 2, the first columns list the independent variable along with the residual model (e.g., the model error). The *df* columns illustrate the degrees of freedom for the independent variable (calculated by subtracting 1 from the number of levels within the variable) and for the residuals. The Sum Sq. *M* columns show the sum of squares (i.e., complete variation) between the group mean and the cumulative mean defined by that variable. The Mean Sq. *F* columns show the mean of the sum of squares, which is determined by dividing the sum of squares by the degree of freedom. The *F* value columns show the statistic of the *F* test: the mean square of each independent variable divided by the mean square of the residuals. The higher the *F* value, the more probable it is that the variance correlated with the independent variable is true and not attributed to chance. The columns Pr ($> F$) display the *p* value of the *F* statistic. This indicates how possible it is that the *F* value determined by the test would have been the same if the null hypothesis of no variation between the group means were accurate.

It must be noted that the results shown in Table 1 are related to student test success based on the two online courses only, whereas the results in Table 2 are related to the cumulative success—GPA—of students during their studies in traditional courses. The following variables have been taken into account: course difficulty, group affiliation, provided and preferred materials, Big Five traits, and VARK learning styles. We consider only those indicators in which the *p* value is equal to a significant code, which indicates how certain we can be the indicator has an impact on the dependent variable.

Significant codes vary between the two tables, showing a distinction between online and traditional courses. The following is an overview of each variable:

- *Course difficulty* proved to be essential for students' test results in online courses, whereas this variable shows no indication in overall academic success.

- *Group affiliation*, whether students belonged to group A or group B, also subsequently proved to be significant for students' test results based on groups they acquired the delivered materials.

- *Gender*'s impact cannot be assessed as significant for the test results in online courses but has significance related to overall academic success in traditional classes.

- From the *Big Five traits*, the Neuroticism trait is noteworthy for test results and also for overall academic achievement, whereas for the online courses, the significance is noticeably reduced.
- *VARK learning styles* are far more significant for students' achievements in traditional courses than in online courses. Also note that students taking online classes preferred the visual learning styles, but in traditional courses, the read/write style was more significant.
- *Provided/preferred materials* are indicated as significant only for overall academic success.

Table 1

ANOVA Analysis for Test Results in Online Courses

Test	*df*	Sum Sq. *M*	Mean Sq. *F*	*F* value	Pr (> *F*)
Course difficulty	1	21.33	21.333	22.887	.000*
Group affiliation	1	3.70	3.704	3.973	.050***
Gender	1	1.55	1.550	1.663	.201
Provided materials	2	0.15	0.076	0.081	.922
Preferred materials	2	1.67	0.834	0.894	.413
Neuroticism	1	2.91	2.911	3.123	.081†
Extraversion	1	0.41	0.411	0.441	.508
Conscientiousness	1	1.37	1.371	1.471	.229
Agreeableness	1	1.26	1.260	1.352	.248
Openness	1	0.80	0.803	0.861	.356
VARK	11	17.97	1.634	1.753	.077†
Visual	1	5.47	5.470	5.868	.018***
Aural	1	0.00	0.002	0.002	.968
Read/write	1	0.00	0.001	0.001	.977
Kinesthetic	1	0.23	0.228	0.245	.622
Residuals	80	74.57	0.932		

Note. Test is normalized using a scale 0 to 5.

* $p < .001$. ** $p < .01$. *** $p < .05$. †< .1.

Table 2

ANOVA Analysis for Overall Academic Success

Grade point average	*df*	Sum Sq. *M*	Mean Sq. *F*	*F* value	Pr (> *F*)
Course difficulty	1	0.000	0.000	0.000	1.000
Group affiliation	1	0.000	0.000	0.000	1.000
Gender	1	1.206	1.206	4.092	.046***
Provided materials	1	2.221	2.221	7.539	.007**
Preferred materials	1	1.206	1.206	4.094	.046***
Neuroticism	1	3.829	3.829	12.995	.001*
Extraversion	1	0.369	0.369	1.253	.266
Conscientiousness	1	0.338	0.338	1.148	.287
Agreeableness	1	0.211	0.211	0.715	.400
Openness	1	0.049	0.049	0.167	.684
VARK	11	10.944	0.995	3.377	.001*

Visual	1	0.005	0.005	0.018	.894
Aural	1	0.600	0.600	2.037	.157
Read/write	1	1.197	1.197	4.063	.047***
Kinesthetic	1	0.434	0.434	1.472	.229
Residuals	80	23.569	0.295		

Note. * $p < .001$. ** $p < .01$. *** $p < .05$. †< .1.

Next, a correlation analysis of these significant variables was generated to determine which variables were positively or negatively correlated with online test results and, subsequently, overall GPA.

Figure 2 indicates that of the variables, course difficulty is the main factor in students' success when taking online courses. Positively correlated are also VARK and the visual learning style, which can be explained due to the majority of delivered materials being in visual format. Group affiliation is also positively correlated to test results: students in group A scored better test results. A negative correlation with the Neuroticism trait was observed, implying that students who scored higher within the range of this trait have difficulties gaining good test results.

Figure 2

Correlation of Significance Codes for Test Results

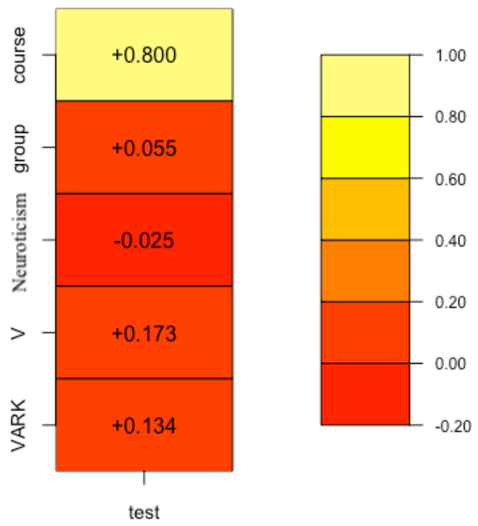
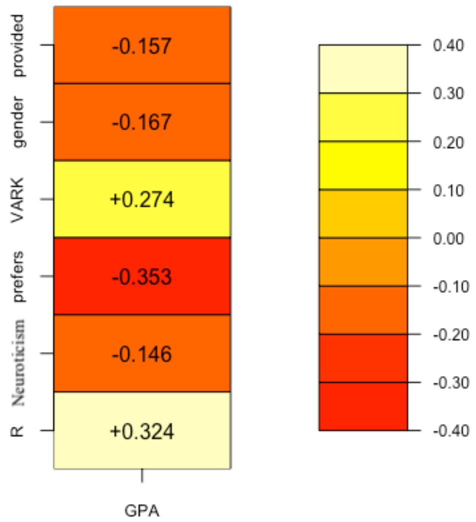


Figure 3 shows the correlation of the significant variables with GPA, highlighting that gender is negatively correlated with GPA. This indicates that male students have lower GPAs than female students taking traditional, in-person engineering classes. Additionally, for overall success rate, it is not important for students to choose their materials delivered since the variables of preferred and provided materials have a negative correlation with overall GPA. The Neuroticism trait is a constraint for students in achieving better academic results and in a more significant manner than in online courses. VARK has a more positive correlation with GPA than test results, since learning styles are more easily identified in traditional classes. The read/write style is enhanced because most materials provided for online classes are in read/write format.

Figure 3

Correlation of Significance Codes for Overall Academic Success



Discussion

Our research results, based on ANOVA analysis, point out some noteworthy connections between different variables that are significant in students' academic success in online classes. They further suggest that online and traditional learning techniques are distinct (Faulconer et al., 2018). Our research highlights the following discussion points (discussed in more detail below): (a) character traits' impact on test results, (b) the impact of students' gender on identifying learning styles and success in online classes, (c) the impact of learning styles on taking online courses compared with traditional courses, and (d) the impact of course difficulty on students' success.

Impact of Character Traits

Our first research question was to determine which character trait was more consistent during traditional and online learning, and whether character traits influenced students' test results. Our research indicates that the Neuroticism trait had the highest influence on students' success rates. The consciousness trait, on the other hand, is understood to be a stable indicator of high academic achievement (Icekson et al., 2020). However, consciousness was not as influential as the Neuroticism trait, which typically has a detrimental effect on the outcome of online course examination but with a higher significance on overall academic performance (Altanopoulou & Tselios, 2018). This suggests that students who rank higher on Neuroticism struggle in all educational settings but marginally less in online classes where they are able to manage their anxieties (Redecker et al., 2011; Wu & Lai, 2019).

Impact of Gender

The second research question focused on gender, that is, whether a student's gender is a factor in their academic success. It should be noted that the gender factor showed variety in its significance in our case study. Namely, gender is not a notable parameter in ANOVA Table 1, which exclusively reflects variables for online learning. This is compared to ANOVA Table 2, which summarizes the overall classes taken in the traditional manner, where gender is a significant variable. In accordance with a prior study

(Stojilović et al., 2012), the findings here indicate that female students outperform their male peers with better grades (Noroozi et al., 2018).

Impact of Learning Styles in Traditional and Online Learning

The third research question asked whether the impact of learning styles differs in traditional and online learning environments. VARK styles are less significant for online courses, whereas they are more important for traditional courses with students' and teachers' physical presence. This is particularly the case with the read/write learning style, since the learning materials used by students in traditional classes are mainly in read/write format. A practical example of this research finding is a male student participating in the case study who scored the highest test results of the class. His answers to the VARK questionnaire further indicate that students often are not aware of which learning style suits them best. In the online environment, identifying styles can be a challenge since instructors cannot directly observe students and assess the most suitable style for them. This once again illustrates the difficulty and unpredictability in assigning the learning materials tailored to students' learning styles in online classes compared with traditional classes (Husmann & O'Loughlin, 2019; Kirschner, 2017).

Impact of Course Difficulty and Group Affiliation

Our fourth research question explored the influence of course complexity and group affiliation. ANOVA analyses reveal that the level of online course difficulty has a key influence on test result outcomes, whereas materials provided based on group affiliation on the basis of student interests have a larger influence on total academic performance than on individual test results.

Conclusion

In conclusion, the findings of this research contribute new information about essential differences in students' academic success between online courses and traditional courses. The online educational environment can be considered more neutral, since the impact of external factors on students is reduced and they can interact with the teaching/learning process as individuals. Course difficulty proved to be the main significant variable and factor in online courses, also influencing student test results. Gender had no major influence on online course test results, compared to traditional class results, where female students scored slightly better on the overall academic success.

Character traits, which define how individuals react in different circumstances, are important information in the teaching process, regardless of the environment. The Neuroticism trait seems to act as an inhibitor for student success. However, in online classes, students who scored higher in the Neuroticism trait did not feel social pressure and were more in control of their emotions, so its significance is clearly less trivial in online classes than in traditional classes. This finding may indicate that this trait is not as impactful in online courses as in traditional classes.

The learning styles indicator (VARK) shows a greater significance in traditional courses contrary to online courses. This is especially important for the read/write style since most materials are available in this format. Assigning the proper style to students in online classes is more challenging than in traditional ones.

These results may provide teachers and course developers with useful insights on how they can influence and reshape their online courses. They can also help define new learning possibilities best suited for students' strengths based on individual preferences. In summary, the analyses conducted and this study's findings provide new understandings of ways to achieve academic success (especially in the emerging sector of online education in North Macedonia) by showcasing both (a) links between personality traits, group affiliation, gender, and learning styles to academic achievements; and (b) the varying impacts of these variables in traditional and online education.

It must be noted that in order to prevent any bias in the results, students were not forced to continue the experiment throughout the semester. This led to students dropping out during different stages of the course. Thus, due to the large number of dropouts, additional research and case studies are needed to confirm that the findings presented in this article can be used in a general context. Future work is needed to enhance our understanding of the complex nature of academic achievement in online classes.

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Parents' Perceptions of Their Children's Experiences With Distance Learning During the COVID-19 Pandemic

Dr. Diala A. Hamaidi[1], Dr. Yousef M. Arouri[2], Rana K. Noufal[3], and Islam T. Aldrou[4]
[1]Department of Psychological Sciences, Qatar University; [2]Department of Curriculum and Instruction, University of Jordan, Jordan; [3]United Nations Relief and Works Agency, Jordan; [4]Jordan Radio and Television Corporation, Jordan

Abstract

This study aimed to investigate the perceptions of primary and secondary students' parents in Jordan toward the distance learning process implemented in light of the coronavirus disease (COVID-19) pandemic. To achieve the study objectives, the researchers used the descriptive survey method to collect and analyze data and interpret the results. After developing the study instrument (questionnaire) and ensuring its validity and reliability, it was distributed to a selected sample, consisting of 470 parents, by random cluster method during the second semester of the 2019–2020 academic year. The study results show that primary and secondary students' parents were moderately satisfied with the distance learning process implemented in light of the COVID-19 pandemic. In addition, the results reveal statistically significant differences in the parents' perceptions attributed to the variables of the child's grade, in favor of grades 5–7; teacher's gender, in favor of female teachers; and school type, in favor of private schools.

Keywords: parents' perceptions, primary/secondary students, distance learning, COVID-19 pandemic, Jordan

Introduction

Jordan, like the rest of the world, has faced the coronavirus disease (COVID-19) pandemic by making rapid and firm decisions that have helped limit the spread of the virus. These decisions have included imposing curfews across the country and forcing people to stay in their homes. The impact of such decisions has resulted in the closure of all schools and the suspension of the teaching and learning process in its traditional form: face to face. Under these circumstances, educational officials have sought to find optimal alternative teaching and learning methods that contribute to the sustainability of the teaching and learning process. The solution was a digital transformation in teaching and learning and the use of digital applications to accomplish distance learning or Web-based learning. This study reveals the perceptions of primary and secondary students' parents toward their children's distance learning in light of the COVID-19 pandemic.

The advent of the Internet has contributed to enhancing learning opportunities; such a network has an enormous ability to support effective and quick communication in different forms between parties. In addition, this network has the potential to help people solve problems, enhance research and investigation, and make the educational process fruitful (Saadeh & Al-Sartawi, 2015). Aboud (2007) and Al-Ghannouchi (2010) demonstrate that the Internet has beneficial uses in the educational field, such as allowing people to keep up with modern developments in the world and providing people with new educational opportunities to address the problem of population explosion. Aboud (2007) asserts that using the Internet has enabled teachers and learners to play new roles. That is, teachers are no longer the only initiators or the only source of information or knowledge. Rather, they have become researchers who seek to pursue professional developments in their fields of specialization. As for learners, they are no longer just the recipients who memorize and store information: they have become active researchers and learners as well.

Bin Ahmed et al. (2019) and Al-Arfaj et al. (2012) explain that Internet technology has helped in education development in general and distance learning in particular; the Internet has helped move distance learning from primitive correspondence through traditional mail, without any interaction between learner and teacher, to more advanced open learning. Al-Smadi (2020) affirms that open learning focuses on the use of Web technology as one source of the knowledge revolution, using applications such as videoconferences, simulation systems, and virtual classes, which all have helped in achieving communication between teachers and learners through learning systems and social networks.

Distance Learning

Distance learning is defined as an educational system that helps teachers organize and manage learning and teaching processes and enhances teachers' communication with learners, regardless of place and time, through the use of electronic or print media (UNESCO, 2002). Amer (2013) explains that distance learning is a group learning system open to all without the restrictions of time and space or the group of learners; this type of education is appropriate for the nature and needs of all members of society. Awad and Hilles (2015) explain that distance learning comprises a set of electronic educational systems that allows learners to interact freely with electronic resources related to topics and courses important to them, whether through mobile learning, classrooms, blogs, or other mediums.

Al-Najem (2019) adds that distance learning is a way of learning in which learners receive knowledge by using applications and various means of communication that may include simple printed materials or more advanced materials sent over the Web. Al-Smadi (2020) stresses that distance learning is a learning method where the learner uses modern communication means such as computers, networks, research engines, Internet portals, and multimedia such as pictures, sound, and graphics. In sum, the current study's researchers found that the definitions of distance learning terms have focused on specific aspects affirmed by Amer (2013). First is the physical separation of the teacher from the learner: the communication between the teacher and the learner becomes indirect, which helps students learn at their own speed, in any place, and at any time that suits their circumstances and needs. Second is the role of effective modern media and communication tools in transferring learning to students using multiple educational media, whether through printed, electronic, recorded, or visual materials.

Distance Learning Importance and Challenges

Al-Najem (2019) explains that the formation and development of distance learning went through several stages. First, in the mid-19th century, a few universities began to send their educational materials by mail to learners in their homes, and thus the process of distance learning began. Second, in the mid-20th century, the technological development of various means of communication helped advance distance learning; learners received their education through television and radio broadcasts. Third, in the late 2000s, learners started using more modern technological means such as computers to receive various educational content. Fourth, at the beginning of the 21st century, it became easy for learners to obtain all necessary audio or visual study materials through computer programs recorded on CDs, through satellite broadcasting, or via the Internet. There is now no need to attend educational institutions; rather, teachers and students can communicate and participate in various educational meetings online.

Al-Smadi (2020) shows that distance learning has become one of the easiest ways to learn because it is in line with current trends and learners' tendencies. In addition, integrating technology into the classroom has not only helped learners to learn better but also enabled them to acquire various skills of great importance, such as technological skills. Amer (2013) explains that the importance of distance learning lies in the following: (a) making educational opportunities available to everyone regardless of spatial or temporal obstacles, (b) enabling students to learn according to their own abilities and circumstances, and (c) allowing students to choose how to receive study materials individually and based on their own learning styles. Al-Rashidi (2018) adds that distance learning increases interactions between teachers and students, especially those who are ashamed to interact face to face. In addition, distance learning brings students in remote areas equal opportunities to acquire the same access to education that is available to urban students (Hamaidi, 2008).

Despite the positive benefits of distance learning in facilitating learning and teaching, many challenges contribute to limiting the effectiveness of its application in an optimal way. Some of these challenges include the following. First is the challenge of designing educational content; teachers face obstacles when preparing digital or printed educational material in ensuring that they will be sufficient for learners achieve learning goals with high efficiency. Further, teachers face hardships in choosing teaching strategies and methods that take into account students' different learning needs and patterns, as well as in choosing appropriate tools to measure student learning (Al-Mukhaini, 2017; Al-Rawadiyah et al., 2014; Al-Sajini & Khalil, 2017). Second is the difficulty in implementing distance learning. Some teachers face difficulties in monitoring, following up with, and evaluating students; in appropriate time management; and in working with learners who are not engaged with the learning process, which improves the feeling of more prevalent isolation in this learning environment (Al-Sharman, 2015). Third is the availability of technology. Some difficulties faced include providing devices, applications, and technical support; the efficiency and speed of one's Internet connection; and teachers' and students' insufficient skills in using these technologies and applications (Lever-Duffy & McDonald, 2018). Fourth is administrative responsibility: this includes all administrative problems that occur during distance learning, such as administrators' and officials' lack of awareness of several factors, such as the importance of this type of learning, its requirements, and how it works (Al-Areifi et al., 2016).

Theoretical Framework

This study's researchers drew on their interpretation of the distance learning process based on Holmberg's (1983, 1995) ideas and assumptions. Holmberg (1983) explains that distance learning (a) supports the learner's motivation and enhances their enjoyment of learning; (b) links individual learners with their subjectivity and their diverse needs, which includes a distinguished relationship between learners and the educational institution that provides distance education supports such as teachers, counselors, and assistants; (c) helps learners deal with educational content and integrates the learner in various educational activities, discussions, and decision making; and (d) helps strengthen real communication and assumptions between the system and all its components and students. Holmberg (1983) observed that his theory of distance learning had an interpretative value in linking the effectiveness of teaching to the influence of feelings about cooperation and affiliation, especially when questions, answers, and discussions are exchanged across different communication media.

Holmberg (1995) presented his theory of distance learning through "interaction and communication theory," which is based on seven basic assumptions and principles. First, teaching revolves around the interaction between the two sides of learning and education. That is, the interaction occurs through the learning of content presented in previous courses; learners interact with these curricula by offering views and presenting different solutions using various methods of thinking. Second, the emotional involvement in learning and the involvement of feelings in personal relationships between the parties to the learning and teaching process contribute to increasing pleasure in learning. Third, enjoyment in learning contributes to increasing the learner's motivation. Fourth, participation in learning decisions can also increase the learner's motivation. Fifth, motivation facilitates learning. Sixth, the harmony of the learning process with the content contributes to increasing the fun of learning and supporting the learner's motivation to learn. Seventh, the effectiveness of teaching is demonstrated by students' learning of what has been taught. Schlosser and Simonson (2015) assert that earlier assumptions are seen as the basic principles of effective distance learning, which makes it easier for students to learn concepts and solve problems by organizing and implementing them in a way in which they are encouraged to research and criticize and appreciate their potentials.

This study attempts to learn more about the implications of the interaction and communication theory by uncovering the perceptions of parents who observe their children's interactions with distance learning during the COVID-19 pandemic. It is crucial to investigate parents' perceptions, as observers of this new learning experience and its impact on their children, because they describe the climate and enthusiasm for this educational experience.

Previous Studies

Many research studies have revealed the perceptions of administrators, teachers, and students toward distance learning in educational institutions. Among studies related to teachers' perceptions, Al-shboul et al.'s (2015) study aimed to reveal the perceptions of faculty members at Yarmouk University in Jordan regarding the application of distance learning in virtual environments. The researchers drew on the descriptive approach to collecting data from 91 faculty members in the 2013–2014 academic year. Faculty members gave distance education in virtual environments a good score. Further, Al-shboul et al. show statistically significant differences attributed to the age variable, in favor of a younger age, as well as the department variable, in favor of the departments of curriculum and instruction and educational administration. The researchers found no statistically significant differences attributed to the variables of experience years and gender.

In the same context, Aqel (2014) aimed to reveal the attitudes of faculty members in Jordanian public universities toward distance learning and its relationship to some variables. The study included 298 faculty members from all academic levels in 2013–2014. University of Jordan faculty members' attitudes toward distance learning were moderately positive. Further, no statistically significant differences were attributed to academic rank; however, statistically significant differences were attributed to the variable of academic specialization, in favor of medical colleges, over human colleges, followed by scientific colleges. Furthermore, Aqel's (2014) results reveal many obstacles that limit the possibility of applying distance learning in public universities in Jordan.

Among studies that reveal learners' perceptions is Rajadurai et al.'s (2018) study, which aimed to reveal students' satisfaction and their level of performance in the online learning environment in Malaysian universities of open and distance learning (ODL). The researchers used the descriptive-analytical method. A questionnaire was distributed to 2,283 students from ODL universities. The results reveal a significant positive correlation between students' performance and satisfaction with the educational content, evaluation management, and services provided by universities. However, only two variables were related to learners' performance—namely, evaluation management and services provided by universities.

In the same context, Awad and Hilles (2015) have revealed the attitudes among graduate students in Palestinian universities toward distance learning technology and its relationship to some variables. The researchers used the descriptive-analytical method. The sample consisted of 91 students studying in graduate programs at colleges of education in Palestinian universities. Results reveal positive attitudes toward distance learning technology among graduate students in Palestinian universities. Further, they show no statistically significant differences in students' responses to distance learning technology according to variables of gender, educational level, and general estimate of the importance of distance learning technology.

By reviewing previous studies, the current study's researchers concluded, to their knowledge, that studies held over the last nine years in Jordan examining perceptions of distance learning are limited; the last study found took place in 2015. In addition, these studies reveal the perceptions of faculty members in Jordanian universities, but no studies reveal the perceptions of primary and secondary students and their parents toward distance learning in Jordan. The current study is considered the first study, according to the researchers' knowledge, that examines parents' perceptions of their children's experiences in primary and secondary education with distance learning during the COVID-19 pandemic.

Problem and Questions

With the COVID-19 pandemic, most countries of the world, including Jordan, have been forced to implement strict procedures and make difficult decisions to help limit the spread of the virus. Jordan imposed a quarantine on the citizens and made the decision to disrupt face-to-face learning and teaching in all public and private schools. It was thus necessary to adopt a new educational system to ensure the continuation of the learning and teaching processes. Therefore, Jordan's Ministry of Education decided to implement a distance learning system in all public and private schools that cover primary and secondary grades. This system's application was accompanied by many questions related to the extent of its effectiveness and the feasibility of its application compared with traditional education, as well as questions related to the challenges that contribute to reducing its success, whether related to technological skills, physical equipment, infrastructure, or distance learning design skills that teachers should possess (Ministry of Education, 2020b).

Since parents are at the forefront of responsibility for their children's learning, and because they are the true observers of children in the distance learning environment, it is necessary to evaluate the parents' viewpoints of their children's experience using the distance learning system during the COVID-19 pandemic. Therefore, this study came to investigate the following questions:

1. What are the perceptions of parents of primary and secondary students in Jordan toward the distance learning process in light of the COVID-19 pandemic?

2. Are there statistically significant differences at the level of significance ($\alpha = .05$) in perceptions of parents of primary and secondary students in Jordan toward the distance learning process attributed to the variable of the child's grade?

3. Are there statistically significant differences at the level of significance ($\alpha = .05$) in perceptions of parents of primary and secondary students in Jordan toward the distance learning process attributed to the variable of teacher's gender?

4. Are there statistically significant differences at the level of significance ($\alpha = .05$) in perceptions of parents of primary and secondary students in Jordan toward the distance learning process attributed to the variable of school type?

Objectives and Importance

This study's aim was to investigate the perceptions of parents of primary and secondary students in Jordan regarding the distance learning process. Further, it aimed to identify the statistically significant differences ($\alpha = .05$) related to the perceptions of parents of primary and secondary students in Jordan of the distance learning process in relation to the variables of child's grade, teacher's gender, and school type.

This study discusses one of the most important current questions in the educational field in Jordan. It reveals the reality of implementing a distance learning process from the viewpoints of learners' parents. The researchers hope that the results of this study will encourage teachers to optimize the application of distance teaching, to seek to improve the distance learning experience, and to further develop its application according to students' needs. This study can help decision makers and specialists in the education sector learn more about the distance learning experience and improve its use in the future in a manner that meets students' needs. The authors expect that this study may inform decision makers and managers in the educational sector about the perceptions of parents of primary-/secondary-education students toward this new learning educational experience. Knowledge of such perceptions can provide opportunities to reinforce the positive aspects of the application and address its negative aspects. This study is expected to open new opportunities for researchers to conduct quantitative and qualitative research related to students' and teachers' perceptions of distance learning in both schools and universities.

Procedural Definitions

Distance learning: An e-learning environment in which primary/secondary students in Jordan obtain knowledge, skills, and attitudes they need without the need for teachers to be with them in the same place or at the same time.

Parents: The fathers, mothers, or guardians who are responsible for their children in primary or secondary school in Jordan, as well as for their learning affairs at homes and schools.

Primary/secondary school students: First-grade to tenth-grade students in public, private, and United Nations Relief and Works Agency (UNRWA) schools in Jordan, whose ages range from 6 to 16 years.

COVID-19 pandemic: The effects of the spread of the COVID-19 virus, which can cause illness in humans, which has resulted in the disruption of the traditional, face-to-face learning and teaching process and its replacement using a distance learning system.

