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Editorial – Volume 24, Issue 3

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Welcome to our third issue of the year.

As you know, this year the use of Artificial Intelligence (AI) has dominated academic discussions around the globe. The editorial team at IRRODL is looking into a policy on generative AI (ChatGPT, Bard, etc.) use. However, in the meantime, authors must reference this as per APA7 guidelines. This does not include spelling and grammar checkers. On a lark, I wanted to know what a large language model might "think" about developing an AI policy. When prompted with "increased discussion around AI this year and how it should be handled for academic journal articles," ChatGPT responded with:

> It's great to hear that there's increased discussion around AI and its handling in academic journal articles. AI has been a rapidly evolving field with significant implications for various disciplines, and addressing its proper handling in scholarly publications is important for maintaining rigor, transparency, and ethical considerations. Developing an AI policy for academic journals involves creating guidelines and principles to address the use of artificial intelligence in scholarly research, publication, and peer review processes. Such a policy should aim to promote transparency, rigor, ethical considerations, and responsible use of AI technologies. (OpenAI, 2023).

Anyways, this issue is bursting with more than our usual number of excellent contributions. We start with **Akbulut**, **Saykılı**, **Öztürk**, and **Bozkurt** studying the limitations of relying solely on student perceptions in their paper "What If It's All an Illusion? To What Extent Can We Rely on Self-Reported Data in Open, Online, and Distance Education Systems?" To achieve more robust conclusions, they suggest other evidence like system and performance data should be considered in addition to just survey data. This research adds significant weight to the IRRODL policy of not accepting submissions describing teaching interventions or surveys on pedagogical approaches that make no reference to student achievement, performance, or retention. See: https://www.irrodl.org/index.php/irrodl/studentachievement

In the ensuing study, "A Systematic Review of Systematic Reviews on Open Educational Resources: An Analysis of the Legal and Technical Openness," the awareness of the importance of the technical openness and tools that might contribute to fostering users' engagement with OER, helping them to reuse, remix, and redistribute these resources according to their needs is raised by **Sousa**, **Pedro**, and **Santos**.

Our next contribution from **Kristiana**, **Prihatsanti**, **Simanjuntak**, and **Widayanti**, entitled

"Online Student Engagement: The Overview of HE in Indonesia," is a mixed-method study looking at learner engagement components – emotional attachment, participation, performance, and skills. Its effectiveness compared with in-person learning is considered.

While social media for professional learning is more commonly used by schoolteachers, in the next article, **Oddone** explores the real-life experiences of university educators in a series of case studies in "University Educators' Experience of Personal Learning Networks to Enhance Their Professional Knowledge."

Maultsaid and **Harrison** in "Can Open Pedagogy Encourage Care? Student Perspectives" provide thoughtful learner insights on this open educational approach that already embodies care as part of its process of co-creation of learning and knowledge.

In the following article, **Heiser** aimed to understand the effects of international research collaboration on three open universities, in "The Emergence of the Open Research University Through International Research Collaboration," by examining the relationship between national comparative universities through citation metrics between 2000 and 2022.

Through topic modeling analysis of news articles, **Lee**, **Kim**, **Sari**, and **Bozkurt** explore the dominant discourses on online distance education that emerged in South Korean society before, during, and after the COVID-19 pandemic in their paper entitled "Shifting Conversations on Online Distance Education in South Korean Society During the COVID-19 Pandemic: A Topic Modeling Analysis of News Articles."

In this next study, **Janfeshan**, **Sharhan**, and **Janfeshan** investigate if the use of blended learning (with mobile-assisted language learning) compared to the traditional method in their contribution "Effects of Using WhatsApp: Iranian Intermediate EFL Learners' Vocabulary Learning and Autonomy."

The benefits of higher education, including increased earnings, are well known, but what does this look like in the context of alternative learning pathways and access? In their submission "Who Gets the Highest Return to Distance Higher Education?" **Wang** and **Li** examine the differences of return to distance higher education at different income levels.

In the final reasearch article, "OXREF: Open XR for Education Framework," **Abeywardena** introduces a novel empirical framework that proposes a holistic solution to Extended Reality (XR) object creation, implementation, and deployment employing open educational resources, open educational practices, as well as free and open-source software tools and platforms.

Pulist then provides us with a first-rate book review of *(Open) Educational Resources Around the World: An International Comparison* edited by Marín, Peters, and Zawacki-Richter (EdTechBooks.org, 2022). The book delivers a solid overview of OER developments at different levels around the globe.

Finally, in our *Notes From the Field* section we have three contributions: In "Can Online Short Courses Foster Business Education for Sustainable Development?" **Dhakal** offers some foundational analysis and proposes this e-learning skill-building innovation. Next, **Durand** and **Balhasan**, in "An Example of Using Collaborative Online International Learning for Petroleum and Chemical Engineering Undergraduate Courses," describe and demonstrate a meaningful international and cross-disciplinary collaboration

experience. Then **Abbadi** and **Alaoui**, in "Distance Mathematics Teaching and Academic Performance in Morocco," offer an in-depth study on distance mathematics education examining both content and professional practices.

This issue is packed full and there is certainly something there for every interest.

We hope you enjoy—happy reading!

Reference

OpenAI. (2023). ChatGPT (Aug 18 version) [Large language model]. https://chat.openai.com/chat

What If It's All an Illusion? To What Extent Can We Rely on Self-Reported Data in Open, Online, and Distance Education Systems?

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Abstract

Online surveys are widely used in social science research as well as in empirical studies of open, online, and distance education. However, students' responses are likely to be at odds with their actual behavior. In this context, we examined the discrepancies between self-reported use and actual use (i.e., learning analytics data) among 20,646 students in an open, online, and distance education system. The ratio of consistent responses to each of the 11 questions ranged from 43% to 70%, and the actual access to learning resources was significantly lower than self-reported use. In other words, students over-reported their use of learning resources. Females were more likely to be consistent in their responses. Frequency of visits to the open, online, and distance education system, grade point average, self-reported satisfaction, and age were positively correlated with consistency; students' current semester was negatively correlated with consistency. Although consistency was not maintained between actual use and self-reported use, consistency was maintained between some of the self-report questionnaires (i.e., use vs. satisfaction). The findings suggested that system and performance data should be considered in addition to self-reported data in order to draw more robust conclusions about the accountability of open, online, and distance education systems.

Keywords: open and distance learning, higher education, self-report, inconsistent responding, learning analytics

Introduction

Surveys are one of the most convenient ways to collect data in social science research. Self-reported learner reflections are considered essential for studying most psychological processes related to human learning, such as motivation, emotions, and metacognition (Pekrun, 2020). They are also used to evaluate the accountability efforts of educational institutions or to inform further policy decisions.

With the increase in Internet access worldwide, conducting online surveys has become one of the most preferred ways to collect data from large populations in a very short period of time. Several factors make online surveys a practical research tool, including the ease of data collection and entry (Evans & Mathur, 2005), the elimination of lack of motivation and low response rates, especially for confidential questions (Gregori & Baltar, 2013), and the ability to expand the geographical scope of the target population and study hard-to-reach individuals (Baltar & Brunet, 2012). Due to the intensive use of technology in the delivery of educational content, open online and distance education processes are often studied through online surveys.

While concerns have often been raised about the decline in the amount of robust educational intervention research (Hsieh et al., 2005; Reeves & Lin, 2020; Ross & Morrison, 2008), systematic reviews of educational technology and distance learning show that researchers often adopt survey design and use questionnaires or scales as a data collection tool and then use the results for descriptive or correlational analyses (Bozkurt et al., 2015; Kara Aydemir & Can, 2019; Küçük et al., 2013; Zhu et al., 2020) with an heavy reliance on positivist paradigm (Kara Aydemir & Can, 2019; Mishra et al., 2009). It is certainly tempting to reach many participants with little effort; however, in some cases, the results of survey designs do not necessarily reflect actual situations. While constructing reliable and valid scales is considered central to robust measurement practices, respondents themselves can be a potential source of measurement error. That is, they may provide inconsistent responses (Castro, 2013), exert insufficient effort in responding (Huang et al., 2015), or alter their responses in socially desirable ways (Chesney & Penny, 2013), all of which result in low-quality data that can bias further hypothesis testing steps (DeSimone & Harms, 2018). In many cases, the proportion of inattentive participants or inconsistent responses within a dataset can be negligible, which does not change the inferences or conclusions of the study (Iaconelli & Wolters, 2020; Schneider et al., 2018). However, there are also cases where pronounced effects on reliability have been found (Chesney & Penny, 2013; Maniaci & Rogge, 2014).

According to Albert Bandura's social cognitive theory, the dynamic and reciprocal interaction of personal factors, environmental factors, and the nature of behavior can predict human learning and development (Bandura, 1977). For example, lack of motivation or effort on the part of participants may lead them to simply provide satisfactory answers rather than answering all survey questions optimally, as this may require considerable cognitive effort (Krosnick, 1991). The primacy and recency of self-report questions (Chen, 2010) or participants' anchoring and adjusting behaviors (Zhao & Linderholm, 2008) may further explain response inconsistencies. More specifically, participants' initial responses to self-report measures may serve as anchors for their subsequent responses, as their memory for the context may be flawed (Chen, 2010). Such an explanation related to poor learner reflections has been observed in the learning analytics literature as well (Zhou & Winne, 2012). Another explanation for inconsistency may be related to the issue of ideal self-presentation. That is, respondents may strategically alter their self-presentation during a psychological assessment in order to present themselves more favorably relative to social norms (Grieve & Elliott, 2013).

2

Differences between the extent and impact of response inconsistency may arise depending on the context in which the study is conducted, the characteristics of the target audience, and the sensitivity of the questions asked. For example, almost half of the participants (46%) responded inconsistently to questions about personal information such as age, gender, and educational status in an online gaming setting (Akbulut, 2015) while the degree of insufficient effort responses varied between 12% and 16% in an educational setting (Iaconelli & Wolters, 2020). In this regard, formal data collection environments may be less prone to low quality data than anonymous online environments. In terms of participants' personal characteristics, a recent empirical study suggested that respondents assigned to the careless responder class are more likely to be male, younger, unmarried, college-educated, and have higher incomes (Schneider et al., 2018). In other studies, personal interest in the research topic (Keusch, 2013) or higher academic and cognitive ability (Rosen et al., 2017) predicted better response quality. The sensitivity of the research topic has been highlighted in several papers. For example, although students gave candid responses about their course-taking patterns, their responses did not adequately reflect the truth about sensitive topics (Rosen et al., 2017). An interaction between gender and topic sensitivity was also observed in terms of the extent of inconsistent responses. Male participants, for instance, tend to underreport physical problems in order not to appear weak (Yörük Açıkel et al., 2018), whereas female participants chose to underreport their behavior when the topic is socially sensitive (Akbulut et al., 2017; Dönmez & Akbulut, 2016).

There are several methods to address low quality data resulting from inconsistent or careless responses (DeSimone et al., 2015; DeSimone & Harms, 2018). For example, direct assessment of response quality can be achieved by including validation items in a survey. Self-reported effort questions (e.g., I read all items carefully), sham items (e.g., I was born in 1979), or instructed items (e.g., Please mark *strongly disagree* for this item) can be used to weed out inconsistent responders; however, these are easily detected by participants who read all items and intentionally provide false responses. On the other hand, unobtrusive methods that are less likely to be detected by participants can be used during survey administration. That is, instead of modifying the survey with validation questions before the study, the response time or the number of consecutive and identical responses can be checked. However, determining the cutoff response time or number of consecutive identical responses to eliminate the flawed data is a tedious process (DeSimone et al., 2015). Finally, statistical methods can be implemented to deal with low quality data, such as checking for outliers or individual consistency across synonymous questions.

Discrepancies or small associations between student self-reports and objective data derived from learning management systems have received recent attention (Gasevic et al., 2017). While the use of self-reports has been the dominant approach to addressing student engagement in instructional settings (Azevedo, 2015), students may be inaccurate in calibrating their self-reported and actual behaviors in an online learning environment, and may tend to overestimate their behaviors (Winne & Jamieson-Noel, 2002). In addition to the construct of careless responding discussed above, such a discrepancy may further result from poor learner reflection or poorly reconstructed memories, such that learners' behavioral indicators in a learning system may be less biased than self-reported reflections (Zhou & Winne, 2012). Such findings have further led scholars to triangulate multiple methods to capture authentic learning processes (Azevedo, 2015; Ellis et al., 2017).

There is a tendency to benefit from learning analytic approaches in higher education in general and in open, online, and distance education in particular (Pelletier et al., 2021). In response to the widespread use of learning analytics and multiple data sources, some scholars are still cautious (Selwyn, 2020) and

have suggested asking further questions about the nature of what is really being measured, why it is really useful, and how such data relate to the learning experience (Wilson et al., 2017). Given the wide range of arguments about the reliability of self-reported data and the promise of learning analytics, we aimed to explore the alignment between self-reported and system-generated data by contextualizing the current study in an open, online, and distance education system where learning was available at scale and such data sources influence decision making in multiple dimensions.

In short, we used an unobtrusive method to identify inconsistencies between different sources of learner data in a formal open, online, and distance education system. That is, rather than adding validation items to the self-report measures, we examined response consistency by comparing different sources of self-report and learning management system (LMS) data. Based on the aforementioned literature, we hypothesized that learners' perceived intentions and actual behaviors may differ, such that their self-reported data may differ from the objective data, likely due to poor learner reflection or poorly reconstructed memories (Zhou & Winne, 2012). However, we expected that the current formal educational environment could be less prone to low-quality data than non-formal online environments such as online gaming sites (e.g., Akbulut, 2015). In line with social cognitive theory, we further hypothesized that personal and environmental factors may have played a role in the degree of response inconsistency. In this regard, we expected several variables such as participants' seniority, academic ability, gender, and satisfaction with the learning system to predict their response patterns. Finally, we hypothesized that participants' poor reflection of their actual behaviors combined with consistency-seeking needs may have led to a certain level of consistency across multiple self-report measures, in line with the concepts of anchoring and adjusting discussed above (Zhao & Linderholm, 2008). In accordance with the above literature and current hypotheses, the following research questions are investigated:

1. How similar are self-reported and LMS data?

2. What are the predictors of inconsistency between self-reported and actual use?

3. Do different sources of self-reported data (e.g., learner satisfaction, preference, and usage) support each other?

Method

Research Context

The research was conducted in an open, online, and distance education university with over two million students worldwide. The Open Education System (OES) consisted of three degree-granting colleges: The College of Open Education, The College of Economics, and The College of Business. These colleges offered a total of 60 associate or undergraduate degrees delivered entirely through open and distance learning. Students accessed courses and learning resources through an LMS. The pedagogy was primarily self-paced, while some courses include optional weekly synchronous videoconferencing sessions (i.e., live lectures). The OES allowed learners to study the learning resources online at their own time and pace, but required them to take proctored face-to-face exams to determine learner success. Applied courses within the OES also incorporated other assessment strategies such as project work. Following a multimedia approach to increase accessibility and flexibility in the learning process, a wide range of multimedia learning resources were provided online, including course books (PDF and

MP3), chapter summaries (PDF and MP3), live lectures, and practice tests. The practice tests also came in a variety of forms, including open-ended questions with extended answers, multiple-choice tests with short and extended answers, practice exams, end-of-chapter exercises, and previous semester's exam questions.

Data Collection and Cleaning

Ethics approval was granted by the institutional review board of the university. The data, then, were collected from different sources: the LMS database, satisfaction and preference questionnaires, and student information system (SIS) data for learner demographics. Learner access to resources was derived from the LMS learning analytics database. The data for each learning resource indicated whether an individual had access to the resource and the frequency of their access over the course of the semester. Self-reported data were collected for two weeks toward the end of the semester. An announcement was made on the LMS homepage, and voluntary participants who responded to the surveys were included in the current dataset.

Satisfaction and preference data came from short questionnaires. The first was a 15-item satisfaction scale developed by Open Education faculty members and used for formal and institutional research. Items were created to address student satisfaction with the open, online, and distance education system on a 5-point Likert scale ranging from 1 (*very dissatisfied*) to 5 (*very satisfied*). Exploratory factor analysis on the current dataset using maximum likelihood extraction revealed that the single-factor structure of the scale explained 77.73% of the total variance, with factor loads ranging from .84 to .92 (Cronbach's alpha = .98).

In the second questionnaire, satisfaction with each of the 11 learning resources was measured with a single 5-point Likert-type question that included options such as: *This learning resource was not available in my courses* (1), *This learning resource was available but I did not use it* (2), *I used the resource but I am not satisfied* (3), *I used the resource and I am satisfied* (4), and *I used the resource and I am very satisfied* (5). This question is regularly used in institutional reports to address student usage and satisfaction.

In the third questionnaire, students were asked to select three of the 11 learning resources that they preferred the most, so that the preference score pertaining to each learning material ranged between 0 and 3. This question was deliberately used by the current research team to see the relationships between usage, satisfaction, and preference. Finally, the SIS database provided us with learner demographics such as gender, age, GPA, and current semester (i.e., 1st through 8th semesters).

Data from these resources were then combined based on unique user IDs. Duplicate responses from the same ID (if any) were removed and the most recent responses were retained. At the end of the data cleaning process, data from 20,646 students were used in the current analyses. Participants ranged in age from 17 to 75 with a mean of 32.22 (*SD*: 10.6). The average number of courses taken by participants ranged from 1 to 12, with a mean of 6.82 (*SD*: 2.11). Their semesters ranged from 1 to 8; but almost 40% of the volunteers were in their first year. The gender distribution of the participants was similar (males, 50.6%; females, 49.4%).

To identify inconsistencies between self-reported satisfaction and actual use, the following criteria were used to cross-reference the various data sources:

- IF the student response was *This learning resource was not available in my courses* BUT there was access to the learning resource, THEN an inconsistency was coded.

- IF the student response was *This learning resource was not available in my courses* AND there was no access to the learning resource, THEN consistency was coded.

- IF the student response was *This resource was available but I did not use it* BUT there was access to the resource, THEN an inconsistency was coded.

- IF the student response was *This resource was available but I did not use it* AND there was no access to the resource in question, THEN consistency was coded.

- IF the students reported usage and satisfaction/dissatisfaction (i.e., *I used* and *I am satisfied/dissatisfied*) BUT there was no access to the learning resource, THEN inconsistency was coded.

- IF the students reported usage and satisfaction/dissatisfaction AND there was access to the learning resource, THEN consistency was coded.

Accordingly, the inconsistencies between the self-reported satisfaction questionnaires and the learning analytics were determined for each of the 11 learning resources. It was also possible to calculate how many consistent (and inconsistent) answers each participant gave.

Data Analysis

Descriptive statistics were used to present self-reported and actual use, proportion of consistent responses, and preference rates. Self-reported and actual use were compared using a paired t-test. Correlations between preference rates and actual use frequencies were presented. Participants' consistency rates were presented using descriptive statistics, and predictors of consistency were examined using correlations and multiple regression. Satisfaction of actual users and non-users was compared using independent t-tests. Finally, different sources of self-reported satisfaction were investigated with further t-tests. Parametric test assumptions (e.g., normality) were checked before each analysis.

Results

Descriptive statistics of self-reported versus actual usage are summarized in Table 1. A comparison using a paired *t*-test indicated that actual usage for each of the eleven learning resources was significantly lower than self-reported usage, with a large effect size, $t(10) = 4.650$, $p < .001$, $\eta^2 = .684$. That is, students seemed to overreport their use of the learning resources. Preference was calculated by asking students to select their three favorite materials (one point each) across eleven learning resources, and the correlation between their total preference scores and their actual usage is shown in Table 1. All correlations were significant at the .001 level; however, this was likely due to the large sample size, as the correlation coefficients were quite small.

Table 1

Statistics on the Use of Learning Resources

Learning resource	Self-reported usage (%)	Actual access (%)	Access frequency	Consistent response (%)	Preference	Preference and actual use correlation (*r*)
Chapter summary (PDF)	76.0	65.8	19.66	66.3	0.56	.24*
Previous exam questions	76.0	75.3	14.04	69.5	0.39	.15*
Multiple choice questions with extended solutions	73.7	53.9	5.75	60.1	0.28	.14*
Practice exams (midterms/finals)	70.6	55.6	3.72	61.2	0.28	.2*
Open-ended questions (Q&A; PDF)	66.9	43.7	3.15	56.7	0.17	.26*
End-of-chapter exercises (multiple choice)	63.4	50.3	5.83	59.3	0.09	.26*
Coursebook (PDF)	60.3	54.0	3.33	58.1	0.47	.19*
Multiple choice questions with answer key	59.9	7.0	0.41	43.0	0.09	.07*
Audio chapter summary	43.1	11.0	0.35	58.4	0.09	.11*
Live lectures	37.0	1.7	0.05	64.1	0.15	.16*
Audio coursebook	30.4	10.5	0.24	67.9	0.05	.13*

Note. n = 20,646 (self-report), 18,233 (learning analytics).

* Correlations significant at the .001 level.

As shown in Table 1, the percentage of consistent responses was also calculated for each learning resource and ranged from 43% to 69.5%. If one chose to eliminate all inconsistent responses across learning resources listwise, the remaining data would look quite limited. Specifically, the number of students whose self-reported data were consistent with actual access data across all learning resources was 394 (2.2%). Table 2 shows the number of consistent responses across 11 learning resources.

Table 2

Consistent Responses Across 11 Learning Resources

Number of consistent responses	*f*	%	Cumulative %
0	126	0.7	0.7
1	397	2.2	2.9
2	647	3.5	6.4
3	936	5.1	11.6

4	1,335	7.3	18.9
5	1,793	9.8	28.7
6	2,567	14.1	42.8
7	3,018	16.6	59.3
8	3,084	16.9	76.3
9	2,531	13.9	90.1
10	1,405	7.7	97.8
11	394	2.2	100.0
Total	18,233	100.0	

The number of consistent responses per student ranged from 0 to 11 (M = 6.65, SD = 2.38) with a relatively normal distribution (skewness = -0.51; kurtosis = -0.26). A gender comparison revealed that females (M = 6.81; SD = 2.27) were more consistent than males (M = 6.47; SD = 2.48) with a statistically significant difference but with a small effect size, t(18,221) = 9.73, p < .001, $\eta2$ = .005. Student consistency was positively correlated with the number of visits to the LMS (r = .146; p < .001), GPA (r = .097; p<.001), student satisfaction (r = .02; p < .006), and age (r = .023; p < .002), while it was negatively correlated with students' current semester (r = -.072; p < .001). However, these variables explained only 4% of the total variance in response consistency, R = .201; R^2 = .04, F(6; 8,475) = 59.18, p < .001. Model coefficients and t-values are shown in Table 3. It should be noted that age was not a statistically significant predictor when entered into the model with the other predictors in the current study.

Table 3

Predictors of Inconsistency

	Unstandardized coefficient		Standardized coefficient	t	p
Predictors in the model	B	Std. error	Beta		
(Constant)	6.371	0.158		40.278	<.001
GPA	0.296	0.036	0.092	8.324	<.001
Age	0.001	0.003	0.003	0.244	.807
Semester	-0.073	0.012	-0.064	-5.888	<.001
Number of visits to the system	0.012	0.001	0.120	10.855	<.001
Gender	-0.425	0.053	-0.088	-7.982	<.001
Self-reported satisfaction	0.082	0.025	0.035	3.260	.001

Note. Dependent variable: consistency.

Learning analytics data and self-reported satisfaction scores were also used to compare the average satisfaction scores of users who actually visited a particular learning resource with the average satisfaction scores of non-users (who never visited a particular learning resource). With the exception of PDF and audio coursebooks, the satisfaction scores of users were slightly higher than those of non-

users, as summarized in Table 4. However, the means of both groups were already high, as indicated by a negatively skewed and leptokurtic distribution (skewness = -1.21; kurtosis = 1.05). In addition, the effect sizes associated with these comparisons were very small. Accordingly, the number of visits to each learning resource did not show substantial correlations with the average satisfaction scores. More specifically, the actual use of each learning resource could explain a trivial amount of the variance in satisfaction scores, — $R = .08$; $R^2 = .007$; $F(11; 18,221) = 11.47$; $p < .001$. Preference rates pertaining to each learning resource and satisfaction scores were not substantially related either, — $R = .14$; $R^2 = .02$; $F(11; 20,634) = 38.67$; $p < .001$.

Table 4

Satisfaction of Users and Non-Users

Learning resource	Usage	n	M	SD	t	df	p	η^2
Chapter summary (PDF)	No	6,235	3.98	1.02	-4.88	18,231	<.001	.001
	Yes	11,998	4.05	0.97				
Previous exam questions	No	4,510	3.97	1.02	-4.53	18,231	<.001	.001
	Yes	13,723	4.04	0.97				
Multiple choice questions with extended solutions	No	8,411	3.96	1.02	-7.79	18,231	<.001	.003
	Yes	9,822	4.08	0.95				
Practice exams (midterms/finals)	No	8,087	3.98	1.01	-6.01	18,231	<.001	.002
	Yes	10,146	4.06	0.96				
Open-ended questions (Q&A; PDF)	No	10,263	3.97	1.02	-9.29	18,231	<.001	.005
	Yes	7,970	4.10	0.93				
End-of-chapter exercises (multiple choice)	No	9,054	3.97	1.01	-7.02	18,231	<.001	.003
	Yes	9,179	4.08	0.96				
Coursebook (PDF)	No	8,388	4.03	0.99	0.99	18,231	.323	<.001
	Yes	9,845	4.02	0.97				
Multiple choice questions with answer key	No	16,952	4.02	0.99	-3.09	18,231	.002	.001
	Yes	1,281	4.11	0.90				
Audio chapter summary	No	16,226	4.02	0.99	-3.72	18,231	<.001	.001
	Yes	2,007	4.10	0.91				
Live lectures	No	17,917	4.02	0.99	-3.67	18,231	<.001	.001
	Yes	316	4.23	0.82				
Audio coursebook	No	16,325	4.03	0.99	0.45	18,231	.655	<.001
	Yes	1,908	4.02	0.96				

Through the aforementioned analyses, we suggested an inconsistency between the objective data derived from the open, online, and distance education system and the subjective data (i.e., self-reports).