Parents' perceptions: A knowledge system for parents of primary and secondary school students resulting from mental activity that includes their values, ideas, opinions, and attitudes toward their children's experiences in a distance learning environment during the COVID-19 pandemic. These perceptions are measured by the degree that the respondent gets on the study instrument.

Limitations and Delimitations

This study is limited to identifying the perceptions of parents of primary- and secondary-education students, in public, private, and UNRWA schools in Jordan, regarding the distance learning process during the COVID-19 pandemic. Further, this study was conducted after the second semester of the 2019–2020 academic year ended. Results were determined by the reliability and validity of the study instrument, as well as the sample individuals' responses.

Methodology

The researchers used the descriptive survey method to reveal the perceptions of parents of primary and secondary students in Jordan of the distance learning process during the COVID-19 pandemic. This method is based on an accurate interpretation of the phenomenon or problem, with the aim of arriving at an accurate and integrated scientific description through data analysis, to generalize the facts or knowledge that were extracted (Al-Manizel & Al-Atoom, 2010).

Population and Sample

The study population consisted of all parents of primary and secondary school students in all governorates of Jordan during the second semester of the 2019–2020 academic year. To achieve the study aims, a cluster randomized method was used to select the study sample, which consisted of 470 parents of primary/secondary students. The parents in the sample were males and females from all regions of northern, central, and southern Jordan. They possessed various academic diplomas and degrees, such as high school diplomas, intermediate diplomas, bachelor's degrees, master's degrees, and doctorate degrees. The parents also have children, male or female, in various grades (1–4, 5–7, 8–10), who study in public, private, or UNRWA schools.

Instrument

The researchers reviewed theoretical literature and previous studies (e.g., Al-shboul et al., 2015; Rajadurai et al., 2018) to develop a questionnaire in order to collect necessary data to answer the study questions. The questionnaire consisted of two parts: the first section was designed to collect demographic information, and the second section included various items that measured the parents' perceptions of the primary/secondary students' learning. Specifically, the second section consisted of two fields. The first field measured the parents' perceptions about themselves, and it was divided into five dimensions (28 items). The second field measured the parents' perceptions about their children's learning, and it was divided into four dimensions (28 paragraphs). In its final form, the questionnaire contained 56 items rated on a Likert-type (five-point) scale: 1 =very low, 2 = low, 3 = medium, 4 = high, and very 5 = very high. The study adopted the following weights to measure parents' perceptions of the distance learning process: a high degree for the items whose means were greater than 3.66, a medium degree for the items whose means ranged between 3.66 and 2.34, and a low degree for the items whose means were less than 2.34.

Validity and Reliability

The content and validity of the study instrument were checked by presenting the instrument's initial form to a number of experts (12) in the fields of curricula and teaching, educational technology, and measurement and evaluation. These experts critiqued questionnaire items based on their harmony with the study objectives, the integrity and clarity of the linguistic formulation, and the affiliation of the domain under which they were classified. Amendments were made according to comments agreed on by 80% of the arbitrators and experts. Most amendments were limited to items' language and wording. In addition, the researchers checked the reliability of the study instrument by calculating internal consistency using Cronbach's alpha after applying the questionnaire to an exploratory sample (31) from the study community and outside the study sample. The reliability coefficients for the dimensions of the study instrument came as follows: dimension 1.1 = 0.88, dimension 1.2 = 0.88, dimension 1.3 = 0.78, dimension 1.4 = 0.90, dimension 1.5 = 0.89, dimension 2.1 = 0.85, dimension 2.2 = 0.92, dimension 2.3 = 0.91, and dimension 2.4 = 0.95.

Variables and Statistical Treatments

This study included one dependent variable—parents' perceptions of primary/secondary students' learning—and three independent variables—child's grade (1–4, 5–7, 8–10), teacher's gender (male, female), and school type (public, private, UNRWA). The researchers used several statistical methods to analyze the collected data and to answer the study questions. Means and standard deviations were calculated to answer all study questions; one-way analysis of variance (ANOVA) and Schiff's post hoc tests were used to answer the second and fourth questions; and the independent samples *t* test was used to answer the third question.

Results and Discussion

First Question

To answer the first question—what are the perceptions of parents of primary and secondary students in Jordan toward the distance learning process in light of the COVID-19 pandemic? —means and standard deviations were calculated. Table 1 shows the results according to the research instrument's fields and dimensions.

Table 1

Means and Standard Deviations of Parents' Perceptions Toward the Distance Learning Process

Field/dimension	*M*	*SD*	Degree of perception
Field 1. Parents' perceptions of themselves	3.5660	1.10287	Medium
Dimension 1.1. Perceptions related to the physical components and the distance learning environment	3.6755	0.74423	High
Dimension 1.2. Perceptions related to technological skills	3.5819	1.09816	Medium
Dimension 1.3. Perceptions related to cooperative skills	3.9447	0.93961	High
Dimension 1.4. Perceptions related to communicating with members of the distance learning environment	2.8862	0.95100	Medium
Dimension 1.5. Perceptions related to the nature of the distance learning process and the content presented therein	3.5000	1.10291	Medium
Field 2. Parents' perceptions of their children's learning	3.4404	1.15516	Medium
Dimension 2.1. Perceptions related to possessing technological skills	3.6128	1.10003	Medium
Dimension 2.2. Perceptions related to commitment to ethics during distance learning	3.9351	0.85677	High
Dimension 2.3. Perceptions related to cooperative skills	2.9191	1.07742	Medium
Dimension 2.4. Perceptions related to developing self-learning skills	3.2426	1.19152	Medium
Average	3.4064	1.12292	Medium

Table 1 shows that primary and secondary students' parents had a medium degree of perception toward the distance learning process during the COVID-19 pandemic (M = 3.4064, SD = 1.12292). Further, parents' perceptions of themselves were rated as medium (M = 3.5660, SD = 1.10287). Means of items in this field ranged between 2.8862 and 3.9447, and all dimensions had a medium degree of perception. These results indicate that parents were satisfied and accepted the process of distance learning. However, they felt more satisfied with the first (1.1. perceptions related to the physical components and the distance learning environment) and third dimensions (1.3. perceptions related to cooperative skills), which were rated highly. This finding shows parents' favorable perceptions of the presented physical components and the cooperation skills children received via distance education during the COVID-19 pandemic.

Furthermore, Table 1 shows that parents had a medium perception of their children's learning (M = 3.4404, SD = 1.15516). Means of items in this field ranged between 2.9191 and 3.9351. All dimensions were rated medium. That is, parents felt satisfied in general regarding their children's learning process during the pandemic. However, the second dimension (2.2. perceptions related to commitment to ethics during distance learning) was rated highly. This finding describes the parents' high level of interest in the ethical climate of distance learning and their readiness to accommodate this type of educational experience.

The medium degree of perception found indicates the satisfaction level perceived by parents. It can be attributed to the circumstances in which the distance learning process was applied suddenly and without any advance preparation or training for teachers and students to learn how to use it. However, during the pandemic, the Ministry of Education in Jordan intensified its efforts and launched a multi-educational platform, Noorspace (Ministry of Education, 2020c), allocating satellite channels to broadcast lessons for different classes and subjects, and urged teachers and students to use multiple applications such as Microsoft applications, including Teams and Forms, to sustain the teaching and learning processes. The Ministry of Education also launched a training program for teachers consisting of 90 training hours aimed at sustaining their professional development to ensure success of the distance learning process with all its components (Ministry of Education, 2020a). Such procedural steps initiated by the Ministry of Education have helped parents form an acceptable perception toward distance learning, even though students and teachers in all Jordanian schools had never previously had such an experience.

The abovementioned results, where parents rated their perception as high, including perceptions about the extent to which parents provided the physical components in the distance learning environment, the extent of their cooperation with their children to sustain teaching and learning processes, and the extent that they verified their children's commitment to ethics during distance learning, can be attributed to the following: (a) the parents' satisfaction with themselves in sustaining their children's learning, (b) their invested financial capabilities to provide the physical components needed to sustain their children's learning, and (c) their great efforts in helping their children achieve their educational goals. Through this study, researchers in the educational field found a disparity between parents in their financial capabilities and their cooperation with children in sustaining the teaching and learning processes. However, parents are satisfied with their performance because they think that they did their best with their available capabilities.

Regardless of the compatibility of the sample, which included parents who were in the samples of previous studies that included teachers and students in universities, the results of this study are consistent with results from previous studies (e.g., Al-shboul et al., 2015; Aqel, 2014; Awad & Hilles, 2015; Rajadurai et al., 2018). This indicates that perceptions and attitudes toward distance learning were moderately positive.

Second Question

To answer the second question—are there statistically significant differences at the level of significance (α = .05) in the perceptions of parents of primary and secondary students in Jordan toward the distance learning process attributed to the child's grade variable?—means and standard deviations were calculated. Table 2 shows these results according to the child's grade level (1–4, 5–7, 8–10).

Table 2

Means and Standard Deviations of Parents' Perceptions Toward the Distance Learning Process According to Child's Grade Level

Child's grade level	*M*	*SD*
1–4	3.0500	0.87571
5–7	3.7454	1.24918
8–10	3.1895	0.94480
Average	3.4064	1.12292

Table 2 illustrates that there are apparent differences between means according to the child's grade level. To find out whether these differences are statistically significant, the one-way ANOVA test was calculated. Results are illustrated in Table 3.

Table 3

One-Way ANOVA of Parents' Perceptions Toward the Distance Learning Process According to Child's Grade Level

Source	Type III sum of squares	*df*	*MS*	*F*	Sig.
Between groups	47.164	2	23.582	20.236	.000*
Within groups	544.217	467	1.165		
Total	591.381	469			

Note. * Statistically significant at α = .05.

Table 3 shows statistically significant differences in the parents' perceptions of primary/secondary students' learning according to the child's grade level ($F = 20.236$). To determine those statistically significant differences, Schiff's post hoc test was calculated. These results are shown in Table 4.

Table 4

Schiff's Post Hoc Test Results of Parents' Perceptions Toward the Distance Learning Process According to Child's Grade Level

Child's grade level		*M* difference	*SE*	Sig.
1–4	5–7	−0.69537*	0.11983	.000*
	8–10	−0.13952	0.13551	.589
5–7	1–4	0.69537*	0.11983	.000*
	8–10[t]	0.55585*	0.12163	.000*
8–10	1–4	0.13952	0.13551	.589
	5–7	−0.55585*	0.12163	.000*

Note. * Statistically significant at $\alpha = .05$.

Table 4 shows that statistically significant differences were in grades 5–7, and then grades 8–10, and finally grades 1–4. The results of grades 1–4 might be attributed to the sensitivity of this age group, a foundational stage for students. Students at this stage are children who lack independent learning skills. They need guided activities to acquire knowledge, skills, and attitudes, which they are not able to acquire without direct interaction with teachers and close monitoring. In addition, parents cannot teach their children at this age in the way that teachers do, due to their lack of sufficient teaching skills and competencies and appropriate ways to deal with the developmental needs of this age group. The results related to grades 5–10 can be attributed to the fact that children in this age group already have some self-learning skills and the ability to achieve learning goals with the help of teachers remotely, without the need to communicate with them face to face.

Third Question

To answer the third question—are there statistically significant differences at the level of significance ($\alpha = 0.05$) in the perceptions of parents of primary and secondary students in Jordan toward the distance learning process attributed to the variable of teacher's gender? —means and standard deviations were calculated. Table 5 shows these results according to the teacher's gender variable (male, female).

Table 5

Means and Standard Deviations of Parents' Perceptions Toward the Distance Learning Process According to Teacher's Gender Variable

Teacher's gender	*M*	*SD*
Male	2.8713	0.90181
Female	3.5528	1.13399

Table 5 indicates differences between means according to the teacher's gender. To find out whether these differences are statistically significant, the independent samples *t* test was calculated. The results are illustrated in Table 6.

Table 6

Independent Samples t Test Results of Parents' Perceptions Toward the Distance Learning Process According to Teacher's Gender Variable

Variable	*F*	Sig.	*t*	*df*
Teacher's gender	15.496	.000*	−6.345	195.346

Note. * Statistically significant at α = .05.

Table 6 shows statistically significant differences in parents' perceptions toward distance learning according to the teacher's gender variable (F = 15.496), in favor of female teachers. This result can be attributed, based on the researchers' experiences in the educational field, to female teachers seeming to put forth more effort in the teaching process than males. In addition, female teachers, compared with male teachers, bear a greater responsibility and work to develop themselves by attending workshops and training courses related to the development of vocational, technological, and cognitive skills. These assumptions are based on higher rates of academic success achieved in female schools, compared with male schools, according to Jordan's Ministry of Education (2020a) statistics.

Regardless of the compatibility of the sample of this study, which included parents within the samples of previous studies that included teachers and students in universities, the results of this study differ from of Al-shboul et al.'s (2015) and Awad and Hilles's (2015) results, which demonstrate no statistically significant differences attributed to the gender variable.

Fourth Question

To answer the fourth question—are there statistically significant differences at the level of significance (α = 0.05) in the perceptions of parents of primary/secondary students in Jordan toward the distance learning process attributed to the school type variable?—means and standard deviations were calculated. Table 7 shows these results according to the school type variable (public, private, UNRWA).

Table 7

Means and Standard Deviations of Parents' Perceptions Toward the Distance Learning Process According to School Type Variable

School type	*M*	*SD*
Public	2.9299	0.93945
Private	4.0052	1.07970
UNRWA	3.2500	0.98786

Note. UNRWA = United Nations Relief and Works Agency

Table 7 illustrates apparent differences between means according to school type. To find out whether these differences are statistically significant, a one-way ANOVA test was calculated. The results are illustrated in Table 8.

Table 8

One-Way ANOVA Results of Parents' Perceptions Toward the Distance Learning Process According to School Type Variable

Source	Type III sum of squares	*df*	*MS*	*F*	Sig.
Between groups	120.098	2	60.049	59.503	.000*
Within groups	471.283	467	1.009		
Total	591.381	469			

Note. * Statistically significant at α=.05.

Table 8 shows statistically significant differences in the of parents' perceptions according to the school type variable ($F = 59.503$). To determine which school type was favored, Schiff's post hoc test was calculated. The results are shown in Table 9.

Table 9

Schiff's Post Hoc Test Results of Parents' Perceptions Toward the Distance Learning Process According to School Type Variable

School type variable		*M* difference	*SE*	Sig.
Public	Private	−1.07537*	0.09925	.000*
	UNRWA	−0.32014	0.14821	.098
Private	Public	1.07537*	0.09925	.000*
	UNRWA	0.75524*	0.15061	.000*
UNRWA	Public	0.32014	0.14821	.098
	Private	−0.75524*	0.15061	.000*

Note. UNRWA = United Nations Relief and Works Agency

* Statistically significant at α = .05.

Table 9 shows statistically significant differences in favor of private schools, followed by UNRWA schools, and finally public schools. These results can be attributed to the implemented system of private educational institutions in Jordan and the supervision provided from the Department of Private Education (Ministry of Education, 2020a). Such supervision urges private schools to make great efforts, even in traditional, face-to-face learning, to create new opportunities for communication with parents for all levels, grades, and subjects. Compared with public and UNRWA schools, private schools work to sustain communication with parents via telephone and ensure that they follow the school's electronic webpages and social media and interact with them.

Conclusion and Implications

This study's aim was to investigate perceptions of parents of primary and secondary students in Jordan toward the distance learning process during the COVID-19 pandemic. The study results demonstrate that parents were moderately satisfied with the distance learning process. In addition, the results show statistically significant differences in the parents' perceptions to variables of child's grade level, teacher's gender, and school type. Because of the scarcity of such studies in Jordan, as a result of not applying this learning before the COVID-19 pandemic, researchers are encouraged to conduct more quantitative and qualitative research studies related to the perceptions of students, teachers, and stakeholders in the educational sector regarding the reality of distance learning and teaching processes in Jordanian schools and universities. Furthermore, further research should investigate which practices implemented in private schools versus public schools result in differences in perceptions for these types of schools.

This study can help decision makers, managers of educational institutions, and specialists in the educational sector learn how parents view distance education and how to improve its use in the future in a manner that suits students' needs. The authors expect that this study can inform decision makers and specialists in the educational sector about parents' perceptions of the distance learning process. Knowing these perceptions can give stakeholders opportunities to maximize the benefits of distance learning and reflect on the parents' perceptions regarding the current application of this teaching and learning avenue.

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Museum-Based Distance Learning Programs: Current Practices and Future Research Opportunities

Megan Ennes
University of Florida

Abstract

Museums play an important role in out-of-school learning. Many museums have begun offering distance learning programs to increase their reach and the accessibility of their collections. These programs serve a wide range of audiences from pre-kindergarten to lifelong learners. This descriptive study examined the current practices in museum-based distance learning programs. Additional data was collected once museums began closing due to COVID-19 and transitioning to distance learning programs. The study found that museums offering programs before COVID-19 predominately offered school-based programs via teleconferencing software. Museums transitioning to distance learning programs following closures due to COVID-19 mainly utilized social media platforms to offer a wide range of programming for the general public. Additional information was gathered regarding how the programs were developed and who facilitated them. Museums are still determining how to respond to COVID-19 closures. This study described the current landscape and potential opportunities for research related to museum-based distance learning programs. These areas for research include establishing best practices, defining high-quality programs, opportunities to engage in instructional design, and professional development for the museum staff facilitating these programs.

Keywords: distance learning, online learning, museums, COVID-19

Introduction

The outbreak of the 2019 coronavirus (COVID-19) pandemic led to the closure of schools around the world. More than 72.4% of students in over 177 countries were impacted by closures (United Nations Educational Scientific and Cultural Organization [UNESCO], n.d.). These closures strained resources as schools pivoted to online learning. For example, the United States suddenly needed to support more than 55 million students online, up from almost 1 million before COVID-19 (Butcher, 2020). Schools were encouraged to use existing online educational resources from other organizations, such as museums (Butcher, 2020).

Museums "spend more than $2 billion a year on education... [and] provide more than 18 million instructional hours for educational programs" in the United States alone (American Alliance of Museums, 2021). However, for many, access remains a barrier to visiting museums (Dilenschneider, 2019), whether due to distance, cost, or accessibility issues. To address this, many museums began offering distance learning programs (Gaylord-Opalewski & O'Leary, 2019). Globally, like schools, more than 90% of museums closed due to COVID-19 (UNESCO, 2020b) leading to an increase in museum-based online programming.

Museum-Based Distance Learning

Museum-based distance learning programs began in the mid-1990s (e.g., Bradford & Rice, 1996). A recent review of the literature found the research examining these programs was primarily evaluative case studies describing benefits and barriers, the importance of partnerships, and the changing roles of educators with the development of distance learning programs (Ennes & Lee, In Press). Some of the benefits included increased outreach opportunities (e.g., Gaylord-Opalewski & O'Leary, 2019), interest in physical visits (e.g., Hilton et al., 2019), and increased engagement with visitors (e.g., Mazzola, 2015). Some of the barriers included cost (e.g., Gaylord-Opalewski & O'Leary, 2019), time constraints (e.g., Sanger et al., 2015), a lack of staff capacity and the need for new training (e.g., Gaylord-Opalewski & O'Leary, 2019), and issues with technology (e.g., Hilton et al., 2019). Ennes and Lee (2021) have argued the need for further research beyond individual evaluative studies.

This descriptive study was conducted to establish a baseline understanding of how museum-based online programs are developed and implemented. A descriptive design was used to create a snapshot of the current practices in museum-based online learning and highlight information of interest to educators and other members of the museum community (Gall et al., 2003). The results of this study identified critical areas for future research and offered practitioners insight into strategies being used by other institutions. The following research questions guided this study:

1. How did museums develop and implement distance learning programs before COVID-19?
2. How did museums develop and implement distance learning programs following closures due to COVID-19?

Methods

A survey containing qualitative and quantitative questions was developed to answer our research questions. Demographic questions were based on the American Alliance of Museums' (AAM) annual survey (C. Walls, personal communication, November 19, 2019) including questions such as museum type, location, budget, and governance. Additional open- and closed-ended questions were included to gain more insight into the development and implementation of museum-based distance learning programs.

The survey was sent directly to individual museums that advertised distance learning programs on their Websites. These museums were identified by searching the institutional member lists of the AAM, Association of Academic Museums and Galleries (AAMG), Association of Children's Museums (ACM), Association of Science-Technology Centers (ASTC), and the Association of Zoos and Aquariums (AZA). Of the 1336 unique museums identified, 47 advertised distance learning programs on their Websites. This included 26 zoos/aquariums, 14 science museums, two art museums, and five other types of museums (multiple categories). These institutions were all located in the United States. An e-mail was sent directly to the address identified in the contact information for each program. The response rate was not measured as the surveys were anonymous. To reach more museums, an invitation to participate in the survey was sent out through professional listservs including AAM, AAMG, AMC, ASTC, AZA, the Museum Computer Network (MCN), and the International Society for Technology in Education's Interactive Videoconferencing Network. The initial survey was open for one month between February and March, 2020.

Just after access to the survey was closed, museums around the world began closing due to COVID-19. To capture information on how museums pivoted their education programs online, a shortened version of the survey was sent out through the same listservs as the first survey. Individuals were invited to participate if their museum had closed and was then offering distance learning programs. To prevent duplication of data, the solicitation asked participants not to take part in the second survey if they had completed the initial survey. The second survey was available for one month between March and April, 2020.

Ninety-one respondents completed the first survey. Participants who completed less than 90% of the survey were excluded (n = 15) for a total of 74 complete surveys. The second survey elicited 136 responses. Participants who completed less than 90% of the survey (n = 41) and respondents who answered *no* to all of the questions (including whether they offered a distance learning program) were removed (n = 6) for a total of 89 respondents to the second survey. Each participant was given a unique ID composed of a number and their museum category. For those who responded to the second survey, a C was added to the front of their ID number (e.g., C1, urban multidisciplinary).

AAM includes 20 classifications for museum type. However, due to the small number of responses from certain categories, the classifications were collapsed during coding into eight categories: (a) zoo/aquarium (aquarium, arboretum/botanical garden/public garden, zoo/animal park); (b) art (art museum/center/sculpture garden); (c) children's (children's or youth museum); (d) cultural (anthropology, ethnically/culturally/tribally specific museum); (e) historical (historic house/site/landscape, history museum/historical society, military museum/battlefield); (f) multidisciplinary (general or multidisciplinary, respondents indicating multiple types that did not fit in any other category); (g) specialized (hall of fame, presidential library, specialized museum, transportation museum); and (h) science (nature center, natural history museum, planetarium, science/technology center/museum). Respondents who indicated they were a visitor center/interpretive center were coded by the other categories they selected.

Open coding (Strauss, & Corbin, 1990) was used for open-ended questions and for questions where *other* was selected. Each question was independently coded by two separate raters. Discrepancies were discussed until an agreement was reached. Frequencies and percentages were found for each theme that arose from the open coding. The remaining questions were analyzed for means or frequencies. The surveys and data analyzed in this study are available from the corresponding author upon reasonable request.

Participants

With the first survey, almost half (44.6%) of the museums were zoos/aquariums (Table 1), more than half (56.8%) identified as private, non-profit organizations (Table 2), and more than half were located in urban centers (59.5%). For many of the museums that responded to the first survey, there was no fee for entry (21.6%, Table 3). Respondents to the second survey did not report museum visitation costs.

Table 1

Frequency of Museum Types

Museum type	Survey 1 (n = 74)		Survey 2 (n = 89)	
	Frequency	Percent	Frequency	Percent
Aquarium/Zoo	33	44.6	24	27.0
Science	10	13.5	22	24.7
Historical	8	10.8	11	12.4
Art	7	9.5	7	7.9
Multidisciplinary	6	8.1	8	8.9
Children's	5	6.8	10	11.2
Specialized	3	4.1	4	4.5
Culturally specific	2	2.7	3	3.4

Table 2

Frequency of Museum Governance Types

Type of governance	Survey 1 (n = 73)		Survey 2 (n = 89)	
	Frequency	Percent	Frequency	Percent
Private non-profit	42	56.8	55	61.8
University	11	14.9	8	9.0
State	4	5.4	3	3.4
Public-private partnership	3	4.1	12	12.5

Municipal	3	4.1	4	4.5
Federal	3	4.1	1	1.1
Private for-profit	2	2.7	1	1.1
County/Regional	1	1.4	2	2.2
Other	4	5.4	1	1.1

Table 3

Museum Visitation Fees (Survey 1; n = 72)

Fee	Frequency	Percent
Free	16	22.2
Suggested donation	2	2.8
Less than $10	9	12.5
$10 to $20	28	38.8
More than $20	17	23.6

Approximately a quarter of the respondents to the second survey worked in a zoo/aquarium (27.0%) or a science museum (24.7%; Table 1). These were predominantly private, non-profit museums (61.8%; Table 2) and mostly located in urban areas (55.1%). The annual operating budgets for these museums can be found in Table 4.

Table 4

Museums' Annual Operating Budgets

Operating budget	Survey 1 (n = 65)		Survey 2 (n = 85)	
	Frequency	Percent	Frequency	Percent
Up to $350,000	8	12.3	8	9.4
$350,000 to $499,999	3	4.6	3	3.5
$500,000 to $999,999	1	1.5	14	16.5
$1 million to $2.9 million	13	20.0	27	31.8
$3 million to $4.9 million	6	9.2	10	11.8
$5 million to $14.90 million	13	20.0	15	17.6
$15 million and over	21	32.3	8	9.4

With the initial survey, participants who reported annual attendance numbers indicated a wide range from 1,500 visitors a year to 4 million a year (n = 61; M = 662,955.18; SD = 781,754.96). Participants who reported annual attendance numbers on the second survey showed visitation ranging from 1,000 to 2.5 million visitors a year (n = 82; M = 333,950.14; SD = 507,279.89). For the first survey, the numbers of full-time staff ranged from zero to 4,000 employees (M = 168.17, SD = 495.36) and part-time staff ranged from zero to 5,000 employees (M = 186.15, SD = 647.09). Staff numbers were not reported on the second survey.

Results

With the initial survey, 60.8% of participants indicated they offered distance learning programs (n = 45). Almost a quarter of the respondents (23%, n = 17) reported they would be offering online programs soon and 16.2% (n = 12) said they were not offering online programs.

Museums Without Online Programs

The 12 participants who reported they did not offer online programs on the first survey were asked to share the reasoning behind that decision. Four participants indicated they preferred in-person learning due to object-based teaching, wished to connect students to the content without using technology, or wanted to serve their local community. For example, “we focus on object-based learning in the museum and at schools” (20, suburban art). Another noted that they have “had discussions about the disconnect between wanting our visitors to experience nature without technology involved” (39, urban science). Three respondents referred to a lack of staff capacity to develop and implement the programs. “As a mid-size museum, we are cognizant of our staff capacity and want to ensure that we are providing the highest quality programming possible by not spreading ourselves too thin” (49, urban children’s).

Three respondents lacked the resources needed to successfully implement a distance learning program and two people discussed cost as being prohibitive. “We lack the knowledge on how to create a distance learning program and possibly the equipment that would be needed” (34, rural multidisciplinary). One participant mentioned that their museum previously had a distance learning program but it was cost-prohibitive and their local school system did not have the infrastructure needed to participate.