In addition, it was not possible to maintain a substantial relationship between the satisfaction, preference and the actual use. However, the validation of the 15-item satisfaction scale with self-reported usage was somewhat successful. Specifically, students who reported use and satisfaction (i.e., *I used the resource and I am satisfied/very satisfied*) were compared with those who reported use but dissatisfaction (i.e., *I used the resource but I am not satisfied*). Almost all comparisons resulted in large effect sizes, as summarized in Table 5. That is, two separate self-report measures of satisfaction were somewhat consistent.

Table 5

Consistency Between the Two Separate Measures of Satisfaction

Learning resource	I am	n	M	SD	t	df	P	η^2
Chapter summary (PDF)	Dissatisfied	1,788	2.93	1.19	-56.82	15,686	<.001	.171
	Satisfied	13,900	4.20	0.84				
Previous exam questions	Dissatisfied	1,142	2.84	1.24	-46.58	15,696	<.001	.121
	Satisfied	14,556	4.15	0.88				
Multiple choice questions with extended solutions	Dissatisfied	1,266	2.80	1.21	-52.27	15,211	<.001	.152
	Satisfied	13,947	4.18	0.86				
Practice exams (midterms/finals)	Dissatisfied	1,328	2.89	1.21	-49.38	14,566	<.001	.143
	Satisfied	13,240	4.18	0.87				
Open-ended questions (Q&A; PDF)	Dissatisfied	1,494	2.90	1.22	-52.67	13,803	<.001	.167
	Satisfied	12,311	4.20	0.85				
End-of-chapter exercises (multiple choice)	Dissatisfied	1,487	2.94	1.22	-50.66	13,090	<.001	.164
	Satisfied	11,605	4.21	0.86				
Coursebook (PDF)	Dissatisfied	2,180	3.04	1.17	-53.24	12,451	<.001	.185
	Satisfied	10,273	4.20	0.87				
Multiple choice questions with answer key	Dissatisfied	1,310	2.93	1.24	-47.62	12,363	<.001	.155
	Satisfied	11,055	4.20	0.87				
Audio chapter summary	Dissatisfied	1,676	3.00	1.23	-51.06	8,896	<.001	.227
	Satisfied	7,222	4.29	0.84				
Live lectures	Dissatisfied	1,416	2.97	1.24	-47.44	7,627	<.001	.228
	Satisfied	6,213	4.29	0.87				
Audio coursebook	Dissatisfied	1,531	3.02	1.25	-44.3	6,266	< .001	.238
	Satisfied	4,737	4.31	0.89				

Discussion

The current research signaled a discrepancy between objective student behavior (i.e., tracking data through digital footprints) derived from the learning management system and subjective data (i.e., self-reports), which supports the findings of empirical studies in the literature (Gasevic et al., 2017; Zhou & Winne, 2012). More specifically, students overreported their use. This could be due to either insufficient motivation to respond, intentional falsification (i.e., faking), or poor recall of learning experiences by students. While the source of such discrepancies should be explored through further research, scholars may choose to use a combination of multiple methods to better reflect the processes used during learning (Azevedo, 2015; Ellis et al., 2017). Learner metacognition may be specifically considered as a covariate when making decisions about inconsistency, as either poor learner reflection or poorly reconstructed memories may have resulted in low-quality data (Zhou & Winne, 2012).

Inconsistency was observed even though the content was not culturally sensitive and even though the setting was a formal learning environment. Furthermore, learners' gender, age (Schneider et al., 2018), and their academic ability (Rosen et al., 2017) predicted consistency, as expected. While the degree of consistency varied across learning materials, both actual use and learner satisfaction were associated with the degree of consistency. In this regard, when learning materials are more satisfying and useful, there seems to be a greater match between what learners say and what the system data provides. However, we do not know about the perceived quality and usefulness of the learning resources as rated by the learners. In this regard, further research could include the perceived usefulness and quality of learning materials as variables of interest.

Students' current semester was negatively correlated with consistency. We speculated that because students were asked to respond to multiple online surveys over the course of their undergraduate studies, survey fatigue may have led to an overdose of research participation and thus higher levels of careless responding. While there were slight differences between actual users and non-users in terms of satisfaction, the overall satisfaction average was very high. In addition, the number of visits to each learning resource was not strongly correlated with satisfaction scores. That is, even learners who did not use the system were satisfied with it. This was considered quite problematic, since it may not be right to make policy decisions based on students' judgments about a system they do not actually use. Similarly, students' preferences and actual use were correlated due to the large sample size, but the coefficients were quite small. Thus, their self-reported preferences did not show a substantial relationship with their actual usage patterns. Several empirical studies have often used student satisfaction (e.g., Alqurashi, 2019; So & Brush, 2008; Wu et al., 2010), intention to use the online learning systems (e.g., Chao, 2019), or learner preferences (e.g., Rhode, 2009; Watson et al., 2017) to evaluate online learning environments. However, the current findings suggested that objective system or performance data should be considered in addition to self-reports in order to draw more robust implications regarding the accountability of online learning systems. In addition, current LMS data is primarily limited to the presence and frequency of access to specific learning resources. Additional objective data sources and variables related to online learning experiences need to be integrated to support or refute current hypotheses.

While we were able to identify some of the predictors of inconsistencies between self-report and LMS data, we were only able to explain a very small percentage of the variability. In this regard, alternative variables from the field of learning analytics can be integrated. On the other hand, the consistency between two sources of subjective data addressing the same construct (i.e., learner satisfaction) was

strong. While the inclusion of such validation items and scales in the research design has been considered as a method to directly assess response quality (DeSimone & Harms, 2018), this was not the case between self-reported and LMS data. That is, our findings suggested that two self-reported data sources may sometimes be compatible with each other, but both may be at odds with the actual usage data. In this regard, unobtrusive methods may be more effective at eliminating low-quality data than integrating validation items. To test this speculation, future researchers could compare the effects of obtrusive and unobtrusive validation methods on multiple groups. In addition, we did not record participants' survey response times, which may be considered as a covariate in further studies.

A critical implication of the current study is to consider the unreliability of self-report data, which is commonly used in educational research to inform policy decisions. In addition to using alternative data collection tools, we need to look for more objective and direct measures. We have tended to focus a great deal on the reliability of measures in general, and the internal consistency of items in particular, to the detriment of validity (Steger et al., 2022). The survey itself was not the only source of measurement error observed in the current study. Participants can also be a critical source of erroneous data. In addition to attitudes and reflections, which may be over- or underreported depending on the sensitivity of the issue, we need to use actual performance data as well. For example, while years of self-report research have emphasized that men have an advantage in technical competence, systematic analyses using performance-based measures have found that the opposite may be true (Borgonovi et al., 2023; Siddiq & Scherer, 2019). These limitations, combined with the implications of the current study, support calls from eminent scholars for robust intervention research that should include sound measures and variables to address relevant instructional technology problems (Hsieh et al., 2005; Reeves & Lin, 2020; Ross & Morrison, 2008). These findings also suggested that strategic planning decisions that guide short-, medium-, and long-term goals can be based not only on self-reported data, but also on learning analytics data available in most LMSs. We recognize the potential of the current findings to unsettle the social science community at large, where thousands of self-report studies are conducted each year. On the other hand, if we do not integrate alternative and more objective data sources into more robust designs, it is likely that the replication crisis will continue.

Concluding Details

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A Systematic Review of Systematic Reviews on Open Educational Resources: An Analysis of the Legal and Technical Openness

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Abstract

Almost all open educational resources (OER) definitions encompass key concepts such as the 5R activities and open licenses. However, little attention is given to the technical aspects and tools that allow the user to interact with these resources. This study aims to answer five research questions regarding (a) 5R activities, (b) open licenses and intellectual property, (c) technical aspects, (d) tools for developing OER, and (e) the topic of sustainability. To answer these questions, a systematic review of systematic reviews on OER was conducted following the reporting checklist of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Sixteen studies were eligible and included in this review. The main findings suggest that although most studies did not mention the term 5R exactly, they mentioned related terms, such as *share* and *adaptation*. There was also a tendency toward focusing on more legal issues than technical aspects. Besides, most of the studies that mentioned tools discussed them as platforms to access OER, not exactly tools that encourage users to develop or adapt resources in an easy way. In relation to sustainability, several studies highlighted the relevance of developing sustainable OER models, but only a few suggested approaches to sustain an OER project. Therefore, with this article, we hope to raise awareness of the importance of the technical openness and tools that might contribute to fostering users' engagement with the OER, helping them to act as producers and contributors rather than mere passive receivers.

Keywords: open educational resources, legal openness, technical openness, systematic review, PRISMA

Introduction

With the advent of the Internet and information technologies, a vast number of digital resources have been created and made available at little or no cost. However, not all these resources available on the Internet are open and can be reused, modified, and re-shared. Most of them are released without clear license terms and are, automatically, protected by copyright, not being allowed to be copied without the author's permission. On the other hand, resources that are made available under open licenses or in the public domain and enable legal use, adaptation, and redistribution are called open educational resources (OER).

In 2002, when the term OER was first coined by UNESCO in the Forum on the Impact of Open Courseware for Higher Education in Developing Countries, the group defined OER as "the open provision of educational resources, enabled by information and communication technologies, for consultation, use, and adaptation by a community of users for non-commercial purposes" (UNESCO, 2002, p. 24), emphasizing that OER is "a universal educational resource available for the whole of humanity" (UNESCO, 2002, p. 28).

Similarly, Wiley (2014) claimed that content is open not only when it is available to be used in other contexts, but also when it gives everyone permission to reuse it in different ways, known as the 5R, which means retain, reuse, revise, remix, and redistribute. *Retaining* is the right to make, own, and control copies of the content, such as downloading, duplicating, storing, or managing a resource. *Reusing* is the right to use the content in a wide range of ways, in a class, in a study group, on a website, in a video, and so forth. *Revising* is the right to adapt, adjust, modify, or alter the content itself as, for example, translating it into another language. *Remixing* is the right to combine the original or revised content with other material to create something new. Finally, *redistributing* is the right to share copies of the original content, its revisions, or its remixes with others.

In 2019, UNESCO updated this definition, saying that OER is "learning, teaching and research materials in any format and medium that reside in the public domain or are under copyright that have been released under an open license, that permit no-cost access, re-use, re-purpose, adaptation and redistribution by others" (p. 5). Creative Commons (n.d., 2020) defined OER as "teaching, learning, and research materials that are either in the public domain or licensed in a manner that provides everyone with free and perpetual permission to engage in the 5R activities." Most of the OER definitions highlight the 5R and the open licenses in their concept, but only a few consider the technical infrastructure and tools necessary for the creation, revising, and sharing of content.

If people are given legal permissions with open licenses to interact with OER through the 5R activities, they should also be given technical tools to unlock the material so that they can revise and remix it according to their needs (Wiley, 2014). The ALMS analysis is a framework developed by Wiley (2014) and Hilton et al. (2010) that puts emphasis on the OER's technical aspects. ALMS is an acronym for access to editing tools, level of expertise required to revise or remix, meaningfully editable, and source-file access.

Access to editing tools is known as access to software that enables users to edit the resource, not only open and visualize it. There is also the aspect related to the *level of expertise required to revise or remix* and, thus, the tools to develop the OER must be simple and easy to use. The OER must also be *meaningfully editable*, meaning that it must be shared in such a format that enables anyone to edit it. A source file must be accessible which means the file that the web developer edits and works with, for

example, is the same one that the web browser displays and the user interacts with (e.g., an HTML file). Consequently, modifying it must be uncomplicated (Hilton et al., 2010; Wiley, 2014). Applying open licenses which allow users to engage with materials in the 5R activities as well as applying the ALMS analysis framework enable OER creators to maximize the openness of the materials they produce (Hilton et al., 2010).

Hylén et al. (2007) defined OER as "digitized materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research" (p. 10). This definition includes not only the implementation resources, responsible for the intellectual property licenses which promote the openness of materials, and the content itself, such as the courses, modules or learning objects, and tools, but also the software used to support the development, usage, and sharing of content.

Although this definition encompasses the tools necessary for the creation and distribution of OER, the William and Flora Hewlett Foundation (2018) has recognized that there is a need for a better technical infrastructure to support OER. They have highlighted recurring topics recommended by the OER community as, for instance, the desire for better OER authoring tools, tools to manage the revision and adaptation of OER, and tools to better handle the import and export of OER across different file formats and platforms (Levin, 2017).

The culture of openness must extend far beyond the simple replacement of a textbook with an open textbook and the expansion of access to free or more affordable learning materials. Although cost savings are considered a potential benefit, OER adoption needs to consider other technical aspects and tools that involve students in the 5R activities and, thus, foster student engagement with the OER, helping them to act as producers and contributors rather than passive receivers in their learning process. According to Axe et al. (2020), in contexts where students create resources collaboratively, the platforms used remained traditional or are not mentioned at all. The technical issues were also considered one of the biggest barriers when adopting OER in an educational context by Dichev et al. (2011). They cited that availability and open access are important factors, but there is a need for supportive environments that foster discoverability and sharing of content, associated with tools for adaptation and redistribution.

Therefore, considering the OER definitions, which have focused more on legal openness and open licenses, neglecting the technical aspects, such as the tools and skills necessary to revise, remix, and redistribute the resource, this systematic review of OER systematic reviews aims at analyzing how the 5R activities and the open and technical aspects are addressed in the systematic reviews and identifying tools and practical examples that are beyond the simple use of OER. The research questions that guide this systematic review are:

1. How are the 5R activities addressed in the systematic reviews on OER?

2. How often are the licenses or intellectual property issues mentioned?

3. How often are the technical aspects discussed?

4. Which open tools are pointed out in the reviews?

5. How relevant is the topic of sustainability in these systematic reviews?

Method

This systematic review was conducted according to the reporting checklist of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Liberati et al., 2009) which consists of four phases: identification, screening, eligibility, and inclusion. In the first phase (identification), we began the process of identification of eligible studies by searching pre-selected terms in the Scopus database. The choice of Scopus lies in the fact that it is one of the largest abstract and citation databases of peer-reviewed literature in this field.

The search was conducted based on the title, abstract, and keywords of articles, using the following search terms: *open educational resource, open educational resources, OER, OERs, review*, and *reviews*. The reason for searching "review" and not "systematic review" was to avoid missing systematic literature reviews that did not use the term "systematic" in their titles, abstracts, or keywords and, therefore, expanding the results. The data collection was conducted on November 5, 2021, and this round of search yielded 1,023 results.

To maintain the quality and feasibility of the present analysis, a filtering process was performed, using the year of publication (2012–2021), language (English), and publication state (final), and 784 articles were retained. As many of the titles referred to OER as *oxygen evolution reaction* and not *open educational resources*, the keywords were filtered, limiting them to those related to education, learning, and teaching, resulting in the selection of 343 articles. The title, abstract, keywords, year, and authors of the identified records were exported to a Microsoft Excel spreadsheet to be screened by an individual reviewer.

In the second phase (screening), the titles of all articles were carefully screened to identify those still related to chemistry and oxygen evolution reaction, and 179 articles were excluded (out of 343). Then, 164 abstracts were read to determine their eligibility, and 56 articles that referred somehow to open educational resources and systematic reviews were selected.

In the third phase (eligibility), 56 full-text articles were assessed to check if they were systematic reviews on open educational resources. Five articles were not available online, one was not written in English, and 19 were excluded because they were not systematic reviews.

In the fourth phase (inclusion), a total of 31 articles had their full text read, and 15 were excluded due to not being systematic reviews on open educational resources. As open educational resource is a broad term and is related to other open terms, such as open educational practice, open pedagogy, and open education, many cited OER in the titles and abstracts but did not refer to OER exactly in their text.

Finally, 16 studies were included in this systematic review. The data collection procedures have been summarized in Figure 1.

Figure 1

PRISMA Diagram of the Data Collection Procedures
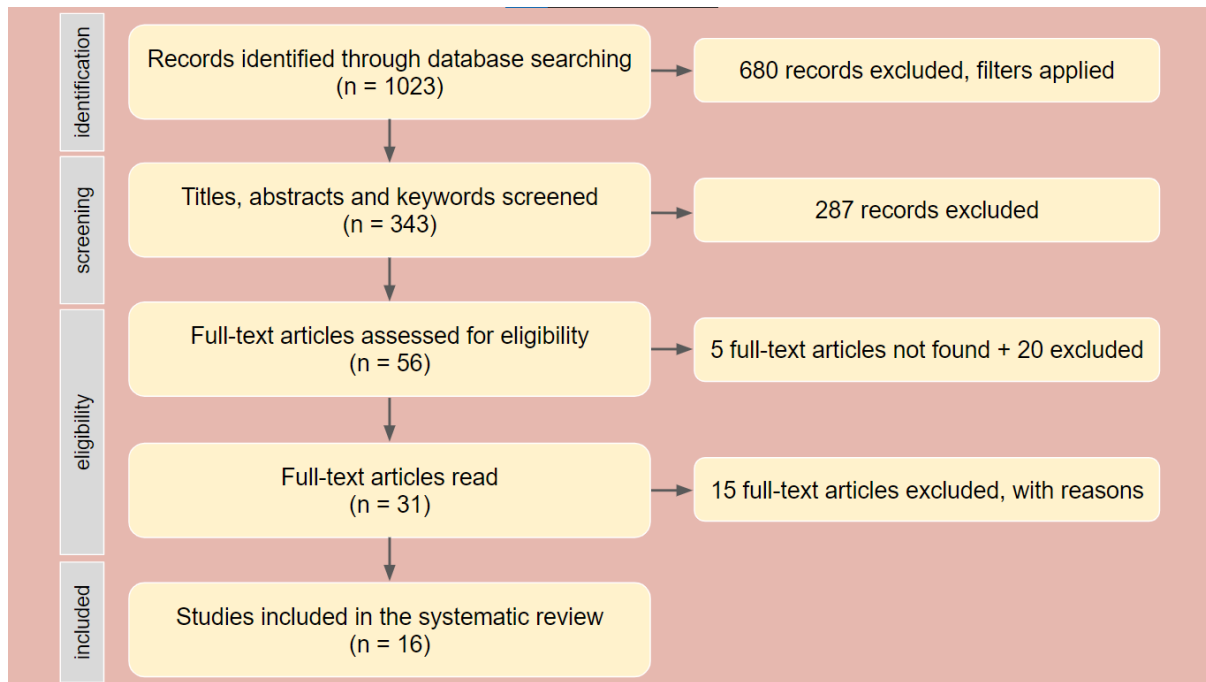
Each study was then reviewed and examined based on the following items: if they mentioned the 5R activities, the licenses or intellectual property issues, technical aspects, open tools, and sustainability (see Table 1). These items provided information to answer the research questions and to conduct the synthesis that is presented in the next section.

Table 1

Papers Selected for This Review

Author(s)	Topic Covered				
	5R	Legal	Technical	Tools	Sustainability
Moon & Park (2021)	yes	yes	no	yes	no
Meng et al. (2020)	related terms	yes	no	no	yes
Zhang et al. (2020)	related terms	yes	no	no	no
Luo et al. (2020)	related terms	yes	no	no	yes
Craig (2020)	yes	no	no	no	yes
Ivanova et al. (2020)	related terms	yes	yes	no	no
Tlili et al. (2019)	yes	yes	no	yes	yes
Wong & Li (2019)	yes	yes	yes	yes	yes

Clinton (2019)	related terms	yes	no	no	no
Moreno et al. (2018)	related terms	yes	no	no	no
Paragarino et al. (2018)	related terms	yes	no	no	yes
King et al. (2018)	related terms	yes	no	yes	no
Wang et al. (2017)	related terms	yes	no	no	yes
Hilton (2016)	related terms	yes	no	yes	no
Yuan & Recker (2015)	related terms	no	no	no	no
Arimoto & Barbosa (2012)	related terms	yes	yes	yes	no

Note. 5R = retain, reuse, revise, remix, and redistribute.

As shown in Figure 2, 11 studies out of 16 were published in recent years: 2018 ($n = 3$), 2019 ($n = 3$), and 2020 ($n = 5$), which can indicate an increasing interest in systematic reviews on open educational resources, maybe due to the coronavirus pandemic and the transition to online learning. However, this tendency was inconspicuous in 2021 ($n = 1$). This may be explained by the fact that the data collection was conducted in November 2021, and there were still some articles to be published that year.

Figure 2

Time Distribution of Sampled Papers Through the Years
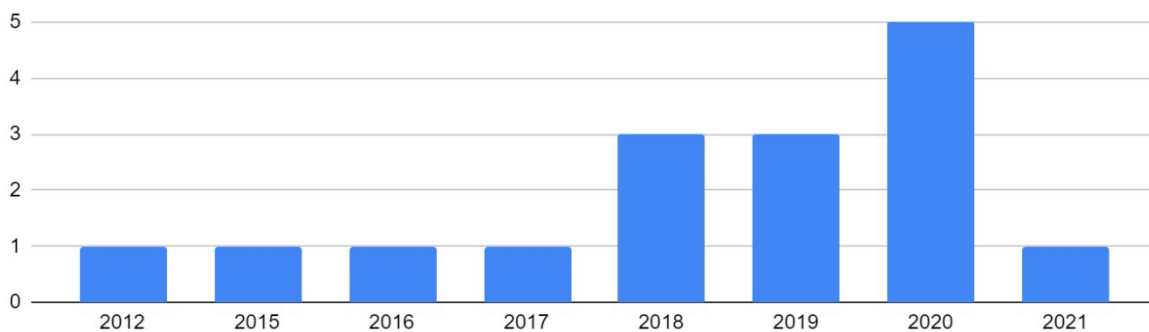
Note. n = 16.

The systematic reviews that were selected used 71 keywords in total. Figure 3 presents these keywords, and the bigger the font size, the more frequently they appeared in the texts. The most frequently used keyword was undoubtedly *open educational resources*, which was mentioned 14 times, followed by *OER*, which appeared seven times. *Open educational practices*, *systematic review*, *higher education*, *textbooks*, *disability*, and *accessibility* appeared twice. The others appeared only once each.

Figure 3

Keywords Used in the Systematic Reviews
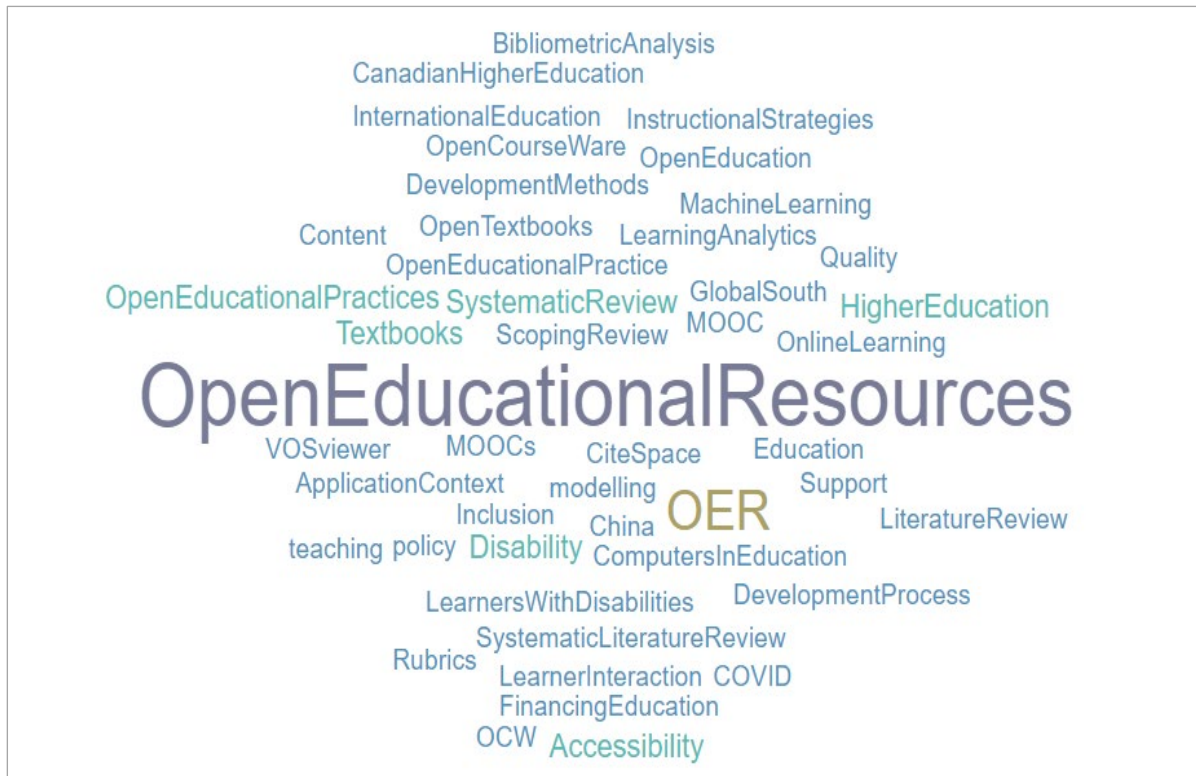
Note. Keywords used most often appear in larger font size.

Furthermore, the systematic reviews mentioned 10 other open terms in their titles, abstracts, and keywords besides the term *open educational resources*, which appeared 24 times and, as it is the focus of this study, it was not introduced in the word cloud below. *Open educational practices* was mentioned five times, *massive open online courses* and *open course ware* appeared three times, and *open textbooks* appeared twice. The other terms, as displayed in Figure 4, were mentioned only once.