> We used to run one but the costs to keep up with the equipment could not be covered by the income. Also, we are in a low-income city and most of the schools did not have the equipment at the time to link to us easily. (05, urban zoo/aquarium)

Finally, one respondent discussed constraints associated with working at a university museum, namely “we are on a college campus and online courses need to go through an approval process” (65, urban multidisciplinary).

Museum-Based Online Programs

Of the 45 participants in the initial survey who offered online programs, (a) 25 were from a zoo/aquarium (55.6%); (b) six were from a science center (13.3%); (c) five worked in a historical museum (11.1%); (d) three worked in an art museum (6.7%); (e) specialized museums and children’s museums accounted for two participants each (4.4%); and (f) multidisciplinary and cultural museums each had one participant (2.2%). The museums were primarily private non-profit institutions (64.4%) located in urban areas (62.2%), though suburban (22.2%) and rural areas (11.1%) were represented as well.

The longest-running program was 31 years old with the newest programs just a year old (M = 7.81, SD = 6.71). Almost all those who participated in the first survey reported their distance learning programs were run by their education department (95.6%) with single museums reporting it was run by their archives department or visitor experiences team. The number of staff involved in the distance learning programs ranged from one to nine people (M = 2.58, SD = 1.82) with 62.8% having only one or two people. Almost all of the programs reported having full-time staff who contributed to the programs (97.8%), 22.2% reported having part-time staff, and 4.4% had volunteers who also worked with the programs. These staff primarily held degrees in education (55.6%) or science (48.9%; Table 5).

Table 5

Museum Staff Education

Academic discipline	Survey 1		Survey 2	
	Frequency	Percent	Frequency	Percent
Education	25	55.6	61	68.5
Sciences	22	48.9	47	52.8
Technology	4	8.9	1	1.1
Communications	3	6.7	10	11.2
Museum education	2	4.4	9	10.1
Marketing	0	0.0	12	13.5
History	0	0.0	18	20.2
Other	8	17.8	18	20.2

Note. Percentages add to more than 100 as respondents could select multiple options.

Participants in the first survey were also asked what kind of training they received to facilitate distance learning programs. Most indicated on-the-job training (60.0%) such as being trained by an experienced educator or observing programs and then teaching on their own (Table 6).

Table 6

Staff Training to Teach Distance Learning Programs

Training	Frequency	Percent
Very little to none	9	20.0
On the job	27	60.0
Professional development	10	22.2
Conference workshops	2	4.4

Note. Percentages add to more than 100 as respondents could select multiple options.

Participants in the second survey reported that their new programs were primarily facilitated by their education (83.1%) or marketing (25.8%) departments with almost a quarter (23.6%) facilitated by both marketing and education. One participant shared the challenge related to this new collaboration as "we are dipping our toes in the water of connecting with audiences via social media which is a big shift for our marketing department who typically doesn't allow us to post education programming in that format" (C61, urban specialized). Six respondents (6.7%) indicated that their programs were being run by members of their administration (e.g., directors).

In response to the second survey, reports of the number of staff running distance learning programs ranged from one to 100 people (M = 7.27, SD = 11.22) with 69.1% of institutions having six or fewer people. Almost all of the programs reported having full-time staff who contributed to the programs (95.5%), 36.0% reported part-time staff, and 5.6% had volunteers. These staff predominantly held degrees in education (68.5%) or science (52.8%; Table 5).

On the initial survey, 29 participants shared information about their budgets, which ranged from zero to $100,000 ($M$ = $11,901.72; SD = $26,167.41). Almost a third of the respondents (31.1%) did not have a budget. Nine participants indicated that their distance learning budgets were part of their overall education budget, as "it is part of the outreach budget, so it can't be easily quantified" (11, urban zoo/aquarium). Five participants indicated they were supported by program partners or one-time grants. One shared that their department had "no specific budget. We were given a $75,000 grant for distance learning and one other project" (18, rural zoo/aquarium). Two participants reported that they were funded by revenue brought in by the program. The cost of programs ranged from free to $200 ($M$ = $59.65, SD = $62.35) with 44.2% of the institutions offering their programs for free.

All respondents were asked what types of programs they offered. Programs on the first survey were overwhelmingly school-based (91.1%). Of the 11 respondents who noted they offered other types of programs, six (13.3%) indicated their programs were for adults and senior citizens (Table 7).

Table 7

Program Types

Program	Survey 1		Survey 2	
	Frequency	Percent	Frequency	Percent
School programs	41	91.1	32	36.0
Teacher professional development	13	28.9	10	11.2
Massive open online courses	0	0.0	4	4.5
Lectures	3	6.7	36	40.4
Conferences	10	22.2	22	24.7
Other	11	24.4	53	59.6

Note. Percentages add to more than 100 as participants could select multiple options.

With the second survey, programs mostly fell into the *other* category (59.6%), but lectures (40.4%) and school programs (36.0%) were commonly indicated as well (Table 7). When the open-ended responses in this category were coded, 10 participants indicated they were offering virtual tours. Nine described activities caregivers could do with their families, seven created videos, six offered printable activities, and five hosted story time sessions. Question and answer programs, blogs, and home-school programs were each identified by three participants. Two museums were offering training opportunities for their staff or volunteers. Uniquely, one respondent was offering virtual dance parties.

Respondents were asked to indicate how they facilitated their programs. Most of those who responded to the initial survey used free or paid teleconferencing software (86.7%, Table 8). More than half felt their programs were easy to use and implement from the facilitator's perspective (53.3%), whereas 44.4% felt their programs were somewhat easy to implement, and one person (2.2%) felt the technology was not user-friendly for the facilitator.

Table 8

Technology Used to Deliver Programs

Technology	Survey 1		Survey 2	
	Frequency	Percent	Frequency	Percent
Teleconferencing software	39	86.7	48	53.9
Proprietary technology	3	6.7	0	0.0
Asynchronous services	1	2.2	0	0.0
Learning management software	1	2.2	2	2.2
Social media	0	0.0	65	73.0
Museum Website	0	0.0	20	22.5
E-mail	0	0.0	5	5.6

Note. Percentages add to more than 100 as respondents could select multiple options.

Almost three quarters (73.0%) of the respondents to the second survey indicated they used social media to facilitate their new programs. More than half (53.9%) used teleconferencing tools and almost a quarter (22.5%) facilitated programs on their institution's Website (Table 8).

All respondents were asked to describe the audiences they served. With the first survey, the most common audiences were elementary (77.8%) and middle school (77.8%; Table 9). Respondents to the second survey indicated their most common target audiences were elementary school (80.9%) and the general public (74.2%; Table 9).

Table 9

Program Audiences

Audience	Survey 1		Survey 2	
	Frequency	Percent	Frequency	Percent
Pre-kindergarten	9	20.0	51	57.3
Kindergarten to fifth grade	35	77.8	72	80.9
Middle school	35	77.8	44	49.4
High school	23	51.1	30	33.7
Universities	6	13.3	13	14.6
Teachers	13	28.9	28	31.5
General public	11	24.4	66	74.2

Note. Percentages add to more than 100 as respondents could select multiple options.

Participants were asked how they chose the topics for their programs. Respondents to the first survey chose their topics based on state or national standards (51.1%) or museum-specific content (48.9%). Respondents to the second survey chose topics related to their museum (48.3%), transitioning existing programs online (38.2%), or state or national standards (31.5%; Table 10).

Table 10

How Topics are Chosen

Influencing factors	Survey 1		Survey 2	
	Frequency	Percent	Frequency	Percent
State or national standards	23	51.1	28	31.5
Museum-specific content	33	48.9	43	48.3
Requested	10	22.2	5	5.6
Existing programs	4	8.9	34	38.2
Museum mission	3	6.7	9	10.1
Available topic experts	3	6.7	9	10.1
Other	0	0.0	6	6.7

Note. Percentages add to more than 100 as participants could select multiple options.

Programs Before COVID-19

Respondents to the first survey described a wide range of programs. A few indicated they only offered distance learning programs as a special event a couple of times a year (n = 3). Many described live programming from either classrooms or exhibits (n = 14) and virtual tours (n = 9).

> Distance learning programs are studio and exhibit based. For more general DL [*sic*] programs, we utilize a studio. We also feature exhibit-based . . . programs [that] do not require sophisticated technology. We utilize tablets with a webcam over IP utilizing Zoom. (71, urban zoo/aquarium)

A few respondents indicated their museums offered professional development programs (n = 4). One shared that their programs were open access and always available. Other unique programs included one co-owned by the school system and the museum, one that engaged senior citizens over the phone, and another that engaged students from a rural, Native American community in a science, technology, engineering, and math club via teleconferencing.

To gain more insight into the programs, the first survey asked participants to indicate the types of materials they used during their programs. Participants indicated they used (a) hands-on demonstrations (57.8%), (b) live animals (55.6%), (c) videos (51.1%), (d) artifacts or biofacts (22.2%), (e) live tours (8.9%), and (f) an online photo gallery of art found in the museum (2.2%). Almost half (42.2%) indicated they sent materials to their participants to use during the program. These were primarily printable activities for students to complete during the program (42.1%) but also included online resources (15.8%) and physical kits that were mailed to participants (15.8%). Just over half (51.1%) of the respondents to the initial survey reported that they offered pre- and post-program materials including vocabulary worksheets (60.9%), teacher guides (26.1%), readings (8.7%), and videos (8.7%). Many respondents (62.2%) indicated they conducted participant evaluations and 24.4% had completed external evaluations of their programs.

Programs After COVID-19 Closures

Respondents to the second survey described a wide range of new programs. One respondent shared that their program "varies from day to day. Our big push is to keep connected with our audience through a variety of ways each day at a set time. We have done guided tours, drawing, and even songs" (C50, urban zoo/aquarium). Many respondents discussed the issues of short turnaround and lack of technology to develop new programs. This led many of the participants to discuss using social media as a ready-made platform (n = 14).

> We have not been doing a program, but we intend to film our staff doing some tours and talks within the house. We thought we'd post them on our Facebook page since we don't have any real technology set up for true "distance learning." (C23, urban historical)

Participants discussed creating virtual tours (n = 15) and videos (n = 12) that could be shared online. Some respondents mentioned transitioning existing programs online as a quick way to create content (n = 8). Use of blogs (n = 4) and pre-recorded content (n = 10) were frequently mentioned. Seven respondents hosted virtual storytime and one had a virtual book club for members. Two museums offered activities to be picked up for use at home. Others discussed moving previously scheduled lectures and special events to online platforms. Many were still determining how to best transition to online (n = 14). One respondent noted that a program was still "non-existent, but plans are in place for neighborhood tours hosted virtually by staff and docents, and making some resources available for download" (C61, urban specialized).

Participants in the second survey were asked to share any other information they felt relevant. Several museums (n = 6) had been planning to offer distance learning programs soon but had to shorten their timelines due to the closures:

> Fortunately, we have been investing in these tools for some time though we did not plan on rolling them out so quickly and extensively. While our staff has been super proactive, it has been a difficult transition since it had to happen very quickly. (C33, multidisciplinary)

Several respondents (n = 11) agreed that the transition to online programs had been very challenging. “We’ve never been so busy and had so many meetings—we are on overdrive trying to reach people who can’t reach us!” (C53, rural science). When developing these new programs, participants discussed the difficulty of collaborating with other departments; “it has been difficult balancing online education/learning based programs and the digital marketing team’s idea of online engagement” (C46, suburban multidisciplinary). Additionally, some respondents (n = 7) felt they did not have the skills, resources, or time to effectively transition their programs to online. One participant indicated that their transition has been “chaotic, not coordinated and [we are] discovering how inadequate our technology and staff skills are” (C67, urban science).

Funding was also discussed as a major challenge:

> Our challenge is 1: little budget available to purchase high quality equipment to continue distance learning and 2: at this time, distance learning does not provide direct revenue to the education department, particularly since revenue is being lost due to closure; paying staff to produce a non-revenue generating program is a tough pill to swallow. (C63, urban zoo/aquarium).

More than one museum was struggling with whether to charge for their programs (n = 5). “We are also discussing fees vs. donations since we need revenue but many parents are out of work” (C74, suburban zoo/aquarium).

Seven participants discussed changes in staffing that made the transition more challenging. As one shared, “all full-time staff have been reduced to part-time” (C60, urban science). Another said, “we have spent the last few weeks trying to create content, but staff are being furloughed soon, so we hope to schedule some posts so that the content can continue for a while without paid staff” (C64, suburban children’s). However, another found opportunities to work around staffing issues. “Live distance learning has been impossible as education staff are not deemed ‘essential’ and therefore cannot work at the museum’s location. However, teachers are loving our prerecorded content because it is more flexible than scheduling live meetings” (C62, urban zoo/aquarium).

Two respondents shared their struggle with distance learning as a replacement for in-person programs. One person shared that this was an “exciting opportunity for us to offer a virtual classroom, but it seems less engaging to young learners than having the Outreach Educator and his/her materials in the actual classroom” (C81, suburban historical). Two other respondents were concerned with maintaining the same high-quality programming they typically offered.

Despite the challenges, five respondents were excited about the opportunity to explore programming that would not have been prioritized, typically. “Making the transition during this time of crisis allows for experimentation in a way that would feel more challenging at a time of stability” (C22, urban art). Another said, “we are currently in a period of experimentation, trying many ideas we have been wanting to do for a long time and building in space to refine and continue to evolve based on best practices” (C46, suburban multidisciplinary).

When developing new programs, six respondents focused on how to engage their audiences. One said “we have had great interest in these programs—over 100,000 views on some!” (C72, urban zoo/aquarium). Another respondent shared they had received an “amazing outpouring of support from [the] public for offering these and donations as a result” (C74, suburban zoo/aquarium). However, one respondent indicated they had to change directions with their programming; “we have found that many parents are overwhelmed with the sheer amount of resources at their disposal and that what they’re really looking for is some familiarity and consistency” (C80, urban children’s).

When thinking about how to transition to online, two respondents suggested leveraging existing materials as a quick way to transition. “Although we have never had online programming before, we’ve been able to take a lot of the things we would be doing normally and convert them to online tutorials” (C38, urban art). Another suggested that “partnering with other organizations seems to help a lot with engagement” (C49, suburban children’s). Ten respondents were still in the planning stages but one participant indicated that they had developed all of the content but could not implement it, saying they were “ready and willing but prevented” (C45, urban art).

Limitations

While an effort was made to contact museums with known distance learning programs, it is unlikely that every program was included. Additionally, the second survey was administered during a global pandemic when museums were closing. This added stress may have prevented participants from responding. Additionally, changes in employment may have prevented participants from receiving the survey if they no longer had access to their institutional e-mail. However, this study still offers insight into the state of museum-based distance learning programs.

Discussion

This study examined the current practices in museum-based distance learning before and after COVID-19 closures. Descriptive studies such as this set the stage for future research, and based on the findings, there are many opportunities for additional research in the field of museum-based distance learning.

When discussing the barriers to engaging in online programming, respondents described many of the same issues identified in the literature: cost, staffing, time, resources, and institutional barriers (Ennes & Lee, 2021). To help educators address the issues described in this study, researchers should examine ways to offset the barriers (real or perceived) museums face when developing online learning opportunities. Resources, time, staffing, and cost can be offset by partnerships and grants as mentioned by several respondents, as well as in a recent report by International Council of Museums (ICOM, 2020) that offered strategies for museums to develop resilience during the pandemic. Choosing partnerships strategically can support a museum's ability to reach greater audiences through online learning (Kraybill & Din, 2015). Identifying potential partnerships and grants will remain a vital strategy for museums to develop and sustain online programs (Ennes & Lee, 2021).

In addition to the barriers described above, some educators viewed online pedagogy as a barrier. Several explained they believed in-person teaching was more effective than teaching online. This could be a result of a lack of training in effective online pedagogy. The range and types of technology available for teaching online will continue to change. Therefore, researchers will need to examine what pedagogical strategies are most appropriate for museum-based online programming; the strategies that are effective for online programs in formal education may not be appropriate in this setting. Education researchers interested in pedagogical strategies and pedagogical content knowledge should investigate the skills needed to effectively teach online in each of the types of programs described by participants in this study. Skills and tactics that are useful for a massive open online course may not be appropriate for a one-time synchronous program, and social media platforms may not allow for the same kind of interactivity available in other types of museum programs (Conrad, 2014). Additionally, there are opportunities to examine whether traditional educational theories such as constructivism remain appropriate or whether educators need to explore theories and frameworks specific to online learning such as cybergogy (e.g., Wang & Kang, 2006) or heutagogy (Hase, 2009).

Respondents discussed transitioning existing programs online following museum closures. While previous studies have discussed this strategy as a way to reduce the burden of developing online programs (e.g., Gaylord-Opalewski & O'Leary, 2019), other studies caution against trying to directly translate programs to online offerings as the pedagogical strategies are different (Mazzola, 2015) For example, educators who rely on physical and verbal cues may find them lacking in the online setting and need different pedagogical strategies to teach effectively (Samuel, 2015). Additionally, online programs are accessible by learners from around the world and it is possible that without culturally responsive pedagogies, misunderstandings and other learning barriers may arise (Gunawardena, 2014). Studies should examine whether programs are culturally responsive and respectful of learners from broad geographic areas (Latchem, 2014).

There is also a need to engage in research to address the digital divide that has been exacerbated by the current global pandemic (UNESCO, 2020a). In a recent study, researchers found access to the internet was impacted by (a) geographic disparities (e.g., rural vs. urban); (b) competition, to help keep prices low; (c) profit-based discrimination, since companies may believe certain areas have a lower demand and will therefore avoid serving those regions; (d) cost to install new technology; and (e) socioeconomic differences, with geography and socioeconomic status having the highest impact on access (Reddick et al., 2020). A similar study in the European Union found that age, gender, education, and income significantly impacted internet access. Addressing the digital divide will need to be context specific as "it is a multidimensional phenomenon and different backgrounds ask for different measures, if the goal is to narrow digital discrepancies in an effective way" (Elena-Bucea et al., 2020, p. 11). Museums must consider how to best reach individuals without digital access, and the strategies they choose will be dependent on their particular community as "each faces unique historical, political, financial and logistical challenges" (Reddick et al., 2020, p. 1). The research on museum-based distance learning programs is still growing, and there are many opportunities to better understand how these programs can be designed and facilitated so they can best reach underserved audiences (Ennes & Lee, 2021).

Several respondents to the second survey discussed the rise in collaboration between education departments and marketing. These new partnerships should be examined to identify best practices for facilitating such collaborations. Crow and Din (2011) highlight the importance of shared goals, responsibilities, leadership, and the ownership of successes and failures in any museum-based distance learning partnership, whether internal or external. Respondents indicated that partnerships brought new challenges and opportunities in developing online programming, particularly as they began using social media to facilitate programming.

Social media has its own sets of affordances and challenges and can influence the nature of interaction and communication in online programs (Conrad, 2014). The number of museums using social media platforms to host programs raises questions about how these platforms may change the interactivity of the programs. For example, researchers may want to examine how to interactively engage learners in programs hosted on Facebook Live. Tools such as learning analytics, network analyses, discourse analyses, and social network analyses may lead to insights into these types of questions (Zawacki-Richter & Anderson, 2014).

In addition to pedagogical studies, quality studies are an area of need for both formal and museum-based online learning (Zawacki-Richter & Anderson, 2014). Some respondents were not satisfied with the programming their institutions were developing. Therefore, museums have an opportunity to explore what constitutes high quality in museum-based online programs. Researchers in formal online learning have questioned whether there should there be a consensus regarding what high-quality programs look like (Latchem, 2014) and this may be an area of interest for museums as well. One suggestion for assessing quality is for institutions to compare their practices and metrics with those of other institutions (Latchem, 2014). This will require studies to compare programs across institutions rather than the current trend of individual case studies (Ennes & Lee, 2021). Therefore, researchers should consider larger studies that examine similar programs across a wide range of institutions.

Museums have flexibility in program offerings and should leverage the creativity of their staff to explore and test new models (Gaylord-Opalewski & O'Leary, 2019; ICOM, 2020). However, previous studies recommended that museums should make use of "systematic instructional design that carefully considers the learners and the learning objectives, followed by the consideration of the best tools to meet those objectives" (Kraybill, 2015, p. 99). This raises questions about how instructional designers may be able to assist museums in developing these programs in ways that can be responsive to society as well as new technologies (Zawacki-Richter & Anderson, 2014). Instructional designers should consider collaborating with museum educators to develop online programming using appropriate pedagogical approaches and theoretical frameworks. This would open the door to research-practice partnerships and increased research grounded in theory.

Finally, participants in both surveys discussed the need for professional development to improve their skills. This is an area of need for museum education research broadly (Tran et al., 2019) and for museum-based online learning research in particular. Research on professional development for museum educators is growing (e.g., Ennes et al., 2020; Piqueras & Achiam, 2019; Tran et al., 2019). For example, in a study of museum educators' levels of self-efficacy related to their position, one of the biggest areas of need for professional development was that of onsite program facilitation (Ennes et al., 2020). Museum educators likely have similar reservations about their ability to effectively facilitate online learning. Research should assess museum educators' levels of self-efficacy regarding these new programs. Additionally, there is a need to examine the skills and preparation educators have to teach online (Zawacki-Richter & Anderson, 2014). These areas should also be considered when developing and examining the efficacy of professional development for museum educators engaged in online learning.

Conclusion

Distance learning programs offer museums the opportunity to engage a broad range of visitors with their collections (Gaylord-Opalewski & O'Leary, 2019). Before the COVID-19 outbreak, these programs predominantly focused on school groups and teacher professional development. Following the closure of museums, institutions began transitioning their in-person programming online to continue serving their educational missions. While challenging, this has offered museums the opportunity to think creatively about how they engage in education and who they are serving with their programming (ICOM, 2020). Museums have risen to the challenge of developing new resources to support their visitors despite experiencing closures due to a global pandemic.

This study offered an overview of the current landscape in museum-based distance learning programs as well as future directions for research. Museums are offering a broad range of programming to serve the needs of their visitors both in person and online. Many museums are using this time to develop creative new approaches to reaching their audiences through innovative programming. This offers researchers the opportunity to examine the impacts these programs have on learning, interest, engagement, and museum visitorship. It is likely there will be an increase in the number of museums offering distance learning programs as the situation surrounding COVID-19 remains unclear. Therefore, museum education researchers should form research-practice partnerships with museums to help establish best practices for effective programming, and to support educators as they explore what is, for many of them, a new frontier. High quality museum-based online programs may offer diverse types of visitors the opportunity to engage with collections in ways that increase their interests and knowledge even if they cannot physically visit an institution. As these types of programs will only gain in importance and popularity in the future, the research community must establish a better understanding of these programs through the strategies outlined in this study.

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Book Review: Guidelines on the Development of Open Educational Resources Policies

Authors: Fengchun Miao, Sanjaya Mishra, Dominic Orr, and Ben Janssen: (UNESCO and Commonwealth of Learning (COL), 2019, 107 pages) ISBN: 978-1-894975-97-1

Reviewed by: Irem Demirbag and Sedef Sezgin, *Anadolu University*

UNESCO and the Commonwealth of Learning (COL) have published these guidelines as a joint effort. They include steps for evaluating, assessing, designing, and implementing OER initiatives and policies. It is comprised of seven chapters, including the concept of OER; policy visions; frameworks; masterplans; implementation plans; and launching strategies. It also includes the purpose, background information, and references, with practical examples. At the end of each chapter, specific tasks are set for the policymaker to help develop a final OER policy.

In Chapter 1, the concept of open educational resources (OER) is provided, and the resources are placed in the context of achieving the *Sustainable Development Goal (SDG 4): Education For All.*

Chapter 2 outlines the educational challenges to achieving SDG4, such as expanding access, enhancing inclusion and diversity, promoting gender equality, supporting high quality education, and providing opportunities for lifelong learning. To deal with these challenges, the authors present across-the-board solutions. It then discusses the reasons or ideas for using OER to tackle the complexities of teaching and learning systems, as well as enhancing or even transforming education.

Chapter 3 presents the principles of a policy's scope and scale, determines the level at which the policy is to be set, and identifies the areas of the education system that will be included in the policy. This chapter also provides a framework for guiding decisions on scope and scale, and addresses policy choices regarding possible regulatory requirements as well as other resources to aid OER implementations.

Chapter 4 introduces four key strategic areas where there are significant gaps that need to be addressed. These strategic areas include the current knowledge level of stakeholders, providing learning materials, possible technical and regulatory barriers to the use of OER, and the type and content of training and support for teachers and instructors.

Chapter 5 presents the main building blocks that an OER policy should include, such as adopting an open licensing framework, integrating OER into curriculum, aligning quality assurance procedures, etc. The reader will have completed a complete masterplan draft for OER by the end of this chapter and will be ready to consider an implementation strategy.

Chapter 6 reveals the five components of the policy implementation plan. The operational task of this plan is to use specific methods, allocate resources, involve stakeholders, and coordinate the implementation of the master plan. It also involves developing an organizational structure for policy governance and collaboration, as well as international cooperation to facilitate peer learning and the exchange of ideas.

In the final chapter, the authors argue that the introduction of a policy requires coordinating core activities sponsored by high-level approval, engaging different stakeholders and user groups with a view to clarifying, and communicating the policy objectives and the implementation plan.

The guide includes many resources with examples of previous OER implementations. These serve to inspire and provide information about OER related activities, organizations, and champions. The guide also includes a map website called the OER World Map that currently has over 3,000 entries from around the world (https://oerworldmap.org/resource/).

Although the guide focuses on developing a policy for OER, at the beginning of the guide there is some limited information describing OER and how they can be used. However, a first reading of this book can be complex for those who are not familiar with the subject. So, the guide recommends resources for those who need a basic understanding of OER, such as *Understanding Open Educational Resources* (Butcher & Moore, 2015), *A Basic Guide to Open Educational Resources (OER)* (Butcher, 2011). In addition, there is online training provided by COL on *Understanding Open Educational Resources* that is accessible and free of charge for anyone.

Compared with these other resources about OER, this guide expands on the common issues, and focuses on policy-making steps for governments and institutions to implement OER projects. One of the principal strengths of the guide is that the chapters include tasks for the reader to complete using common concepts and design criteria, while referring to cases from all over the world. The tasks are completed by considering your own countries' circumstances and initiatives. Here is an example from the tasks: "What are the major challenges or issues your education system is facing in achieving SDG 4? Based on your understanding of OER, how can adopting OER contribute to their solution?" (p. 17).

Upon completion, anyone who has finished the tasks provided would have an extensive framework that included essential and urgent points to start developing an OER policy. Furthermore, the cases around the world that demonstrated successful OER implementations in projects and polices at the institutional or government levels encourage the reader to take action. One of the cases focuses on the considerable costs for teaching and learning materials for both education providers and learners. Using this case, the reader compares the cost of materials in given countries with his/her own country and realizes that OER can eliminate much of these costs. OER can help institutions and students internationally to cope with the rising cost of education.

According to UNESCO SDG4, everyone has the right to education, and countries have an obligation to include everyone equitably, and to ensure gender equality. Using OER can help further access to quality learning opportunities for everyone. In sum, this guide provides a comprehensive structure for governments and institutions to set out their policy vision and scope, then create and implement a policy masterplan for OER. This detailed guide on how to develop systematic and effective policies on OER can assist anyone concerned with OER implementations. SDG4 can be achieved using distance education and OER to provide inclusive and equitable quality education and promote lifelong learning opportunities for all.