Figure 4

Other Open Terms Cited in the Titles, Abstracts, and Keywords
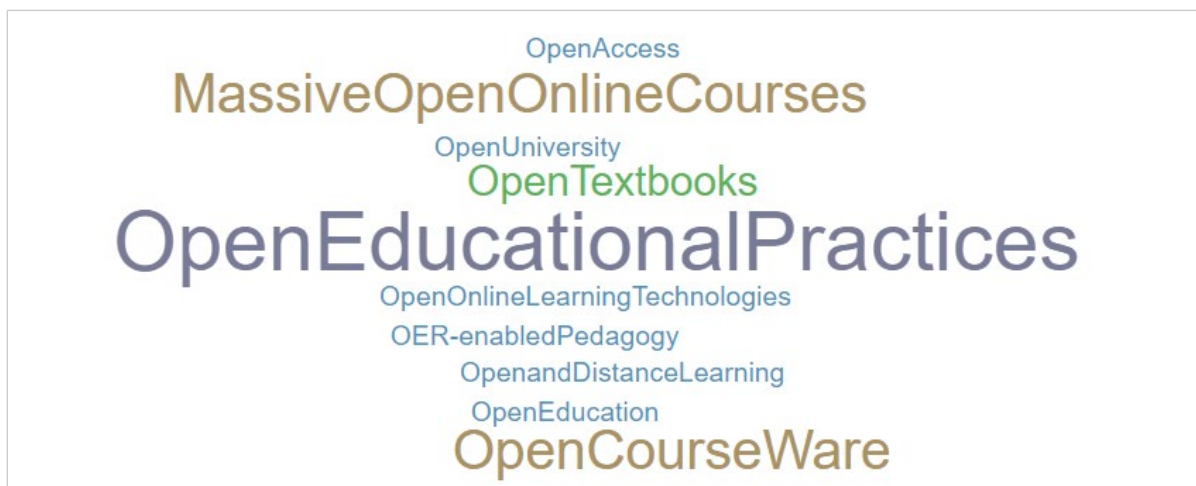
Note. Terms used most often appear in larger font size.

Results

1. How are the 5R activities addressed in the systematic reviews on OER?

Only four texts mentioned Wiley's 5R principles, as displayed in Figure 5. Three texts mentioned it before the presentation of the results, that is, in the introduction and/or theoretical background (Craig, 2020; Moon & Park, 2021; Tlili et al., 2019), and two texts mentioned the 5R in the results (Craig, 2020; Wong & Li, 2019). From these three and two texts that mention the 5R before and in the results, respectively, only one text cited the 5R both before and in the results (Craig, 2020).

Figure 5

Studies Mentioning the 5R

Note. n = 16. 5R = retain, reuse, revise, remix, and redistribute.

Moon and Park (2021), for example, said that while most studies have emphasised the 5R, they hardly ever debate approaches to enhance learners' engagement and interactions with the resource. They also said that OER-enabled pedagogy expands learners' interactions with the OER beyond the simple use for information retrieval. Through this pedagogy, learners can create, modify, and share these resources.

In addition to this, Craig (2020) reported that learners could benefit more from the 5R if they had at least a basic understanding of editing tools. The access to editing tools and the level of expertise required to revise or remix materials are two aspects discussed in the ALMS framework (Hilton et al., 2010; Wiley, 2014) and essential to the technical openness requirements.

Most texts (n = 12) did not mention Wiley's 5R exactly, but referred to some words related to it, such as *share*, *dissemination*, *adaptation*, *copy*, and *combine* (Arimoto & Barbosa, 2012; Hilton, 2016; Ivanova et al., 2020; King et al., 2018; Luo et al., 2020; Meng et al., 2020; Moreno et al., 2018; Paragarino et al., 2018; Wang et al., 2017; Yuan & Recker, 2015; Zhang et al., 2020). From these texts, seven mentioned related terms both before and in the results. Therefore, all the texts cited the 5R, directly or indirectly.

2. How often are the licenses or intellectual property issues mentioned?

In total, 14 out of 16 studies mentioned the licenses, such as Creative Commons, copyright, or intellectual property issues in their texts (Figure 6). Eleven mentioned them in the introduction and/or background theory (Arimoto & Barbosa, 2012; Clinton, 2019; Hilton, 2016; Ivanova et al., 2020; Meng et al., 2020; Moreno et al., 2018; Paragarino et al., 2018; Tlili et al., 2019; Wang et al., 2017; Wong & Li, 2019; Zhang et al., 2020), 11 mentioned them in the results (Arimoto & Barbosa, 2012; Clinton, 2019; Hilton, 2016; Ivanova et al., 2020; King et al., 2018; Luo et al., 2020; Meng et al., 2020; Moon & Park, 2021; Tlili et al., 2019; Wang et al., 2017; Wong & Li, 2019), and eight mentioned copyright issues both before and in the results (Arimoto & Barbosa, 2012; Clinton, 2019; Hilton, 2016; Ivanova et al., 2020; Meng et al., 2020; Tlili et al., 2019; Wang et al., 2017; Wong & Li, 2019).

Only two of the 16 studies selected for this review (Craig, 2020; Yuan & Recker, 2015) did not mention the licenses in their texts, revealing the high importance given to the legal aspects of OER, one of the key elements in the OER definition.

Figure 6

Studies Mentioning the Licenses
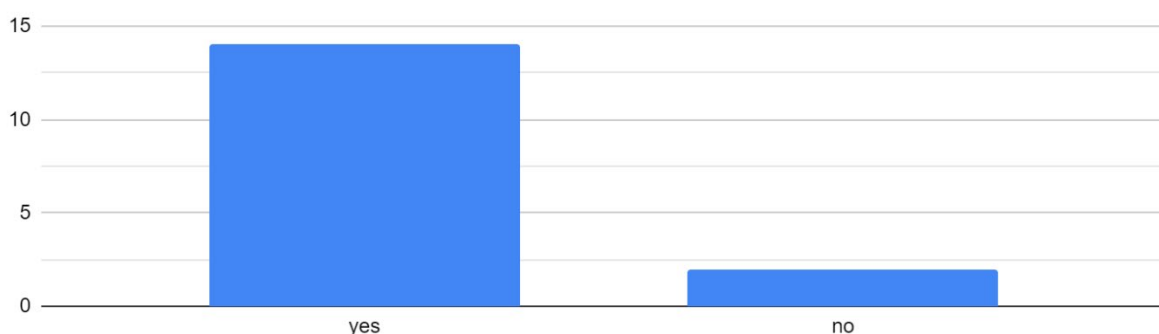
Note. n = 16.

One of the texts that did not mention the licenses is about the implementation of OER in Canadian higher education during the pandemic (Craig, 2020). Although it talks about Wiley's 5R principles, it does not cite any aspect regarding intellectual property and technical issues related to the reuse, sharing, and adaptation of resources. The other text that did not comment on licenses is about the use of rubrics to evaluate the quality of OER (Yuan & Recker, 2015). It used related terms to talk about the 5R activities and did not mention technical aspects (discussed in the next subsection).

3. How often are the technical aspects discussed?

Only three texts addressed concerns about the technical aspects of OER as, for example, tools that support the development and reuse of learning content, as visualized in Figure 7. Three mentioned the technical aspects in the introduction and/or background theory (Arimoto & Barbosa, 2012; Ivanova et al., 2020; Wong & Li, 2019) and only one mentioned the technical aspects in the results (Arimoto & Barbosa, 2012), being also the only one that mentioned them before and in the results.

Figure 7

Studies Mentioning the Technical Aspects
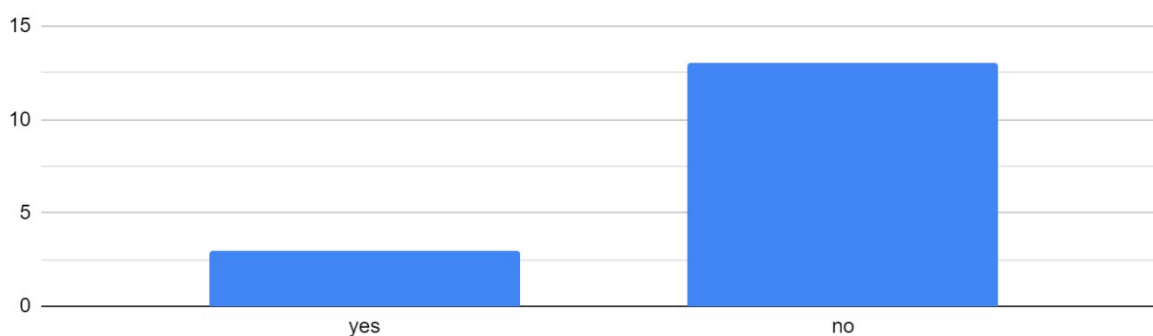
Note. n = 16.

When comparing these numbers from the technical aspects to the numbers from the legal openness discussed in the previous subsection, it can be noted that they are almost opposites. While 14 articles mentioned the legal openness and two did not mention it, 13 articles did not discuss the technical aspects and only three did.

These results supported few studies that have highlighted the importance of technical infrastructure and knowledge that enables technical openness in OER. The William and Flora Hewlett Foundation, for example, has recognized the need for "tools for authoring and automated feedback, tools for metadata management, analytical tools, [and] tools for import/export in different platforms and formats" (Ivanova et al., 2020, p. 67). Arimoto and Barbosa (2012, p. 6) argued that, "The integration of social tools encourages the active participation of developers and users in the construction of OERs, also important in distributed and collaborative development of such resources." These tools can also facilitate the development of OER, besides contributing to the quality of the final resource.

4. Which open tools are pointed out in the reviews?

Six of the 16 texts pointed out open tools through their texts (Arimoto & Barbosa, 2012; Hilton, 2016; King et al., 2018; Moon & Park, 2021; Tlili et al., 2019; Wong & Li, 2019), as can be seen in Figure 8.

27

Some open tools mentioned are Moodle, edX, Sina Weibo, XuetangX, CNMOOC, iCourse163, P2PU, Canvas Network, Coursera, EdX, Khan Academy, OpenCourseWare (OCW), Openstax, The Saylor Foundation, Washington State's Open CourseLibrary, and The Minnesota Open Textbook Library.

Figure 8

Studies Mentioning the Open Tools
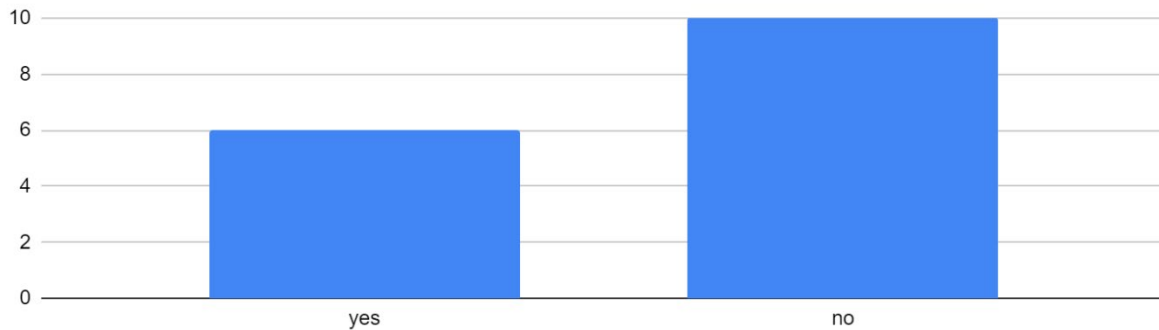
Note. n = 16.

Almost all these tools are platforms to access materials and content, not tools that facilitate the practice of the 5R activities, fostering the creation and adaptation of existing materials. Only three texts out of six mentioned tools intrinsically linked to the development of OER, such as blogs and wikis. These results are in close relation to the demand that exists in the OER field discussed by Ivanova et al. (2020). According to them, the William and Flora Hewlett Foundation has already recognized the need for a better infrastructure to support these resources.

As was mentioned in the previous subsection, Arimoto and Barbosa (2012) discussed the integration of social tools in the OER to encourage the active participation of users in the collaborative construction of these resources. Arimoto and Barbosa (2012) pointed out that the use of these tools tends to make the development of resources easy, contributing to the quality of the final resource.

5. How relevant is the topic of sustainability in these systematic reviews?

Only seven texts out of 16 (Craig, 2020; Luo et al., 2020; Meng et al., 2020; Paragarino et al., 2018; Tlili et al., 2019; Wang et al., 2017; Wong & Li, 2019) mentioned the sustainability issue regarding the OER (Figure 9). Sustainability refers to the ability of an OER to continue or be continued for the long term. According to Wang et al. (2017, p. 303), "Sustainability is a core issue and major challenge faced by not only end-users but also OER developers, foundations and policymakers."

Figure 9

Studies Mentioning the Sustainability
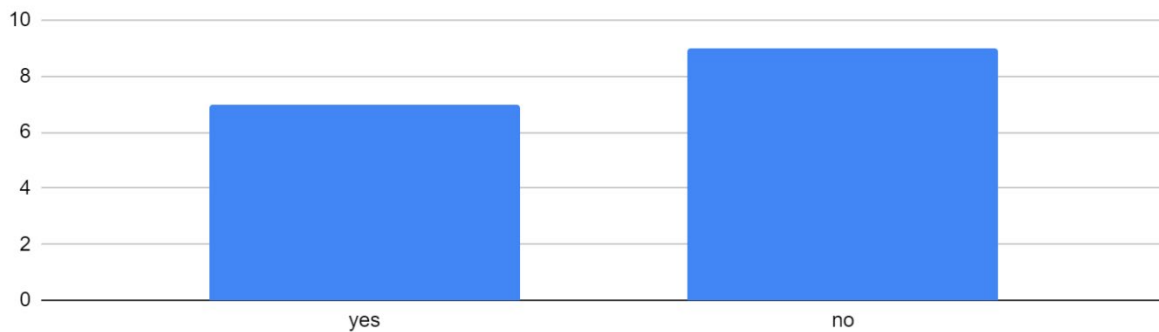
Note. n = 16.

According to Paragarino et al. (2018), very few OER projects are continued after the end of funding. Few successful examples have impacted the general financial model of OER development, and designing new business models for the sustainability of OER is one of the main challenges in this area. In 2019, UNESCO released a recommendation on OER, and one of the areas of action is "nurturing the creation of sustainability models for OER" (Tlili et al., 2019, p. 11). Wong and Li (2019) also defended the position that developing policies to support OER is essential for the sustainability of their practices.

In Meng et al. (2020), the topic of sustainability is highlighted in the keyword analysis, highly cited publications, and OER practice. Similarly, the study also showed that many projects could not survive beyond their initial funding and argued that self-finance models should be explored to maintain OER projects. Meng et al. (2020) suggested two approaches to sustain an OER project: to advertise or offer other services to obtain extra income, and to extend the traditional mode of donation.

However, although sustainability is frequently considered from an economic perspective, it is not restricted to financial issues. According to Downes (2007), sustainable OER models can be categorized into four aspects: funding, technical, content, and staffing (Wang et al., 2017). Luo et al. (2020) found that sustainability is the most frequently cited barrier that stands in the way of OER, and suggested that partnerships among designers, e-learning staff, academic librarians, and teachers, for example, can contribute to the sustainability of OER.

Discussion and Conclusions

The majority of OER definitions are centered on the 5R activities and legal aspects, such as the open licenses, neglecting the technical aspects and tools that are necessary to fulfill the objectives of the OER movement, giving anyone not only legal permission but also technical support to reuse, adapt, and share materials.

This study performed a systematic review of systematics reviews on OER with the aim of analysing if these reviews mentioned and how often they mentioned the 5R activities, the licenses or intellectual

property issues, technical aspects, open tools, and the topic of sustainability, and comparing if these studies also follow this tendency of emphasizing legal aspects over the technical ones.

The main findings revealed that all the texts mentioned the 5R or related terms, such as *access*, *share*, *copy*, and *adaptation*, and almost all the selected texts discussed the legal issues (*n* = 14), corroborating the definitions presented by UNESCO (2002, 2019), Creative Commons (n.d, 2020), and Hylén et al. (2007), which say that OER is any resource used in the teaching, learning, or research context, that resides in the public domain or is under an open license, giving anyone permission to engage with these materials through the 5R activities.

On the other hand, 13 texts out of 16 did not mention the technical aspects necessary to create, reuse, adapt, and share OER. Besides, the studies that talked about tools did not point out tools that facilitate the creation and adaptation of resources. Most of them were platforms used to access OER. As discussed by the William and Flora Hewlett Foundation (2018) and Levin (2017), there is a lack of technical infrastructure, such as tools, to support the revision and adaptation of OER. This technical challenge was also mentioned by Dichev et al. (2011), who cited that there is a need for environments that facilitate the sharing of content as well as tools for OER modification and redistribution.

There are some limitations to this systematic review. The first one is related to the database used, Scopus. Besides not covering all the publications, we did not search the articles on other databases to complement our research. Furthermore, research outcomes are published in several languages and this systematic review encompassed only those written in English. Because of this, we might have missed some relevant articles due to the database restriction and data collection process.

To conclude, having access to tools and technical knowledge that enable users to engage with resources through the 5R activities and knowing the legal issues that permit users to reuse or adapt these resources should have the same level of importance when talking about OER. If users are given legal permission to engage with OER through the 5R activities, they should also be given technical tools to unlock these resources so that they can interact with them as producers and contributors, and not only as passive consumers, maximizing the openness of content.

Therefore, with this study we hope to raise awareness of the importance of the technical openness and tools that might contribute to fostering users' engagement with OER, helping them to reuse, remix, and redistribute these resources according to their needs.

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Online Student Engagement: The Overview of HE in Indonesia

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Abstract

The use of technology in higher education learning has been shown to increase student engagement. However, how its application can increase student engagement is still largely unreported in Indonesia, especially during and after COVID-19, when online learning was used massively and suddenly. This study aims to examine students' engagement with online learning using a sequential explanatory mixed-method study design that is expected to produce in-depth information. The study involved a number of n = 775 students, with 149 participants who identified themselves as male (19.3%) and 626 participants who identified themselves as female (80.7%). The age range of the participants was 18 to 22 years (M-age = 20.12). Quantitative data analysis was carried out using descriptive tests and ANOVA variance tests, while qualitative data analysis was carried out using thematic analysis. Integration of quantitative and qualitative data analyses results was conducted using a joint display approach. The results showed that 94.45% (n = 732) of students had low engagement scores. Gender and field of study were found to have no effect on the level of student engagement in online learning ($F_{1,775} = 3.259$, $p = .071$, $\eta^2 = .004$). Data integration results showed that online learning reduces emotional attachment, participation, and performance, although it does not reduce students' skill engagement. Based on student experience, online learning is considered less effective than in-person learning. Students with higher self-regulation show engagement in online learning. The online learning model needs an effective formula for increasing student engagement, in addition to help students develop self-regulation skills.

Keywords: student engagement, online learning, mixed-method, Indonesia

Introduction

The COVID-19 pandemic has caused a shift in student learning practices from face-to-face to online learning (Blythe & Thompson, 2022; Fauzi, 2022; Garg, 2020). The online learning mode has become an alternative for universities even after the COVID-19 pandemic has passed. However, digital transformation has yet to develop equally in all educational institutions due to the uneven digital resources across Indonesian regions (Bunga et al., 2021). The Indonesian Directorate General of Higher Education (DIKTI) has issued several policies to optimize student learning processes. One policy is that every university must possess a learning management system (LMS) to provide equal opportunities for students to access learning resources (Herlina, 2021). The DIKTI implements these policies and regulations to encourage and maintain student engagement during online learning.

Student engagement is defined as how involved students are in their learning experience and how connected they feel to their classes, peers, and institutions (Axelson & Flick, 2011). In the context of technology-based and online learning, Dixson (2010, 2015) defines student engagement as a student's effort to direct their time, energy, thoughts, and feelings toward learning. Dixson (2015) states that student engagement will relate to what students are learning, their feelings regarding the learning process, and how connected they are with the materials, lecturer, and peers across four components: skill, participation, performance, and emotion.

From a social cognitive learning perspective, knowledge is constructed when individuals engage in activities, receive feedback, and participate in human interactions in social contexts (Henning, 2004). Social cognitive learning theory is widely implemented in Web-based learning environments (WBLE). The integration of tools and resources to support interaction within WBLE has received much attention (e.g., Hill and Hannafin, 2001; Krentler and Willis-Flurry, 2005; Northrup, 2001). Research shows that students perceive that their social interaction increases when they create and share immersive online messages (King, 2002). There are many ways to support interaction in WBLE, but first, how much interaction is needed, the form of interaction is expected, and how interaction can affect the learning process from the perspective and experience of students participating in online learning need to be determined. Thus, this becomes part of the questions in this research.

The influence of culture on interaction is also a concern from a social learning perspective. The influence of culture on online learning is primarily explored through two lenses: gender and ethnicity. Recent research has shown that female students tend to desire more support, have a stronger sense of learning community, and exhibit more connected communication patterns (Jeong, 2006; Rovai, 2002; Wheeler, 2002). Other research from Fahy (2002) examines gender differences in communication, namely in the use of linguistic qualifications and intensifiers in online learning for postgraduates, reporting that female students tend to use more qualifications (e.g., "I think," "maybe"), while male students tend to use more intensifiers (e.g., "very," "only"). Thus, an investigation of gender in relation to online student engagement is a necessity, especially in Indonesia, considering there are still very few studies on this matter.

In Indonesia, online learning in universities is still shrouded in doubt, a recurring question being whether students truly engage or take online learning seriously. Answering this question through extensive evidence allows researchers to evaluate and improve the online learning system. The researchers believe that a study using a mixed-method approach is needed to gain an integrative understanding of student engagement in the Indonesian online learning context. This study aims to

investigate students' engagement with online learning by using a mixed-method approach to answer the following research question:

1. What is the level of student engagement in online learning settings?

2. Which component of engagement do students most exhibit during online learning?

3. Do levels of student engagement during online learning differ based on gender and field of study?

4. What are students' perceptions of online learning?

5. How do students experience (in terms of emotion, learning behavior, participation, and academic achievement) online learning?

Conceptual Framework of Study

Adapting to online learning during the pandemic was challenging for lecturers and students. Online learning refers to types of distance-based education, also known as Web learning and e-learning. Although blended and hybrid learning can be considered online learning models that also integrate offline learning, this paper exclusively examines fully online learning activities that use the Internet, including online assessment and discussion activities.

Student engagement is one of the factors that contribute to learning effectiveness (e.g., Anjarwati & Sa'adah, 2021) and the sustainability of studies because it refers to the amount of time and energy spent by students to carry out activities related to learning (Kuh, 2003), which is indicated by emotional engagement, cognitive engagement, and behavioral engagement (Ginting & Ratnaningsih, 2021). Recent studies have shown that students' perceptions of their engagement in the behavioral, emotional, and cognitive dimensions can produce positive results. Affective or emotional attachment is defined as related to interest, pleasure, happiness, boredom, and anxiety during academic activities (Lawson & Lawson, 2013). Academic institutions are advised to focus on developing feelings of belonging, identification, and connectedness with peers, teachers, and universities. Cognitive engagement refers to participation in academic assignments, development of ideas, and in-depth study of lecture material. Behavioral engagement relates to how much time is spent on assignments and class attendance.

Student Engagement in the Online Learning Context

Online learning refers to learning methods that use the Internet or a Web-based learning environment (WBLE). Students are expected to have technology skills and internet access to retrieve and use information easily in online learning (Brown et al., 2015). Well-designed learning methods can support student engagement online. Learning methods are expected to foster interaction and social presence as well as create a direct and appropriate learning process that efficiently uses limited time, connects learning activities with goals, builds understanding, and provides stimulation or real experience (Farrell & Brunton, 2020). In contrast, inappropriate learning methods undermine student engagement online (Stone & O'Shea, 2019).

Dixson (2015) states that student involvement in online learning contexts is shown through the use of students' time and energy to learn material and skills, as well as their ability to demonstrate meaningful learning interactions with other people in a class. Engagement consists of individual attitudes, thoughts, behaviors, and communications with others. The components of online engagement include skills engagement (what students "do"), emotional engagement (how connected they are to learning), participation/interaction engagement (whether they interact with others; whether they are enjoying learning), and performance engagement (how well they perform; whether they have the desire or goal to succeed in learning). Dixson (2015) has developed an engagement measurement tool known as the online student engagement (OSE) scale.

Online learning can be as effective as traditional learning as long as there are clear instructions, collaborative and active learning, and competent instructors (lecturers) (Dixson, 2010). Some activities that can increase student engagement include application of case-study concepts, forum discussions, project groups, research papers, and contextual assignments that are aligned with actual events. Dixson (2010) mentions that students who work on projects with others, review papers, and discuss specific topics in forums are shown to be more engaged during online lectures. In line with Hollister et al. (2022), quality, design, difficulty, relevance, and level of need for collaboration and use of technology can influence the type of interaction students face, which has an impact on their engagement in the learning process.

Hollister et al. (2022) describe engagement in online learning as the interaction between students, teachers, peers, curriculum, and technology. Fadde and Vu (2014) explain that online learning can occur in synchronous, asynchronous, or mixed models depending on time availability and technology from university. . However, the asynchronous model provides little opportunity for interaction between students and teachers, resulting in students receiving less feedback. - fFeedback is more accessible in synchronous learning model if the technology and strength of the network are sufficient.

From the perspective of social cognitive learning theory, individual social interaction plays an important role in WBLE in the form of self-regulation. In Indonesia, a radical change in the learning scheme from offline to online transforms the individual regulatory system in learning (in students) and the social interactions that occur in it. Thus, when looking at the engagement of students in online learning, how much energy and time is devoted to the emotional, social, cognitive, and behavioral dimensions in participation can be investigated. Using the Student Center Learning (SCL) perspective to understand OSE will lead to efforts to understand the role of the individual (self-regulation) and the social environment in WBLE or online learning in the context of this research.

Methodology

Research Design

Mixed-method research is used when researchers want to collect in-depth data that a single approach might not achieve, and it focuses on the meaningful integration of quantitative and qualitative data (Alexander et al., 2008). The type of mixed-method approach used in this study is a sequential explanatory design. In this design, quantitative data collection is run first, followed by qualitative data collection to describe the quantitative results further. The rationale for this approach is that quantitative data and results provide an overview of the research problem. At the same time, further analysis through

the collection of qualitative data is needed to refine, expand, or explain the general picture (Creswell et al., 2011). The mixed-method research design follows the guidelines from the Good Reporting of a Mixed Methods Study, or GRAMMS (O'Cathain et al., 2008).

Sampling and Participants

A purposeful random sampling technique was used due to the large population and potentially rich information and to avoid favorability to a particular case. Every student who met the characteristics and was willing to participate was an eligible research participant. The participants' involvement in the research was verified through informed consent. The characteristics of this study's participants included the following: 1) undergraduate students; 2) aged 18 to 24 years; 3) currently, or have experience, participating in online learning; and 4) not working full-time or part-time. In the end, 775 students participated in the study, with a proportion of 149 participants who identified themselves as male (19.3%) and 626 participants who identified themselves as female (80.7%). The age range of the participants was from 18 to 22 years (M-age = 20.12). Students involved in the research were categorized in one of two groups according to field of study: 238 (31.7%) were categorized in natural and technological sciences and 537 (69.3%) were categorized in social sciences.