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Book Review: Learning Online-The Student Experience

Author: George Veletsianos (Baltimore: Johns Hopkins University Press, 2020, 174 pages)

Reviewed by: Özlem Oktay and Fırat Sösuncu, *Anadolu University*

Online learning is widely used at the global level and thousands of students are experiencing online learning. Online learners demonstrate demographic diversity. Therefore, the experiences of online learners also differ. Not knowing the difficulties experienced by online learners is an obstacle to designing effective courses, making necessary decisions, and acting with the feeling of empathy. In order to overcome this obstacle, it is necessary to have detailed information about the experiences of learners in online learning. Veletsianos acted with this idea, focusing on the experiences of online students, and analyzing the situation, presenting a true or composite story of an online student which was firstly gathered from his own research and experience, and occasionally from other reports. Thus, he aimed to provide a perspective to online learning, by looking through a different lens. He thinks that his perspective will help online instructors, researchers, administrators, instructional designers, teaching and learning center managers, policy makers, entrepreneurs, technology developers and higher education consultants to create a future that will meet the needs based on students' experiences.

Learning Online-The Student Experience, created with this in mind, consists of 17 chapters. In these chapters, the learner is defined in different ways: comparing face-to-face learning with online learning, fully motivated, deregistering, using a family computer, having the necessary literacy, watching videos alone, showing emotion, listening, cheating, taught by the internet robot, taking notes, using social networks, independent, using the advantage of openness in MOOCs, using the advantage of flexible learning and the learner of the future.

In Chapter 1, it is stated that modality should not be a barometer in evaluating quality in online and face-to-face learning and comparing face-to-face learning with online learning may cause misleading results. The reason for this is the differences in instructional design and differences in the situation of learners. In measuring the goodness of an online course, emphasis is placed on the degree of design and meeting the learner needs. In Chapter 2, it is stated that non-traditional students are composed of a large group of individuals who follow online learning opportunities, although there is an increase on a global scale, this is not the same in every country, and the majority of the group that feeds the increase trend is employees or adults. In Chapter 3, the reasons for the emergence of completely interested and highly motivated learners are emphasized, and it is stated that learners tend towards online learning due to internal and external factors. Attention is drawn to factors such as autonomy, flexibility, accessibility, financial concerns and belonging.

Chapter 4 explains the reasons for the learner's tendency to start online learning or quit online learning, as a complex problem consisting of the learner, curriculum, and environmental factors. It is stated that learning-oriented and innovative strategies should be developed with an ecological approach towards the solution. In Chapter 5, it is mentioned that the social justice orientation requires defining and removing obstacles based on the lack of access alone in achieving success in online learning. Chapter 6 describes 21st century skills, digital literacy, information literacy and participation literacy. Emphasis is placed on the necessity of participation literacy in online learning. It is pointed out that some learners may already exhibit participation literacy, while some learners may need support.

Chapter 7 focuses on learner isolation and loneliness. The importance of creating an online learning community is emphasized and learn how to use social media in order to provide social learning, cooperation and interaction easily. It is pointed out that there is a need for new pedagogical approaches that are appropriate for the digital age and emphasize connectivity. Chapter 8 articulates online learning as an emotional experience. It is explained that accepting online learning as an emotional experience may contribute to strengthening learner-teacher relationships and improving the quality of emotional relationships and education programs. Chapter 9 focuses on what is called a listener learner who does not participate in online learning. Implementation communities, community environment issues and reasons for lack of learner participation are addressed.

In Chapter 10, the subject of fraud in the academic environment is discussed with the title of cheating learner. It is pointed out that the methods developed to prevent this should be made not to wear down the sense of trust in the learner-teacher relationship. Chapter 11 deals with the learner taught by the internet robot, which can be valuable in terms of allowing us to think and develop new pedagogies, and the reader is encouraged to think about it with the help of questions. Chapter 12 details the topic of note taking learner, and it is stated that trainers and digital learning platforms can support the efforts of learners with applications that facilitate notetaking. In addition, emphasis is placed on collaborative notetaking, which can be effective in creating learning communities. In Chapter 13, the benefits of using social media in online learning for the learner are discussed, and the compatibility of social media technologies with progressive pedagogical approaches that value social interaction and participation is emphasized. Veletsianos argue that social media can be used as part of an effective tool set in online learning designs.

Chapter 14 focuses on learner autonomy, and self-directed learning skills are defined as a central component of online learning. Online learners are described as self-governing, autonomous and knowledgeable individuals. In addition, it is expressed that institutions should support and encourage learners to develop these features. In Chapter 15, the structure, advantages and disadvantages of MOOCs are demonstrated with examples from related research. Chapter 16 focusses on the flexibility of online learning that enables learners to balance multiple responsibilities. The chapter emphasizes that institutions should follow new policies and approaches to ensure and develop flexibility. In the last chapter, future trends in online learning are explained under the title of 'The Learner of the Future', and weaves of plausible stories around artificial intelligence, virtual and augmented reality, and high-resolution simulations within a coherent learning ecosystem. However, it is stated that these trends should not be accepted blindly, and the underlying reasons should be investigated. In addition, the issue of focusing on macro-scale studies rather than micro-scale studies in research on online learning is emphasized.

With *Learning Online-The Student Experience*, Veletsianos sees individuals from different backgrounds as the target audience and points out that, for each target audience, there are lessons they can learn from the book. It aims to provide readers with introductory information about online learning and presents an experiential picture about it, as they are interested in online learning or are thinking about becoming an online learner. The author's suggestion for those who intend to offer an online program or improve their online education is to read the stories of the learners again and to answer some questions based on these stories.

These questions are as follows (pp. 166):

- Who are the students in the proposed online program?
- What do they need and why?
- Who has decided that an online degree or course is required and what are their motivations?
- Have students been consulted in the development of this program?

By answering these questions and keeping in mind that our target audience is not only learning but having other responsibilities and problems in life, it is necessary to think about providing learning and planning curriculum and designs accordingly.

As a result, *Learning Online-The Student Experience* reveals a different structure compared to its peers with the student experiences in each chapter, and presents the online learning experiences in a concrete way. In this context, it can be said that the book will benefit a wide spectrum ranging from the author's target audience to students, educators, designers, curriculum creators, education planners, and education managers.

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Mentoring Graduate Students Online: Strategies and Challenges

Rhiannon Pollard and Swapna Kumar, EdD
University of Florida

Abstract

The proliferation of online graduate programs, and more recently, higher education institutions' moves to online interactions due to the COVID-19 crisis, have led to graduate student mentoring increasingly occurring online. Challenges, strategies, and outcomes associated with online mentoring of graduate students are of primary importance for the individuals within a mentoring dyad and for universities offering online or blended graduate education. The nature of mentoring interactions within an online format presents unique challenges and thus requires strategies specifically adapted to such interactions. There is a need to examine how mentoring relationships have been, and can best be, conducted when little to no face-to-face interaction occurs. This paper undertook a literature review of empirical studies from the last two decades on online master's and doctoral student mentoring. The main themes were challenges, strategies and best practices, and factors that influence the online mentoring relationship. The findings emphasized the importance of fostering interpersonal aspects of the mentoring relationship, ensuring clarity of expectations and communications as well as competence with technologies, providing access to peer mentor groups or cohorts, and institutional support for online faculty mentors. Within these online mentoring relationships, the faculty member becomes the link to an otherwise absent yet critical experience of academia for the online student, making it imperative to create and foster an effective relationship based on identified strategies and best practices for online mentoring.

Keywords: e-mentoring, online mentoring, virtual mentoring, graduate mentoring

Introduction

The relationship between students and faculty mentors has been established as one of the most important factors in determining the success and quality of graduate education as well as student retention (Khan & Gogos, 2013; Kumar et al., 2013; Lechuga, 2011). The ubiquity of ICT (information and communications technology), the proliferation of online graduate programs, and more recently, higher education institutions' move to online interactions due to the COVID-19 crisis have led to mentoring increasingly occurring online. Although mentoring conducted in an online format aspires to similar goals as traditional mentoring, it needs to adapt to the online environment (Erichsen et al., 2014; Kumar et al., 2013). In this context, it is important to examine how dyadic mentoring relationships between a graduate student and their faculty mentor (research supervisor) have been, and can best be, conducted when little to no face-to-face interaction occurs. What strategies or best practices have been identified in the literature to effectively mentor graduate students online?

Graduate education includes a wide spectrum when it comes to the clarity of expectations and programs of study, the experience of setbacks, and the growth of the student into individualized study, depending on the discipline and level (master's or doctoral). The crux of this process is often the one-on-one dialogue between a student and their advisor or mentor (Berg, 2016; Deshpande, 2017; Sussex, 2008). This process can become more difficult in an online context, in which enrolled students might be non-traditional and culturally diverse, and faculty members might lack experience mentoring students in the online environment (Deshpande, 2017; Kumar & Johnson, 2017). Issues, strategies, and outcomes surrounding the online mentoring of graduate students are of primary importance for the individuals within a mentoring dyad and for universities offering online or blended graduate education; during the COVID-19 pandemic, this applies to almost all universities in the US. For online students, the faculty advisor may represent the entirety of their university experience (Deshpande, 2017; Nasiri & Mafakheri, 2015), which places significant pressures on the mentoring relationship in this context. During this pandemic, traditional, on-campus graduate students are confronted with campus closures and the inability to meet with their mentors face-to-face (Pardo et al., 2020), and as such, these pressures typical to online mentoring relationships are being felt more widely.

Research Purpose

Research on online mentoring in graduate education, specifically on the challenges, effectiveness, practices, and outcomes of online mentoring of graduate students, is scarce (Bender et al., 2018; Kumar & Johnson, 2019). Skepticism exists regarding the ability of online programs or faculty members to provide sufficient mentoring in online settings, especially within doctoral programs (Columbaro, 2009). Given the recent increased need for mentoring graduate students online—even within on-campus and blended graduate programs due to COVID-19—there is an urgent need for research into the practices and outcomes of online graduate mentoring relationships.

This review of literature was guided by the following questions:

1. What challenges exist when mentoring graduate students online?

2. What recommendations for best practices and strategies can be drawn from the peer-reviewed literature on online graduate student mentoring?

3. What factors influence the nature and quality of the mentoring relationship in an online environment?

Methods

For the purposes of this inquiry, the following terms were searched in various combinations to ensure maximum possible results within the published literature: online, graduate student, virtual, distance, e-learning, Web-based, e-mentoring, supervision, telementoring, cybermentoring, advising, supervising, mentoring, doctoral, PhD, and master's. Databases searched included ERIC, Google Scholar, and a combined search tool from a US university library that accessed EBSCO, DOAJ, JSTOR, and SpringerLink. The results were restricted to peer-reviewed online and print journals published between 1999 and 2019.

The literature found by this search was then perused based on three criteria. Any articles that did not pertain specifically to graduate education (master's and doctoral) were excluded. Second, we included only peer-reviewed journal articles that directly addressed the one-to-one mentoring of graduate students at a distance or online, and by faculty members in higher education institutions. The focus was on faculty (mentor) to graduate student (mentee) dyads in which academic and research supervision occurred, regardless of the presence of supplemental group or peer mentoring. Third, we included only empirical research. Studies that did not include the explicit investigation of mentoring dyads were excluded. This resulted in 24 articles from 20 journals worldwide. We then included literature reviews that focused on graduate mentoring at a distance (Byrnes et al., 2019; Columbaro, 2009; Deshpande, 2017; Nasiri & Mafakheri, 2015), leading to a total of 28 articles from 22 journals worldwide (Table 1). These four literature reviews focused solely on online doctoral student mentoring whereas our broader literature review examined both master's and doctoral student mentoring online across disciplines. Seminal articles about e-mentoring or mentoring at a distance across contexts were used for background information and for discussing the identified strategies or challenges in the included studies but were not included in the research findings presented in this article.

Table 1

Empirical Articles Included by Journal

Journal	Citation
Adult Learning	Columbaro, 2009
American Journal of Distance Education	Berg, 2016; Kumar & Coe, 2017; Stein & Glazer, 2003
American Journal of Qualitative Research	Duffy et al., 2018
Group & Organization Management	de Janasz & Godshalk, 2013
Higher Education for the Future	Deshpande, 2017
Innovations in Education and Technology	De Beer & Mason, 2009
International Education Studies	Deshpande, 2016

International Journal of E-Learning & Distance Education	Kumar et al., 2013
International Journal of Nursing Education Scholarship	Welch, 2017
Journal of Counselor Preparation and Supervision	Bender et al., 2018
Journal of Educational Research and Practice	Jameson & Torres, 2019
Journal of Professional Nursing	Broome et al., 2011
Mentoring & Tutoring: Partnership in Learning	Crawford et al., 2014; Kumar & Johnson, 2017
Occupational Therapy in Health Care	Jacobs et al., 2015
Occupational Therapy International	Doyle et al., 2016
Online Learning Journal	Byrnes et al., 2019; Rademaker et al., 2016
Quality Assurance in Education	Andrew, 2012
Studies in Higher Education	Erichsen et al., 2014; Kumar & Johnson, 2019; Nasiri & Mafakheri, 2015
The Journal of Continuing Higher Education	Roumell & Bolliger, 2017
The Journal of the National Academic Advising Association	Schroeder & Terras, 2015
Teaching in Higher Education	Ross & Sheail, 2017
Turkish Online Journal of Distance Education	Suciati, 2011

The terms online, virtual, and distance, as well as e-mentoring, advising, and mentoring, have been used interchangeably in the literature to describe students and faculty who are in disparate geographic locations for the majority of their time in a mentoring relationship. In this paper, we used the term online mentoring to encompass the various roles played by faculty with respect to the academic, professional, psychosocial, and cognitive development of students (Kumar & Johnson, 2019).

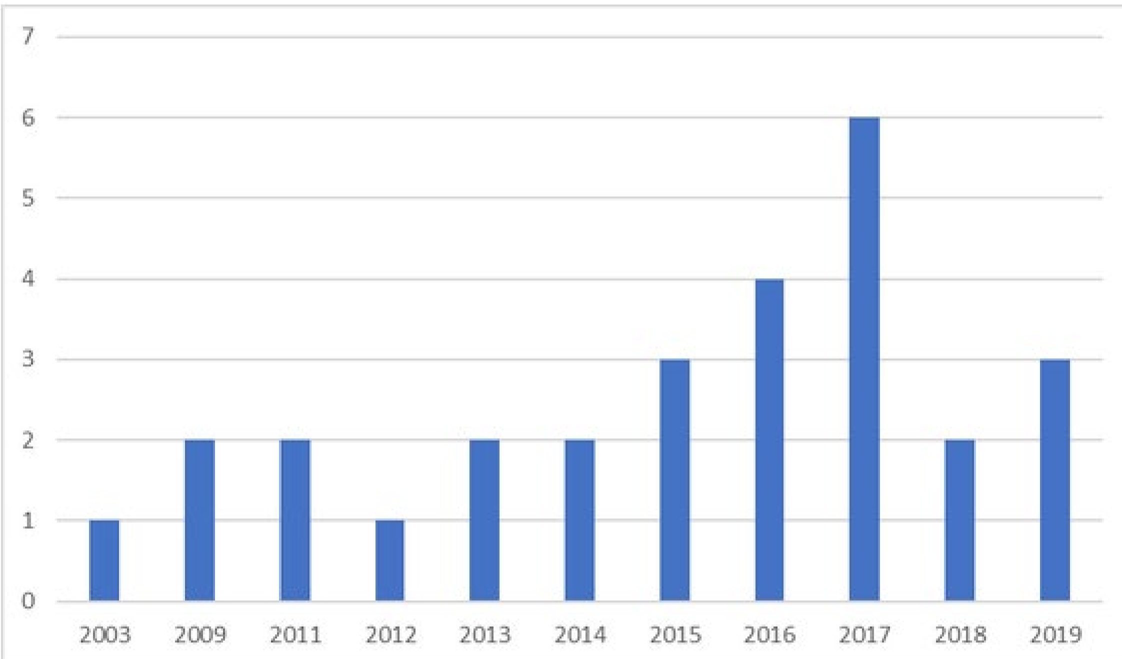
Each article was read once in its entirety without conducting analysis. During the second read, findings within the article relevant to the research questions were collected in a spreadsheet and given an initial code to generate categories such as: (a) benefits, (b) challenges, (c) strategies, (d) methodological approaches, (e) faculty perceptions, (f) student perceptions, and (g) technologies. When all articles were read and coded, these categories were synthesized to form the following themes that are described in detail below: (a) general details of articles and research approaches; (b) positive aspects of online mentoring; (c) challenges to mentoring online; (d) strategies and best practices for mentoring online graduate students; and (e) factors influencing the online mentoring relationship. The spreadsheet of codes, themes, and citations was shared between co-authors to ensure integrity and consistency as well as accuracy.

Findings

The 28 articles found were published between 2003 and 2019, with the largest number of articles published in 2017 (Figure 1). Twenty of the articles focused on doctoral education, three on master's programs, and five included participants across master's and doctoral programs. Twenty of the studies were conducted in completely online programs, four in blended programs, two in both online and blended programs, and two included participants from online, blended, and on-campus programs. Twenty-two of the programs studied were in the United States, three in the United Kingdom, and one each in Australia, South Africa, and Indonesia.

Figure 1

Number of Articles Published Per Year



Various research methods were used in the empirical studies. Twelve of the 28 were purely qualitative studies; nine of these studies included interviews, one was a collaborative autoethnography, and another a case study. Of the remaining 16, seven articles were quantitative and used surveys, five articles were mixed-method studies that used both surveys and interviews, and four were literature reviews.

Researchers made use of a variety of approaches to explore the relationship between mentor and mentee online, including the focus of the investigation (e.g., on the relationship, the methods of interaction, the perceptions of mentors and mentees), the theoretical and/or conceptual foundations, and the method of study. The literature spanned almost two decades, and therefore included many technologies, such as learning management systems, text messaging, telephone calls, social networking, videoconferencing, and more. However, researchers tended to focus on the process rather than technologies. This appeared to reinforce de Janasz and Godshalk's (2013) conclusion that comfort with computer-mediated communication may no longer be a relevant construct in considering satisfaction with the mentor-mentee relationship online due to the extensive use of ICT. Articles often mentioned the technologies involved and how they were used within online mentoring relationships, but the emphasis was on why and how online mentoring was occurring in graduate programs, rather than analyses of which technologies were used and how well they performed.

Positive Aspects of Online Mentoring

Online mentoring serves the same functions as traditional mentoring and can be just as effective, providing similar benefits (de Janasz & Godshalk, 2013; Welch, 2017; see Table 2). Students in multiple studies have reported high satisfaction with online mentoring and their positive experience with peer groups (Broome et al., 2011; Jacobs et al., 2015). Online mentoring can be used to guide graduate students in areas of professional development as well as in their research (Doyle et al., 2016). Logistically, one advantage of online mentoring over traditional mentoring is the ability to overcome obstacles of distance and time. The affordances of convenience and flexibility granted by online interactions (An & Lipscomb, 2013; Schichtel, 2010) can also serve to enhance student diversity and access to education. The nature of the online environment in which mentoring takes place also creates a written record of interactions which can be referenced for reflection, clarification, or even research (de Beer & Mason, 2009; Kumar & Johnson, 2017; Sussex, 2008). Though online graduate students preferred synchronous interaction (Andrew, 2012; Kumar et al., 2013; Kumar & Coe, 2017), they nonetheless reported an appreciation for the opportunity to reflect using asynchronous technologies.

Lechuga (2011) found that online mentoring relationships may mitigate perceptions of status differences between mentor and mentee, thus allowing lower status individuals more freedom to express themselves within the relationship (An & Lipscomb, 2013; Griffiths & Miller, 2005). In fact, Griffiths and Miller (2005) extended the definition of e-mentoring laid out by Bierema and Merriam (2002) with the qualification that it was precisely the boundarylessness and egalitarian nature of e-mentoring that distinguished it from traditional mentoring; the ability to have an interaction with a more experienced, supportive role model in the absence of social status pressures and influences may be a key factor regarding the beneficial possibilities of online technologies to mediate mentoring.

Mentoring online benefits faculty by providing them with opportunities for professional growth and refinement of mentoring skills, opportunities to learn from students' ideas, and can lead to a renewed commitment to their fields of expertise (Broome et al., 2011; Doyle et al., 2016; Lechuga, 2011).

Table 2

Positive Aspects of Online Mentoring

Positive aspect	Perspective	Citation
High levels of satisfaction with program	Students	Broome et al., 2011; Jacobs et al., 2015
Positive impacts to students' professional development	Students Faculty	Doyle et al., 2016; Jacobs et al., 2015 Doyle et al., 2016
Ability to use multiple means of communication	Students	Kumar & Coe, 2017
Peer groups (community) enhancing experience	Students	Broome et al., 2011; Jacobs et al., 2015; Kumar & Johnson, 2017; Ross & Sheail, 2017
Positive impacts to faculty professional development	Faculty	Broome et al., 2011; Doyle et al., 2016; Lechuga, 2011
Convenience and flexibility	Students	Andrew, 2012; Ross & Sheail, 2017
Records of correspondence	Students	Andrew, 2012; Kumar et al., 2013

	Faculty	de Beer & Mason, 2009; Kumar & Johnson, 2017; Nasiri & Mafakheri, 2015
Scalability of mentoring	Faculty	de Janasz & Godshalk, 2013

Challenges of Online Mentoring

A commonly-stated challenge when mentoring students online is the potential for miscommunication and reduction of information exchanged during online interactions due to lack of social presence, the loss of non-verbal cues, and the one-way-at-a-time nature of asynchronous communication (Duffy et al., 2018; Kumar & Johnson, 2017, 2019; Lechuga, 2011; Ross & Sheail, 2017). Faculty mentors and their graduate students may feel anxious about the online relationship and less connected as a result of the absence of social presence within textual communication, and this may impede their ability to form a strong mentoring dyad (Sussex, 2008).

Additional challenges of online mentoring for students involve (a) cultural differences, (b) technical difficulties, (c) time management, (d) difficulty writing and receiving written feedback, and (e) life events interrupting study (Table 3). Despite their commitment to supporting their online graduate students, a lack of institutional incentives for faculty time spent advising can impact how much mentoring they are willing or able to give to mentees (Nasiri & Mafakheri, 2015; Roumell & Bolliger, 2017; Sussex, 2008). In addition, faculty reported feeling limited in the ways in which they could mentor online graduate students (Roumell & Bolliger, 2017), which might be an indication of professional development or other instructional support needed at the institutional level.

Table 3

Challenges of Online Mentoring

Challenge	**Perspective**	Citation
Anxiety about online relationship	Students	Bender et al., 2018; Ross & Sheail, 2017
Difficulty with technology	Students	Bender et al., 2018; Welch, 2017
Need for more communication	Students	Andrew, 2012; Broome et al., 2011; Ross & Sheail, 2017; Schroeder & Terras, 2015
Lack of connection with faculty/students	Students	Andrew, 2012; Deshpande, 2016; Erichsen et al., 2014; Ross & Sheail, 2017; Sussex, 2008
Cultural difference—impact on communication	Students	Berg, 2016; Deshpande, 2017; Nasiri & Mafakheri, 2015; Sussex, 2008
Limitations of online communication	Faculty	Duffy et al., 2018; Kumar & Johnson, 2017, 2019; Lechuga, 2011
Time commitments and increased workload	Faculty	Duffy et al., 2018; Kumar & Johnson, 2019; Nasiri & Mafakheri, 2015; Roumell & Bolliger, 2017; Sussex, 2008
Learning time management	Students	Kumar & Coe, 2017; Welch, 2017
Difficulty with writing	Students	Broome et al., 2011; Kumar & Johnson, 2017, 2019
Understanding written feedback	Students	Erichsen et al., 2014; Kumar & Johnson, 2017
Life events interrupting study	Students	Kumar & Johnson, 2017
	Faculty	Duffy et al., 2018; Kumar & Johnson, 2019

Difficult to research in professional practice	Students Faculty	Ross & Sheail, 2017 Kumar & Johnson, 2017
Unfamiliarity with best practices	Faculty	Deshpande, 2016, 2017; Duffy et al., 2018; Roumell & Bolliger, 2017; Kumar & Johnson, 2017

Strategies and Best Practices for Mentoring Online Graduate Students

Supporting Online Graduate Students

The role of the faculty mentor is to provide educational, professional, and personal support for their graduate students, whether online or in-person (Columbaro, 2009; Doyle et al., 2016; Kumar & Coe, 2017; Welch, 2017). Important strategies for effective online mentoring in the literature (Table 4) revolved around fostering interpersonal aspects of the relationship, such as trust, connection, respect, and confidence, through online communication (Bender et al., 2018; Deshpande, 2016). Common behaviors of good mentors included treating mentees as individuals, taking the mentoring process seriously, and maintaining high availability for mentee needs (Crawford et al., 2014; Kumar & Johnson, 2017; Schroeder & Terras, 2015). Faculty in the research described the development of trust through feedback, consistency (which includes providing structure), and personal connection (Rademaker et al., 2016). One strategy that seemed to strongly influence student perceptions of satisfaction with the online mentoring relationship was that mentors should be responsive, and express concern and care for the well-being of the student as an individual (Crawford et al., 2014; Jacobs et al., 2015; Kumar & Coe, 2017; Ross & Sheail, 2017; Stein & Glazer, 2003; Welch, 2017). Further, mentors should maintain cultural sensitivity during communications with mentees who may experience communication and social norms differently than do their mentors (Berg, 2016; Deshpande, 2017; Nasiri & Mafakheri, 2015; Sussex, 2008).

Frequent communication has been identified as critical to the online mentoring relationship (Broome et al., 2011; de Janasz & Godshalk, 2013; Jacobs et al., 2015; Kumar & Coe, 2017) as it helps to foster immediacy and reduces temporal distance that can create difficulties in the relationship (Duffy et al, 2018; Nasiri & Mafakheri, 2015). The emphasis on communication in the literature, coupled with students' need for timely, clear, and constructive feedback as well as encouragement, indicated that online mentors should have technical, communication, social, and cognitive competencies (Byrnes et al, 2019; Erichsen et al., 2014; Kumar et al., 2013; Schichtel, 2010). Both faculty mentors and student mentees emphasized the need for an awareness of netiquette—communicating politely and with care online—as asynchronous communication opens the potential for miscommunication due to the absence of body language, vocal intonation, and facial expression. Videoconferencing was effectively used by mentors in the literature to overcome this challenge (Kumar & Johnson, 2019). Sussex (2008) also recommended the use of recorded audio for students as a personal method of providing feedback.