To get research participants, the research team conducted open recruitment by distributing pamphlets to several universities in Indonesia. The pamphlet included a registration link, an explanation of the research to be carried out, and a request for willingness to fill out the survey and participate in focus group discussions (FGD). When registering, prospective participants were asked to identify the scientific area they were studying, with three categories provided: natural, technological, and social sciences. Researchers did not involve students from the faculties of medicine and health because most of these faculties at universities in Indonesia do not carry out online learning, including at Diponegoro University. Participant recruitment was carried out over a period of 3 to 3.5 months. Not all participants who filled out the survey expressed willingness to be involved in the FGD. Of the 775 study participants, 45 expressed their willingness to take part in the FGD.

This research was approved by the ethical committee board, Faculty of Public Health, Universitas Diponegoro.

Data Collection Procedures

Quantitative data was collected using the online student engagement (OSE) scale from Dixson (2015), which was translated into Indonesian following the Brislin (1970) translation stages. The OSE scale consisted of 19 items with a McDonald's score of (ω = 0.919, 95% CI 0.891-0.947). The scale was filled out online via Google Forms, and informed consent as a form of ethical consideration was included in the Google Form, which participants had to fill out before they filled out the online scale. Qualitative data was collected through online focus group discussions using Microsoft Teams. Participants involved in the FGD provided informed consent, which had been sent via email. The FGD questions were arranged in a guide (see Appendix), and were as follows: 1) What are your thoughts on online learning? 2) Tell us about your experience participating in online learning (for example, what is felt and done during online face-to-face sessions and how the assignments were). 3) How is the condition during online learning (facilities, environment, the role of close people)? 4) What learning methods are used by lecturers during online learning sessions? 5) How are your interactions with lecturers and friends during online learning? 6) What obstacles are encountered during online learning (internal or external)? 7) Have any efforts been made to overcome those obstacles?

Data Analysis

Quantitative data analysis was conducted using descriptive tests and different ANOVA tests, while qualitative data analysis was conducted using thematic analysis following the procedures of Braun and Clarke (2006). Next, quantitative and qualitative data analysis results were integrated using a joint display approach (Stange et al., 2006; Creswell & Tashakkori, 2007). This was a way to bring it together through visual means to draw new insights beyond the information obtained from different quantitative and qualitative results (Fetters et al., 2013). Shared views provided a visual means to integrate and represent mixed-method results to generate new conclusions (Creswell, 2015; Creswell & Plano Clark, 2011; Greene, 2007).

Results

Quantitative Results

Common Method Bias

Collecting data from one source in one time frame can risk the study's consistency, especially in behavioral research (Podsakoff et al., 2003). In this study, the researchers applied Hermann's one-factor test to determine the threat of common method bias (CMB). The result of the CMB test on the scale indicated six categories of factors, and the first factor explained only 38.861% of the inconsistency (smaller than 50). Thus, the researchers believes that CMB did not pose a threat in this study.

What is the Level of Student Engagement With Online Learning?

The descriptive statistical test results (Table 1) show that 94.45% (n = 732) of students were categorized with a low engagement score, while 5.55% (n = 42) of students were categorized with a high engagement score.

Table 1

Level of Student Engagement

OSE score			n
Mean		69.701	
SD		16.692	
Score category	Low	<52.009	732
	High	>52.009	43

Which Engagement Component Is Most Shown by Students during Online Learning?

As shown in the analysis and categorization table (Table 2), the engagement component that had the most students with a high engagement score is skill. Skill interest is related to what students do in online learning. For the other three components, namely emotional attachment, participation, and performance, more than 50% of the participants had low scores.

Table 2

Categorization of Scores Based on OSE Dimensions

OSE components	Mean	SD	Category	N
Skill	3.553	0.849	Low	20
			High	755
Emotion	3.698	0.810	Low	745
			High	30
Participation	3.597	0.897	Low	747
			High	28
Performance	3.896	0.710	Low	683
			High	92

Are There Any Differences in the Level of Students' Engagement in Online Learning Based on the Field of Study and Gender?

Two-way ANOVA test results with gender (male, female) and field of study (natural and technological sciences, social sciences) as between-subjects factors revealed a primary consequence of gender, $F_{(1,775)} = .017$, $p = .897$, $\eta 2 = 2.156e\text{-}5$; and field of study, $F_{(1,775)} = .407$, $p = .524$, $\eta 2 = 5.248e\text{-}4$. These main effects were not qualified by an interaction between gender and field of study, $F_{(1,775)} = 3.259$, $p = .071$, $\eta 2 = .004$. It could be concluded that gender and field of study had no effect on OSE engagement levels.

Qualitative Results

Qualitative analysis using thematic analysis techniques from Braun and Clarke (2006) resulted in four final themes: student perceptions of online learning, the process of online learning, the experience of participating in online learning, and the obstacles faced. The following themes shown in Table 3 were then identified:

Table 3

Initial Themes and Final Themes

Final themes	Initial themes
Perception of online learning	Flexible in practice
	Boring
	Less effective
Online learning process	Learning method is less effective
	Many assignments
	Limited interaction with lecturer and peers
Online learning experience	Positive and negative emotions
	Active involvement and independent studies
	Challenges in staying focused
	Multitasking
	Choose to be passive

Online learning barriers	Maintain achievement by learning from multiple sources Difficulty in understanding materials Technical and facility (media, signal, technology) Social (distracting house environment) Psychological wellbeing (motivation, self-regulation, stress) Health (cybersickness)

What Are Students' Perceptions of Online Learning?

Perceptions of online learning include flexibility, which infers that it can be attended anywhere (regardless of space) as an advantage of online learning. However, it is also perceived as boring and less effective in practice because it creates technical, social, and comprehension challenges. Generally, perceptions can be categorized as either positive or negative. Overall, the majority of participants' perceptions were negative, emphasizing that online learning was deemed less effective than in-person learning. Several words that appear a lot about the experience of participating in online learning from the results of FGD data analysis on students are less effective ("kurang efektif") , the lecturer gives too many assignments ("penugasan yang banyak dari dosen"), lots of obstacles ("banyak kendala"), lots of distractions ("banyak gangguan"), uncomfortable ("tidak nyaman mengikuti kuliah online"), bored ("muncul rasa bosan"), and lacks confidence in expressing opinions virtually ("malu menyampaikan pendapat secara virtual"). This is the word cloud that describe students' experience on online learning.

Figure 1

Word Cloud of Qualitative Data

How Do Students Experience (Emotions, Learning Behavior, Participation, and Academic Achievement) Online Learning?

This research question can be answered by seeing the result of the integration of quantitative and qualitative analyses using the following joint display model (Table 4):

Table 4

Integration of Results of Quantitative and Qualitative Analyses

Skills engagement	
Study behaviors or habits during online learning	
Low OSE score	"I cannot become mindful during lecture processes."
	"It is difficult to stay focused during lectures, especially with more assignments during online learning."
High OSE score	"Online assignments are much easier."
	"I can follow along by reading existing materials in literature/e-books."
Emotional engagement	
Emotions experienced during online learning	
Low OSE score	"I tend to get bored more easily during online face-to-face learning, watching lecturers who only give materials for a long duration."
	"Feel like the task is more taxing during online learning."
High OSE score	"I am quite comfortable with face-to-face online learning and can still complete assignments well."
Participation/interaction engagement	
Interaction intensity and involvement during the online learning process	
Low OSE score	"Online face-to-face interaction with lecturers is less interactive, and assignments are given less thought."
	"During lectures, all students turn off their cam and only open them when lecturers ask to turn on the camera."
	"I choose to be more passive because you feel shy, and it is also difficult to make an appointment when group work is assigned."
	"Usually, students multitask when class is in session."
High OSE score	"My interaction with lecturers and friends during online learning is also quite good, and I can communicate via platforms such as WhatsApp."
	"Quite interactive; I often ask questions during the online lessons."
Performance engagement	
Ability to obtain good results in online learning Obtaining good results in online learning	
Low OSE score	"It is difficult to understand the materials well."
	"Experience difficulties concentrating, decreased interest and motivation to learn, and poses lots of distractions."
High OSE score	"When taking online classes, I feel that the online learning system is not so bad because it is flexible. I can still get good grades."

Note. Quotes related to experiences in and perception of online learning with high and low OSE scores.

Based on the data integration in Table 4, a statement containing negative emotions indicated low emotional engagement. For example, responses that indicated annoyance, intense feelings, and being easily bored during online learning were more frequently seen compared to positive emotional content. Even so, some participants felt quite comfortable participating in online learning, which projects an

interesting prospect of analyzing such positive deviances. Skill attachment was shown through attitudes and learning behavior, and the students with low skill engagement scores showed an inability to adapt learning attitudes and behaviors to online learning. Students with high skill engagement scores had adaptive learning attitudes and behaviors.

High participation/interaction in the online learning experience was characterized by actively participating in the discussion process and maintaining communication with lecturers and friends using social media platforms such as WhatsApp. Low participatory engagement scores were characterized by passive attitudes and absenteeism in synchronous or asynchronous learning process involvement.

On the performance dimension, students with high engagement scores were able to maintain their academic achievement. In contrast, students with low engagement scores reported that they experienced difficulties in understanding materials, which, in turn, affected their academic achievement.

Discussion

The quantitative data analysis results showed that the number of students with low engagement scores was greater than those with high scores. It was acknowledged that online learning had a benefit, which was that it was not limited to time and space. Its flexible nature in the dimensions of time and space in learning was supported by the qualitative analysis results indicating that students were interested in participating in online learning (Thomson, 2010). Online learning has also been believed to bring opportunities and quality education to all students across location barriers, including in developed countries, such as the United States (Bowen et al., 2014).

According to social cognitive learning theory, individual social interaction plays an important role in WBLE as self-regulation. This means that it takes both the readiness of students and the environment to create meaningful interactions in learning. In Indonesia, the rules regarding online learning have been formally established based on the Minister of Education and Culture Regulation No. 109/2013 (Kemdikbud, 2013) in terms of distance learning. The distance learning in question is the process of teaching and learning that is carried out remotely through the use of various media and communication technologies. The aim of distance learning is to provide higher education services to groups of people who cannot attend face-to-face education, and to expand access and facilitate higher education services in learning specifically in Indonesia, with its geographical conditions in the form of islands. The distance learning scheme as referred to in the regulation has not been fully implemented by all higher education institutions in Indonesia. The COVID-19 pandemic replaced the function of offline (traditional) learning with distance learning, which has come to be known as online learning, in an effort to prevent prolonged learning loss. Until the end of the COVID-19 pandemic in the first half of 2023 online learning was an alternative learning strategy maintained by several tertiary institutions. The findings of this study (see table 1), indicating a low level of OSE in higher education students, is not surprising considering the difficult access (e.g signal) of online learning in the context of Indonesia because of its geographical conditions.

The findings of subsequent research showed that there was no difference in student online engagement levels based on gender and field of study, which was also indicated by Dembereldorj's (2021) study. The absence of differences in the level of engagement between male and female students is quite an

interesting finding and is different from the findings of previous studies (e.g., Jeong, 2006; Rovai, 2002; Wheeler, 2002; Fahy, 2002) conducted more than a decade ago. There is a possibility that the shift in culture and the principle of equality in education has eliminated some of the differences in the characteristics and learning needs of male and female students.

The results of this study revealed that the most significant engagement score was in the skill dimension, which describes students' behavior or learning habits, as signified by both the qualitative and quantitative integrated data findings. Specifically, high scores in the skill dimension are demonstrated by self-learning efforts to build understanding from various sources. Students who undertake independent efforts in learning show they have good self-regulation, with self-regulation and motivation being two crucial factors in online learning success (Matuga, 2009).

Students with self-regulated learning are described as independent and academic achievement–oriented learners (Winne & Hadwin, 2010; Zimmerman & Moylan, 2009). Asking students about their experience of online learning, including what resources they used in learning, is an appropriate way to explore students' self-regulation effort (Harris et al., 2022). This finding explains students' low scores in the skill dimension, as they stated they have difficulty maintaining focus during online learning practices. Students who lack self-regulation skills in learning cannot anticipate obstacles. They also cannot devise strategies to help themselves study and stay focused on an assignment, which is reflected in their lower online learning performance (negative self-reflection).

Regarding the emotional dimension, data integration results showed that the form and intensity of positive and negative emotions felt by students appear to be related to learning strategies and assignments given by lecturers. In this category, 96.1% of responses had low engagement scores, which reflected negative emotions demonstrated in the responses of getting bored listening to lecturers' explanations and feeling overwhelmed with assignments given during online learning. Previous studies revealed that emotional attachment can affect students' persistence in learning, which is an integral feature of online learning. It is argued that greater emotional attachment correlates to a greater possibility of increased learning persistence (Oh & Lee, 2016; Yu et al., 2020). This study revealed that low emotional connectedness followed low participation and performance. A large number of assignments given by lecturers in several courses during online learning causes students to experience burnout syndrome (Simanjuntak, 2022; Radha et al., 2020). Burnout syndrome (Paro et al., 2014; Schmidt et al., 2013) is a condition characterized by emotional exhaustion, depersonalization, and low achievement attitude (Miranda-Ackerman et al., 2019). Feelings of boredom and difficulty completing assignments describe emotional exhaustion known as fatigue, implying that a person lacks sufficient emotional energy (Mazzetti et al., 2020). Prior studies support the result of this study regarding the arguments of difficulty understanding materials (Argaheni, 2020) and inability to maintain focus. Therefore, the low emotional engagement of students can result in low participation and low academic performance, as supported by Treglown et al. (2016). Low personal achievement is associated with feeling unable to be productive and low self-esteem regarding work or activity. Depersonalization is characterized by a lack of empathy demonstrated by non-participatory behaviors, such as turning off the camera when not requested by the lecturer and being passive during classes. Such conditions are supported by several studies involving Indonesian university students (Argaheni, 2020; Rachmaniar et al., 2021).

According to Dixson's (2010) study regarding student engagement, the skill component also becomes a challenge for students during online learning practices. Low literacy skills certainly demotivate students

to study materials further and hinder emotional connectedness with the application of the material (Argaheni, 2020; Bunga et al., 2021; Simanjuntak, 2022). Mastery of self-regulation is a crucial factor in learning performance (Simanjuntak, 2015; Febriana & Simanjuntak, 2021). Students with adequate self-regulated learning can set and achieve learning goals. Self-regulated learning abilities will direct students to learn and overcome difficulties specific to online learning.

This study reveals a compelling finding that the number of students with high engagement scores did not result in high numbers of students with emotional, participation, and performance engagement. The qualitative data showed that low scores in these three dimensions were related to teaching methods involving interaction and communication between students, teachers, and peers. The conventional way of delivering one-way lectures can also weigh in the low student engagement scores (Keller, 2010). Lecturers who deliver a monotonous teaching style and do not demonstrate the relevance of the material will lower student learning motivation (Simanjuntak, 2022). More specifically, monotonous delivery methods cause students to feel boredom, which triggers stress during online lectures (Simanjuntak, 2022; Utami, 2021). This condition will reduce student performance and result in low student engagement during online classes (Dixson, 2015). A meta-analytic study by Freeman et al. (2014) states that one-way lectures are ineffective in attracting students' attention. The lecturing method causes student involvement in learning to be low, which limits the maximum performance ability in learning compared to other active learning methods, such as group problem-solving, workshops, and tutorials in a small group (Freeman et al., 2014). This argument is supported by a study conducted by Pamarthi et al. (2019), which proved that didactic teaching and hybrid interactive methods are more effective for increasing student attention in learning than one-way lecturing methods. Therefore, lecturers must strive to use interactive teaching methods to increase student involvement when conducting online learning.

Conclusion and Implication

The potential of learning with technology depends on the continuous development of technology and the effort to design new ways to support lecturers in conducting collaborative problem-solving and creative learning methods. This study highlights the fact that learning methods play a crucial role in fostering student engagement and are supported by students' capacity, namely through their self-regulation skills and motivation in learning.

The result of this study provides information that 94.45% (n = 732) of students were categorized in the low engagement score category, and that gender and field of study had no effect on different online student engagement levels. Online learning reduces emotional attachment, participation, and performance but does not reduce skills. Additionally, online learning implemented so far is considered ineffective, based on students' experience. Therefore, learning needs to be designed in such a way as to be relevant and meaningful to students' lives so that students are motivated to be actively involved and make meaning from what they have learned.

This study is the first mixed-method study regarding online student engagement in Indonesia. Qualitative and quantitative data integration is sufficient to describe student attachment to online learning. However, this research has yet to reveal whether there have been changes or fluctuations in student engagement while participating in online learning, considering that online learning has been implemented on a massive scale for two years in Indonesia. It is impossible to conclude whether online

learning is genuinely ineffective and what factors explicitly influence its effectiveness. Therefore, longitudinal studies must be conducted to explain this matter further. Additionally, the researchers recommend expanding the number of participants to reach various universities and regions in Indonesia to enrich the information.

Availability of Data and Materials

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Conflict of Interest

The author declares that there are no competing interests in financial or non-financial terms.

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Appendix

Focus Group Discussion Guide

Focus Group Discussion Guide

Topic	:	Online student engagement
Aim	:	Exploring student experiences that show their engagement in online learning
Participants	:	45 students
Number of groups	:	Participants are divided into 5 groups (each group consists of 7 participants and 1 facilitator)
Media	:	zoom meeting
tools	:	paper and stationery to note the FGD results and a laptop
Discussion guide design	:	To maximize the effectiveness of the discussion, the FGD was conducted for a maximum of 45 minutes with a focus on a list of questions that had been prepared
List of questions	:	1. What are your thoughts on online learning
		2. Tell us about your experience participating in online learning (for example: what is felt and done during online face-to-face sessions and how the assignments were)
		3. How is the condition during online learning? (Tell us more detail about facilities, environment, and the role of close people)
		4. What learning methods are used by lecturers during online learning sessions?
		5. How are your interactions with lecturers and friends during online learning?
		6. What obstacles are encountered during online learning (it can be source from internal or external)
		7. Have any efforts been made to overcome those obstacles?

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University Educators' Experience of Personal Learning Networks to Enhance Their Professional Knowledge

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Abstract

This paper explores the experiences of university educators who use personal learning networks (PLNs) to enhance professional knowledge. With growing expectations to design and deliver effective online learning experiences, the PLN may offer flexible and supportive professional learning opportunities that build digital pedagogical capabilities. Previous research investigating PLNs has focused on how school teachers leverage social technologies to build these networks. However, there is limited examination of PLN use by university educators. This research is informed by the theories of networked learning and connectivism and uses a case study approach to deeply consider the experiences of five university educators from different disciplines across the globe. They share their understanding of the concept of the PLN, the influence of the COVID-19 pandemic, and how their PLN affects their digital pedagogies. The findings reveal nuanced insights of university educators' real-life experience, shedding light on how the use of social media and other digital tools for professional learning is changing and the implications this has for the development of university educators' understandings of digital pedagogies.

Keywords: personal learning network, networked learning, connectivism, university educator, digital pedagogy

Introduction

The global mass migration of education into the online space hastened by the COVID-19 pandemic has highlighted university educators' understanding of digital pedagogy and the requisite skills to teach effectively within digital environments (Bozkurt et al., 2022). Many in higher education continue to grapple with the implications of the transition to online teaching and the impacts of COVID-19 (Gonzalez et al., 2021). This paper presents findings about university educators' experience of personal learning networks (PLNs) to enhance professional knowledge, particularly the development of digital pedagogies, by addressing the following research questions:

1. How do academics understand the concept of personal learning networks?

2. How has the capacity to connect with others through social technologies influenced academics' professional learning experiences since the worldwide pandemic began?

3. In what ways do academics use personal learning networks to enhance their understandings of digital pedagogies?

A critical factor underlying successful implementation of educational technologies within higher education is the competence of teachers to know why, when, and how best to implement them (Englund et al., 2017). Networked learning may support university educators' confidence and capabilities, as the transition to learning and teaching within digital environments is complex, requiring more than a simple skill-based focus (Hodgson & McConnell, 2019). The PLN offers an environment where university educators can experience networked learning to build their capabilities and enable digital pedagogy initiatives.

Despite increasing research about PLNs in K–12 education (Oddone et al., 2019; Ranieri, 2019; Trust et al., 2018), to date there has been limited attention to their use in higher education (Pallitt et al., 2021). As PLNs support self-directed online learning, they would seem well suited to educators working remotely by choice or force of circumstance such as a pandemic. Untethered from face-to-face requirements and driven by the needs of the individual at their choice of time and place, the PLN is an under-recognised method of enhancing professional knowledge for time- and budget-poor university educators (Bali & Caines, 2018; Pallitt et al., 2021).

This paper reports research that investigates the experience of five university educators using a PLN for professional learning throughout and beyond the COVID-19 pandemic. The purpose of the study was to develop an informed understanding of the nature of university educators' engagement with PLNs and how their associated professional learning shapes their teaching practice.

Conceptual Framework of Study

This study posits the PLN to be a purposefully created network of digital connections to enable self-directed professional learning. Conceptually, it embodies networked learning and connectivism. Supported by social media, the PLN enables conversational interaction between individuals and groups (Dabbagh & Kitsantas,

2012; Dron & Anderson, 2014). The following section presents the literature in which this research is situated.

Networked Learning and Connectivism

Networked learning seeks to explain how learning takes place through the intersection of human relationships, digital communications technologies, and meaningful collaborative engagement (Networked Learning Editorial Collective, 2020). Rather than focus on the impact of educational technology on learning, networked learning critically examines the changing nature of learning through connections and collaboration, as enabled by increasingly ubiquitous technology (Hodgson & McConnell, 2019; Jones, 2015; Networked Learning Editorial Collective, 2020). Networked learning is characterised by non-linear paths to knowledge construction, driven by the needs of the learner, within online spaces constructed through the action of seeking and creating connections (Blaschke et al., 2021; Gourlay et al., 2021; Siemens, 2005). Networked learning has been related to professional learning across a range of disciplines, including higher education (Pallitt et al., 2021). It has been found to offer opportunities for synergy and collaborative learning experiences that enable social innovation, agency, and action (Dohn, 2014; Goodyear, 2019; Jones, 2015).

Associated with networked learning is connectivism. This concept focuses the construction of personal connections and individual networks for knowledge acquisition in changing and unpredictable environments (Downes, 2012; Siemens, 2005). Connectivism suggests that learning and knowledge rest in diversity of opinions and learning entails a process of connecting network nodes, both human and non-human (Siemens, 2005). The distributed nature of connectivism aligns it closely with the experiences of collaborative online learning (Reese, 2015; Utecht & Keller, 2019). Connectivism centres around autonomy and agency and the capacity of the individual to construct and interact within networks, motivated by personal learning needs (Blaschke et al., 2021; Downes, 2012).

Personal Learning Networks

PLNs are initiated autonomously by individuals to meet personally identified learning goals, leveraging the affordances of social media to create connections at any time or place (Carpenter & Krutka, 2015; Oddone et al., 2019). A PLN has been described as a "learning artefact and a real world tool" (Fair, 2021, p. 213). Thus, the PLN can be visualised (as seen in the PLN maps presented in this research) and also remain intangible, enabling informal learning occurring through connections with people, platforms, and information resources (Fair, 2021). Described as "learning in the wild" (Haythornthwaite et al., 2018; Schreurs et al., 2019), informal networked professional learning using PLNs is a flexible and innovative source of learning and support which may stand alone or be used to enhance formal learning opportunities (Dabbagh & Kitsantas, 2012; Oddone et al., 2019).

Most exploration of university educators' use of social technologies for informal professional learning is focused on a particular platform, with Twitter being the most common (Budge et al., 2016; Ehsan et al., 2018; Xie & Luo, 2019). Far less is known about how university educators engage with informal professional learning through PLNs involving interaction across a range of social networking sites, including Facebook, Twitter, blogs, social bookmarking, LinkedIn, and YouTube (Krutka et al., 2016; Trust et al., 2017).

University Educators and Digital Pedagogies

The COVID-19 global pandemic initiated a rapid transition to online learning, which consequently required many university educators to learn and implement digital pedagogies (Väätäjä & Ruokamo, 2021; Van der Klink & Alexandrou, 2022). Digital pedagogies require not only using digital technologies in teaching but the enhancement of learning, teaching, assessment, and curriculum through effectively embedding digital technologies (Kivunja, 2013; Väätäjä & Ruokamo, 2021). Therefore, university educators' digital pedagogical skills require capacities that go beyond foundational ICT practices, where technology use is teacher driven and implemented simply (Prestridge, 2012).

The development of digital pedagogical skills involves leveraging digital technologies to facilitate thinking and knowledge construction, supporting students to navigate digital spaces as they critically analyse, synthesise, and remix information for collaborative investigation and problem solving (Gonzalez et al., 2021; Prestridge, 2012). To develop digital pedagogical competencies, university educators require high self-efficacy to respond to technological challenges and problems with resilience and perseverance. They must also understand that pedagogical competence (and digital pedagogical competence) requires ongoing learning and maintenance (Kivunja, 2013; Prestridge, 2012; Väätäjä & Ruokamo, 2021). The shift to greater incorporation of online learning in higher education during and after the COVID-19 pandemic has elevated the focus upon the development of these capabilities (Bećirović, 2023; Blonder et al., 2022; Van der Klink & Alexandrou, 2022). Significantly, educators who learn through PLNs often display similar attributes and dispositions which include autonomy, curiosity, and a desire for continued learning and development (Oddone et al., 2019; Prestridge, 2017).

Method

As the PLN is idiosyncratic to each individual, I adopted a qualitative case study approach for this research. This method explores and compares related individual experience within a real life context, and is suited to the evaluation of complex educational innovations (Simons, 2009). Therefore, I sought firsthand insights from university educators who engage with a PLN for professional learning.

After approval from the University Human Ethics Committee, participants were recruited through several social media channels, including Twitter, Facebook, and LinkedIn. Using social media as a recruitment tool for this study reflects the context and content of the research. Five people volunteered, met the selection criteria, and participated in the study. Each participant had engaged with online teaching and learning in different disciplines, namely: medical science, teacher education, instructional technology, business administration, and academic development. Two participants were in the United States, and one each in France, Great Britain, and Sweden. The variety of disciplines and global spread of the participants ensured rich data and a good depth of experiences and responses (Moser & Korstjens, 2018). All participants were familiar with the terminology of the PLN and had active PLNs used for professional learning. Participants taught in both online and face-to-face settings, working with undergraduate and postgraduate students. Exploring the experiences of a small number of participants allowed this research to deeply examine the nature of the PLN experience from individual perspectives. I sought similarities and differences between cases, relevant to real-life personal and professional contexts (Lincoln & Guba, 2016).

Participants were invited to construct a visualisation of their PLN using a method of their choice. They were guided by exemplar maps but were encouraged to design the map in a style of their choosing, with the content they felt most relevant. The maps stimulated reflection prior to the interview and acted as a prompt throughout the interview, surfacing unspoken thoughts and feelings about the PLN and enriching data collection (Kearney & Hyle, 2004; Mannay, 2010). I had successfully developed and applied this method of online map-based interviewing in a previous study with school teachers (Oddone, 2019, 2022; Oddone et al., 2019). The semi-structured interview was based on questions included in the Appendix.

Using networked learning as a theoretical frame, I analysed the data from the transcripts of the interviews and the PLN maps using thematic analysis, to identify implicit and explicit themes and ideas within and across each case (Fugard & Potts, 2019; Guest et al., 2012). I manually coded each case individually, before comparing and contrasting through cross-case analysis. The manual coding process involved reading the transcripts several times. I read each transcript twice initially; once for overall meaning and a second time for more thorough coding. After conducting this process for all cases, I read all again sequentially, noting similarities and differences in the emerging themes, and identifying overarching themes. I identified shared and contending perspectives, as presented in the Findings and Discussion. The participant names shown are pseudonyms.

Findings and Discussion

The findings respond to questions about how university educators understand the concept of the PLN and use it in their practice; how their experiences of informal networked professional learning through PLNs may have been influenced by the recent COVID-19 global pandemic; and how they considered their PLN may have informed or enabled their use of digital pedagogies. This section presents the general findings of each of the research questions in turn. The findings for each research question are presented as the major themes emerging from the data. In each case, these themes are then discussed under relevant subheadings. While this research reveals that some educators' experiences echoed previous findings in PLN research (Oddone, 2022; Prestridge, 2017; Trust et al., 2017), new approaches to engaging with PLNs are also emerging, which are described in the following sections.

University Educators' Understandings of PLNs

The educators interviewed each identified a distinctive understanding of their PLN and the value that they gained through it. This reflects the findings of previous research which suggested that a PLN is an individual creation, described through idiosyncratic verbal and visual descriptions (Oddone, 2019; Trust et al., 2017). The common thread through each participant's insights was that the PLN was subject to constant change, informed by personal needs and interests, connections with different individuals and groups, and the platforms which enabled the connections. This is illustrated by the following examples of how the participants viewed the PLN as *people and platforms* and as *knowledge management*.

PLN as People and Platforms

Examination of the PLN visualisations revealed a recognised relationship between the social media that enabled the network to exist and the human presence which enlivens the learning taking place. While each

participant placed different emphases upon the technology within the network, there was the recognition that the PLN consisted of both people and platforms.

For research participant Bodhi, the technology is important only as an enabler of connections with other people and resources. Bodhi referred to their PLN map, (Figure 1 and Figure 2), and observed that they "would have loved to put everyone's faces on there" but conceded that naming different platforms allowed them to organise how they connected with these people.

Figure 1

Bodhi's PLN Map
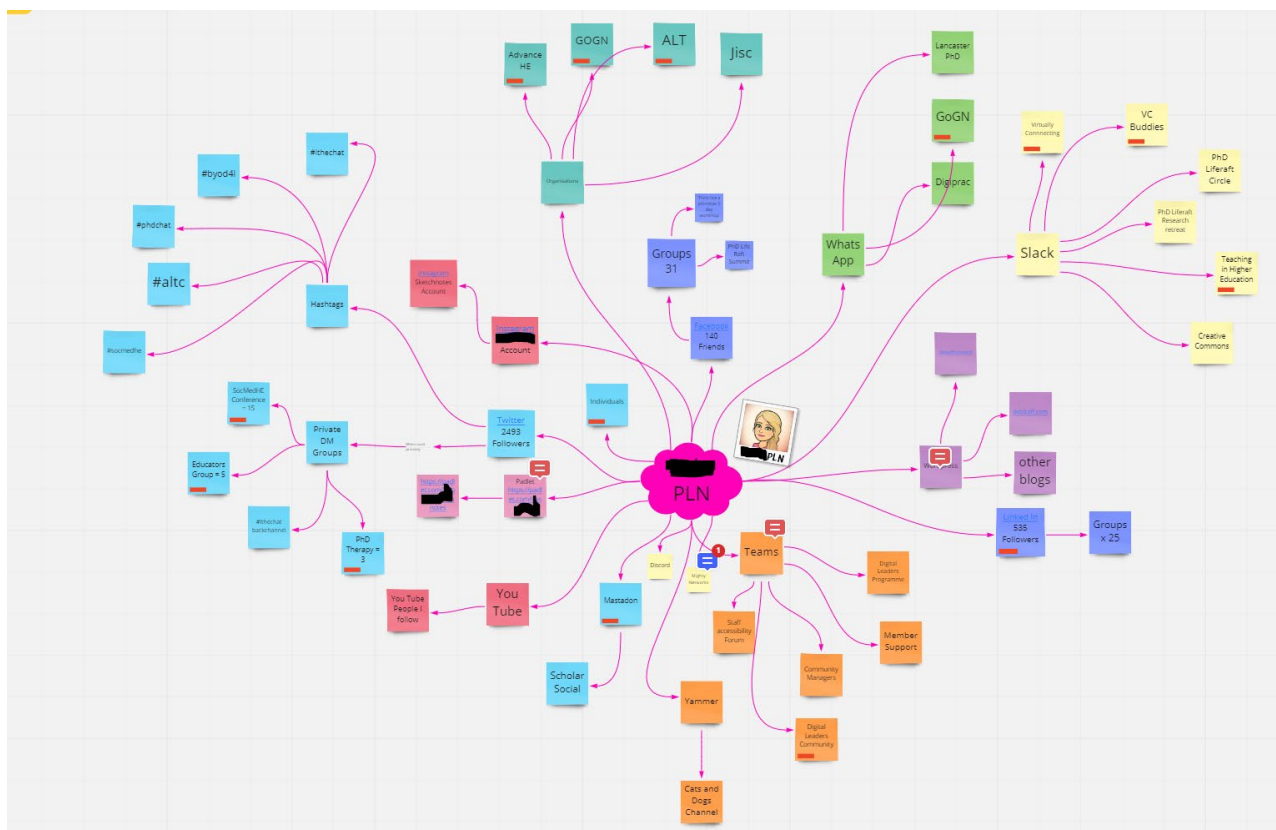
Figure 2

Magnified Section of Bodhi's PLN Map
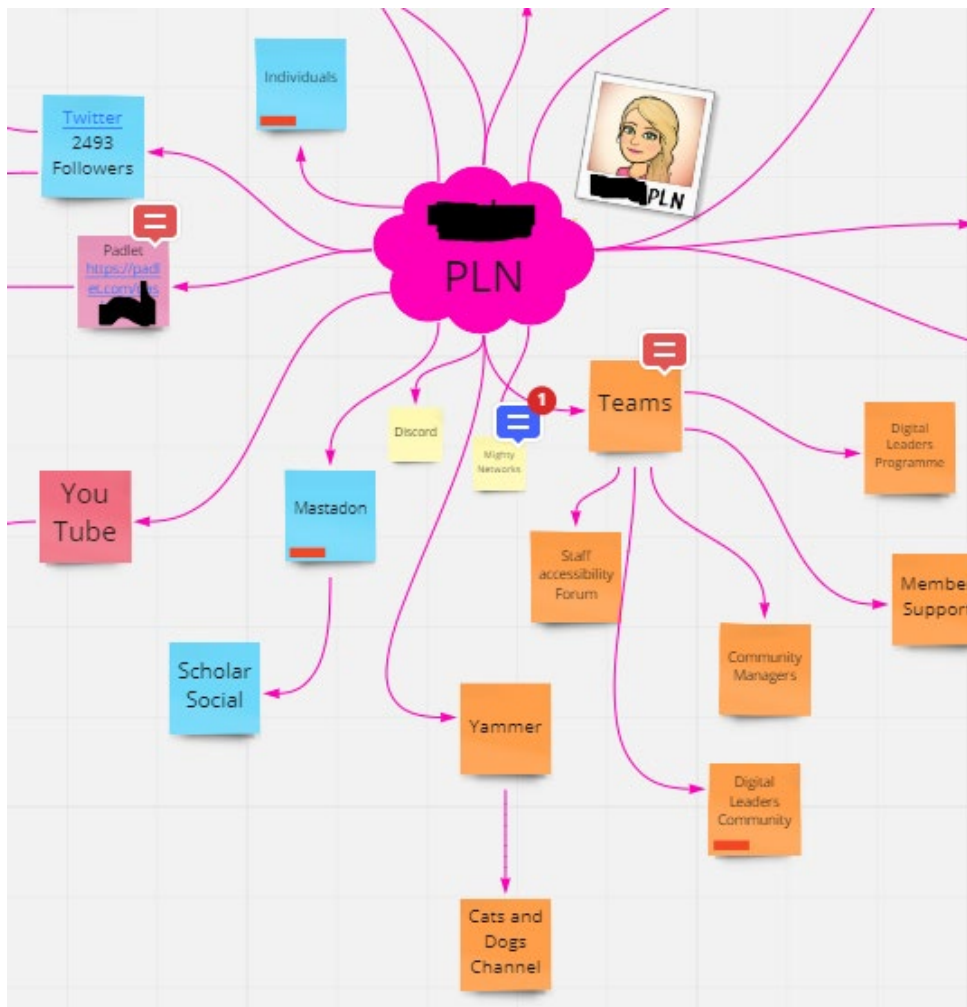
Technology plays a stronger role for Peyton, as it is depicted enabling access, creation, curation, and sharing knowledge, as can be seen in their visualisation (Figure 3).

Figure 3

Peyton's PLN Map
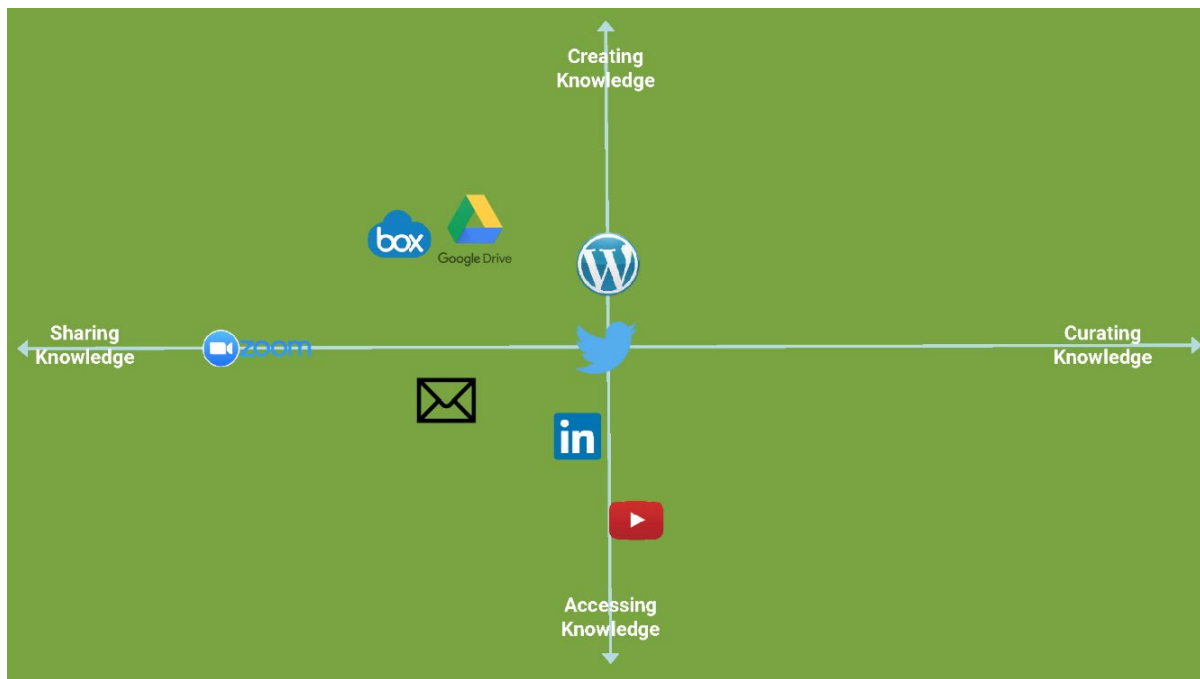
The blend of people and platforms is also reflected in the map created by Manning (Figure 4) who divides their network into tools, communities, and services.

Figure 4

Manning's PLN Map
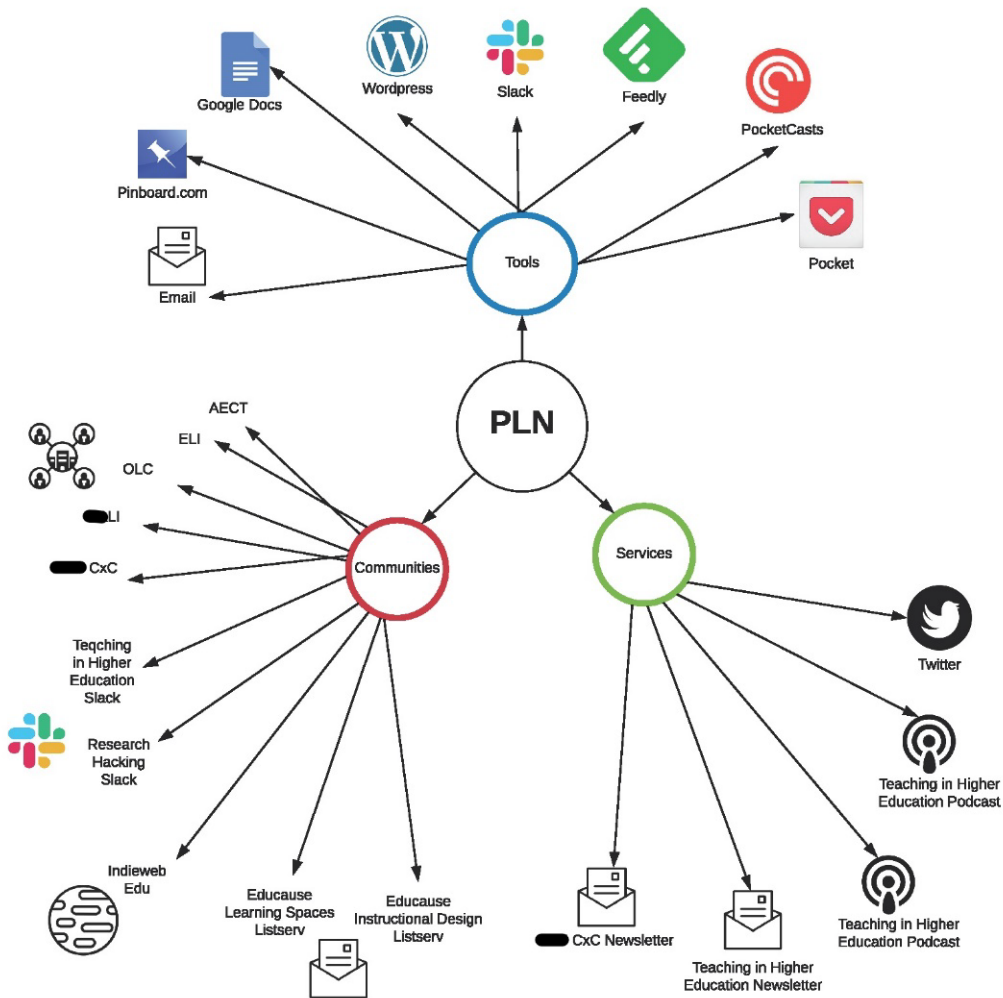
Each of these descriptors symbolises a different way to express the learning happening through the PLN. Manning explained that while the services represent the passive receipt of information via different digital channels, the communities indicate online spaces with more frequent two-way communication. The learning happening through interactions with services and communities is enabled through different tools, which are the avenues through which creation and connection occurs.

The Entangled Characteristics of Networked Learning. As exemplified in Figures 1–4, the participants' visualisations and accompanying insights emphasise connection as a prerequisite for learning to take place in the PLN. The entangled characteristics of people and platform within each PLN reflects the networked nature of this type of learning and demonstrates the complexity of social learning occurring within digital environments. Although learning through the PLN is informal, the inability to disentangle people and platforms has implications for the design of authentic formal learning opportunities within the digital space. As learning in higher education increasingly transitions to the digital space, educators may

find a PLN assists them to shift their pedagogical paradigms, moving beyond paradigms of teaching (objectivism) and learning (subjectivism) to a paradigm of knowledge (complexivism). A complexivist paradigm views learners as active agents and knowledge as residing within individual cognition and the networks that extend and connect individuals to other individuals, resources, and tools (Downes, 2010; Dron & Anderson, 2022; Siemens, 2005). Building experience of this type of learning paradigm through engaging with a PLN may enable educators to engage successfully with digital learning and teaching contexts where place, pace, relationship, media, time, and delegation may be undetermined (Dron & Anderson, 2022).

PLN as Knowledge Management

The concept of knowledge management through the PLN emerged in the visualisations of some participants, most notably in those by Oakley (Figure 5) and Flynn (Figure 6).

Figure 5

Oakley's PLN Map
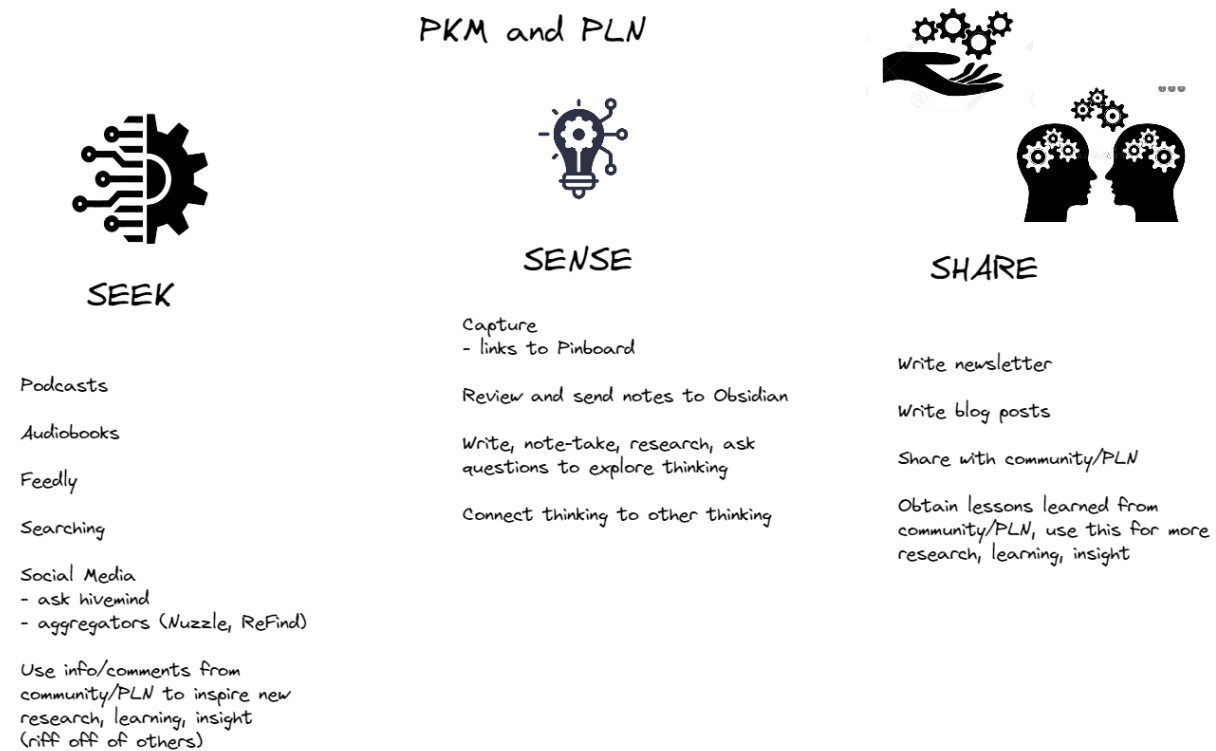
Figure 6

Flynn's PLN Map
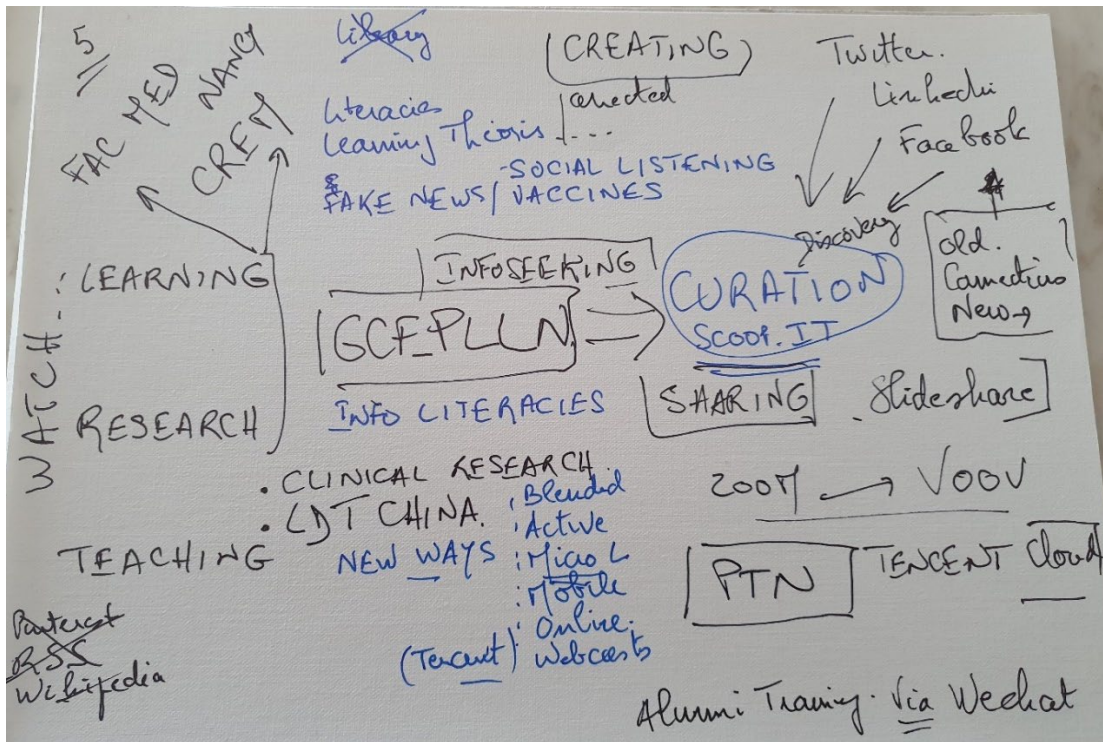
Oakley stated that they used the concepts of sensing, seeking, and sharing to visualise their PLN based upon their interpretation of the personal knowledge mastery framework (Jarche, 2020, Chapter 7). They explained that their habits and learning through the PLN had changed over time—from frequently sharing and resharing to a reflective approach, commenting that "maybe I should only share stuff that has my insight on it, my spin on it, and not just share other people's ideas like a bot or algorithm." Building in processes of knowledge management means that Oakley sees the PLN as "a circular iterative process, so this seeking is informing the sensemaking—making sense of information—and then the sharing is begetting new seeking so it never ends, it's a constantly turning wheel."

Flynn also referred to the way in which the PLN can assist university educators and students to manage the extreme amount of information currently available and continuing to be published, observing "it will be impossible to memorize everything, of course .... We need to have practices to find and to manage information." They commented that in their discipline, students do not receive training for information management and therefore students may not have the requisite skills to engage effectively with information overload. Flynn suggested that the strategies of personal knowledge management developed using content curation should be actively taught to students so they can remain abreast of new information and undertake the synthesis of topics that enable the discovery of new areas of research.

Learning Through Knowledge Management. Using the PLN for information discovery and sharing has previously been identified (Oddone et al., 2019; Prestridge, 2019; Trust & Prestridge, 2021). However, connections with the concept of knowledge management have not been drawn as clearly. The

64

actions of seeking, sensing, and sharing, and the steps involved in digital content curation, reflect a process of locating, analysing, and enriching the information prior to redistribution (Jarche, 2020, Chapter 7; Kanter, 2011). Engaging with these practices as university educators may inform ongoing development of innovative digital pedagogies that respond to changing student learning needs. Gonzalez et al. (2021) observed that considering university educators as subject matter experts may no longer hold relevance, as they are but one source within an information-saturated environment. Instead, emphasis might now shift to building student capacity to define, locate, evaluate, and apply information—to become efficient knowledge managers. Using the PLN as a method of personal knowledge management builds capacity through informal professional learning, raising educators' confidence and enhancing digital pedagogy.

Networked Professional Learning and the COVID-19 Pandemic

Research investigating informal professional learning through PLNs prior to the COVID-19 pandemic identified the flexibility of this mode of learning. Learning at any time or place, seeking just-in-time solutions, and engaging with people and resources beyond physical boundaries are drawcards of the PLN for time-poor educators (Prestridge, 2019; Trust et al., 2016). Each of the university educators interviewed had initiated their PLNs prior to the global pandemic. Their responses to whether and how the pandemic had influenced their PLN generated unexpected results. As discussed below, the findings relate to *changing spaces and configurations within the PLN* and *privacy, authenticity, and identity*.