Providing Structure

Student needs and expectations relative to online mentoring may not be well understood or may be presumed rather than explicitly explored (Roumell & Bolliger, 2017; Schroeder & Terras, 2015; Stein & Glazer, 2003), and the context of the interaction itself can lead to different expectations on the part of student mentees and faculty mentors (Lechuga, 2011). Because of this, providing a structure for online mentoring and negotiating explicit expectations and agreements at the outset of the mentoring relationship has been seen as an important strategy (Andrew, 2012; Jacobs et al., 2015; Kumar et al., 2013; Kumar & Johnson, 2017, 2019; Suciati, 2011). Maintaining consistency of mentoring interactions, as well as frequency, was also important (Byrnes et al., 2019; Rademaker et al., 2016). Establishing predictable virtual office hours was suggested as one way of accomplishing this (Nasiri & Mafakheri, 2015), as was scheduling regular meetings or updates (Kumar et al., 2013; Kumar & Johnson, 2019). Barnes and Austin (2009) suggested that mentoring structures and agreements may be best addressed by institution-level clarification of roles and expectations for mentoring graduate students with, and without, online technology. In spite of the emphasis in the literature on the significance of providing structure, students in different stages of development were also reported to need different emphasis in their mentoring relationships (Jameson & Torres, 2019). Such flexibility in terms of modality, frequency, and/or type of interaction was another important strategy for supporting online mentees (Byrnes et al., 2019; Doyle et al., 2016; Nasiri & Mafakheri, 2015; Sussex, 2008). Notwithstanding the existence of agreed-upon structures and processes, flexibility of faculty mentors to support students as needed was seen as essential in the online environment to reduce student anxiety and isolation.

Communities, Groups, and Cohorts

Because online students are separated from the social and structural support networks typically found in a university campus environment, such structures or networks should be created in the online environment. Many studies indicated online graduate student preference for, and emphasis on, peer mentoring groups, and that a sense of community positively influenced the experience of being an online graduate student (Broome et al., 2011; Jacobs et al., 2015; Kumar & Coe, 2017; Ross & Sheail, 2017; Welch, 2017). Such community has been fostered by the implementation of one-time or periodic group experiences, communities of practice, or the use of cohorts for online graduate students (Andrew, 2012; Deshpande, 2016; Kumar & Coe, 2017; Nasiri & Mafakheri, 2015).

Technological Strategies

Participants in some studies expressed frustration with technology and the amount of time spent working through technical problems (Bender et al., 2018; Nasiri & Mafakheri, 2015; Welch, 2017). Because individual needs and technical access may vary widely across time and students, a flexible and engaging variety of technical options for communication and the provision of feedback were essential (Doyle et al., 2016; Jacobs et al., 2015; Kumar & Johnson, 2017; Nasiri & Mafakheri, 2015; Welch 2017). Participants in the research we reviewed recommended using live Webcam interaction when possible, as a close approximation to face-to-face interaction and a way to foster connection (Bender et al. 2018; Doyle et al., 2016; Kumar & Johnson, 2019; Sussex, 2008). Student participants indicated that their own anxiety related to technology concerns was alleviated when their mentors displayed confidence and competence in managing the communication methods. In this context, online orientations to technology can be helpful for both faculty and students (Andrew, 2012; Bender et al., 2018).

Supporting Faculty Who Are Mentoring Online

Workloads were a common challenge for faculty mentoring online (Kumar & Johnson, 2019; Nasiri & Mafakheri, 2015; Roumell & Bolliger, 2017; Sussex 2008). While institutional support was important for student success, it was just as important for faculty members engaging in online mentoring (Kumar & Coe, 2017; Kumar & Johnson, 2019). Strategies to incentivize participation, to minimize unnecessary temporal costs, to acknowledge mentoring workload, and to support the online mentoring experience have been employed by departmental or institutional administration. Additionally, the provision of templates or procedural frameworks (agreements, evaluations, and other milestone documents) as well as a repository of online resources for online mentoring helped faculty mentors (Doyle et al., 2016; Duffy et al., 2018).

Institutions have supported faculty who are mentoring online graduate students by offering professional development to assist them with learning how to mentor students online, how to create effective interactions and/or environments, and also to help them acquire the technical, communication, social, and managerial skills important in the online environment (Kumar & Johnson, 2017; Roumell & Bolliger, 2017; Schichtel, 2010). Deliberate pairing of more-experienced mentors with less-experienced faculty has been helpful as well (Deshpande, 2016, 2017; Kumar & Johnson, 2017). Participation in peer groups, peer networks, and mentoring communities has been beneficial for faculty who have not previously experienced online learning environments; as with online students, they may experience isolation (Duffy et al., 2018).

Table 4

Strategies for Graduate Mentoring Online

Strategy	Citation
Supporting mentees	
Fostering interpersonal aspects, especially trust and care for individuals	Bender, et al., 2018; Crawford et al., 2014; Deshpande, 2016; Jacobs et al., 2015; Kumar & Coe, 2017; Rademaker et al., 2016; Ross & Sheail, 2017; Stein & Glazer, 2003; Welch, 2017
Availability of mentor	Crawford et al., 2014; Kumar & Johnson, 2017; Schroeder & Terras, 2015
Cultural sensitivity	Berg, 2016; Deshpande, 2017; Nasiri & Mafakheri, 2015; Sussex, 2008
Frequent, timely, and clear communication/feedback	Broome et al., 2011; Byrnes et al, 2019; de Janasz & Godshalk, 2013; Erichsen et al., 2014; Jacobs et al., 2015; Kumar & Coe, 2017; Kumar et al., 2013; Schichtel, 2010
Providing structure and setting expectations	Andrew, 2012; Byrnes et al., 2019; Jacobs et al., 2015; Kumar et al., 2013; Kumar & Johnson, 2017, 2019; Lechuga, 2011; Nasiri & Mafakheri, 2015; Rademaker et al., 2016; Roumell & Bolliger, 2017; Schroeder & Terras, 2015; Stein & Glazer, 2003; Suciati, 2011
Flexibility to address individual needs	Byrnes et al., 2019; Doyle et al., 2016; Jacobs et al., 2015; Jameson & Torres, 2019; Kumar & Johnson, 2017; Nasiri & Mafakheri, 2015; Sussex, 2008; Welch 2017
Creation of cohorts or communities	Andrew, 2012; Broome et al., 2011; Deshpande, 2016; Jacobs et al., 2015; Kumar & Coe, 2017; Nasiri & Mafakheri, 2015; Ross & Sheail, 2017; Welch, 2017
Use of videoconferencing for interaction	Bender et al 2018; Doyle et al., 2016; Kumar & Johnson, 2019; Sussex, 2008
Technological competence	Andrew, 2012; Bender et al., 2018; Nasiri & Mafakheri, 2015; Welch, 2017

Supporting mentors	
Incentives for increased workload	Kumar & Coe, 2017; Kumar & Johnson, 2019; Nasiri & Mafakheri, 2015; Roumell & Bolliger, 2017; Sussex 2008
Professional development	Kumar & Johnson, 2017; Roumell & Bolliger, 2017; Schichtel, 2010
Mentoring communities	Deshpande, 2016, 2017; Duffy et al., 2018; Kumar & Johnson, 2017
Standardized templates and resources	Doyle et al., 2016; Duffy et al., 2018

Factors Influencing the Online Mentoring Relationship

Differences in motivation, participation, values, and personal characteristics influence the effectiveness of mentoring relationships (Sussex, 2008). Researchers have asserted that the online mentoring relationship should include psychosocial and interpersonal as well as intellectual aspects (Berg, 2016; Doyle et al., 2016; Jameson & Torres, 2019; Kumar & Johnson, 2017; 2019).

Trust

Mentors in the research expressed a belief that their most important role was to build trust and a relationship with the student because this contributed to the success of the relationship (Rademaker et al., 2016; Roumell & Bolliger, 2017). These conclusions were supported by Erichsen et al.'s (2014) research where trust and personal connection were the factors described by students as the most positive aspects of the mentoring relationship.

Similarities in Values

de Janasz and Godshalk (2013) found that during online mentoring, similarities in values could quickly facilitate trust between mentor and mentee. They also found that the perceived similarity of values, not demographics, had an effect on the mentoring relationship. If value similarities lead to more trust and more trust leads to higher satisfaction, it follows that mentoring pairs should be intentionally matched whenever possible (Berg, 2016). The same authors suggested that it was not only personalities and values but also knowledge and skill matching that were important to effective mentoring. In contrast, Doyle et al. (2016) found that mentors felt the level of similarity they shared with their mentees was not important.

Empathy

Along with trust, faculty members' demonstrated empathy towards students was perceived to influence the online mentoring relationship (Duffy et al., 2018). In addition to complicating factors such as financial difficulties, personal commitments, or changes that might be common to all types of programs, students in online graduate programs often work full-time. Some might also conduct their graduate projects or research in professional contexts. Faculty members' adaptability to and support of online students' navigation of multiple commitments influenced the mentor-mentee relationship online (Jameson & Torres, 2019; Kumar & Coe, 2017).

Mentor Presence

Student satisfaction with the online mentoring relationship across contexts was positively affected by the perception of the mentor as a present and supportive confidant or ally (de Janasz & Godshalk, 2013; Kumar

& Coe, 2017; Lechuga, 2011). Several studies (Deshpande, 2017; Nasiri & Mafakheri, 2015) corroborated the notion that "in a distance environment, the mentor becomes the connector to resources, to institutional culture, to scholarly values, to other learners, and to the content of learning" (Stein & Glazer, 2003, p. 21). Online doctoral students suggested that it was their own responsibility to continue the momentum of the mentoring relationship by engaging frequently with their mentor (Kumar et al., 2013).

Workload

From a faculty perspective, while the focus and nature of online mentoring was dependent on the type of university and program, mentors' satisfaction with online mentoring was influenced by their workload (i.e., the number of students that they mentored at a time, as well as their access to institutional resources that supported online mentoring; Duffy et al., 2018; Kumar & Johnson, 2019).

Prior Experiences

Kumar and Johnson (2017) found that mentors' experiences as doctoral student mentees influenced their approaches to mentoring online. Roumell and Bolliger (2017) found that mentors of online doctoral students expected them to have generally the same attitudes, engagement, and drive as face-to-face students, despite acknowledging the difficulties in establishing the relationships that foster these qualities (Sussex, 2008).

Discussion and Implications

This literature review focused only on peer-reviewed journal articles and did not include dissertations, book chapters, or other literature (e.g., conference proceedings). Additionally, only empirical research that focused on online graduate mentoring in higher education was included. The literature search spanned two decades (1999–2019), and the articles reviewed were published between 2003 and 2019, during which time information and communications technologies have rapidly evolved. Although the studies reviewed focused on processes and strategies rather than technology, it is important to acknowledge that availability of technologies, and the affordances they provide to students and faculty, can influence mentoring process, strategy, or both. Although bandwidth and access to technologies might have differed even within the United States (where most of the studies took place), insight into mentoring practices in other countries, regions, and cultures can enhance the literature on online mentoring, especially as online education increases opportunities for students globally.

Online mentoring is "qualitatively different than land-based mentoring" (Bierema & Merriam, 2002, p. 214), and though it shares many similarities in goals and even structures, mentoring online has generated a new kind of mentoring relationship requiring contextual negotiations and specialized strategies (Kumar & Johnson, 2017; Stein & Glazer, 2003). The studies reviewed in this paper were conducted in a variety of contexts—online for-profit universities, universities (some of which were research intensive) with online programs or blended programs, and on-campus programs with online mentoring components. Common challenges, factors, and strategies that were identified notwithstanding, the types of support required by students and faculty engaged in online mentoring relationships should be expected to differ based on the program in which they teach and learn, and based on the focus of the relationship itself (e.g., projects, research, career development).

Though there is as yet no concrete model for how to mentor graduate students online, the literature reviewed revealed several factors that influence these mentoring relationships and provided strategies that were found to be valuable to participants. Graduate students in online mentoring relationships need frequent and timely communication and feedback, structure and clear expectations for themselves and their faculty mentors, and they need to feel their mentors are personally engaged with them as individuals. Faculty mentors' presence, as discussed by Anderson et al., 2001, and their ability to connect, develop trust, and communicate with students have all been acknowledged as essential in online courses. In addition, these attributes appear to be even more crucial in graduate mentoring relationships, whether they occur at the master's or doctoral level, within formal courses, internships, projects, or during dissertation supervision processes. Faculty mentors can be primarily supported by institutional efforts to improve their comfort and skill with online mentoring and to incentivize or reduce the workload increases they may experience when serving as online graduate student mentors, especially in cohort-based programs.

The nature of mentoring activity, and its meanings and effects, changes when it takes place online. Online technologies afford flexibility in more ways than time, space, and convenience; they provide means to communicate differently, both more multi-faceted and more immediately at the same time, using images, sharing links or files, emoji, reactions, and always, textual commentary. The lack of non-verbal social status and demographic cues are reported to foster a more equitable relationship between mentor and mentee. At the same time, technology has also been reported to interfere with the development of personal connections, which are more natural to establish when a faculty mentor and student mentee meet in person. On-campus environments that adopt or incorporate online mentoring processes or online programs with on-campus meetings might benefit the most; in those cases, mentors and students may have formed relationships in person and can continue the process in an online environment.

An important challenge in the current COVID-19 crisis relates to transitioning and supporting traditional, on-campus graduate student mentees as they find themselves operating in a fully online format. Faculty must "reimagin[e] how to do mentoring" (Ghani, 2020, p. S37) even as faculty and graduate students alike may be experiencing significant challenges and distress due to personal, emotional, economic, or health-related issues in addition to the educational and professional challenges of learning to interact in new ways, using new technologies. Although the theme of life events interrupting study (see Table 3) was extant within the literature published prior to 2020, it is likely to hold greater relevance in the near-term future, as large numbers of currently-enrolled graduate students are undoubtedly experiencing interruption in the status quo of their lives. While the research on academic and professional impacts of the pandemic is still emerging, it seems reasonable to suggest that faculty engaging in online mentoring should emphasize the supportive and nurturing aspects of the relationship during this period of potentially unprecedented stress on graduate education and on the mental health of these students (Ghani, 2020; Pardo et al., 2020), as well as tending to their own stress and mental well-being.

Conclusion

The goal of this literature review was to identify challenges faced and strategies used by online mentors and mentees, as well as factors that influence online mentoring in graduate education in empirical research published in the last two decades, a period in which online master's and doctoral programs have proliferated in higher education. The number of publications on this topic were found to have increased since 2016, probably indicating the increased need for, and prevalence of, graduate student mentoring online. Empirical literature on online mentoring in graduate education mainly focused on doctoral dissertations at a distance, highlighting the unique nature of online doctoral mentoring and challenges faced in the online environment. Given the increasing number of master's projects, practica, internships, and theses also being mentored online, there is a need to investigate strategies, challenges, and factors related to the online mentoring of master's students as well.

Although some studies addressed the effectiveness and outcomes of online graduate mentoring, these were often equated to mentee satisfaction with online graduate mentoring, and, occasionally, faculty satisfaction with the relationship. Further in-depth investigation of strategies for effectiveness and specific outcomes, and what works for specific contexts or mentoring content (e.g., master's projects, group projects), is needed. Given the increasingly global nature of online education and diversity of online learners, research is also needed on online graduate mentoring that takes into account cultural and epistemological differences between the faculty mentor and student mentee. Perhaps "a new framework, model, and theory are needed in order to give purpose and direction to the transformational potential" (Ambrose & Williamson Ambrose, 2013, p. 79) and unique affordances of online graduate mentoring.

The literature reviewed emphasized a need for professional development and awareness on the part of both faculty who are mentoring students online and students participating in mentoring online. Institutions can provide some or all of the following: (a) orientations to online mentoring; (b) webinars or workshops on best practices for online mentors and for online mentees; and (c) workshops and tutorials on technologies that are current, available to faculty and students at that specific institution, and how those can be best used for different purposes. Additionally, online resources to help faculty and their student mentees as well as incentives for faculty with a high online mentoring workload could contribute to more effective and satisfying mentoring relationships.

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A Systematic Review of Questionnaire-Based Quantitative Research on MOOCs

Mingxiao Lu[1], Tianyi Cui[2], Zhenyu Huang[3], Hong Zhao[1], Tao Li[1], and Kai Wang[1]

[1]College of Computer Science, Nankai University, China; [2]Business School, Nankai University, China; [3]College of Business Administration, Central Michigan University, USA

Abstract

Massive open online courses (MOOCs) have attracted much interest from educational researchers and practitioners around the world. There has been an increase in empirical studies about MOOCs in recent years, most of which used questionnaire surveys and quantitative methods to collect and analyze data. This study explored the research topics and paradigms of questionnaire-based quantitative research on MOOCs by reviewing 126 articles available in the Science Citation Index (SCI) and Social Sciences Citation Index (SSCI) databases from January 2015 to August 2020. This comprehensive overview showed that: (a) the top three MOOC research topics were the factors influencing learners' performance, dropout rates and continuance intention to use MOOCs, and assessing MOOCs; (b) for these three topics, many studies designed questionnaires by adding new factors or adjustments to extant theoretical models or survey instruments; and (c) most researchers used descriptive statistics to analyze data, followed by the structural equation model, and reliability and validity analysis. This study elaborated on the relationship of research topics and key factors in the research models by building factors-goals (F-G) graphs. Finally, we proposed some directions and recommendations for future research on MOOCs.

Keywords: MOOC, factors-goals graph (F-G graph), questionnaire-based survey, quantitative analysis, research topics

Introduction

Massive open online courses (MOOCs), an innovative technology-enhanced learning model, have offered educational opportunities to a vast number of learners, and have attracted much interest from educational researchers and practitioners around the world (Zhou, 2016). When COVID-19 suddenly broke out in early 2020, schools in many countries had to be closed to stop the spread of the pandemic according to media reports. MOOCs became a top choice for students studying online from home. Some stakeholders have suggested that MOOCs may have a groundbreaking impact on higher education, potentially making traditional physical universities obsolete (Shirky, 2013). While acknowledging the potential of MOOCs, some educators have expressed concerns about the pedagogical models based on information transmission that have been widely applied in MOOCs (Albert et al., 2015; Babori et al., 2019; Veletsianos & Shepherdson, 2016; Zhu et al., 2018). Despite the polarized debate, the number of MOOC courses offered and students enrolled has continued to grow, which has aroused the interest of researchers. There have been a substantial number of research studies and reports investigating various aspects and effective practices of MOOCs in recent times, some of which have focused on empirical research.

Questionnaire-based surveys can directly and quickly obtain information about the attitudes, behaviors, characteristics, and opinions of MOOC participants, all of which can be used as first-hand data for empirical research. Most questionnaire-based research has made use of measurement scales, with the collected answers quantitatively analyzed to extract value. Researchers considered various factors and used classical models and theories when they designed their questionnaires. Follow-up research is necessary to analyze and summarize this prior work. This paper explored the research topics and paradigms of questionnaire-based quantitative research on MOOCs. The main contribution is a graphical summary of the classical models and theories, as well as analysis of the key factors frequently considered in certain key topics.

Literature Review

Over the years, MOOCs have yielded many research publications and have attracted numerous types of review articles including systematic as well as critical reviews. Zhu et al. (2018) summarized the typical research topics and methods directed to MOOCs, as well as their geographical distribution, by reviewing 146 empirical studies of MOOCs published from 2014 to 2016. They summarized the typical research topics and methods through only a few statistical results in the form of numbers, bar charts, and pie charts. Rasheed et al. (2019) adopted a systematic mapping methodology to provide a fine-grain overview of the MOOC research domain by identifying the quantity and types of research, available results, and publication trends in educational aspects of MOOCs from 2009 to 2018. Their findings showed that most MOOC studies focused on addressing learners' completion, dropout rates, and retention. Babori et al. (2019) examined the content of MOOC research in 65 peer-reviewed papers produced in five major educational technology research journals between 2012 and 2018. Their analysis revealed that these articles were mainly concerned with MOOCs' objectives, prerequisites required for participation in MOOCs, and types of learning scenarios. In addition, empirical studies adopted a variety of conceptual frameworks that focused mainly on learning strategies. Montes-Rodriguez et al. (2019) examined the prevalence and characteristics of case studies on MOOCs, based on 92 articles selected from the Web of Science and Scopus. Their findings showed that even when searching solely for case studies, quantitative analysis was more prevalent for data collection and analysis in research on MOOCs.

The reviews cited above showed MOOC research trends and topics as rapidly evolving. Although the majority of early MOOC studies were mostly theoretical and conceptual, more empirical studies and topics have emerged in recent years. According to Fang et al. (2019) and Zhu et al. (2018) most empirical research on MOOCs has used quantitative methods for gathering and analyzing data. As a methodology, quantitative analysis is generally linked to interpretive paradigms that analyze the quantitative characteristics, relations, and changes of social phenomena. A key process in quantitative analysis is that of establishing a mathematical model to calculate various indicators and values of the research object based on statistical data. Therefore, how to effectively collect quantitative data is the basis of this methodology. For research on MOOCs, surveys, especially questionnaire-based surveys, have been the most frequently adopted method of data collection (Sanchez-Gordon & Lujan-Mora, 2017; Zhu et al., 2018).

Research Questions

Few studies have reviewed the questionnaire-based quantitative research about MOOCs and summarized the theories such research has been based on. A comprehensive picture of the methodologies adopted in these studies is needed in order to investigate the characteristics of research on MOOCs, including topic areas, theoretical models, and research methods. We reviewed questionnaire-based quantitative studies about MOOCs published from January 2015 to August 2020, in order to increase awareness of methodological issues and theoretical models in the MOOC research field. The following three research questions guided our review:

1. What research topics or focuses have been addressed in questionnaire-based quantitative MOOC studies?

2. What research models have been used for examining the critical topics in these MOOC studies?

3. What analysis methods were most often used in these MOOC studies?

Research Methodology

Data Collection

By using the keywords MOOC, MOOCs, massive open online course, and massive open online courses, we searched for articles from the Web of Science database as our source data. The attributes of each selected article included authors, title, year of publication, journal name, research focus, research model, analysis methodology, and article URL. We classified research methodologies as qualitative, quantitative, or mixed method (i.e., combining quantitative and qualitative approaches). In this study, we focused on articles with quantitative or mixed method research. We filtered the articles according to six ordered selection criteria, as shown in Table 1. Each criterion is a hard one, which means that an article was filtered out if it did not meet even one criterion. The filtering process comprised reading the title and abstract of each article and assigning a value of relevant or irrelevant. When the relevance was not evident from the title and abstract, we examined the article in detail, reading the methodology and results sections. A total of 126 articles about MOOCs were selected and verified, including 89 quantitative studies and 37 with mixed methods.

Table 1

Criteria for Selecting MOOC Articles

Criterion	Operational definition
1	The article was retrieved from the SCI or SSCI database.
2	The article was published in English.
3	The article was published between January 2015 and August 2020.
4	The terms MOOC(s) or massive open online course(s) were used to screen titles, abstracts, and keywords.
5	The study mainly investigated the educational aspects of MOOCs.
6	The article reported on an empirical study using questionnaire-based survey data and quantitative analysis.

Data Analysis

To address our first research question, thematic content analysis was used to examine the key research topics in studies of MOOCs. First, researchers read the MOOC research articles and identified the specific research focuses of each paper; topics were then grouped into four categories, namely dropout rates and continuance intention to use MOOCs, learners' performance, assessing MOOCs, and others. To answer research question two, related to the research models typically employed, we systematically presented the models by means of factors-goals (F-G) graphs. These graphs, which were first designed as a graphic device for this study, showed the correlation between research goals and influencing factors in order to provide a reference framework for building hypothesis models. F-G graphs provided a statistical baseline for accuracy, consistency, and representativeness to improve data quality. Finally, to answer the third research question, researchers counted the data analysis methods most often used in the quantitative studies.

Results and Analysis

Research Topics and Focuses in Questionnaire-Based Quantitative Studies on MOOCs

To examine the general topics and focuses of quantitative MOOC studies, we divided the key topics of 126 papers into four different categories: (a) dropout rates and continuance intention to use MOOCs (n = 36; 28.57%); (b) factors influencing learners' performance (n = 45; 35.71%); (c) assessing MOOCs (n = 29; 23.02%); and (d) others (n = 16; 12.70%).

Dropout Rates or Continuance Intention to Use MOOCs

MOOCs might not be equally successful in keeping learners through to course completion, though they are successful in attracting and accommodating numerous learners. Some studies showed that only a small number of participants completed an entire course, and others quit partway through after experiencing a few MOOC lessons (Shao, 2018; Yang et al., 2017). High dropout rates have been widely regarded as a serious issue for MOOCs (Bozkurt et al., 2017).

Most of the extant literature considered completion rate as a metric for evaluating the success or failure of a MOOC. It is vital to investigate the reasons why learners persist and complete their courses or drop out, so a large number of researchers have explored this issue through quantitative methods based on questionnaires. Both subjective and objective factors influenced MOOC participants' retention and completion. The main subjective factors included learners' preferences (Li et al., 2018), experience (Li et al., 2018; Zhao et al., 2020; Zhou, 2017), expectancy (Botero et al., 2018; Luik et al., 2019; Zhou, 2017), and psychological motivation (Botero et al., 2018; Yang & Su, 2017; Zhou, 2016). Objective factors included course quality (Hone & El Said, 2016; Yang et al., 2017), network externalities (Li et al., 2018), social motivation (Jung & Lee, 2018; Khan et al., 2018; Wu & Chen, 2017), and MOOC systems (Wu & Chen, 2017).

Factors Affecting MOOC Learners' Performance

Dropout rate is not the only metric of the success of a MOOC. Learners have various motivations for taking online courses (Carlos et al., 2017), which can affect their attitude and intention to continue learning in MOOCs. The performance of learners attending a MOOC can be used as an essential reference for improving MOOC design and quality. Learners' performance in MOOCs has been measured by course engagement, social interactions, sociability, and learning gains. Many studies have focused on the factors that influence learners' performance (Carlos et al., 2017; Kahan et al., 2017; Soffer & Cohen, 2015; Zhang, 2016). From the articles reviewed in this study, we summarized the major factors affecting learners' performance into four categories: motivation, self-regulated learning (SRL), attitudinal learning, and learning strategies.

Learners with different motivations for participating in a MOOC targeted different learning goals and strategies (de Barba et al., 2016; Watted & Barak, 2018). General participants were oriented toward acquiring knowledge and academic advancement, while university-affiliated students were also concerned with a need to obtain certificates. SRL is a learning strategy that influences MOOC learners' academic performance. Independent learning in MOOCs calls for completing course content, making full use of platform resources, and allocating study time reasonably (Jansen et al., 2017; Kizilcec et al., 2017; Maldonado-Mahauad et al., 2018). The scale items of attitudinal learning conform to the following four-dimensional theoretical structure: cognitive learning, affective learning, behavioral learning, and social learning (Watson et al., 2016). Finally, learning strategy has been defined as a complex plan for a learning process that learners have purposefully and consciously formulated to improve their learning effectiveness and performance in MOOCs (Kizilcec et al., 2017; Maldonado-Mahauad et al., 2018).

Assessment of MOOCs

Some articles investigated the overall assessment of MOOCs, specifically evaluation of the teaching model, course structure and content design, the MOOC platform technology, and the benefits from participating in MOOCs. We divided the studies we examined into two categories: assessment from the perspective of learners, and assessment from teachers' points of view. Some student-oriented research used learners' perceived benefits to determine which course design better helped learners meet their goals (Jung et al., 2019; Lowenthal et al., 2018). Teacher-focused evaluation paid close attention to teaching skills and challenges in MOOCs, as well as opportunities for future development (Donitsa-Schmidt & Topaz, 2018; Gan, 2018).

Research Models for Examining the Key Topics in MOOC Studies

Questionnaire-based quantitative research generally includes the following steps: (a) propose the research questions to be solved; (b) select an appropriate theoretical model or develop a new model, drawing on classical theories and the hypothetical relationship between factors; (c) design questionnaire items, usually in the form of a Likert scale, to measure the factors and variables in the research model; (d) collect the questionnaires from research subjects; and (e) analyze the collected data to verify the hypothesis model.

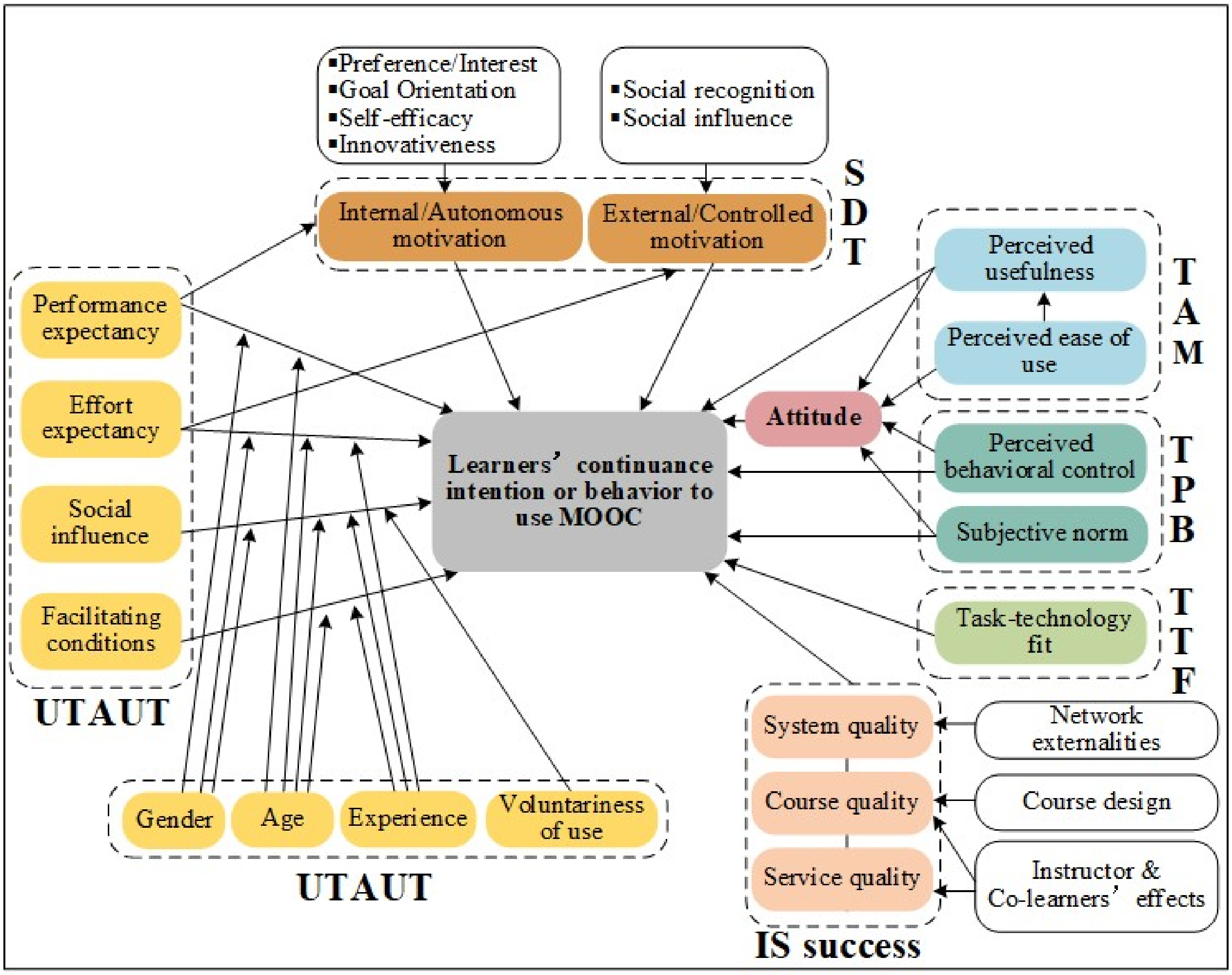
Building a hypothesis model is the foundation of quantitative research. In examining the sorts of models MOOC researchers have relied on, we described three F-G graphs to depict the correlation between the top three categories of research topics and the research models summarized from the 126 articles. Tables A1, A2, A3 in Appendix A provide background details from 32 typical articles for the top three topics, including article titles, research topics, theoretical models and factors involved in the questionnaire, and analysis methods. This data formed the foundations for drawing the F-G graphs for our study.

F-G Graph for Learners' Dropout Rates and Continuance Intention to Use MOOCs

An F-G graph was built to demonstrate the correlation among the research models and the research goal of investigating factors that affect learners' intentions to continue to use MOOCs. As shown in Figure 1, the F-G graph integrated the factors of research models frequently used in the articles we examined. The relationship hypotheses between factors are shown with straight arrows. The direction of an arrow points from an explanatory variable to a dependent variable. The factors in rounded rectangles are those that directly or indirectly affected learners' intentions to continue to use MOOCs.

Figure 1

F-G Graph: Factors of Research Models for Dropout Rates or Continuance Intention to Use MOOCs



In the 126 articles we examined, most researchers designed questionnaire items by extending classical theoretical models, including: (a) the technology acceptance model (TAM; n = 12); (b) the self-determination theory (SDT; n = 7); (c) the task-technology fit (TTF; n = 4); (d) the theory of planned behavior (TPB; n = 4); (e) the unified theory of acceptance and use of technology (UTAUT; n = 3); and (f) the information system (IS) success model (n =2). In Figure 1, the key factors from each model are enclosed within black dotted boxes. In addition, some studies enhanced these models by adding new elements or adjustments to further explain learners' continuance intention to use MOOCs. In Figure 1, these new factors, often considered by the reviewed articles, are listed in black solid boxes. The specific explanations of these theoretical models are summarized in Table 2 and addressed in detail following the table.

Table 2

Classical Models That Address Dropout Rates or Continuance Intention to Use MOOCs

Model	Hypothesis
TAM	Perceived usefulness and perceived ease of use determine the individual's attitude toward a MOOC as well as the behavioral intention to use it (Davis, 1989).
SDT	A motivation theory to investigate how and why a particular human behavior occurs. Distinguishes between autonomous and controlled motivations in terms of the degrees of self-determination (Deci et al., 1999).
TPB	Explains three determinants of individual's behavioral intentions: perceived behavioral control, subjective norms, and attitude toward the behavior (Ajzen, 1985).
TTF	Task characteristics and technology characteristics can affect the task-technology fit, which determines users' performance and utilization (Goodhue et al., 2000).
UTAUT	Incorporates eight classical models or theories, including TAM, TPB, theory of reasoned action (TRA), the motivational model (MM), a model combining the technology acceptance model (C-TAM-TPB), the model of PC utilization (MPCU), innovation diffusion theory(IDT), and social cognitive theory (SCT) (Venkatesh et al., 2003).
IS success	Users' satisfaction with an information system depends on six variables: system quality, information quality, perceived usefulness, net benefits to individuals, net benefits to organizations, and net benefits to society (Seddon, 1997).

In our analysis of factors in the TAM, attitude was considered a direct and positive factor that determined an individual's intention and behavior. The TAM assumed that two main factors, perceived usefulness and perceived ease of use, determined an individual's attitude toward a new MOOC technology as well as the behavioral intention to use it (Joo et al., 2018; Shao, 2018; Tao et al., 2019; Wu & Chen, 2017). To some extent, perceived usefulness also had a direct impact on the learner's behavior.

The TPB aimed to explain that an individual could decide whether or not to continue learning in a MOOC according to his or her own free will, as affected by three factors—attitude, subjective norms, and perceived behavioral control (Khan et al., 2018; Shao, 2018; Sun et al., 2019; Zhou, 2016). The latter two were hypothesized to directly influence one's attitude towards online learning. Subjective norms referred to the individual's perception of social pressures. Perceived behavioral control, defined as the individual's perceived ease or difficulty, had a direct impact on learning behavior.

Motivation significantly affected learners' psychological and behavioral engagement, which is important to reduce the dropout rate of MOOCs. The SDT, a well-established motivation theory that has been widely adopted to investigate participants' persistence in MOOCs, indicated that behavior may be encouraged not only by autonomous motivations but also by controlled motivations. It was found that meeting students' needs for autonomy, competence, and relatedness can increase their intrinsic motivation and lead to their active engagement in MOOCs (Castano-Munoz et al., 2017; Hone & El Said, 2016; Khan et al., 2018; Sun et al., 2019). In addition to the SDT, some new factors were put forward that affect learners' motivation and persistence in MOOCs, such as an individual's preference or interest, goal orientation, self-efficacy, and innovativeness (Jung & Lee, 2018; Tsai et al., 2018; Zhang et al., 2016). External motivational factors were also investigated, including social recognition, social influence, and environmental stimulus (Luik et al., 2019; Wu & Chen, 2017; Zhao et al., 2020; Zhou, 2017).

The UTAUT was applied as a basic framework for designing questionnaire items, integrating eight classical models (Botero et al., 2018; Zhao et al., 2020). The UTAUT proposed several hypotheses regarding the impact of four factors on behavioral intentions: (a) performance expectancy, (b) effort expectancy, (c) social influence, and (d) facilitating conditions. It also considered that learners' gender, age, experience, and voluntariness of use affected these four factors.

The TTF was used to evaluate how information technology leads to learners' performance and utilization in MOOCs, and to judge the match between the learning task and the characteristics of MOOC technology (Khan et al., 2018; Wu & Chen, 2017).

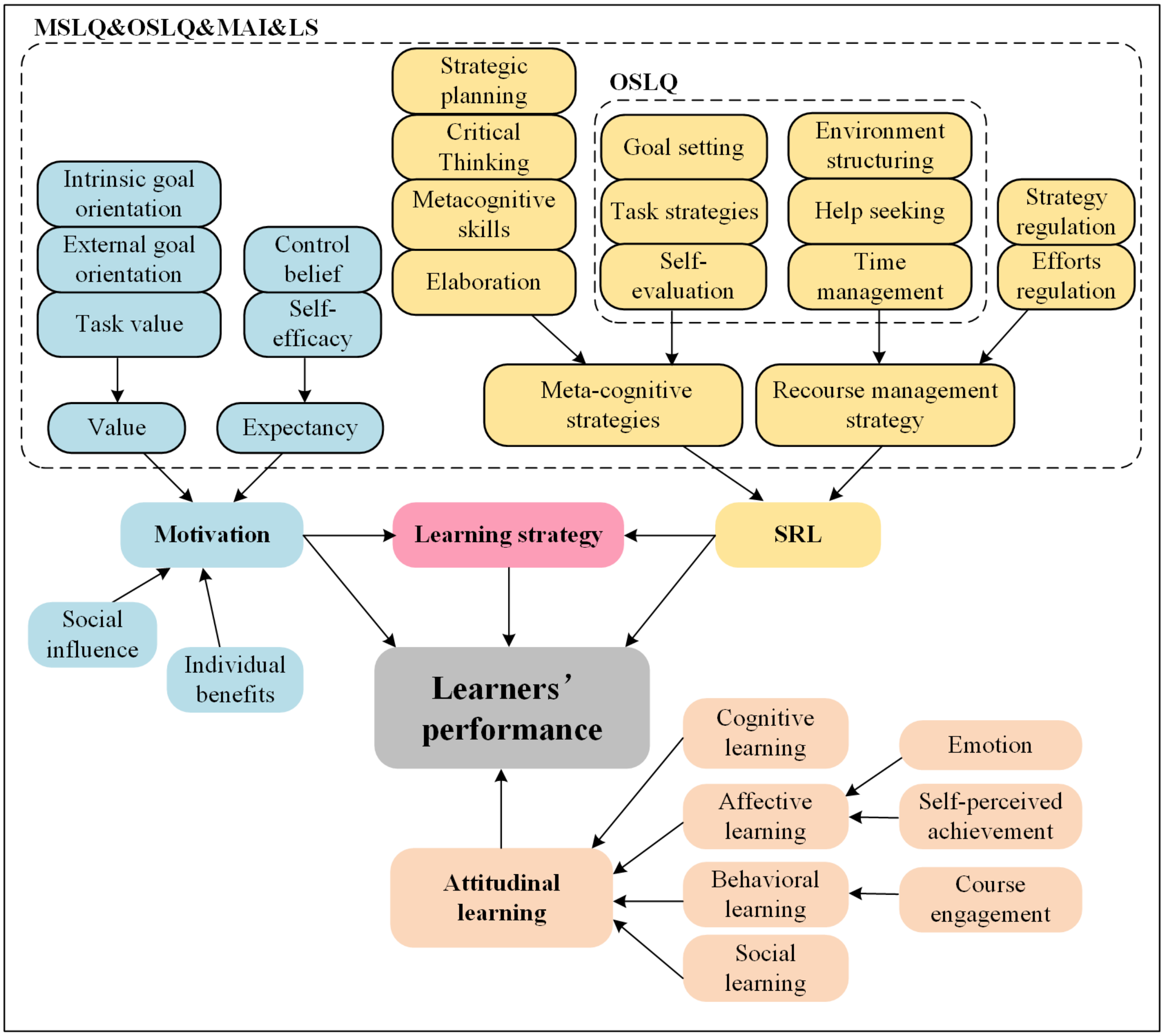
In the analysis of factors in the IS success model, system quality, course quality, and service quality were significant antecedents of learners' continuance intention to use MOOCs (Yang et al., 2017). Some new factors that influenced MOOC quality were also considered. Network externalities affected users' persistence through the mediation of system quality (Li et al., 2018). MOOC course quality was mainly determined by the course design including course content and course structure (Hone & El Said, 2016). Instructor and co-learners effects, such as interaction, support, and feedback, influenced both course quality and service quality (Hone & El Said, 2016).

F-G Graph for Learners' Performance in MOOCs

A challenge for this study was to build an F-G graph to summarize various factors about learners' performance in MOOCs in terms of aspects of the research models that were examined. After reviewing the articles, we divided these factors into four categories: motivation, SRL, attitudinal learning, and learning strategies, clearly shown in different colors in Figure 2. The factors in the rounded rectangles had direct or indirect impacts on learners' performance in MOOCs. The direction of an arrow points from an explanatory variable to a dependent variable.

Figure 2

F-G Graph: Factors Affecting Learners' Performance in MOOCs



Many studies about learners' performance have integrated existing survey instruments to design questionnaire items, such as the motivated strategies for learning questionnaire (MSLQ; n = 12), the online self-regulated learning questionnaire (OSLQ; n = 7), the meta-cognitive awareness inventory (MAI; n = 5), and the learning strategies questionnaire (LS; n = 5). The key factors in these instruments that have been considered in MOOC environments are enclosed with dashed boxes in Figure 2. In addition, Table 3 summarizes how factors about MOOC learners' motivation and learning strategies have been addressed in these four instruments. A checkmark indicates that the questionnaire considered the corresponding factor.

Table 3

Factors Related to MOOC Learners' Motivation and Learning Strategies in MSLQ, OSLQ, MAI, and LS

Scale	Factor	Instrument			
		MSLQ	OSLQ	MAI	LS
Motivation	Intrinsic goal orientation	✓			
	Extrinsic goal orientation	✓			
	Task value	✓			
	Control beliefs	✓			✓
	Self-efficacy	✓			
Meta-cognitive strategies	Goal setting		✓	✓	
	Strategic planning			✓	
	Task strategies		✓	✓	✓
	Elaboration				✓
	Critical thinking	✓			
	Meta-cognitive self-regulation	✓			
	Self-evaluation		✓	✓	✓
Resource management strategies	Time management	✓	✓		
	Environment structuring	✓	✓		
	Help seeking	✓	✓		✓
	Strategy regulation			✓	
	Effort regulation	✓			

The MSLQ, a self-report questionnaire, has been used to measure types of academic motivation and learning strategies in educational contexts (Pintrich et al., 1991), and in the reviewed articles, it was used to study how motivation and learning strategies affect MOOC learners' performance (Carlos et al., 2017; Hung et al., 2019; Jansen et al., 2017; Watted & Barak, 2018). The motivation section assessed learners' goals (including intrinsic and external goals), value beliefs, and their expectations for a course. The learning strategies section included cognitive and meta-cognitive strategies and resource management strategies.

The OSLQ was adopted to measure learners' SRL ability and strategies, including goal setting, environment structure, task strategies, time management, help-seeking, and self-evaluation (Kizilcec et al., 2017; Lee et al., 2020; Martinez-Lopez et al., 2017).

The MAI was constructed to measure meta-cognitive awareness as classified into two categories—cognition knowledge and cognition regulation (Schraw & Dennison, 1994).

The LS questionnaire has been used to measure three learning strategies—cognitive learning, behavioral learning, and self-regulatory learning—as associated with learning gain in MOOCs (Warr & Downing, 2000). The factors within these strategies included elaboration, help-seeking, motivation control, and comprehension monitoring (self-evaluation), among others.

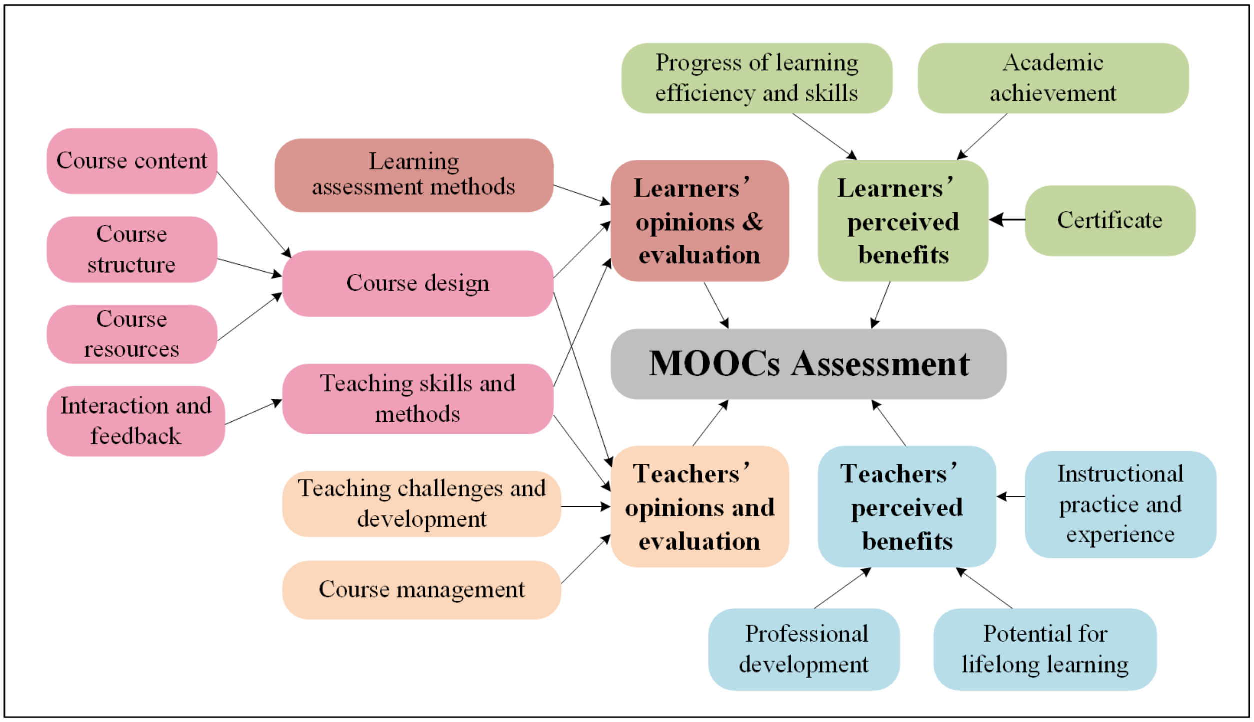
In the analysis of new factors not included in the classical questionnaires, attitudinal learning was investigated in order to study the relationship between learners' inherent positive attitudes and their belief in being able to complete learning tasks well (Watson et al., 2018; Watson et al., 2016). Learners' emotional state and self-perceived achievement when attending a MOOC has been shown to affect their attitudinal learning. Behavioral learning was mainly predicted by learners' engagement with activities (Ding & Zhao, 2020). Some new factors affecting learners' motivation were also explored, such as individual benefits, including career, personal, and educational benefits. Social influence, similar to situational interest, was also studied and included certain conditions or stimuli in the social environment, such as peers' recommendation and teacher's support (de Barba et al., 2016; Durksen et al., 2016; Gallagher & Savage, 2016). MOOC instructors can refer to the influencing factors listed in Figure 2 to design for learner-centered experiences in the MOOC space (Blum-Smith et al., 2021).

F-G Graph for Assessment of MOOCs

In the reviewed articles, some researchers investigated students' and teachers' overall evaluation of MOOCs before or after participating in their courses. Figure 3 is an F-G graph that illustrates our summary of research models for assessment of MOOCs. This analysis spanned four dimensions, namely, (a) learners' evaluation, (b) learners' perceived benefits from learning, (c) teachers' evaluation, and (d) teachers' perceived benefits from teaching. The factors in the rounded rectangles directly or indirectly affect the assessment of MOOCs by learners and teachers. The direction of an arrow points from an explanatory variable to a dependent variable.

Figure 3

F-G Graph: Factors for Assessment of MOOCs



Regarding evaluation by learners and teachers, in order to obtain feedback that contributed to improving MOOCs, most researchers collected opinions and suggestions from students and teachers about course design, including course content, course structure, and available resources (Gan, 2018), as well as teaching skills and methods (Gan, 2018; Kormos & Nijakowska, 2017; Lowenthal et al., 2018). Regarding teaching methods, students' main concerns were feedback from and interaction with instructors and co-learners (Marta-Lazo et al., 2019). In addition, students' views on criteria for evaluating academic performance were crucial to assessment of MOOCs (Robinson, 2016; Ruiz-Palmero et al., 2019; Sari et al., 2020; Teresa Garcia-Alvarez et al., 2018). Teachers were concerned about their course management skills, teaching challenges, and personal development (Donitsa-Schmidt & Topaz, 2018; Robinson, 2016).

Students evaluated MOOCs based on what they perceived as benefits, including academic achievement, expected certificates or rewards, progress of learning efficiency, and effort invested in acquiring new knowledge or practical skills (Jung et al., 2019; Ruiz-Palmero et al., 2019; Teresa Garcia-Alvarez et al., 2018). Through participating in MOOCs, learners gained tangible and intangible benefits that generally justified their expectations, usually coinciding with individuals' plans to change their career, education, or life trajectory (Sablina et al., 2018).

Teachers' perceived benefits from providing courses as MOOCs were the key factors when they evaluated MOOCs. Benefits consisted mainly of enriching their instructional practice and experience, professional development, and potential for lifelong learning (Donitsa-Schmidt & Topaz, 2018). A teaching-quality control system was proposed as a way to provide teachers with motivation for continuous teaching with

MOOCs, and to promote teachers' self-confidence and self-efficacy (Gan, 2018).

Analysis Methods Used Most Often in Research on MOOCs

After collecting questionnaire data, researchers chose analysis methods according to their different research needs. Based on our summary of the analysis methods used in the 126 reviewed studies, 61 articles (48.41%) used descriptive analysis, 53 studies (42.06%) used a structural equation model (SEM), 48 articles (38.10%) performed reliability analysis, and 41 studies (32.54%) adopted validity analysis. Most articles used several quantitative analysis methods at the same time. Researchers used various statistical analysis software to assist the processes of data analysis, most often IBM SPSS (n = 34) and AMOS (n = 14).

In the research we investigated, descriptive statistics often dealt with demographic data including participants' gender, age, educational background, and experience with MOOCs (Botero et al., 2018; de Barba et al., 2016; Farhan et al., 2019; Hone & El Said, 2016). Descriptive statistics of data characteristics included data frequency analysis, centralized trend analysis, dispersion analysis, distribution, and some basic statistical graphics.

Reliability analysis refers to the degree of consistency of the results obtained when a questionnaire repeatedly measures the same object. It is best to verify the reliability of the items before using a questionnaire instrument to collect data. In the articles we reviewed, Cronbach's α was the most commonly used reliability coefficient (Kovanovic et al., 2017; Sun et al., 2019; Tsai et al., 2018; Zhao et al., 2020). The data collected through questionnaires was generally considered credible when Cronbach's α was greater than 0.7.

Validity analysis determines the degree to which the measurement results of a questionnaire can accurately reflect what needs to be measured. Validity analysis comprises content validity and structural validity. In the studies we examined, researchers usually invited people with extensive development experience to check the content validity of their questionnaires (Jo, 2018; Zhou, 2017). Structural validity consisted of two main methods, namely exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). EFA was commonly used in item analysis for scale preparation to explore the model structure, while CFA was used in reliability and validity analysis of mature questionnaires to verify the structure of a model (Jansen et al., 2017; Luik et al., 2019; Shahzad et al., 2020).

SEM is a more often recommended analysis method when attitude-related variables are included in the hypothesis model. SEM is a statistical method to analyze the relationship between variables based on a covariance matrix of variables for multivariate data analysis. The SEM methods used most frequently in the studies we examined were the partial least squares method (PLS-SEM) (Hone & El Said, 2016; Shao, 2018; Yang et al., 2017; Zhao et al., 2020) and the maximum likelihood estimation method (MLE-SEM) (de Barba et al., 2016; Teo & Dai, 2019; Zhou, 2016). When the collected data had no significant distribution characteristics, researchers most often used PLS-SEM analysis.

Conclusion

Through systematic review and analysis of 126 questionnaire-based quantitative research articles on MOOCs published between January 2015 and August 2020, this study explored the research paradigms associated with this field including research topics, models, and data analysis methods.

Our findings show that MOOC research remains an important and growing field of interest for educational researchers. Empirical studies of MOOCs explored multiple issues, most of which were based on quantitative investigation and research. This paper divided the key topics of these reviewed articles into three different categories: (a) the determinants of learners' dropout rate or continuance intention, (b) the relevant factors of learners' performance, and (c) participants' assessment of MOOCs. Most research focused on MOOC participants or learners, with a few researchers actively concentrating on MOOC instructors, curriculum design, and platform development. It may be promising for researchers to conduct more in-depth exploration of the characteristics and profiles of MOOC participants and instructors, the potential for personalized customization in MOOCs, and MOOC quality improvements.

As shown in this study, most questionnaire-based quantitative studies of MOOCs had a solid theoretical foundation, a standardized research process, and effective research methods. By understanding the research paradigms summarized and expanded in this study, researchers will be better able to carry out more empirical research while experimenting with research methods that have not yet been commonly used. This paper provides three F-G graphs to separately analyze the correspondence between research topics and factors involved in the models or hypotheses studies were based on. By referring to the F-G graphs, MOOC researchers can design more reasonable questionnaire items and collect high-quality data to better support data science research.

This study revealed several limitations of MOOC research as apparent in the studies we reviewed, including small sample size during data collection, lack of diversity among the survey participants, and the limitations inherent in traditional statistical analysis. Based on these limitations, we suggest three new directions for the future development of research on MOOCs.