Changing Spaces and Configurations Within the PLN

COVID-19 incited rapid technology evolution to meet newly created needs. A surge in uptake of communications platforms such as video conferencing and messaging applications occurred as people sought to connect digitally in lieu of face-to-face (Kemp, 2020, 2022). Participant Peyton observed this trend, saying:

> Zoom is actually pretty good for just creating a little space with colleagues with different channels, where you can invite external partners and individuals to certain channels …. Before the pandemic, I didn't know about this. Since the pandemic, I'm all Zoom and like it a lot … video calls, meetings, but also the chat channel.

Flynn echoed this sentiment, commenting that greater use of digital discussion tools improved their ability to find and connect with people sharing a common interest, regardless of their location. They tempered this by saying that although these connections were easier to make, maintaining them could be a challenge, as, in their experience, many prefer in-person communication. These observations highlight the complex and interrelated nature of people and the technologies that enable connections for learning. While the capacity to connect continues to proliferate, the success and longevity of these connections cannot be assumed.

Another impact of the global pandemic upon PLNs described by some research participants was a desire for closer and more purposeful connections. As a long-time user of a PLN, Oakley reflected that when they initially engaged online with others, they were more positive about open scholarship and complete transparency. They observed that "for a while I was totally open online and lately I've been thinking that it's better to have smaller tighter connections." This was in response to their personal experiences, where "some of the spaces have become so toxic that it's like is it worth it?" These negative experiences have shifted

Oakley's position, and they commented, "I think there's a need for a mix of public and private"—that university educators might continue to maintain a digital presence, but also interact within small private spaces where critical feedback from trusted others could be sought.

Having a nuanced approach to the PLN where spaces of varying openness exist was also highlighted by Bodhi and Manning, who each described a configuration of the PLN which included private direct messaging (DM) groups or channels on instant messaging (IM) applications. Research conducted prior to the pandemic focused on individuals connecting openly using applications such as Twitter and Facebook (Oddone, 2019). While Twitter continued to be a commonly mentioned tool in the visual depictions during this research, nodes in the network that consisted of small groups who met in private DM groups or IM channels were also a part of several participants' PLNs.

Co-Existing Communities and Networks. A differentiating characteristic of learning networks is that actors (the nodes in the network) may not know each other and are often connected through weak ties—relations or connections which are infrequent, serendipitous, and sometimes temporary (Haythornthwaite & de Laat, 2010). Weak ties within a PLN have previously been cited as a strength of learning through a network—creating an open structure potentially allowing access to a wider range of information, resources, and individuals than possible in a learning community dominated by strong ties (Dron & Anderson, 2014).

The emergence of strong ties within the PLN in contrast to a previous preference for openness may reflect shifts due to context collapse hastened or altered by the increased reliance upon online communication during the COVID-19 pandemic and ongoing. Context collapse refers to the blurring of boundaries which enables people, information, and norms to blend or merge so that different contexts are literally collapsed into a single space (Boyd, 2002; Marwick & Boyd, 2011). The potential for context collapse increased during periods of lockdown and social distancing, as students and teachers video-conferenced from their homes rather than in the public lecture theatre. The private environment of the home became visible in ways not previously experienced (Bjursell et al., 2022). While the ideals of open, connectivist approaches encourage the widest possible engagement (Siemens, 2007), it is possible that the blurred boundaries between professional and personal, exacerbated by the pandemic, created a desire for greater levels of control over spaces in which interaction occurred. This may have resulted in participants' reflections about privacy, authenticity, and identity, as outlined next.

Privacy, Authenticity, and Identity

Associated with changes in the configuration of the PLN, some of the educators interviewed discussed ways in which their beliefs about privacy, authenticity, and identity had altered in recent times. Learning by openly sharing thoughts and opinions created new concerns for Oakley, who commented that fear of reprisal had made them rethink the spaces in which they engaged. This reflection has had a flow-on effect to their teaching. While Oakley maintains that students should develop a digital identity, they encourage students to be more mindful about the degree of openness with which they share. Oakley thus sees digital identity as multi-layered across different spaces, while Peyton describes having a "split in my academic personality", using different platforms to meet different needs that reflect their learning goals and the requirements of their position. Bodhi, on the other hand, says, "I like to think that I'm the same online as I

am in person." Bodhi acknowledges open sharing requires a level of vulnerability, but that, in their experience, the risks to privacy and safety are like those in offline settings. They acknowledged that they are in a privileged position and that this might not be the case for everyone.

Shifting Spaces for Informal Networked Learning. The idea of different identities or different levels of visibility according to the purpose and place of interaction aligns with the visitors and residents model (White & Le Cornu, 2011). This model suggests that individuals interact online at different points along a continuum, from visitor to resident. Visitor behaviour is goal or task directed, generally leaving minimal traces as they use Internet resources, rather than engage in group membership. Conversely, residents engage, share information, and generally "belong", developing and expressing their digital identity through interactions and publications. This model can demonstrate the shift in how spaces within the PLN are viewed. While value persists in "visiting" open spaces, such as Twitter, to discover and distribute, it is within more private spaces that some educators may be taking up "residence." Desires for more efficient and trustworthy privacy infrastructure (Beduschi, 2021) may be impacting upon how some university educators manage their own privacy and digital identity while engaging with informal networked learning.

The PLN and Evolving Digital Pedagogies

Each participant highlighted benefits of having established connections with others for informal learning through their PLN. In addition, they experienced authentic and sustained opportunities for *developing digital pedagogies through the PLN*.

Developing Digital Pedagogies Through the PLN

Although each educator interviewed mentioned different digital pedagogies, some highlighted how their PLN engagement had influenced how they embedded digital technologies in their pedagogy. Flynn highlighted how their experience with curation and information discovery informs resource development and scaffolding students' own abilities in information management. They noted this is a vital skill in their rapidly changing discipline. Staying abreast of vast amounts of information and locating this information efficiently are key capabilities Flynn teaches students because of their own PLN experience. They introduce digital curation platforms such as Scoop.it to students and encourage use of these platforms to support research and additional reading.

Manning spoke about how their own experiences of learning through the PLN had encouraged the introduction of networked learning experiences to their students, aiming to build students' digital capabilities useful beyond their study. They discussed using the online annotation tool Hypothesis as a way of generating an open discussion among students about readings outside of the learning management system (LMS). Hypothesis is an open-source platform that enables social annotation—annotations are visible to others and can be commented upon (Kalir, 2022). Moving beyond the LMS, Manning hoped to find "a way to move from that kind of traditional discussion forum into something that started to resemble what I think is already happening in some kind of communities online and could happen productively inside of our class."

Informal Learning to Enhance Digital Pedagogical Practices. These examples demonstrate how university educators' experiences of informal learning through the PLN build their confidence and awareness of the use of different digital tools and platforms in teaching and learning. The thread connecting these examples is that using digital technologies and connecting with others through digital channels builds not only technical skills but also digital pedagogical practices—where technology is viewed as a tool to enable engagement and enhance learning (Prestridge, 2012). Digital pedagogical competencies in these examples of practice are demonstrated by leveraging technology to empower students as active users and creators of information (Prestridge, 2012; Väätäjä & Ruokamo, 2021). The PLN enables university educators to nurture their digital literacy skills, with a flow-on impact upon their digital pedagogy competency. Personalising and enacting agency over informal professional learning through the PLN offers support for educators who are "bruised" from the disruption and forced transition to online created by COVID-19 (Romero-Hall & Jaramillo Cherrez, 2023, p. 9).

Limitations of This Study

This research aimed to investigate the lived experience of university educators who engage with a PLN for professional learning. I sought a global reach by recruiting participants via different social network channels, although the number of university educators who volunteered (five) was lower than anticipated. This may be attributable to high workloads and levels of occupational stress as the COVID-19 pandemic has exacerbated already demanding roles (Karatuna et al., 2022; Lee et al., 2022; Watson et al., 2022). However, a relatively small number of participants is appropriate to a qualitative study like this which seeks in-depth insights about a particular aspect of human experience from a range of individual perspectives and disciplinary backgrounds. The qualitative exploratory nature of this study differentiates it from larger scale quantitative research which usually aims to produce generalisations regardless of context (Lincoln & Guba, 2016).

Conclusion

The findings presented in this article present some important implications for further research. When compared to research findings of school teachers' experiences with professional learning through PLNs, the university educators interviewed placed a greater emphasis upon connecting with people and platforms, and information and knowledge management. There is also growing awareness of how the PLN builds information skills and knowledge management, which can be embedded within digital pedagogical approaches with students. The findings suggest that further research is needed to investigate how PLNs might enable educators to further develop their digital pedagogies and more effectively support their students' management of digital information, in order to effectively navigate a complex information environment in times of crisis and information disorder (Anthonysamy & Sivakumar, 2022; Tekoniemi et al., 2022). This article reveals that although engagement with a PLN continually changes, there remains rich potential for informal networked learning to enhance the teaching practices of university educators.

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Appendix

Prompt Questions of the Semi-Structured Interview

The PLN Map

- Could you please explain the design and content of your PLN map?

- Did the process of mapping your PLN surprise you or provide new insights into how you describe the professional learning you undertake when online? Why do you think this may or may not be the case?

- Would you please share any thoughts or feelings you experienced while creating this map of your PLN.

Experience of PLN

- How would you describe the professional learning you undertake when engaging with your PLN?

- To what extent has the COVID pandemic influenced your professional learning experiences? Why do you think this is so?

- How has your engagement with your PLN changed since the beginning of, and during the COVID pandemic?

- What inspired you to begin developing an online PLN?

- How do you develop and maintain and/or extend your PLN?

- How does interacting with your PLN make you feel?

PLN for Professional Learning About Digital Pedagogies

- Would you recommend professional learning through a PLN for improving your understanding of digital pedagogies? Why or why not?

- Please tell me about an example of digital pedagogy that you have implemented as a result of your learning through your PLN.

- What would you consider to be advantages and disadvantages of a PLN for professional learning?

- What are your words of advice for academics considering initiating a PLN for the purposes of professional learning?

Can Open Pedagogy Encourage Care? Student Perspectives

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Abstract

As a response to the increasing commercialization of postsecondary education, educators argue for a practice of care in education. Open pedagogy (OP) seems like an ideal practice where care, trust, and inclusion can be realized. OP is characterized as a democratic and collaborative pedagogical practice, in which students and teachers work to co-create learning and knowledge using openly licensed materials, open platforms, and other open processes. The purposes of this study were, first, to reveal ways students in postsecondary institutions perceive care and, second, to determine how students suggest OP can be used to create an open/caring learning process. A task-oriented focus group method engaged students from four teaching-focused institutions. The students created open cases on social issues for class discussion and reflected on care and OP processes in postsecondary settings. Using four elements of the ethics of care—attentiveness, responsibility, competence, and trustworthiness—as conceptual categories, the study examined students' experience of care and care in OP using affective coding and thematic analysis. The results showed that through OP, with teacher support and explicitly designed practices of care, students can assert their agency, have quintessential roles in creating and participating in highly relevant curriculum and importantly, care about others, and be cared for. OP is a process able to involve a diverse population of students and embody care as an all-encompassing practice.

Keywords: open pedagogy, ethics of care, inclusion, student perspectives

Introduction

Educators have warned against the increasingly commercialized, transactional relationships created in postsecondary institutions: with students as individual customers and teachers as providers of credentials according to market forces (Molesworth et al., 2009; Tomlinson, 2016). Countering these transactional relationships between teachers and students, educators have argued for a practice of care in education. Teachers and students need to develop trusting relationships with each other (Anderson et al., 2020; Velasquez et al., 2013) and create inclusive classrooms for everyone (Bovill et al., 2016; Faulkner et al., 2020).

Open pedagogy (OP) is an educational practice in which care, trust, and inclusion can be realized and through which students are intended to be thriving, collaborative learners creating knowledge together. OP has long associations with constructivist and critical approaches (DeRosa and Jhangiani, n.d.). Morgan (2016) traces an early iteration to Paquette (1979), who outlines three foundational values of OP: autonomy and interdependence, freedom and responsibility, and democracy and participation. These values resurface in more recent OP approaches which DeRosa and Jhangiani (n.d.) emphasize are committed to open access, learner agency and learning processes that aim to involve students in helping shape the "public commons of which they are a part" (para. 13). OP can be seen to be democratic, collaboratively involving students and teachers in knowledge co-creation that can then be shared back to the community through openly licensing materials, using open platforms and open processes. According to DeRosa and Robison (2017), in their examples of OP, teachers would support a diverse population of students to create open educational resources (OER) that can represent their own experiences and contexts. DeRosa and Robison (2017) give examples of OP such as class co-created "textbooks" or syllabi and "open" assignments where students edit Wikipedia pages or create videos of course content to share on social media.

By its nature, OP is an ideal place to enact attentive, responsible, competent, trust-building care, as it has been defined by ethicists such as Noddings (2013), Held (2006), and Tronto (2013). OP embodies care by encouraging inclusion of underrepresented peoples (Robertson, 2020) and student agency (Baran & AlZoubi, 2020; Werth & Williams, 2021) and by facilitating the creation of curriculum and assignments that contribute to social goals (Hodgkinson-Williams & Trotter, 2018).

Care is relational. Teachers may believe that care is shown by facilitating student agency and encouraging their involvement in creating curriculum. Not enough is known about how students perceive this care or how an open pedagogical design can help to foster sustained care in teacher-student relations in education. These are important investigations. The two purposes of this research are, first, to reveal ways that students in postsecondary institutions perceive care and, second, to determine how students suggest OP can be used to create an open/caring learning process. Using cross-institutional focus groups and thematic analysis, this qualitative study explores the following research question:

- How and in what ways does the process of open pedagogy allow for care to be enacted in teacher-student relations in postsecondary institutions?

Literature Review

Ethics of Care

This research investigates student perspectives on care using the philosophy of an "ethics of care" (Barnes et al., 2015; Held, 2006; Noddings, 2012, 2013; Tronto, 2017). Instead of using traditional ethics where humans are considered autonomous decision-making individuals, care ethicists argue for a description of humans as embedded and needing relationships (Barnes et al., 2015; Held, 2006; Noddings, 2012, 2013; Tronto, 2017). An ethics of care has the following elements (behaviours): attentiveness, responsibility, competence, trust, and responsiveness (Noddings, 2012, 2013; Tronto, 2013). An attentive carer is mindful and receptive; they take responsibility for meeting needs, and they competently cultivate knowledge to meet an array of expressed needs, thereby building trust (Nodding, 2012; 2013). Sometimes responsiveness to care is not possible; the cared for may be vulnerable or unknown to the carer (Held, 2006; Tronto, 2013). Care ethicists also argue that care is central to democratic society (Held, 2006; Tronto, 2013, 2017), including that care ethics should respond to the "distance and difference" that race brings to care in an unequal world (Parvati, 2019).

The "ethics of care" have been operationalized in education. Educators Sinkinson & McLure (n.d.; 2021) created a framework for reflection based on Noddings' (2012, 2013) and Tronto's (2013, 2017) elements of care as above. For example, Sinkinson and McLure (n.d.) show how teachers, when creating OER with students, can enact "attentiveness" by reflecting on "How might you actively listen and make visible attentive enactments of your listening?" (section 2). However, operationalizing the ethics of care in education is not always uncomplicated. Lansdown (2021) asserts that an ethics of care practice must mean being patient and letting ideas *emerge* from dialogue in trusting relationships between students and teachers. Walker & Gleaves (2016) observe that teachers talk about their practices in terms of trust and attentiveness and that they centre relationships with students; however, these teachers reported that emotional boundaries with students become muddied. Waghid (2018) controversially argues that in classrooms, intentional dialogue, debate, and even dissonance should be considered acts of caring.

The Commercialization of Postsecondary Education and Pedagogical Care

Educators have expressed concern that students are increasingly considered as customers and postsecondary education as a commercial business answering to market demands (Lolich & Lynch, 2016; Molesworth et al., 2009; Tomlinson, 2016; Wilkinson, 2020). The commercialization of postsecondary education encourages heightened individualism and undermines pedagogical relationships between teachers and students. This commercialization devalues human connections, exploratory learning, and the transformation of students into critical thinkers, collaborative learners, and caring people (Carey, 2013; Lolich, & Lynch, 2016; Molesworth et al., 2009; Tomlinson, 2016; Wilkinson, 2020).

Despite the commercialization of postsecondary education or because of it, educators argue for a practice of pedagogical care. Reviews of research confirm teachers' exemplifiers of care: showing empathy, giving praise, having high expectations of work, and showing concern for students' personal lives (Velasquez et al., 2013). The student-teacher relationship should be one of care and trust (Anderson et al., 2020; Walker & Gleaves, 2016). Teachers should be vulnerable, real people to create trust (Frizelle, 2020; Hardwick, 2021).

Beyond inclusive relationships between students and teachers, students want their ideas and experiences to be an influential part of co-created curriculum (Bovill et al., 2016; Cook-Sather, 2015; Faulkner et al., 2020; Maultsaid, 2022; Wymer & Fulford, 2019). Similar to care ethicists who argue that care is central to democratic society (Held, 2006; Tronto, 2013, 2017), educators and researchers assert that practices of care and inclusion should be underpinned by recognition of systemic inequalities that may challenge students and teachers' practices of care (Mariskind, 2014; Parvati, 2019).

Open Educational Practice and Open Pedagogy

Open educational practices can take place in live or online classes or as multi-site projects and can include multiple elements of teaching and learning, including participatory and critical pedagogies, open librarianship, open science, the use of open-licensing and open technologies, the use and/or creation of OER and a focus on collaboration and representation of multiple perspectives (Cronin, 2017; Koseoglu & Bozkurt, 2018). Hegarty (2015) describes OP as having several attributes, among them that it develops trust and openness in working with other people, encourages free sharing of ideas, facilitates learner contributions to OER, and contributes to a practice of peer review. With the focus of OP on the co-creation of knowledge and empowerment of students to help shape their education and communities, proponents contend that open educational practices and OP in particular can help realize social justice goals in the world (Bali et al, 2020; DeRosa & Jhangiani, n.d.; Hodgkinson-Williams & Trotter, 2018; Lambert, 2018).

Student Perspectives on Open Pedagogy

Empirical research on open educational practices with students has historically focused on the cost-savings of free, open textbooks and on the learning outcomes of students; these outcomes were comparable whether OER or commercial textbooks were used (Clinton-Lisell, 2018; Hilton III et al., 2016; Jhangiani et al., 2018). More recently, and encouragingly, given the commercialization of postsecondary education, studies have considered student perceptions of their participation in OP and of using OER. Students have valued their greater sense of self and agency (Axe et al., 2020; Baran & AlZoubi, 2020; Werth & Williams, 2021) and believed that their skills at collaboration are improved (Ashman, 2021). Students believe their learning in OP processes is relevant and meaningful (Baran & AlZoubi 2020; Hilton III et al., 2019). Finally, students perceive faculty who are involved in OP as kind teachers (Vojtech & Grissett, 2017).

Students are often willing to contribute to public knowledge and to the learning community (Clinton-Lisell, 2021; Werth & Williams, 2021; Zhang et al., 2020). However, students have expressed concerns about OP: that is, about whether their material is accurate (Hilton III et al., 2019) and of high quality (Hendricks, 2021). Some studies reveal that students are concerned about having enough skills to navigate open technologies (Harrison, 2021; Zhang et al., 2020) or about protecting their digital privacy if they publish their names (Harrison, 2021). Given these concerns, OP appears as a sometimes-challenging process for students.

Care in Open Pedagogy

As described in the literature above, the theory and practice of OP appear to discourage treating students as individualistic customers and instead encourage treating them as respected, collaborative learners. With its emphasis on facilitating student agency and encouraging their involvement in creating curriculum, OP appears to be a practice that enacts care as described in the literature cited above. To research how the

emerging educational practices of OP might enact care, we conceptually mapped OP qualities to understand how those qualities might be similar to qualities of the ethics of care (which are a description of human behaviours in general). We used the elements of the ethics of care—attentiveness, responsibility, competence, and trustworthiness—as our organizing categories for analysis to investigate how students describe care and OP. We posited that we would see OP demonstrate care in many ways. Through research on students' perspectives, we would be able to confirm that OP is, in truth, an actualization and demonstration of the ethics of care (see Table 1).

Table 1

Ethics of Care Actualized in Open Pedagogy

Ethics of Care	Open Pedagogy
Relational (we are embedded in and need relations)	Relational/anti-individualistic (projects are collaborative/in context)
Encourages vulnerability (by offering and receiving care)	Encourages vulnerability (by being inclusive and soliciting peer review)
Shows reciprocity	Is reciprocal/sharing
Shows trust	Shows trust in the learning community through modifiable open education resources (OER)
Attentive (mindful)	Considers learners', teachers', and learning community's needs
Responsibly maintains relationships even when not reciprocal	Committed to creating open resources even when it is unknown who is using the shared OER and how
Competent (to provide care)	Relevant: uses OER creators' experiences and the real world

Methods

The two purposes of this research are to reveal ways that students in postsecondary perceive care in general and to determine how students suggest OP can be used to help create and sustain an open/caring learning process between teachers and students.

Research Design

A qualitative research approach, using thematic analysis, was chosen as it allows for the analysis to be informed by themes in existing research and for the examination of multiple meanings interpreted based on researchers' own contexts and subjectivities (Braun & Clarke, 2021). This type of thematic analysis contributes to the conceptual bodies of knowledge about postsecondary students, about the ethics of care, and about OP and does not need to claim to be generalizable to all students (Braun & Clarke, 2021). Because the focus of this research was student perspectives, thematic analysis was a suitable method; as Nowell et al. (2017) emphasize, thematic analysis can be a powerful tool to examine the "perspectives of different research students, highlighting similarities and differences, and generating unanticipated insights" (p. 2).

The goals were to investigate student perspectives on care and OP, as well as whether (according to students) the pedagogical *process* embodies and enacts care between students and between teachers and students. Therefore, a task-oriented focus group method (Krueger & Casey, 2015), designed to be inclusive (Bergmark, 2019; Siry & Zawatski, 2011), was chosen so students could discuss issues of OP and care (as in Table 1 above) but also work together in an OP process.

Participants and Data Collection

Following research ethics board (REB) approval, students were recruited at four British Columbia postsecondary institutions. Institutions which focused on small class sizes, had various programs, and both domestic and international students were chosen so that participants would represent a diverse population. Participation was solicited over three months using email invitations through faculty, student service departments, and open education working groups and by using institutional news sources. Participants self-selected in by completing the consent form and enrolment questionnaire. Multiple institutions were also targeted to reduce assumptions and to facilitate democratic functioning (an OP principle), as the students would likely be unfamiliar with the principal investigator / focus group facilitator and each other.

Students were invited to participate in an OP project, where they would develop ideas (during collaborative focus groups) for an OER case book that would provide realistic class discussion scenarios to explore ethical issues related to discrimination, diversity, and other social issues in the workplace. Recruitment invitations provided a link to the consent forms and an enrolment questionnaire that also collected student data (institution, program, demographics) and asked about interest in potential topics for discussions for the case writing in the focus groups. The questionnaire also helped to determine eligibility, which was intended to include undergraduate students in any program. Twenty-eight students completed the questionnaire, and of these, 16 students further self-selected (via email) to participate in the focus group series in the fall of 2021. Of these 16 participants, 10 self-selected to continue to write for the OER case book project over the spring of 2022.

Focus Group Process

Students were organized into four smaller groups (of three to five students) and agreed to participate in three 3-hour focus group sessions. Facilitated by the principal investigator and a student assistant, each focus group discussed care in postsecondary institutions and also worked through tasks to begin drafting the OER cases (Maultsaid, 2023). In the questionnaire, students listed preferences on social issues of concern, for example, "Invisible disabilities at work." In the focus groups, students chose from this list and

started discussing the development of a scenario to be included in future cases. Due to COVID protocols, as well as geographic distributions, Microsoft Teams video conferencing was used to host and record the focus groups. The focus group organization was based on principles of OP that included democratic processes encouraging vulnerable, collaborative, and caring student co-creation of relevant materials based on their experiences and anticipated sharing of free, openly licensed materials. At the end of each session, students responded to a reflection prompt with their thoughts about OP and the focus group process (Maultsaid, 2023). Throughout the spring of 2022, students ($N = 10$) in groups of two to four asynchronously continued to develop the OER (cases) from the focus groups. The student groups had autonomy and worked on the cases on their own schedules, using their own ideas. These students' final reflections were also collected ($N = 6$).

Data Analysis

Coding and Thematic Analysis

The questionnaires of focus group participants ($N = 16$), their focus group transcripts, and their reflections were analyzed using qualitative coding and thematic analysis (Braun & Clarke, 2021; Nowell et al., 2017; Saldaña, 2021). The team (the co-authors and student assistant) focused on the student experience, using "affective" coding: students' emotions, beliefs, and dilemmas to look for patterns (Saldaña, 2021, Ch. 7, p. 159). We also coded for the focus group process of OP, looking for phenomena such as "developing student agency," codes inspired by Baran & AlZoubi (2020) and Hegarty (2015).

Keeping the background concepts of ethics of care and OP in mind (Table 1 above), each member of the team completed and documented several rounds of coding. The team discussed and compared codes to establish a rich, nuanced understanding of each other's ideas and established trust in each other's interpretations based on the literature, the data, and researchers' experiences (Braun & Clarke, 2021; Saldaña, 2021). Each member consolidated their analysis into a codebook. See codebook examples in Table 2.

Table 2

Codebook Examples

Focus Group Context	Participant Speech	1. Top Code (Care or Open pedagogy)) 2. Code for Role 3. Affective Code
What does care look like to a student?	*"I found it really caring of an instructor who adapted their regular syllabus [by] keeping in mind that we were all stressed out and overwhelmed…"*	1. Care 2. Teacher 3. Aware of students
How is creating materials together showing care?	*"…just really making sure you're not jumping to any conclusions or rash judgments about what they're sharing or saying and just really having in this case, that mutual respect for one another."*	1. Open pedagogy 2. Student 3. Mutual respect / No judgement

The researchers then organized codes under four sub-research questions that would help us answer different facets of the overall research question: *How and in what ways does the process of OP allow for care to be enacted in teacher–student relations in postsecondary institutions?*

The sub-research questions are as follows:

- "How have students experienced care (self, other students)?"

- "How have students experienced teacher's care?"

- "What do students think about open pedagogy?"

- "How does open pedagogy embody an ethics of care?"