First, we recommend expanding the scope of data collection and establishing big data sets. In some studies of MOOCs selected for this paper, the sample size for surveys was relatively small. Some research results failed to be persuasive, or the factors investigated had no significant impact on the research subjects. A preferable approach may be to expand the scope and target of data collection, and establish a large-scale database in the MOOC field, perhaps even worldwide. This would serve to make the data sources more objective, more universal, and more convincing (Ang et al., 2020).

Second, we suggest standardizing multi-sourced heterogeneous data about MOOCs. This is an essential feature of big data, since the survey data from different studies are based on different collection scales and standards. Standardized multi-sourced heterogeneity data can provide a solid data foundation and further insights for subsequent data analysis.

Finally, we recommend applying data mining and deep learning methods. In the articles we reviewed, data analysis methods were mostly limited to traditional statistical approaches. Data mining and deep learning emphasize correlation judgments between samples and infer the population from the standard data set

(Peral et al., 2017). What is more, researchers can apply data mining and deep learning to analyze objective behaviors and subjective perceptions of MOOC learners and instructors, make feature profiles of users, and propose personalized optimization schemes (Geng et al., 2020; Cagiltay et al., 2020).

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Appendix A

Details of 32 Typical Articles for the Top Three Topics

Table A1

12 Typical Articles About Dropout Rate or Continuance Intention to Use MOOCs

Article	Questionnaire model and items design	Quantitative analysis	Sample size
Yang & Su, 2017	(1) TPB: Perceived behavior control, attitudes, subjective norms, behavior intention, actual behavior (2) TAM: Perceived ease of use (PEU), perceived usefulness (PU)	PLS-SEM Reliability analysis Validity analysis	272
Wu & Chen, 2017	(1) TAM: PU, PEU, attitude toward using MOOCs, continuance intention to use (CIU) (2) TTF: Individual technology fit, task-technology fit (3) Social motivations: Social recognition, social influence (4) Features of MOOCs: Openness, reputation	PLS-SEM	252
Khan et al., 2018	(1) TTF: Task characteristics, technology characteristics (2) Social motivation: Social recognition, social influence (3) SDT: Perceived relatedness, autonomy, competence	Multivariate assumptions Kolmogorov-Smirnov test	414
Zhu et al., 2018	(1) TPB: Attitudes, perceived behavioral control, subjective norms, behavioral intention (2) SDT: Controlled motivation, autonomous motivation	CFA MLE-SEM	475
Yang et al., 2017	(1) IS: System quality, course quality, service quality (2) TAM: PU, PEU, CIU	PLS-SEM	294
Botero et al., 2018	UTAUT: Performance expectancy, effort expectancy, social influence, facilitating conditions, behavioral intention, attitudes towards behavior	SEM Descriptive statistics	587
Zhang et al., 2016	(1) TAM: PU, PEU, CIU (2) Perceived learner control, personal innovativeness, information technology, E-learning self-efficacy	PLS-SEM Validity analysis: AVE Cronbach's alpha	214
Jung & Lee, 2018	(1) TAM: PU, PEU, academic self-efficacy (2) Teaching presence: Instructional design and organization (3) Learning engagement: Behavioral engagement, emotional engagement, cognitive engagement, learning persistence	SEM Reliability analysis: CR Validity analysis: CFA AVE	306

Wang & Baker, 2018	(1) Motivation: Goal orientation, self-efficacy, grit, need for cognition(2) Three subscales of patterns of adaptive learning survey: Academic efficacy, mastery-goal orientation, performance-goal orientation	t-tests False discovery rate Bonferroni correction	10348
Luik et al., 2019	(1) Social influence (2) Expectations on suitability: Personal suitability of distance learning, suitability for family and work (3) Interest and expectations on course, importance and perceived ability, usefulness related to certification, usefulness related to own children	EFA CFA Kaiser–Meyer–Olkin measure Correlation: Bartlett's test	1229
Hone & El Said, 2016	(1) Instructor effects: Instructor-learner interaction, instructor support, instructor feedback (2) Co-learner effects: Learner-learner interaction (3) Design and implementation effects: Course content, course structure, information delivery technology, perceived effectiveness	PLS-SEM Descriptive analysis Chi-square analysis EFA	379
Li et al., 2018	(1) Network externalities: Network size, perceived complementarity, network benefit (2) User preference, user experience, motivation to achieve, persistence in completing MOOCs	PLS-SEM Reliability and validity Harman's single-factor test	346

Table A2

10 Typical Articles About Learners' Performance in MOOCs

Factor	Article	Questionnaire model and items design	Methodology	Sample Size
SRL	Lee et al., 2020	OSLQ: Self-regulated learning strategies MSLQ: Self-efficacy, task value	Multiple regression Pearson's correlation analysis	184
	Martinez-Lopez et al., 2017	OSLQ, MAI, and LS Goal setting, environment structuring, task strategies, management help, help-seeking, self-evaluation	Modified kappa Coefficient content validity Indexing (CVI) SEM	45
	Jansen et al., 2017	MSLQ, OSLQ, MAI, and LS (1) Preparatory phase: Task definition, goal setting, strategic planning (2) Performance phase: Environmental structuring, time management, help-seeking, comprehension monitoring, task strategies, motivation control, effort regulation (3) Appraisal phase: Strategy regulation	EFA CFA Descriptive statistical analyses	162

	Kizilcec et al., 2017	MSLQ, OSLQ, MAI, and LS Goal setting strategies, strategic planning, elaboration, help-seeking	Descriptive statistics Spearman correlation coefficients Fitted logistic regression	4831
Motivation and learning strategy	Carlos et al., 2017	Motivation: (1) Value component: Intrinsic goal orientation, task value (2) Expectancy component: Self-efficacy for learning and performance LS: (1) Cognitive and meta-cognitive strategies: critical thinking (2) Resource management strategies: Time, study environment	Descriptive statistics	6335
	de Barba et al., 2016	(1) Motivation: Individual interest, mastery-approach goals, value beliefs (2) Situational interest: Entering situational interest, maintaining situational interest	Cronbach's alpha Descriptive statistics MLE-SEM Bootstrap Chi-square	862
	Fryer & Bovee, 2018	(1) Prior competence, prior computer use, teacher support, smartphone use (2) Ability beliefs, effort beliefs, task value	CFI (confirmatory fit index) RMSEA (root mean square error of approximation) MANOVA Latent profile analysis (LPA)	642
	Watted & Barak, 2018	(1) Career benefits: Certificate (2) Personal benefits: Improving knowledge (3) Educational benefits: Research and professional advancement	Kruskal-Wallis analysis	377
Attitudinal learning	Ding & Zhao, 2020	(1) Emotion, self-perceived achievement (2) Video engagement, assignment engagement	Reliability analysis Cronbach's alpha	378
	Watson et al., 2018	Cognitive learning, affective learning, behavioral learning, social learning.	Descriptive statistics CFA	1009

Table A3

10 Typical Articles About Assessment of MOOCs

Respondent	Article	Questionnaire	Methodology	Sample Size
Learners	Martin Nunez et al., 2017	Available resources, course forums, evaluations adequacy	Statistical analysis MANOVA	112
	Jung et al., 2019	(1) Course content, course structure, assessment method, learner-content interaction (2) Learner control, sense of progress, perceived effectiveness	Hierarchical linear regression	1364
	Robinson, 2016	Teaching effectiveness, course objectives, overall rating, personal learning objectives, recommendation to others	t-tests Cronbach's α Post-hoc power analysis	21
	Donitsa-Schmidt & Topaz, 2018	(1) Flexibility and convenience (2) Learning opportunity, professional development	Descriptive analysis	84
	Meinert et al., 2018	Motivation, learning methods, course content	Kruskal-Wallis analysis Logistic regression Descriptive analysis	16
Teachers	Gan, 2018	Teaching quality control security system: Teaching team, teaching content, teaching skills, teaching resources, course arrangement, policy support	Descriptive analysis	20
	Sari et al., 2020	(1) Course design: Preparation, attraction, participation, assessment, feedback (2) Teaching challenges	Descriptive analysis	65
	Lowenthal et al., 2018	(1) Teaching motivation: Interest and passion, publicity and marketing, benefits and incentives (2) Teaching experience (3) Perception of MOOC educational value	Descriptive analysis	186
	Kormos & Nijakowska, 2017	Participants' attitudes, self-confidence, concerns about teaching practices, self-efficacy beliefs	Principal component analysis Regression factor scores MANOVA GLM	752
	Sneddon et al., 2018	Course development, course evaluation, course delivery	Descriptive analysis	219

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A Scoping Review on Open Educational Resources to Support Interactions of Learners with Disabilities

Jewoong Moon and Yujin Park
Department of Educational Psychology and Learning Systems, Florida State University

Abstract

This scoping review explored the trends in open educational resources (OER) that support the interactions of learners with disabilities and the challenges of supporting these interactions in such environments. Emerging OER and open educational practices allow learners to interact with digital learning resources in self-regulated learning. Since OER assume learners' self-regulation, research has explored how to promote learner interactions to facilitate better engagement and motivation. Emerging research on OER-enabled pedagogy corroborate this trend. However, despite increasing interest in OER and open educational practices, few studies have demonstrated how OER support various types of interactions for learners with disabilities. Learners with disabilities are likely to experience challenges in interacting with OER due to their modality constraints. A comprehensive literature synthesis is essential to investigate the needs of learners with disabilities in their interactions in OER. In this study, we reviewed and synthesized existing research on how OER and open educational practices support the interactions of learners with disabilities across different OER platforms. Our findings suggest both research and design implications for future OER designs suited for learners with disabilities.

Keywords: open educational resources, scoping review, learner interaction, learners with disabilities

Introduction

Open educational resources (OER) have expanded due to their potential use in teaching and learning. For example, Web-based OER, such as open courseware and massive open online courses (MOOCs), have increasingly attracted learners' attention by encouraging interconnectedness and allowing for remote access. OER generally refer to educational resources that are publicly sharable through multimodal data (e.g., text, audio, and visual stimuli). OER include various types of learning environments, as well as sharable and electronic materials that are publicly accessible. The variety of OER platforms range from Web-based learning materials to stand-alone computing applications across different learning contexts.

Research faces a new challenge in determining how to promote learners' interactions in OER environments. Emerging research on learners' 21st-century skills, such as collaboration and creativity (Amornrit, 2019; Okada et al., 2014), has increasingly focused on how OER and open educational practices can develop these skills. This research considers learners' deeper learning, which comprises the mastery of domain-generic problem-solving skills, through OER. While most studies have focused on the principles of OER design and use, such as the 5Rs (i.e., reuse, retain, revise, remix, and redistribute), they rarely discuss ways to enhance learners' interactions in OER. Correspondingly, the emerging notion of OER-enabled pedagogy (Wiley & Hilton III, 2018) suggests a new role for OER that better emphasizes learners' interactive and hands-on experiences.

OER-enabled pedagogy expands the significance of learners' interactions with OER, with an understanding that learners not only use OER for information retrieval but also interact with OER by creating, modifying, utilizing, and recreating artifacts from OER-driven environments. Despite emerging views on OER that are aligned with OER-enabled pedagogy, the question remains: How do existing OER support the interactions of learners with disabilities? Although a new paradigm of OER supposes learner-centered manipulation of learning resources, the current discussion on the role of OER in developing 21st century skills has failed to suggest ways to embrace learners with disabilities in this paradigm. Specifically, the issue of how existing OER can support the various interactions of learners with disabilities is not well understood.

According to the National Center for Education Statistics at Institute of Educational Sciences (IES; NCES, 2020) in the United States, the percentage of learners aged 3–21 years who are served under the Individuals with Disabilities Education Act (IDEA) is quite large (13% of all learners, 7.1 million in total). Furthermore, more than 10% of learners with disabilities spend less than 40% of their time taking general classes. This statistic shows that OER can be particularly beneficial for learners with disabilities, who are more likely to face challenges in accessing learning opportunities than typically developing learners. Research on open learning is essential to understand how OER can be designed and implemented to guide the meaningful learning experiences of individuals with disabilities.

Aligned with the goal of our study, we chose to adopt the interactionist model's definition of disability (Howard, 2003), among the various approaches to the definition (e.g., medical and social models). The interactionist model focuses on individuals' social processes and dynamics instead of their heterogeneous medical diagnoses. This model admits the social barriers and limitations of some impairments and the relationships among them and emphasizes the significance of a system or an environment as a social place where interactions between individuals and environments occur (Howard, 2003). From this perspective on disability, we explored how OER facilitate the different interactions types of learners with disabilities in OER environments (i.e., learner–learner, learner–instructor, learner–interface, and learner–content interactions). Specifically, this scoping review aimed to reveal the gap between current OER, in terms of learner interaction design, and what learners with disabilities need.

OER in the 21st Century

OER refers to digital learning materials that are open to anonymous users. OER include various types of educational materials for teaching, learning, or assessment, such as textbooks and digital toolkits that consider human modalities (e.g., video and narrations). Since OER focus on the openness of learning resources, OER can contribute to digital equity (Park et al., 2019). Digital equity indicates that each learner has an equal opportunity to access and experience learning resources without physical constraints (Solomon, 2002). Hence, OER can ensure digital equity by supporting learners' access to educational materials. Recent reviews on open education support this perspective (Lambert, 2019; Leahy et al., 2016).

In addition to existing OER, advances in computing technologies have significantly changed the role of OER. Emerging OER do not limit their online platforms but flexibly embrace various learning environments (e.g., open-source software and games) that meet the 5R standards. Wiley and Hilton III (2018) suggest OER-enabled pedagogy as a framework for expanding the role of OER in view of constructionism and openness in education. Constructionism believes that learners actively construct new knowledge from their learning experiences, particularly when they engage in creating personally-meaningful artifacts (Resnick, 1996). In the same vein, OER-enabled pedagogy emphasizes learners' creative and critical thinking through learning-by-doing exercises. Guided by this epistemological foundation, researchers have highlighted the importance of learners' interactions and actions that revise and re-create existing OER and result in deeper learning. From a constructionist perspective, OER highlight open-access to learning materials and underscore learners' creations and artifacts through the use of digital tools. Similarly, OER-enabled pedagogy assumes learners' interactions, including artifact creation through OER. In other words, OER-enabled pedagogy describes learners' highly-interactive and experiential learning as comprising manipulation, modification, and re-creation of OER (Van Allen & Katz, 2019; Wiley & Hilton III, 2018).

Despite attention to OER and OER-enabled pedagogy, studies have rarely investigated how existing OER and open educational practices can embrace learners with disabilities and how they can promote their interactions. In terms of digital equity, research has failed to identify clearly the contextual challenges that learners with disabilities face when using OER (Park et al., 2019; Willems & Bossu, 2012). Considering such challenges, we noticed a possible discrepancy between OER designs and learners' disabilities, which may interrupt the expansion of OER-enabled pedagogy for learners with disabilities. This discrepancy underscores the importance of a scholarly review that identifies the types of learner interactions that are supported across different OER platforms. A comprehensive review of how OER support the interactions of learners with disabilities is essential to identifying relevant design indications and implications.

Accessibility and Universal Design for Learning (UDL)

Digital equity denotes a learner's right to access educational resources without barriers. Prior research has explored how to embrace learners with disabilities through OER as a practice of digital equity (Park et al., 2019; Treviranus, 2018). Research on OER for learners with disabilities have been rooted in two concepts:

accessibility and universal design for learning (UDL; Spencer, 2011; Spooner et al., 2007). According to the IMS Global Learning Consortium (2012), accessibility refers to the ability of a learning environment to adjust to individual learners. A major goal of accessibility design is to consider the visibility of information to allow learners with disabilities greater understanding in OER. Specifically, accessibility considers information presentation that enables individuals to better access and comprehend information without interruption by physical body constraints.

In terms of Web accessibility, previous research has focused on building more accessible Web resources that consider learners with disabilities. Similarly, the international World Wide Web Consortium (W3C, 2020) has offered the Web content accessibility guidelines (WCAG) since 2008. Following these guidelines, two examples demonstrate how accessibility in OER has been considered: 1. The FLOE Project is an online learning resource that incorporates user-interface options and inclusive-technology resources (Treviranus et al., 2014). The project aims to offer personalized and "one-size-fits-one" learning materials for learners with disabilities. 2. Hashey and Stahl (2014) suggest a voluntary product accessibility template, which demonstrates how educational devices are tailored to learners' contexts, involving modality preferences. This template also helps designers to conceptualize multimodal interactions in a Web-based platform.

In addition to accessibility, research has considered UDL as a major framework to envision instructional strategies to promote learners' engagement in a digital learning environment (Meyer et al., 2014). UDL refers to instructional products or practices that are optimized for all learners, including individuals with disabilities. While accessibility refers to enhanced information visibility that is tailored to learners with disabilities, UDL seeks to provide a set of learning strategies with digital tools that inclusively support learners' engagement (Spencer, 2011). In this sense, UDL demonstrates three principles regarding learners' improved participation in learning (Spooner et al., 2007): a. *representation*, which refers to providing multiple formats of representation (e.g., visual and auditory) to allow learners to choose the optimal channel of information; b. *action and expression*, which denote using methods that enable learners to demonstrate their behaviors and thoughts in various ways; and c. *engagement*, which refers to choosing a variety of sources that are personally meaningful to an individual learner to enhance their motivation. Although both accessibility and UDL have been pivotal to understanding OER design and development for learners with disabilities, few studies have attempted to bridge the two perspectives and explain how each framework has been incorporated in current OER (Navarro et al., 2016; Ngubane-Mokiwa, 2016).

Supporting the Interactions of Learners with Disabilities

Engagement is a key indicator of the success of OER. Learner interaction determines an individual's engagement levels in an educational setting. Thus, researchers have been interested in boosting learners' engagement through OER (Panke & Seufert, 2013). Since OER depend on learners' self-regulation (Kocdar et al., 2018), such as time management and strategic planning, research has underscored the promotion of learners' interactions to maintain their engagement. In particular, an emerging concern for learners' hands-on practices in OER-enabled pedagogy (Wiley & Hilton III, 2018) emphasizes ways to promote learner interaction.

Multiple lines of OER research provide clues on how to better facilitate learners' interactions. In terms of accessibility, research has investigated how to improve perception, navigation, and interaction in Web environments that serve as OER. Such research has focused on designing and developing graphical user interfaces (GUIs), which allow learners to control multimodal inputs and navigation paths in a Web system (Bittencourt et al., 2016; Navarrete & Luján-Mora, 2018). In addition, the field of human-computer interaction suggests an ability-based design, which intends to optimize learners' existing capabilities in their interactions (Wobbrock et al., 2011). Such research aims to provide a system interface that corresponds to an individual's characteristics. Research on UDL considers the external design factors of a learning environment, such as peer- or instructor-interaction settings. UDL research aims at designing multiple modes of instruction that enable learners with disabilities to choose their preferred learning materials to assist in their learning. UDL focuses on optimizing individuals' learning experiences (Spooner et al., 2007) across different instructional settings.

Despite the various streams of OER for learners with disabilities, a comprehensive review of learner interactions in OER is lacking. The ways in which OER and open educational practices specifically guide and support the interactions of learners with disabilities are not well understood. Few studies encompass the breadth of literature, including current trends and knowledge gaps in studies, on how learners with disabilities interact in OER environments. Thus, we aimed to map the landscape by collecting and synthesizing existing OER studies. This study proposed two research questions:

1. How have OER supported the interactions of learners with disabilities?

2. What are the major challenges of supporting interactions in OER for learners with disabilities?

Methods

We conducted a scoping review to identify key concepts, theoretical accounts, and scholarly evidence that correspond with the research questions. A scoping review is a data-synthesis method that organizes and synthesizes the literature on a specific topic. The major goal of a scoping review is to identify the "extent, range, and nature of the literature" that is aligned with a research interest (Pham et al., 2014, p. 371). In contrast to a systematic review, which answers specific and narrow research questions, a scoping review focuses on identifying a body of literature on a subject area, as well as gaps between current practices and the research questions.

Data Sources and Search Strategies

We searched multiple electronic databases (i.e., Web of Science [WoS], ERIC, Google Scholar, ScienceDirect, ACM, and IEEE Xplore), using several sets of keywords related to OER and disabilities, to gather relevant literature. Keywords on OER included terms, such as "open educational resources," "OER," "open learning," "open education," and "MOOC." Keywords on disabilities included terms, such as "accessib*," "disab*," "universal design," and "inclusive design." We also included the term "interaction" to search for literature on the types of interaction that are designed and supported in existing OER. To complement the search results, we conducted snowball sampling to identify additional literature (see Wohlin, 2014). Snowball sampling is a data-collection technique used to explore and then include feasible evidence that is aligned with the research questions. This method aligns with Arksey and O'Malley's (2005) "hand-searching of key journals" approach (p. 24), which recommends manually checking articles because the results of keyword searches in select electronic databases are incomplete. In addition, we searched the Horizon Report 2020 (EDUCAUSE, 2020), an academic resource that demonstrates significant trends and emerging educational practices (e.g., maker education and computational thinking), to identify relevant literature. Table 1 shows the inclusion and exclusion criteria used to select the articles for this study. As this scoping review aimed to identify and explore the themes and issues of OER and OER-enabled pedagogy, we included peer-reviewed conference proceedings that address emerging issues in addition to journal articles.

Table 1

Inclusion and Exclusion Criteria for Data Collection

Inclusion criteria	Exclusion criteria
• Empirical studies that apply accessibility and universal designs for learners with disabilities. • Empirical studies that demonstrate educational practices, including OER aligned with the underlying notions of OER-enabled pedagogy. • Studies with a conceptual framework for OER design, especially for learners with disabilities. • Studies that use emerging educational practices from the Horizon Report, such as OER.	• Studies not written in English. • Studies unrelated to the research questions. • Duplicates of the same study results. • Studies that implement systematic or scoping reviews.

Figure 1

A PRISMA Diagram of the Data Collection Procedures

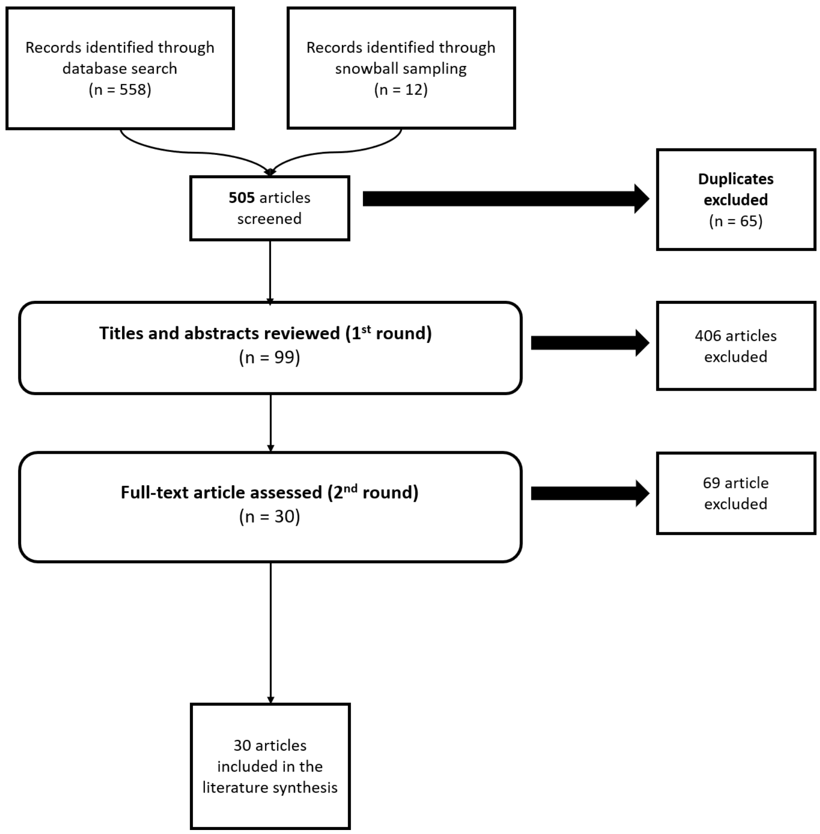


Figure 1 displays a PRISMA diagram of our data collection procedures. Using both database searches and snowball sampling, we identified a total of 570 articles with a combination of the keywords mentioned above. We then carefully read the titles and abstracts of all articles and selected the applicable articles for further review. We retained 99 articles for full-text screening and excluded 406 articles. Each of the researchers subsequently read the full texts of the selected articles and rated evaluated them. We iteratively discussed any discrepancies between the ratings until we reached an agreement. After excluding 69 articles, a total of 30 articles remained for the literature synthesis.

Data Analysis and Procedures

We conducted a content analysis of the selected articles to organize and synthesize the studies. To this end, we developed and implemented a coding scheme to systematically review the collected literature. The coding scheme was designed based on Moore's (1989) and Hillman et al.'s (1994) classifications of learner interactions, which primarily appear in online education. The scheme consisted of several categories: bibliographic information, article types, study foci, OER platform types, intervention types, learner interaction types, and design implications and challenges. Investigating the types of learner interactions in OER can contribute to understanding how learners interact with peers, instructors, content, or computing systems. Specifically, learners with disabilities may face difficulties in interacting with peers or digital platforms because the platforms are not inclusively designed and optimized for all learners.

Correspondingly, our coding scheme addressed four interaction types: 1. learner–learner interactions, which indicate learners' social interaction patterns or collaborations through OER; 2. learner–instructor interactions, which focus on the instructional supports that appear in OER; 3. learner–interface interactions, which describe how OER directly support learners' self-discipline through system elements; and 4. learner–content interactions, which indicate learners' use of educational content in OER for knowledge acquisition and the transformation of their cognitive state. Two coders were trained to conduct the coding. They first randomly coded 20% of the collected articles and iteratively discussed the results until they reached 100% agreement. After the coders completed training through the discussion process and learned the coding scheme, they individually coded the remaining articles. The collected literature was then categorized into major themes, which were used to determine how this body of the literature answers the research questions (see Arksey & O'Malley, 2005).

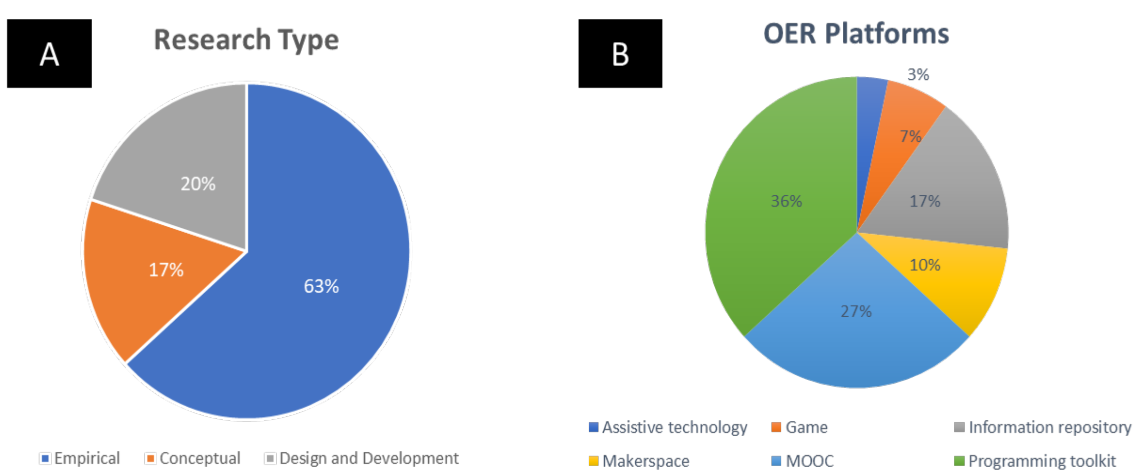
Findings

Descriptive Statistics

Figure 2 illustrates the 30 articles selected for the literature synthesis in terms of the type of study and type of OER platforms they describe. Among the selected articles, 19 articles (63%) describe empirical research on OER implementation for learners with disabilities and include both quantitative (e.g., experimental, or survey-based) and qualitative (e.g., interview) data collection and analyses. Six articles (20%) describe conceptual studies that envision OER design or theoretical frameworks for learners with disabilities. Finally, five articles (17%) illustrate OER design and development across different platforms and hardware.

Figure 2

Research Types and OER Platforms in the Selected Articles



Note. Panel A: Research types. Panel B: OER platforms.

Figure 2 and Table 2 present the different types of OER platforms that support learner interactions in the selected studies, including information repositories (*n* = 5, 16.7%), MOOCs (*n* = 8, 26.7%), programming toolkits (*n* = 11, 36.7%), makerspaces (*n* = 3, 10.0%), assistive technologies (*n* = 1, 3.3%), and games (*n* = 2, 6.7%). The number of OER platforms and the study types in this literature synthesis differ because a single study could include multiple types of learning platforms.

Table 2

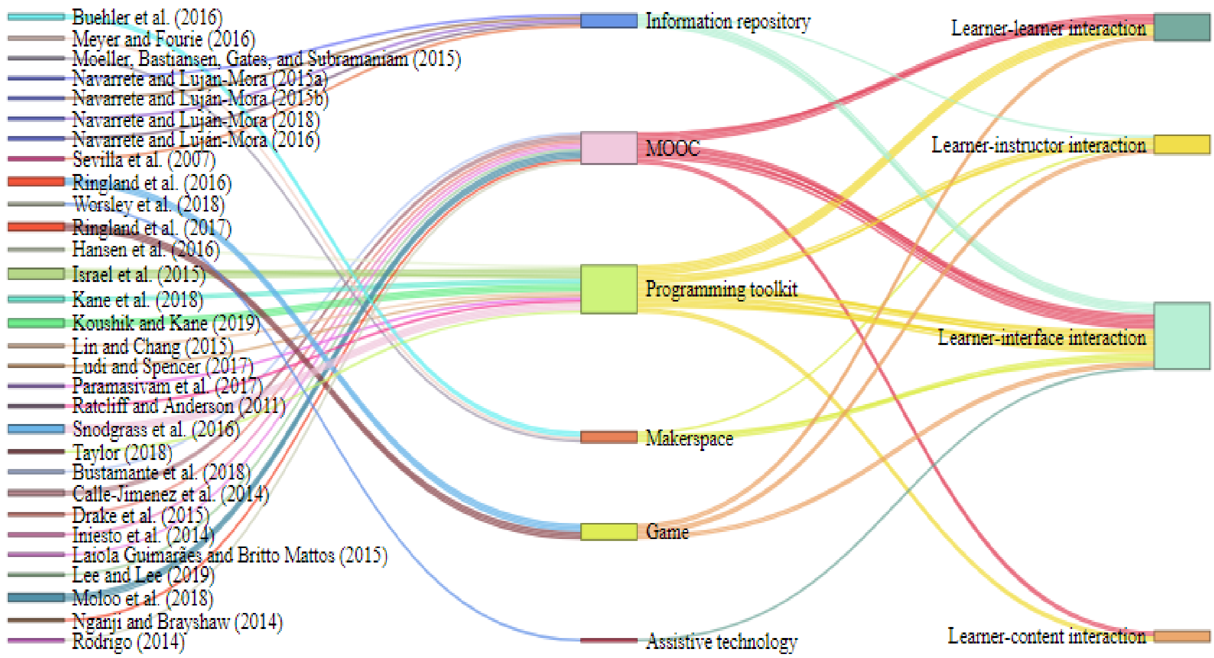
OER Platforms Coded in This Study

OER platform types	Operational definition	Reviewed articles[a]
Information repositories (*n* = 5)	Online platforms that provide either teaching or learning resources for both teachers and learners.	17–20, 27
MOOCs (*n* = 8)	Online platforms that comprise lectures and learning management systems.	2–4, 6, 10, 16, 21, 26
Programming toolkits (*n* = 11)	Computing applications that teach learners the language of object-oriented and block-based programming (e.g., Scratch and Google Blockly).	5, 7–9, 11–13, 22, 23, 28, 29
Makerspaces (*n* = 3)	Informal workspaces that allow learners to experience maker activities and provide various maker equipment (e.g., 3D printer, sewing machine, and e-textures).	1, 14, 15
Assistive technologies (*n* = 1)	Any devices used to support the capacity of learning materials and communication.	30
Games (*n* = 2)	Educational games that encourage learners to play and communicate with peers.	24, 25

[a] The identification numbers of the articles included in the synthesis are listed in Appendix A.

Figure 3

Types of Learner Interactions and OER Platforms in the Selected Literature



The sampled literature demonstrates four major interaction types that have emerged in OER research: learner–learner interactions (n = 9, 20.9%), learner–instructor interactions (n = 5, 11.6%), learner–interface interactions (n = 23, 53.5%), and learner–content interactions (n = 6, 13.9%). The results suggest that most studies primarily explored how learners behave and interact with OER systems (i.e., learner–interface interaction). We mapped our results on research articles, OER platforms, and types of learner interactions using a Sankey diagram to demonstrate learner interactions (i.e., learner–learner, learner–instructor, learner–interface, and learner–content interactions) across different learning environments (Figure 3). To address the two research questions, we mapped the collected articles according to research type, OER platforms, and types of learner interactions (see Appendix A).

Research Question 1: How Have OER Supported the Interactions of Learners With Disabilities?

Learner–Learner Interaction

A number of studies (4, 7–9, 16, 24–26, 28; see Appendix A) present examples of learner–learner interactions when using OER. These studies coherently demonstrate that peer collaborations were helpful in adaptively supporting learners with disabilities in OER. The learner–learner interactions varied across different OER platforms:

- Programming toolkits (7–9, 28): A group of studies focused on learners' collaborations when implementing open-source programming toolkits (Israel et al., 2015; Kane et al., 2018; Koushik &

Kane, 2019, Snodgrass et al., 2016). For example, Kane et al. (2018) implemented a toolkit called *Bonk*, which is an accessible game that teaches visually-impaired learners how to use programming language to create, share, and play audio games. Learners joined collaborative programming exercises with peers in informal and loosely formed groups. Collaborations emerged differently in each group: Learners either experienced all roles in a project or were individually assigned a role (e.g., programmer, tester, designer, and debugger). Learner–learner interactions mostly occurred when learners contended with programming task challenges.

- MOOCs (4, 16, 26): A few studies discussed learner–learner interactions in MOOC environments (Drake et al., 2015; Moloo et al., 2018; Rodrigo, 2014). They focused on enhancing the accessibility and usability of MOOC platforms and, in particular, peer to peer modalities (Rodrigo, 2014), which foster learners' online communication in discussion boards.

- Games (24, 25): Ringland and colleagues used open-source games to enhance learners' socialization and sensory development through 3D artifact designs (Ringland et al., 2016; Ringland et al., 2017). In these studies, the researchers demonstrated the effect of Autcraft, a modified platform of the 3D game Minecraft designed for learners with autism spectrum disorder. The game platform facilitated learners' social interactions, allowing them to practice interpersonal communication skills safely with collaborative designs. Learners with autism spectrum disorder could share their artifacts and discuss design ideas with their peers through synchronous communications on the Minecraft server.

Learner–Instructor Interactions

Five studies (1, 7, 24, 25, 28) show how learner–instructor interactions emerge when using OER. Learner–instructor interactions in OER appear vital to managing learners' attention because OER encourage learners to seek, identify, and apply knowledge mindfully in problem-solving. Since the benefits of OER depend on learners' self-regulated attitudes (Gil-Jaurena, 2014), fostering learner engagement is essential. Different types of learner–instructor interactions emerged across the various OER platforms discussed in these studies.

- Makerspaces (1): Buehler et al. (2016) suggest several guidelines to promote engaging experiences for learners with disabilities when using 3D printers. The researchers collected suggestions for device management (i.e., budgeting time for training, ensuring printer reliability and maintenance, and developing a plan to share resources equally) in learning activities in a makerspace.

- Programming toolkits (7, 29): Two studies observed instructors' learning supports for learners with disabilities in programming toolkits (e.g., Scratch and Alice). Since computer programming exercises appeared challenging to novice learners, specific and adaptive learning supports were emphasized.

    - Israel et al. (2015, [7]) demonstrate a contextualized UDL framework for teaching computational thinking through programming toolkits (e.g., Scratch and Alice). The researchers suggest strategies to promote learners' attention (e.g., presenting multiple means of representations/action and expression/engagement). This study indicates the necessity to consider instructional sequences and flow that allow learners to practice their skills and then recognize underlying concepts from explicit instruction.

- Snodgrass et al. (2016, [28]) investigated various instructional supports for implementing Scratch in Code.org. Code.org is a web platform that encourages both teachers and students to learn the fundamental concepts of computer science. This web environment provides learners with free coding tutorials and hands-on exercises. The teacher in this study provided several types of individualized instructional supports to each participant with disabilities (e.g., access to materials, verbal directions, problem-solving techniques, and task-specific guidance) and incorporated computational thinking pedagogy.

- Games (24, 25): Ringland and colleagues used the sandbox 3D video game Minecraft to implement social-skills' training for learners with autism spectrum disorder. Since the studies focused on learners' social-interaction practices and collaborations during the interventions, the role of the instructor was limited to providing minimal guidance and virtual community rules (e.g., avoiding abusive behavior, building a social relationship).

Learner–Interface Interaction

Most of the selected studies demonstrate learner–interface interactions, which are related to learners' hands-on practices and self-regulated learning through OER (1-3, 5-9, 11-13, 16-23, 26, 27, 29, 30). We categorized these studies based on their specific emphasis on learner–interface interactions across various OER platforms: 1. pedagogical approach (e.g., open educational practices); 2. design and development of accessible OER; and 3. quality assurance of OER.

- Pedagogical approach (1, 2, 5, 9, 11, 12, 22, 23, 27, 29): A group of studies emphasized the pedagogical approach of OER for learners with disabilities. These studies primarily observed learners' learning processes and evaluated the user interface designs of OER.
  - Observations (1, 5, 9, 12, 22, 23, 29): Research using open-license programming toolkits (e.g., Scratch, Logo, Blockly) and makerspaces tended to observe learners' behavior patterns (Buehler et al., 2016; Hansen et al., 2016; Koushik & Kane, 2019; Lin & Chang, 2015; Paramasivam et al., 2017; Ratcliff & Anderson, 2011; Taylor, 2018).
  - User-testing in OER (11, 27): Two studies focused on user-testing of OER Websites that serve as Web-based information repositories for instructional practices. They primarily addressed possible navigation issues and requirements of adaptive interface design that could enhance ease of use in OER (Sevilla et al., 2007).
  - Accessibility training: One study (2) implemented a training program to teach engineering educators how to apply the Web content accessibility guidelines (WCAG 2.0; W3C, 2020) when designing accessible online courses (Bustamante et al., 2018).
- Design and development of accessible OER (6, 7, 8, 13, 19–21, 26, 30): Nine studies on learner–interface interactions emphasized the design and development of accessible OER for learners with

disabilities. For example, five studies suggest design strategies or standards to enhance the OER Website interface to support learners' needs and preferences based on their ability levels (Navarrete & Luján-Mora, 2016, 2018; Nganji & Brayshaw, 2014; Rodrigo, 2014). In addition, a group of studies explored learners' interactions with programming toolkits. They observed the types of interactions that appeared when learners manipulated the toolkits (Israel et al., 2015; Kane et al., 2018; Ludi & Spencer, 2017; Worsley et al., 2018). Only one study discussed general strategies to improve MOOC accessibility (Iniesto et al., 2014).

- Quality assurance of OER (3, 16–18): Four studies focused on the quality assurance of OER in terms of learner–interface interactions. These studies assessed the quality of the accessibility of OER Websites (e.g., OER Commons, MERLOT, and MOOC), using either WCAG 2.0 (W3C, 2020) or automated accessibility test tools (Calle-Jimenez et al., 2014; Moolo et al., 2018; Navarrete & Lujan-Mora, 2015a, 2015b).

Learner–Content Interaction

Five studies demonstrate learner–content interactions, mainly when learners experienced problem-solving across different subject matter, and identify strategies to promote such interactions (2, 8, 9, 16, 26):

- Using code templates for programming exercises (8, 9): Two studies identified youth learners' behavior patterns while using interactive whiteboards and videos, reviewing content, and activating prerequisite knowledge through templates to complete exercises in computer programming toolkits. Kane et al. (2018) observed learners while they used an online repository that allowed them to explore template codes shared by open-source projects and then create new ideas based on a code structure.

- Using guideline design and implementation (2, 16, 26): Three studies demonstrate strategies to promote learner–content interactions in OER. Rodrigo (2014) proposes the access-for-all meta-data guideline for accessibility in OER. This guideline considers the available use of learning objects, learner preferences, and environmental resources. Moloo et al. (2018) identified several components of facilitating learner–content interactions in MOOCs, including ease of understanding, interactivity, personalization, and audio pedagogy in audio learning MOOCs. Bustamante et al. (2018) implemented teacher training, aligned with accessibility guidelines, on organizing course materials, so that learners can select materials based on their needs.

Research Question 2: What Are the Major Challenges of Supporting Interactions in OER for Learners With Disabilities?

Learner–Learner Interactions

Learner–learner interactions present a number of challenges in the selected literature. First, Ringland et al. (2016) confirm that the transferability of social skills acquired in games for social-skills' training may be limited. Relying on a single channel of communication could negatively affect the transfer of social skills; hence, they recommend that interventions incorporate varied and interchangeable means and modes of training. This finding raises concerns about dependence on a single game mode without variations, which may hinder the transfer of learners' social skills. Second, the challenge of assistive technologies also impacts learner–learner interactions through OER. Research has found that learners experienced technical issues when communicating with peers and that inadequate communication tools interrupted seamless discussions during learner collaborations (Kane et al., 2018; Koushik & Kane, 2019). In addition to technical problems, instructors' limited familiarity with assistive technologies is a critical issue, because learners may struggle to maintain conversations when facilitators fail to provide them timely help to cope with technical issues.

Learner–Instructor Interactions

Some of the studies found that teachers were not familiar with contextual- and subject-oriented teaching supports (e.g., computational thinking) and consequently struggled to guide learners' hands-on exercises (Israel et al., 2015; Ludi & Spencer, 2017). Since OER and OER-enabled pedagogy assume that learners engage in open-ended explorations, content-related and timely guidance to facilitate learners' mindful exercises is essential. Teachers' limited familiarity with teaching supports could delay feedback, resulting in learners' disorientation. For the most part, these instructional challenges appeared in classroom settings. In addition, some of the studies show that learners' developmental disabilities may affect the learning process; specifically, the following challenges commonly appear among novice learners when presented with highly complex tasks, cognitive distraction, difficulties understanding task circumstances, and difficulties in manipulating figures (Guimaraes & Mattos, 2015; Israel et al., 2015; Lin & Chang, 2015; Ratcliff & Anderson, 2011; Taylor, 2018).

Learner–Interface Interactions

Some challenges emerged in learner–interface interactions through OER in the selected literature. First, research shows that the complicated interfaces of OER failed to consider learners' physical difficulties and the unique circumstances they create (Navarrete & Luján-Mora, 2016). Most studies report that both complicated interfaces and learners' motor-skill limitations negatively impacted their ability to navigate OER and identify personalized supports. Some studies argue that existing Web-based OER appear complex and inconsistent (Navarrete & Luján-Mora, 2016; Rodrigo, 2014). Specifically, learners with disabilities faced challenges when manipulating OER interfaces in inapplicable formats, such as font sizes or media types, which require adaptive changes (Kane et al., 2018; Navarrete & Luján-Mora, 2018). Learners were unable to adapt the information format to their various needs when navigating interfaces, which likely hindered information retrieval (Buehler et al., 2016; Hansen et al., 2016, Sevilla et al., 2007). Second, the selected studies demonstrate the need for adaptive designs that foster learners' access to OER. Adaptivity indicates interface changes in computing systems that can be automatically tailored to learners' needs (Sanchez-Gordon & Luján-Mora, 2020). Three studies specifically identify weaknesses in OER design, which demonstrate the need for adaptive designs to support learner–interface interactions: lack of personalized learning (Moloo et al., 2018), inadaptable interfaces (Navarrete & Luján-Mora, 2015a), and limited representation of accessible interfaces (Calle-Jimenez et al., 2014).

Learner–Content Interactions

Research demonstrates that OER implemented by educators did not particularly contribute to improving the memory and problem-solving skills of learners with disabilities due to inappropriate formats or presentation methods (Israel et al., 2015). Learner–content interaction assumes learners' internal and mental processes when interacting with OER, which excludes many variables among individual learners. To address this issue, Israel et al (2015) recommend incorporating diverse sequencing of visual representations and activities in interventions. Another challenge in supporting learner–content interactions is a lack of multimedia stimuli adapted to learners with various disabilities. Bustamante et al. (2018), Moloo et al. (2018), and Rodrigo (2014) suggest that a one-size-fits-all approach fails to consider the most appropriate and accessible stimuli for learners with different disabilities in OER and OER-enabled pedagogical environments.

Discussions and Conclusion

This study identified the ways in which OER have supported different types of learner interactions (i.e., learner–learner, learner–instructor, learner–interface, and learner–content interactions) and the challenges that emerge when learners with disabilities use existing OER. Based on our study findings, we suggest both research and practical implications in terms of future OER research and design practices.

Research Implications

The study findings expand upon the research trend of accessibility and universal design for learning in OER. The findings demonstrate that existing research has adopted the concept of accessibility or UDL across various OER platforms in different ways. While research on Web-based information repositories or MOOCs primarily considers accessibility design for learners with disabilities (Iniesto et al., 2014; Laiola Guimarães et al., 2015), research on computing education (e.g., programming toolkits) mainly addresses the integration of UDL instructional practice principles with OER (Israel et al., 2015). A major reason for the different foci is the variety of OER platform characteristics. Both Web-based information repositories and MOOC environments consider better navigation paths and alternative interaction features for learners' information retrieval. However, a group of studies on UDL principles focus on exploring how to foster learners' participation through various representations (Hansen at al., 2016; Snodgrass et al., 2016). OER studies embracing UDL tend to highlight the design of instructional practices because they aim to promote learners' problem-solving skills via hands-on and self-regulated interactions with programming toolkits. This finding implies that OER implemented according to UDL principles consider learner engagement, whereas OER with accessibility address the usability of interaction options.

Furthermore, our synthesis results reveal the need for future research on OER-enabled pedagogy. OER-enabled pedagogy assumes that learners evaluate, modify, and create artifacts to deepen their learning experiences (Wiley & Hilton III, 2018). However, the sampled literature rarely discussed instructional practices related to OER-enabled pedagogy and, instead, focused on learners' re-creations and distributions through OER. Existing OER research emphasizes designing better accessibility for online information retrieval more than pedagogy. This finding suggests a discrepancy between increasing interest in OER-enabled pedagogy and current OER designs for learners with disabilities. Moreover, while existing OER research tends to focus on the evaluation of OER accessibility and usability, supporting the engagement of learners with disabilities in OER and OER-enabled pedagogy has received little attention.

A few of the studies in this review examined learners' manipulations in programming toolkits (Snodgrass et al., 2016; Koushik & Kane, 2019); however, most of the studies could not bridge the concept of constructionism through OER and open educational practices. Thus, further studies are essential to implement OER-enabled pedagogy for learners with disabilities. In particular, as OER-enabled pedagogy requires learners to attain high-order thinking and creative skills, additional supports, including scaffolding, should be considered. Future studies could design instructional supports for OER-enabled pedagogy that address the needs of learners with disabilities.

Design Implications

This literature synthesis demonstrates a number of design implications. First, our study reveals the importance of designing legitimized and collaborative activities for OER. We found that learners with disabilities tended to experience technical problems in managing their assistive technologies and significant difficulties when attempting highly complex learning tasks (e.g., programming). Such situations require more learning supports to provide scaffolding for learners with disabilities. A few studies in our review highlight examples of designing legitimized and collaborative activities that help learners with disabilities by facilitating learner–learner and learner–instructor interactions (Kane et al., 2018; Koushik & Kane, 2019). Informal small group activities in schools managed by teachers and peer tutors can effectively manage collaborative activities using OER.

Second, we conclude that it is necessary to train teachers in technology-integration skills to support learners with disabilities when using OER. Our study suggests that learner–instructor interactions were hindered due to instructors' unfamiliarity with the technology used. Teachers' difficulties in supporting learners with assistive technologies interrupted communications during exercises. Therefore, it is essential to consider teacher training that provides a skill set to handle assistive technologies for OER effectively.

Third, we found that OER research tends to consider personalized supports that enhance learners' ease with web navigation paths and consider individual special needs. However, such research rarely demonstrates whether and how OER-driven interventions that support learner interactions enhance learner outcomes. In other words, scholarly work on how OER help learners with disabilities experience deep learning by supporting different types of interactions are needed. In response to this need, further research should integrate various instructional design practices (e.g., knowledge type, sequencing, and content scoping) into learning supports for learners with disabilities across various OER cases.

Study Limitations

This study has a number of limitations. First, the literature synthesis did not include many experimental studies that investigate the effect of OER-driven interventions on key learning outcomes (e.g., learning achievement, problem-solving skills, and motivation). Thus, this scoping review could not extend the discussion on how different types of learner interactions across OER platforms boost learning outcomes. Future research is necessary to identify how specific interactions in OER can improve the achievement of learners with disabilities. Second, of the 30 articles included in our literature synthesis, 12 were from conference papers, and 13 researchers co-authored 11 of the selected articles. This indicates that OER research on learners with disabilities is still limited and less generalizable; as such, further research is necessary in this area. Third, due to the lack of relevant studies that corresponded to our scope, we could not explore and compare target learners' characteristics in each study. This limitation indicates that future qualitative studies should be considered to deeply explore how OER and their practices provide scaffolding for learners with specific types of disabilities.

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Appendix A

Coding Results

Number	Article	Research type	OER platform types	Interaction types	Description
1	Buehler et al. (2016)	Empirical	Makerspace	LI, LF	Study of the challenges of implementing makerspace activities for learners with disabilities. Qualitative notes included.
2	Bustamante et al. (2018)	Empirical	MOOC	LF	Implementation of teacher training on how to design accessible virtual courses in MOOC.
3	Calle-Jimenez et al. (2014)	Design and development	MOOC	LF, LC	Development and evaluation of a GeoMOOC with focus on accessibility.
4	Drake et al. (2015)	Empirical	MOOC	LL	Literature review on MOOC design decisions.
5	Hansen et al. (2016)	Empirical	Programming toolkit	LF	Experimental study to examine the results of differentiated instruction and UDL.
6	Iniesto et al. (2014)	Design and development	MOOC	LF	Discussion of strategies for improving accessibility in MOOCs.
7	Israel et al. (2015)	Empirical	Programming toolkit	LL, LI, LF, LC	Examination of the implementation of a UDL framework for learners with disabilities in computing education.
8	Kane et al. (2018)	Empirical	Programming toolkit	LL, LF	Development of an audio-programming game for blind and visually impaired learners.
9	Koushik and Kane (2019)	Empirical	Programming toolkit	LL, LF, LC	Qualitative study to explore the learning of learners with cognitive disabilities in computing education.
10	Laiola Guimarães and Britto Mattos (2015)	Empirical	MOOC	LL	Examination of how learners with intellectual disabilities learn through MOOCs.
11	Lee and Lee (2019)	Empirical	MOOC	LF	Development of a checklist for assessing the usability of educational applications for blind users.

12	Lin and Chang (2015)	Empirical	Programming toolkit	LF	Use of technology from a real-time feedback concept through external Webcam and Scratch 2.0 and investigation of results for learners with developmental disabilities.
13	Ludi and Spencer (2017)	Empirical	Programming toolkit	LI	Development of accessible block-based programming for blind learners and suggestions for consideration.
14	Meyer and Fourie (2016)	Conceptual	Makerspace	LF	Practical guidelines to establish a blend-able makerspace environment using UDL and ergonomics for learners with physical disabilities.
15	Moeller et al. (2015)	Conceptual	Makerspace	LF	Qualitative study to explore design features that makerspace facilities should address for learners with disabilities.
16	Moloo et al. (2018)	Empirical	MOOC	LL, LF, LC	Development and assessment of a new audio learning system in MOOCs.
17	Navarrete and Luján-Mora (2015a)	Design and development	Information repository	LF	Evaluation of the findability of resources in some important OER Websites.
18	Navarrete and Luján-Mora (2015b)	Design and development	Information repository	LF	Guidelines for the creation and release of accessible educational resources and applications.
19	Navarrete and Luján-Mora (2018)	Design and development	Information repository	LF	Development and implementation of an OER Website named OERfAll.
20	Navarrete and Luján-Mora (2016)	Design and development	Information repository	LF	Presentation of an OER Website designed for enhancing the user experience (UX) of learners with disabilities.

21	Nganji and Brayshaw (2014)	Design and development	MOOC	LF	Development of the ontology-driven disability-aware personalized e-learning system (ONTODAPS), which personalizes e-learning resources for disabled learners.
22	Paramasivam et al. (2017)	Empirical	Programming toolkit	LF	Demonstration of the effect of an end-user-programming tool.
23	Ratcliff and Anderson (2011)	Empirical	Programming toolkit	LF	Qualitative study on the implementation of a programming tool.
24	Ringland et al. (2016)	Empirical	Game	LL, LI, LF	Examination of how learners with autism spectrum disorder search for Minecraft community and practice sociality.
25	Ringland et al. (2017)	Empirical	Game	LL, LI, LF	Exploration of how designers and researchers learn by observing the youngest users' augmentation and mainstream of assistive technology.
26	Rodrigo (2014)	Conceptual	MOOC	LL, LF, LC	Discussion of specific strategies for accessible MOOCs for all learners.
27	Sevilla et al. (2007)	Empirical	Information repository	LF	Comparison between adapted and conventional MOOC Websites for learners with cognitive deficits.
28	Snodgrass et al. (2016)	Empirical	Programming toolkit	LL, LI, LF	Exploration of the development of critical thinking skills for learners with disabilities and instructional support by teachers.
29	Taylor (2018)	Empirical	Programming toolkit	LF	A case study to examine the potential for pre-kindergarten through 1st grade learners with intellectual disabilities learning programming skills.
30	Worsley et al. (2018)	Conceptual	Assistive technology	LF	Presentation of an exemplar of multimodal interfaces as tools for inclusive learning.

Note. LL = learner-learner interactions, LI = learner-instructor interactions, LF = learner-interface interactions, and LC = learner-content interactions.