According to the sub-research questions above and using the predetermined conceptual categories of the four elements of the ethics of care—attentiveness, responsibility, competence, and trustworthiness—we analyze students' experience of care and care in OP in more detail below. Note that "responsiveness" is another element of the ethics of care, but we did not portray this here. In the ethics of care elements, "responsiveness" means that the cared for person responds to show that care was received (Held, 2006; Noddings, 2013). We could not investigate this element as it would require longer observation of relations in focus groups and classroom settings. Instead, we categorized codes such as "reciprocity" as part of the "trust building" conceptual category.

Results

Student Profiles

The focus group participants were from five subject areas: arts, business, health, social sciences, and science. In the questionnaire, students were asked to identify themselves by race, disability and/or as members of the lesbian, gay, bisexual, transgender, queer, two-spirit plus (LGBTQ2+) community. Obtaining this unpublishable, protected information ensured underrepresented students would be able to speak freely in the focus groups. Though these populations were not targeted (participants were self-selected), 100% of the focus group students (N = 16) were from one or more underrepresented groups by gender, race, disability, sexual orientation, or international student status.

How Do Students Experience Care in Postsecondary Education?

In this section, we portray students' experience of care. We combine two sub-research questions— "How students have experienced care (self, other students)" and "How students have experienced teacher's care"—since the ethics of care elements are describing relations between people and we are investigating student-to-student and teacher-to-student relations together.

We portray results as themes, using the four elements of care—attentiveness, responsibility, competence, and trustworthiness—and combining students views of student-to-student and teacher-to-student relations under the theme. Our themes below are as follows: "Attentive Students and Teachers"; "Responsible Students and Teachers"; "Competent Students and Teachers"; and "Students and Teachers Building Trust."

Attentive Students and Teachers

To be attentive is to be mindful, observant, and receptive. Many students stated that "attention" and "empathy" represented care for them; they had *sometimes* experienced this care in postsecondary education. Students experienced teachers' care when teachers provided individual attention, such as reaching out for personal "check-ins" and treating students as "whole people." Teachers were considered receptive (attentive) if they were available and gave their time. Students also experienced teachers as attentive (mindful) if teachers openly addressed inequalities of our institutional systems.

Responsible Students and Teachers

To be responsible is to figure out how to provide respectful care and to provide care even if there is no response. Students experienced responsible care from other students when they were "non-judgmental" when creating curriculum together. As participants said, teachers would "take responsibility" when they used clear communication and guidelines and designed ways to encourage student connections with each other.

Students also experienced challenges to experiencing responsible care, for example, when they did not feel safe. As one student shared, when the teacher saw their many-coloured pens, "The teacher said, 'Ya, right, her coloured pens. It's so silly. Like what is this, Kindergarten?' I was shocked . . . It made me feel less safe to speak in his class."

Competent Students and Teachers

To be competent is to be able to show care by developing knowledge and skills to meet a variety of needs. Students described showing and receiving competent care from other students when there was active participation in the course community. Students experienced teachers as caring when teachers provided relevant curriculum and created materials and activities that were contextualized, authentic, and inclusive (e.g., diverse readings). Care for students was shown by teachers providing choices, alternative assessments, and low-stakes options such as participants suggesting "games" that encouraged learning and "fun." Students believed that when teachers inflexibly adhered to the rules, teachers were not showing care.

Students and Teachers Building Trust

To build trust is to take on the sustained responsibility and attentiveness of providing care. Students want care to be reciprocated by other students. When discussing caring teaching approaches, one participant shared:

> In my class we are free to speak as much or as little as we like. We often use the break to talk with other class members. I feel more at ease in that class because I can express my opinions without any judgement, and I feel welcomed.

However, students shared that they sometimes felt "shy" or "anxious" in trying to make connections with others. Some students expressed a need to focus on their jobs, their own academic careers, and "personal lives," which created challenges in showing care. One participant stated, "Sometimes a student is working part time. They're taking full-time courses. They're probably falling behind in their courses."

To help build a sense of trust within the classroom, students thought that teachers could be facilitative of connections by talking about their own lives. Students also believed that teachers were trustworthy when the teacher took time to solicit student input and encouraged their agency. Students contrasted that sense of trust with experiences of teachers being dismissive of students or treating them, as one participant mentioned, like "robots."

Another participant stated: "With professors, care is not returned when it's just empty words and intentional egotistical misunderstanding of what we are going through. [The professor believes] you just need to power it through and get this done for me."

As above, the researchers portrayed the results under four themes. In addition to the student's own words above, see Table 3 below for a condensed interpretation of ways students experience care under these themes.

Table 3

Student Characterizations of Care

Role	Attentive	Responsible	Competent	Trustworthy
Students show care (to selves, other students)	• Empathy	• No judgement	• Active participation	• Reciprocity • Peer support
Teachers show care	• Check-ins • Time • Sustained, intentional attention • Seeing whole person • Addressing power inequalities	• Clear guidelines • Respect • Designing ways to support connections	• Inclusive materials • Relevant curriculum • Student experience included • Alternative assessments • Low stakes activities	• Encouraging connections • Soliciting student input • Encouraging student agency • Being vulnerable

Open Pedagogy: How Is Care Experienced?

In this section, we show students' perspectives on OP, combining two sub-questions: "What do students think about OP?" and "How does OP embody an ethics of care?" Again, we express the results as themes. Our themes below are as follows: "Attentive Students and Teachers"; "Responsible Students and Teachers"; "Competent Students and Teachers"; and "Students and Teachers Building Trust." We again combine participant views of student-to student relations and teacher-to-student relations under the themes. For a condensed interpretation of ways participants experience care in OP, see Figure 1 below.

Attentive Students and Teachers

As highlighted above, attentive care means being mindful, observant, and receptive. From an OP perspective, students emphasized that instructors could show attentive care by providing or co-creating curriculum that is inclusive and representative of the diverse population. As one participant shared,

> . . . knowing that more marginalized people are being represented properly. That is first and foremost what I think care looks like in this situation. Knowing people took the time to properly represent other peoples' experiences that maybe don't have their experiences as magnified as more dominant.

Students also felt that teachers being receptive was important; that meant not just being available, but overtly addressing the inequality of power/relationships in the classroom and building student perspectives into the curriculum.

Responsible Students and Teachers

Students felt that OP would enable them to be more responsible. Students shared that contributing to current and future student learning—by creating and sharing materials, providing constructive feedback, and being active participants in a wider learning community—were ways of showing care. To students, care could be shown by providing recognition for others' work, including sharing and commenting on that work, or "citing it."

At the same time, students shared that open pedagogical processes (student-directed learning) might impart too much responsibility. A participant stated,

> I would freak out ... I am always over stressed about the quality of the work that I put in, but I think it would have the extra layer if I don't do this right ... if somebody else needs this for their career and I don't give them the right information, then I would feel that stress.

Students also believed that they needed teachers' guidance about the rationale for, and benefits of, OP. They also suggested that they needed encouragement as they learned how to create their own materials, take more self-direction, and provide peer feedback.

Competent Students and Teachers

As previously highlighted, competent care means people use and develop broad knowledge and skills to meet needs. From an OP perspective, students shared that having relevant, accurate OER that elicited meaningful learning would be caring. For students, relevance meant that content and assignments had links to the real world (authenticity), were relatable (to their own contexts), were transferable, and also helped them learn. Students emphasized that OP can provide opportunities for meaningful learning that "sparks imagination," is "super empowering," and helps students feel they are "making a difference."

In the focus groups, students shared concerns about accuracy, both in creating materials themselves and in not feeling confident enough to critique others. They believed that instructors showed care when they provided clear feedback and corrections around misconceptions or errors. In the final reflections of the student case writers ($N = 6$), after participating in their own OP only one writer-participant continued to express concern about "low quality writing." One writer-participant said that they had never been concerned because they expected the teacher to review the OER. Other writer-participants changed their perspective because they believed their peer review process had ensured accuracy. A writer-participant stated,

> After going through the whole writing process myself, I am starting to think that OER are not that bad. ... The writing process is extensive and well thought by the student writers [who] are the editors. The ongoing reviews on the same piece of writing is [sic] what makes it so much more inclusive of any potential readers of the resource. The reviewing is done by a wide variety of people all of different genders, beliefs, race, etc., this diversity makes the resource quite accurate and inclusive of all readers.

Those writer-participants who had gone through the peer review process during asynchronous case writing were less concerned about accuracy of materials. However, throughout the results, including in the final

reflections by case writers (*N* = 6), some participants still believed that they needed teachers to help ensure that they were being inclusive in their OP processes and in their OER.

Students and Teachers Building Trust

Students said trust could be built if teachers intentionally plan for student connections, including encouraging students to have "roundtable" discussions with each other to plan OP projects. Students shared that a sense of reciprocity in their OP processes and the learning community—not being "competitive," compromising, not judging, sharing materials—would create trust and show care. A participant stated,

> Because maybe someone can give you insight on how they do it or what worked for them, and then you can try it out too. [There is a] community, maybe you can meet like-minded people who care so much about the subject.

That desired sense of reciprocity was present in the focus group process. Part of the research design was to investigate the active OP process in the focus groups, and we observed active sharing of ideas, student initiative (agency), and respectful peer feedback. The writer-participants who worked on the cases later, confirmed that having agency was significant, with a writer-participant stating, "[We had] space and liberty."

For students, encouraging agency builds trust. Students also highlighted ways teachers might discourage agency and suggested they needed guidance, but not rigid rules: "I feel like [restrictive guidelines] would almost stifle creativity, especially if all of a sudden you have these sort of rules and regulations."

In addition to the participants' own words above, Figure 1 displays a condensed interpretation of ways participants experience care in OP under the four themes.

Figure 1

Participant Perspectives: Care in Open Pedagogy
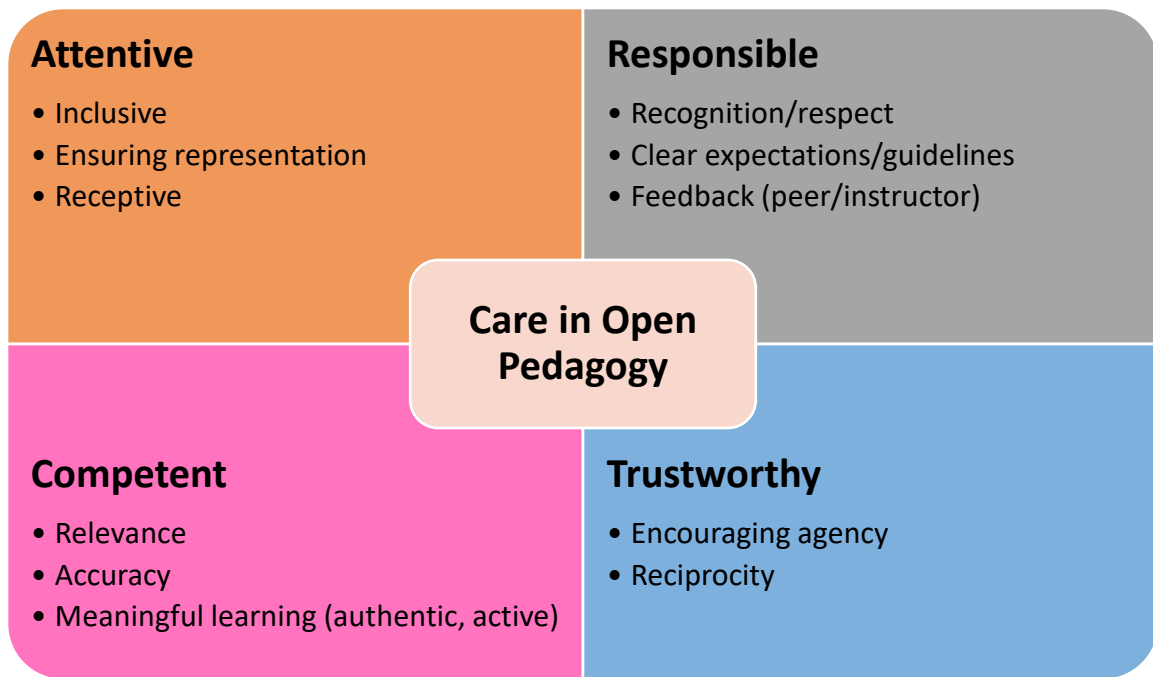
Discussion

This study focused on student perspectives of the care they have experienced in postsecondary institutions. The study then explored how OP can promote student and teacher relationships of care. Our findings resonate with past studies and further elaborate on researchers, educators and students' views on pedagogical care and on OP.

As highlighted in Table 1, we believe that OP is an actualization of the ethics of care. According to students, OP, because of its relational, collaborative nature, highly values and embodies care. The processes of OP encourage students and teachers to be attentive, responsible, competent, and trust-building. This research demonstrates that these students view the exemplifiers of teaching practice such as "giving time" as, in fact, features of a practice of care. Students also view exemplifiers of OP such as "creating relevant curriculum" as features of an overarching practice of care.

The researchers used the elements of the ethics of care as the categories for analyzing data. Firstly, concerning results about *attentiveness*, students in this research suggest that they experience care from teachers if attention is sustained and intentional. As students are more likely to show care for one another when they are actively participating in class and groups, we suggest that teachers design for these opportunities. In an OP practice, teachers can foster sustained and intentional attention by creating inclusive, democratic classrooms, soliciting student perspectives, listening to student's requests for representation, and encouraging everyone to take their own lives into account during projects (Anderson et

al., 2020; Faulkner et al., 2020; Sinkinson & McClure, n.d., 2021; Vojtech & Grisset, 2017; Walker & Gleaves, 2016). Students also expect teachers to address power imbalances in and outside of the classroom. Literature suggests that addressing power imbalances and working for social good are built-in aims of OP (Bali et al., 2020; DeRosa & Jhangiani, n.d.).

Secondly, concerning results about *responsibility*, students shared that they experienced *responsible* care from other students when those students were non-judgmental. Responsible care from teachers would mean teachers use clear communication and guidelines and help to create group processes that promote dialogue, as suggested by Lansdown (2021) and Waghid (2018). Teachers can design for collaboration and intentional student connections (Axe et al., 2020; Hegarty, 2015; Velasquez et al., 2013). Teachers can provide scaffolding and feedback for writing and collaboration (Axe et al., 2020; Baran & AlZoubi, 2020).

While students want to contribute to the wider learning community by being involved in OP and by sharing OER, as acts of responsible care, and while students see the benefits of doing so for themselves and other students, they are also somewhat concerned about the responsibility of creation and public sharing (Harrison, 2021; Hendricks, 2021). Not all research indicates that students are concerned about public sharing (Clinton-Lisell, 2021; Werth & Williams, 2021; Zhang et al., 2020) and teachers and students could ameliorate this concern by giving sustained attention and building trusting collaborative processes in OP projects.

Thirdly, concerning results about *competence*, students experienced teachers as providing *competent* care when teachers facilitate meaningful learning by providing or co-creating relevant curriculum. Other literature explored "relevance" not as a sign of care but as an enabler of student engagement and learning in OP (Baran & AlZoubi, 2020; Werth & Williams, 2021). Students view the offering or co-creating of relevant and accurate curriculum/OER as competent care. Although current participants and some research show concerns about ensuring OER is accurate (Hilton III et al., 2019), some students in this study changed their perspective following their own OP process. They now believed their peer review process ensured enough accuracy and authenticity. A guided peer review process may help allay concerns for many students. However, these students still want teachers to help correct misconceptions, to help them integrate student experiences, and to offer or co-create materials that are authentic and unbiased. Students also highly value and want help to ensure inclusion and representation of the diverse population in their OER and in their own class experiences; the literature confirms that this inclusion and representation should happen (Bovill et al., 2016; Mariskind, 2014; Parvati, 2019; Robertson, 2020).

Fourthly, concerning results about *trustworthiness*, the students say that the teachers' actions as outlined above—soliciting student input and planning for student connections—are acts of responsible, competent care that also *build trust*. Similar to other studies, students believed that teachers build trust when the teachers act like whole people (Frizelle, 2020), see students as whole people, and encourage student agency (Anderson et al., 2020; Baran & AlZoubi, 2020; Werth & Williams, 2021).

Students were able to build trust with peers when there was an overall sense of reciprocity—interacting, compromising, and sharing materials. That building of trust would then help students interact with and trust the wider learning community (DeRosa & Robison, 2017). Although students reported being more awkward with than mistrustful of others, students encountered challenges in showing care to others since

they sometimes needed to focus on their own studies and lives. As suggested by Lolich & Lynch (2016), Molesworth et al. (2009), and Tomlinson (2016), this could indicate that students are pressured by their institutions to individually compete to succeed in the commercialized educational setting. Students' responsibility to be mindful and solicitous of others may not be fostered in their education programs. As suggested by Held (2006), Noddings (2012, 2013) and Tronto (2013), care requires not only *trust building*, but also a mindset of *attentiveness* and the development of *competence* to provide care. Students and teachers need to see themselves as embedded in relationships and *responsible* for providing care in educational settings, rather than students seeing themselves as paying customers and teachers seeing themselves as service providers in a business.

Limitations and Future Research

The students self-selected into the research. Although not recruited specifically, the focus group students were all from underrepresented groups. Drawing students from four institutions and hearing the perspectives of underrepresented students allowed for significant insights. However, the students were from smaller teaching-based institutions in British Columbia, Canada. Internationally, students' experience may differ. Future studies could investigate what types of students, in what programs, are interested in the values of OP and, therefore, volunteer for research.

The focus group series and reflections took approximately eight hours. Unlike projects conducted in a course, this was not enough time to observe full student participation in the OP process. Longitudinal research could follow students in OP projects, including those in courses with graded assessments and in low stakes cross-institutional projects.

Conclusion

OP has been researched in terms of student perspectives, including whether students experienced relevant, engaging learning. This research heard the thoughtful insights of students who wanted to speak about the curriculum and their relations with teachers and other students. These students have described many ways that students and teachers show care. To them, OP is a significant educational process in which care is already embodied. The student perspective is that the practice of care is all-encompassing, including all the exemplifiers of care and the OP qualities analyzed above. Valuing and deliberately practising care would counteract the increasing commercialization of postsecondary education, which doesn't encourage relationships, collaboration, or exploratory learning. Care is and should be the overarching value and practice in education.

OP is a process able to fully involve a diverse population of students, create democratic, inclusive environments, and embody care. With teacher support as needed and designed practices of care, in OP, students can assert their agency, have quintessential roles in creating and participating in highly relevant curriculum, and, importantly, care and be cared for. Students and teachers can practise attentive, responsible, competent, trust-building care in OP processes. Making the practice of care that is already happening in OP explicit and valued can buttress the open education movement in its aims to democratize

education and involve self-directed students in contributing to open knowledge and social good beyond the classroom.

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The Emergence of the Open Research University Through International Research Collaboration

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Abstract

In higher education, international research collaboration functions as a visible mechanism of cooperation and competition, serving as a proxy for quality and academic excellence. Open universities use revolutionary education models but are not often associated with quality or academic excellence. To investigate the impact of international research collaboration by active researchers affiliated with open institutions, a bibliometrics analysis was conducted of three open universities and nine traditional, comparative universities between 2000 and 2022. The results indicate that research outputs that are open access, sponsored and funded, and developed with international coauthors have positive and statistically significant effects on citation counts. Moreover, international research collaboration significantly affects all universities, not just open institutions. The results conclude that researchers affiliated with open universities are only 4.3% less cited than their comparative peers, which is attributed to publication factors, research disciplines and subject areas, and journal characteristics. Findings are discussed and imply a strategic shift in the institutional functions and outputs of open universities as collaborative conduits of knowledge production and dissemination.

Keywords: internationalization, higher education, international research collaboration, open universities

Introduction

Twenty-first-century higher education institutions aim to support the empowerment and development of people and nations through knowledge transfer, knowledge creation, and the application of knowledge (Altbach & Salmi, 2011; Jong et al., 2021). Traditionally, universities regard these functions and achievements as indicators of quality or the degree of excellence (Elken & Stensaker, 2018). Open and distance education universities, hereafter referred to as open universities, are often overlooked (Peters, 2008; Xiao, 2022) in their pursuit of academic excellence (Moore, 1995; Paul, 2023), despite their innovative model and relevance in twenty-first-century higher education (Daniel, 1996; Paul & Tait, 2019). Open universities use distributed education models, including single and dual modes, and incorporate flexible curriculum structures and admission processes. Additionally, open universities engage in transnational distance education and other internationalization strategies (Bruhn-Zass, 2022; Hou, 2022; Mittelmeier et al., 2021). Globalization and the rise of the knowledge economy have catalysed new opportunities and risks for higher education institutions (Knight & Liu, 2019), including open universities, which evolved quality assurance efforts to quantify internationalization. Further, Wysocka and colleagues (2022) argue that internationalization in higher education "is also an attribute of quality and an indicator" (p. 208). Building from this premise, this study examines the degree to which open universities participate in internationalization strategies through knowledge transfer, creation, and application using international research collaboration as an indicator.

It is challenging to use a universal approach to measuring quality across diverse sociocultural contexts. Esfijani (2018) and Maringe (2010) broadly identify internationalization and quality outputs as stakeholder satisfaction, learner graduation and completion rates, research publications and grants, and academic achievement. These output metrics drive a reductionist narrative in which the materialization and perception of evaluating the quality of internationalization in higher education are reduced to two paradigms: competition and cooperation (van der Wende, 2001). First, institutions and stakeholders have placed increased importance on higher education rankings to display status, competitive advantage, and international prestige in hopes of increased funding and international mobility (de Wit, 2019). As a result, academic rankings have dramatically shaped policy and practice, transforming universities into national and international strategic investments while obscuring higher education activities into comparative forms for measurement (Hazelkorn, 2015). Second, higher education embraces cooperation as a mechanism to engage in academic exchange as a bilateral communication channel to maintain relations (Altbach & de Wit, 2015). Cooperation is the pathway to participating in knowledge networks, which also enables a path to competition (Guerrero Bote et al., 2012; van der Wende, 2007).

However, there is a third paradigm: collaboration, a dynamic process that engages partners in shared creation with a common goal. In contrast, cooperation allows partners to work together to address independent goals. International collaboration in higher education has various forms (Lopez, 2015); for the purposes of this study, only international research collaboration is explored.

Accelerated by globalization, the creation and production of knowledge flow across international borders and social networks at an unprecedented pace in the form of international research collaboration (Ribeiro et al., 2018). This exchange leverages the strengths of collaborative partnerships to generate knowledge as a soft power (Knight, 2022). International research collaboration is the visible mechanism of cooperation

and competition; it is both an input and output indicator that serves as a proxy for quality and academic excellence (Knobel et al., 2013). For example, international research collaboration can be input criteria for global university rankings. As output criteria, such collaboration results from successful partnerships that can lead to increased visibility, funding, research effectiveness, scientific productivity, and opportunities (Abramo et al., 2009). The outputs of international research collaboration have the potential to demonstrate knowledge transfer, creation, and application.

Research universities generate most of the attention given to international research collaboration due to supportive governance and regulations, financial resourcing, and attracting highly qualified talent (Altbach & Salmi, 2011); these factors overshadow knowledge generated and disseminated by open universities (Tait, 2018) and universities located in the Global South (Gueye et al., 2022). Based on my extensive literature review, scholars have not yet investigated the degree of international research collaboration in open universities as an indicator of academic excellence and quality dimensions of internationalization. Therefore, this study aims to address the gap in research and examine the significance of international research collaboration to shed light on the question: How does international research collaboration affect knowledge production and dissemination in open universities compared with non-open universities?

Literature Review

Measuring Internationalization of Higher Education

Scholars have not agreed on a singular definition of the internationalization of higher education due to the term's complex concepts (Qiang, 2003) and because it is a phenomenon that has rapidly evolved over the past three decades (Lee & Stensaker, 2021). Additionally, internationalization is highly contextual and dependent on the cultural, political, societal, and economic priorities of countries and education systems that engage in knowledge exchange (Knight, 2008). However, internationalization is understood as the academic mobility of people, programs, providers, policies, and projects that flow physically and virtually across geographic boundaries in response to globalization (Knight & de Wit, 2018). Internationalization practices and strategies in higher education are diffuse (Yesufu, 2018), and the methods and measurement of global partnerships and their effectiveness are scarce (Gao, 2019). The practices and strategies of internationalization function across a broad spectrum of mobility models, including study-abroad programs, branch campuses, targeted recruitment of international students for financial incentives, and distance learning programmes (Youssef, 2014). One of these mobility models is international knowledge networks (Jaffe et al., 1993), which support the flow and globalization of knowledge through international research collaboration (DeLaquil et al., 2022). Unlike other internationalization strategies and practices, international research collaboration can be quantified to measure the effectiveness of international knowledge networks for self-evaluation, comparisons, and classification purposes (Gao, 2019).

International Research Collaboration

The internationalization of research in higher education is known as international research collaboration, which is an influential indicator of the production and dissemination of knowledge from researchers affiliated with a nation who partner with researchers affiliated with another nation (Frame & Carpenter,

1979). The factors that affect international research collaboration include graduate education faculty and students and their mobility, contextual characteristics of sciences and disciplines, access to funding opportunities, communication and dissemination strategies, and regional or intranational initiatives (Woldegiyorgis et al., 2018).

According to Barnett (1990), research outputs indicate higher education's relevancy and intellectual contributions. Therefore, for some, the internationalization of research serves competitive agendas focused on increased productivity of individual researchers, institutions, nations, and their rankings (Buckner, 2022). Nevertheless, others consider the cross-pollination of ideas across geographical borders as a cooperative and collaborative process (Turner & Robson, 2007). Moreover, the mutually shared benefits of international research collaboration continue to drive researchers and policymakers to support the globalization of knowledge and knowledge diplomacy (Knight, 2022). Due to these diverse motivations and rationales, scholars aim to identify indicators to measure the internationalization of research. However, there is a dearth of knowledge on the role of knowledge production generated by open universities and their participation in the internationalization of research.

Open Universities

Following the establishment of the Open University in the United Kingdom (UK) in 1969, over 60 open education universities have expanded access to higher education worldwide (Tait, 2018). Moreover, within the first 30 years of the open education model, some universities, such as Indira Gandhi National Open University, the Open University of China, Universitas Terbuka Indonesia, and Anadolu University, quickly accelerated enrolment to support learning for millions of students (Bozkurt, 2019; Daniel, 1996). The revolutionary model of open universities ushered in innovative practices and functions, including opening admissions procedures, shifting instructional paradigms, prioritizing adult learners, embracing collaborative development models, using modular curriculum structures, and adopting emerging communication technologies (Guri-Rosenblit, 2019; Perry, 1970). Built on the foundations of access and social justice (Tait, 2013), open universities have evolved to meet the needs of contemporary knowledge societies and international knowledge networks (Teixeira et al., 2020).

Open universities have significantly contributed to educational systems through policy, practice, and research (Veletsianos & Houlden, 2019); unfortunately, these efforts have come with challenges. Often shaping the narrative of open and distance education are negative perceptions regarding quality and academic excellence at national and international levels (Gaskell & Mills, 2014). However, interpreting quality practices and indicators for open and distance education universities is well documented and implemented (Ossiannilsson et al., 2015; Tait, 1993). Therefore, more research is necessary to holistically capture institutional-level quality dimensions and performance metrics on quality inputs, processes, outputs, outcomes, and impact (Esfijani, 2018; Jung, 2022). With a focus on quality outputs and the internationalization of higher education, this study focuses on knowledge production and dissemination from three open universities.

Methodology

Bibliometrics Analysis

Bibliometrics analysis is a quantitative approach that enables researchers to statistically analyse research indicators as performance metrics to assess publication patterns and impact (Price, 1965). Bibliometric indicators measure research results in scientific publications or other research outputs and meaningfully normalize research outputs across indicators (Tunger et al., 2020). Bibliometrics analysis was deemed the most appropriate method due to its ability to examine large datasets across sciences, disciplines, and topics (Donthu et al., 2021). This study uses the Scopus database, which some (Aksnes & Sivertsen, 2019; Mongeon & Paul-Hus, 2016) contend covers more journals and international resources than the Web of Science or Google Scholar. These databases are essential tools for collecting, processing, and extracting data for bibliometric analysis (Bauer, 2020).

Sample

Informed by the first phase of an exploratory mixed-methods study (Heiser, 2022), this paper reports on the second phase of a more extensive investigation to test the outputs of three open universities that met inclusion criteria. Open universities were required to have doctoral programs of study, an active research centre, a publishing extension, and accessible grant and funding reports, as well as to use quality assurance standards and frameworks. Furthermore, the universities had to meet the Scopus database search criteria, including affiliation, open access, and peer-reviewed journal articles published between 2000 and 2022. Additionally, geographical and cultural considerations were made to study a more internationally diverse representation of open universities to amplify unique contexts and support generalizability. Once these criteria were applied, total publication counts were calculated to determine the top three universities for analysis: Anadolu University in Turkey, the Open University of the UK, and the University of South Africa.

Finally, nine universities were identified for a controlled comparison to understand the effects of international research collaboration. These nine universities are the three most frequently collaborated national universities with the open universities, according to the Scopus database in February 2023 (Table 1). Therefore, this study examines the international research collaboration outputs from 12 universities to examine the significance of open universities' international research collaboration.

Table 1

Most Frequent National Collaboration Affiliations with an Open University

Open university	Top three most frequent national collaboration affiliations	Total national collaboration research outputs
University of South Africa	University of Johannesburg	873
	University of Pretoria	862
	University of Witwatersrand, Johannesburg	827
Anadolu University	Eskişehir Osmangazi Üniversitesi	705
	Gazi Üniversitesi	286
	Hacettepe Üniversitesi	364
The Open University	University College London	784
	University of Cambridge	736
	University of Oxford	832

Descriptive Analysis

A descriptive analysis using R (R Core Team, 2021) was performed to delineate themes and patterns within the data, which included only peer-reviewed journal outputs published between 2000 and 2022 by researchers affiliated with the 12 universities. These data (observations = 609,365) included all subject areas, sciences, open access types, and languages. The preliminary analysis presented emerging variables regarding the total number of publications and active researchers, as well as the annual average of citations, open access, sponsored funding, and international collaboration.

Since 2000, publications have steadily increased across all institutions, as presented in Figure 1. Except for the Open University, institutions in the UK publish more frequently than all other institutions examined in this study. Further, scholars affiliated with open institutions publish less often than those affiliated with comparative institutions. Therefore, additional analysis was conducted to understand the population size of active researchers.

Figure 1

Total Number of Publications by Institution, 2000–2022

(a) South Africa

(b) Turkey

(c) United Kingdom
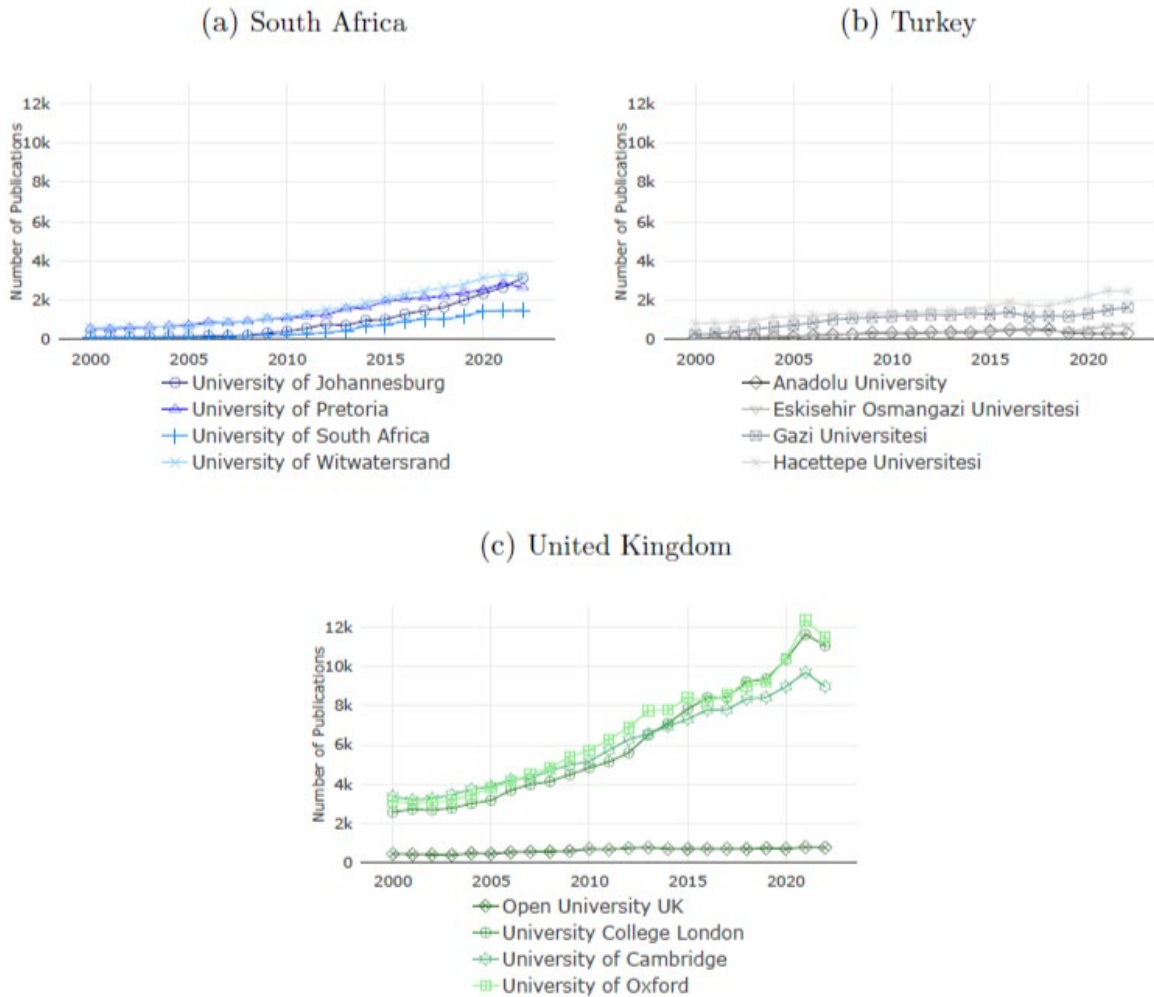
Figure 2 shows that UK institutions, except for the Open University, have increased the number of active researchers over the past 20 years upwards to 7,200 researchers. By comparison, South African and Turkish traditional institutions typically range from 1,000 to 2,000 active researchers, and the open institutions reported fewer than 1,000 active researchers with peer-reviewed publications.

Figure 2

Total Number of Active Researchers by Institution, 2000–2022

(a) South Africa

(b) Turkey

(c) United Kingdom
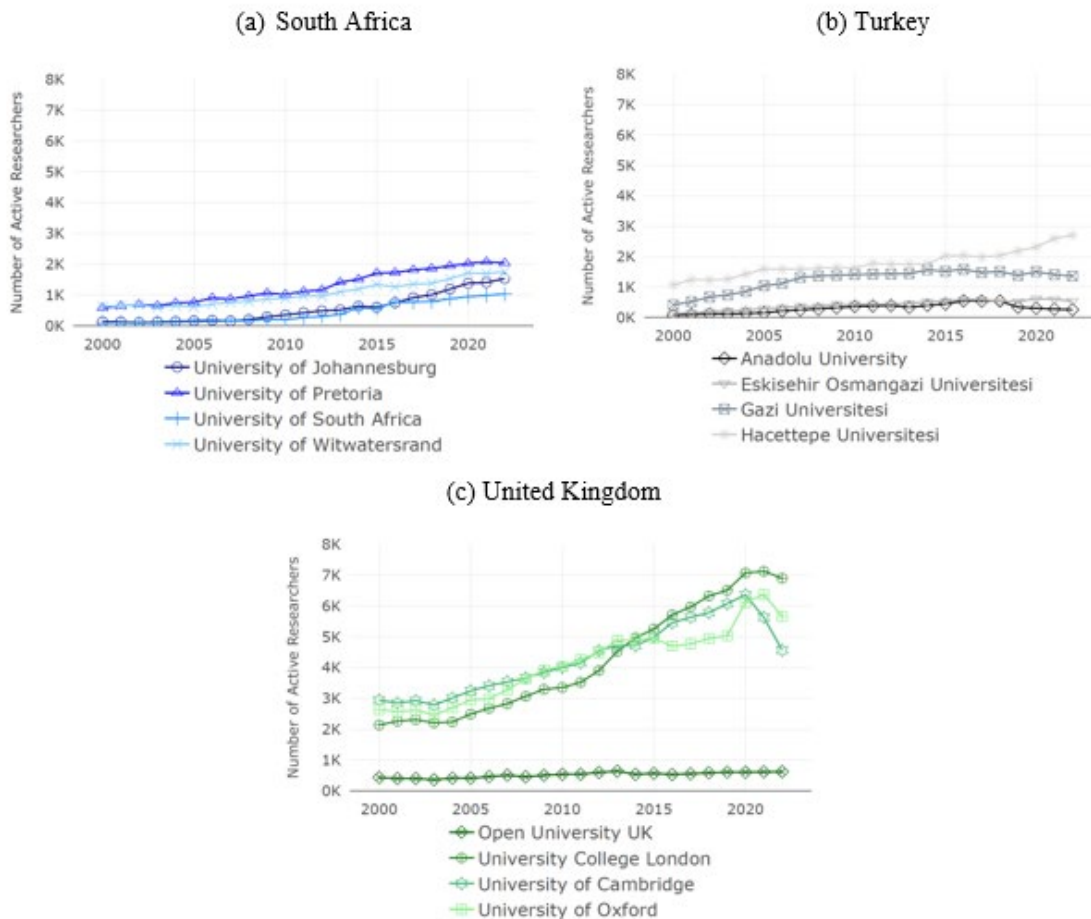
Figure 3 reports that the average number of citations declines over time, indicating that the institutions in the UK are cited more frequently than the comparative institutions in South Africa and Turkey. Unlike the other open institutions in this sample, publications affiliated with the Anadolu University are more frequently cited than their national comparative institutions.

Figure 3

Average Number of Citations on Published Articles by Institution, 2000–2022

(a) South Africa

- University of Johannesburg
- University of Pretoria
- University of South Africa
- University of Witwatersrand

(b) Turkey

- Anadolu University
- Eskisehir Osmangazi Universitesi
- Gazi Universitesi
- Hacettepe Universitesi

(c) United Kingdom

- Open University UK
- University College London
- University of Cambridge
- University of Oxford
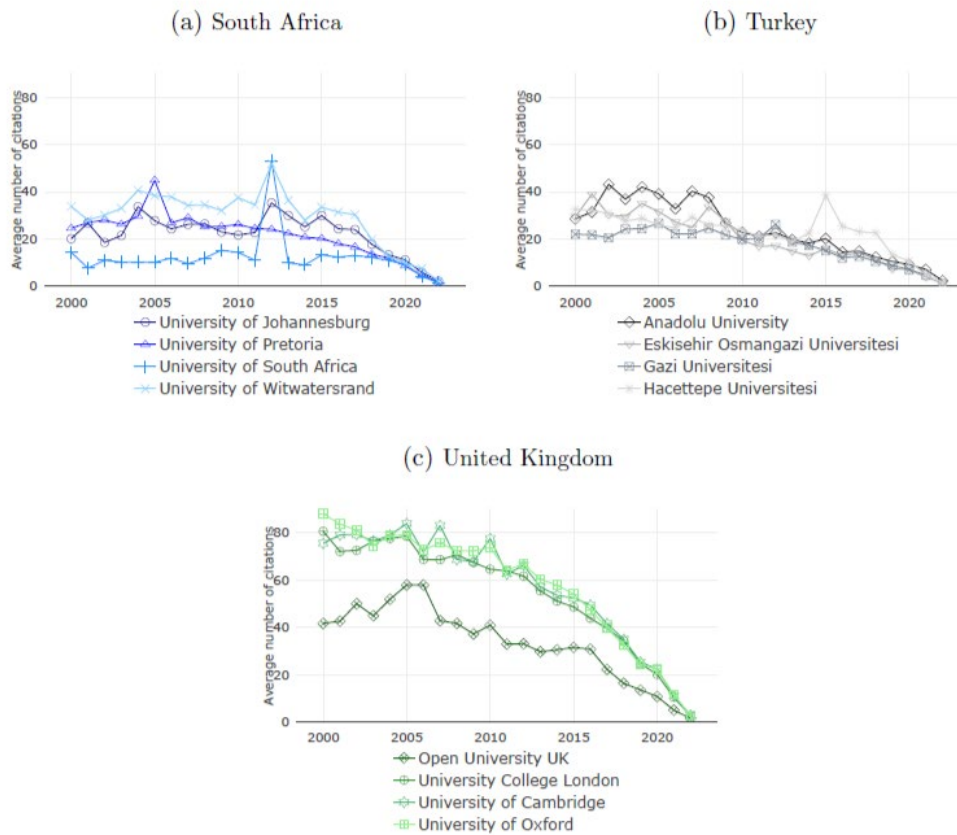
Consistent with the literature (Laakso et al., 2011), open access publications have increased across all universities, as presented in Figure 4. Institutions in the UK and South Africa frequently publish more openly than Turkish institutions in this study.

Figure 4

Percentage of Open Access Articles Published by Institution, 2000–2022
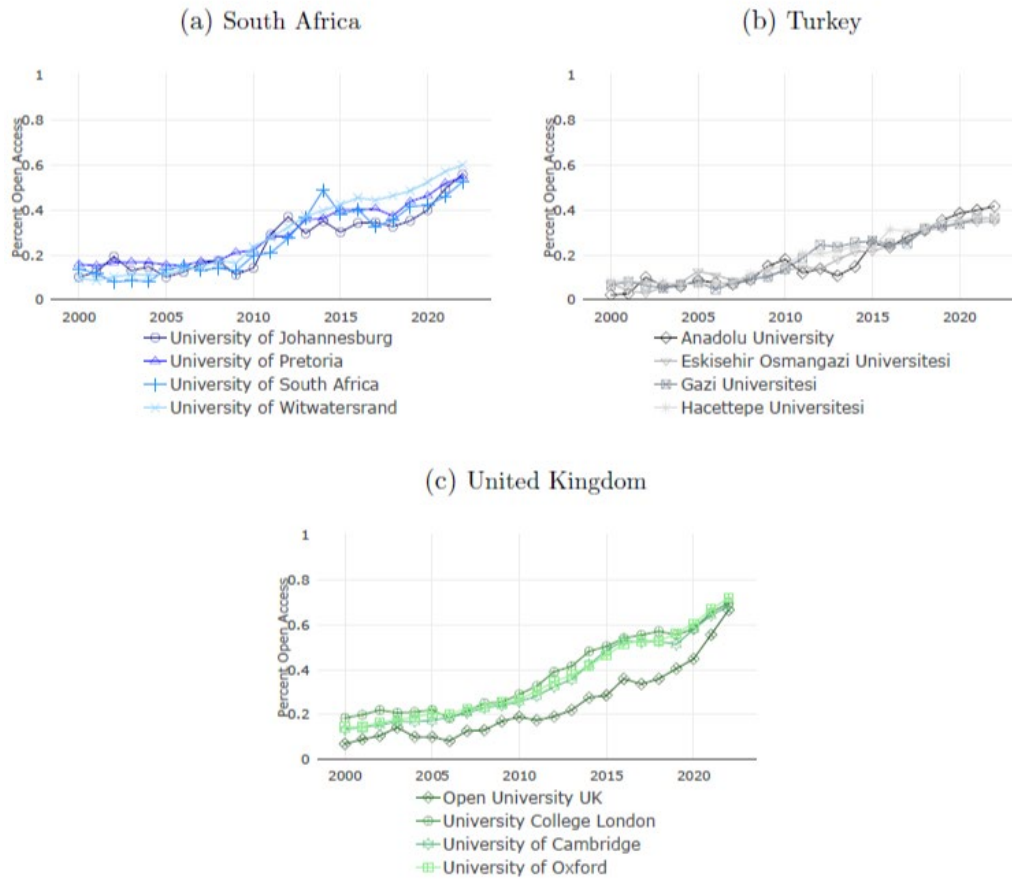
The annual percentage of funded research is reported more frequently by the comparative institutions except in Turkey, where Anadolu University strongly contends for sponsored research at the national level (Figure 5). Additionally, institutions in the UK have a higher percentage of funded research than South African and Turkish institutions.

Figure 5

Percentage of Funded Research Articles Published by Institution, 2000–2022
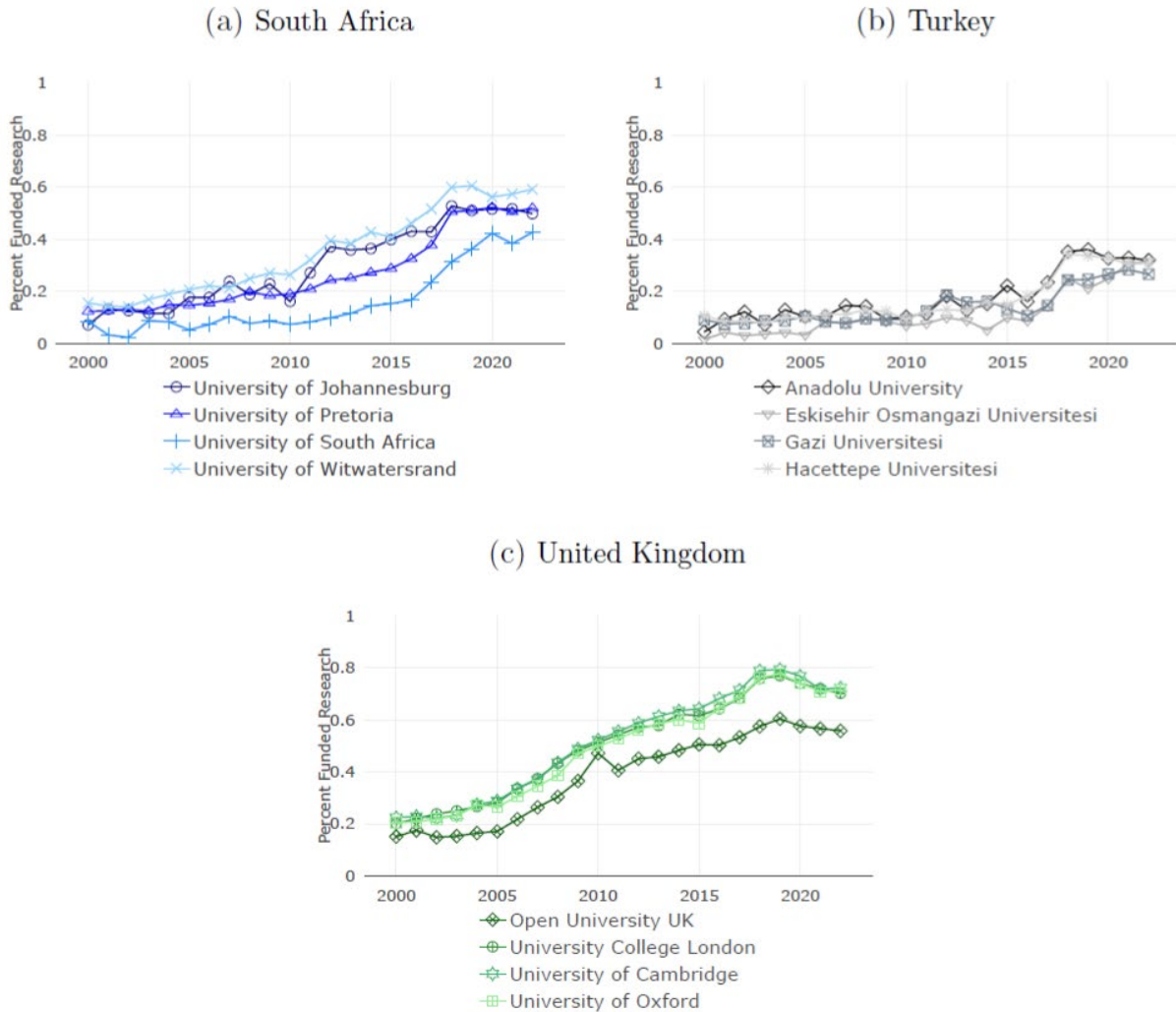
Finally, Figure 6 shows the percentage of international research collaboration, demonstrating an increase in international research collaboration across all institutions. It is important to note that all open universities in this sample collaborate internationally to a significant degree compared with their national comparative institutions.

Figure 6

Percentage of International Research Collaboration Publications by Institution, 2000–2022

(a) South Africa

- University of Johannesburg
- University of Pretoria
- University of South Africa
- University of Witwatersrand

(b) Turkey

- Anadolu University
- Eskisehir Osmangazi Universitesi
- Gazi Universitesi
- Hacettepe Universitesi

(c) United Kingdom

- Open University UK
- University College London
- University of Cambridge
- University of Oxford
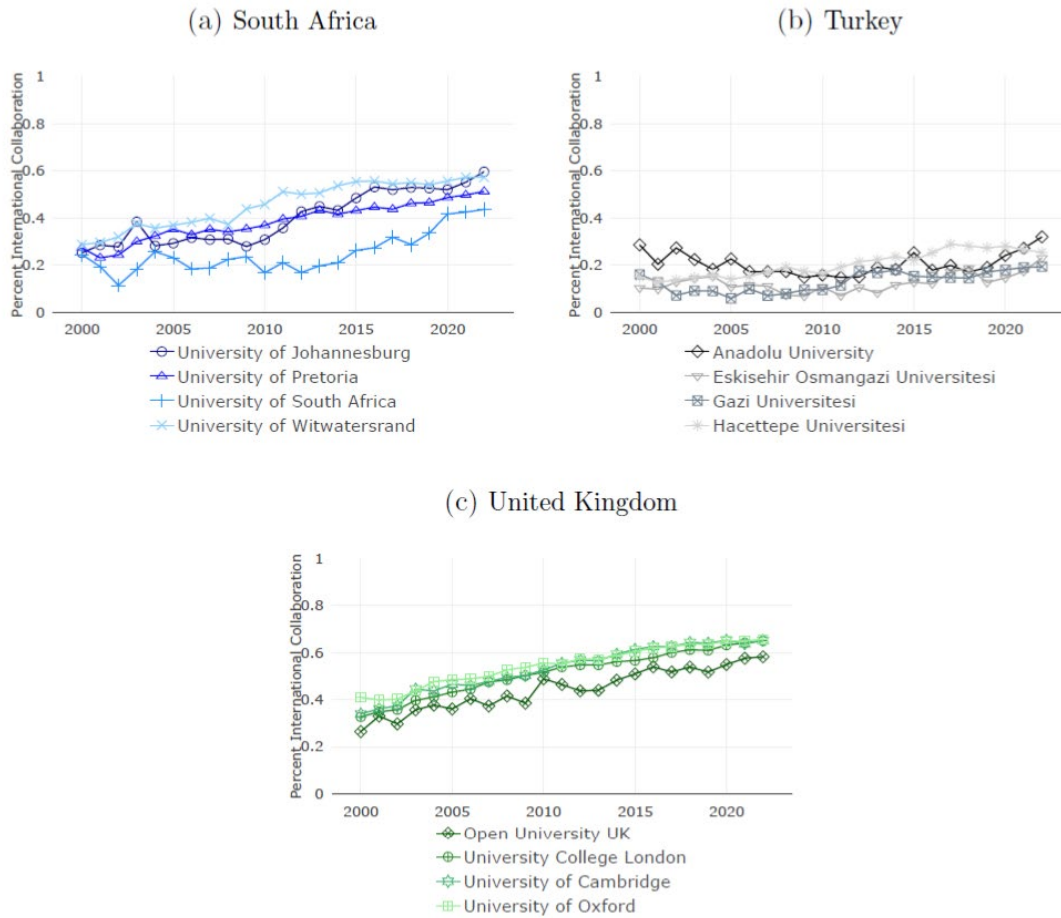
The descriptive analysis identified patterns and trends emerging in 12 institutions from three countries. Based on these findings, further statistical analysis was conducted to answer the primary research question and understand the effects of international research collaboration in open universities.

Empirical Methodology

A linear regression model was used to examine the effect of several key research input variables on citation counts over time:

$$\log(\text{Cites}_{ijt} + 1) = \beta_1 \text{Authors}_{ijt} + \beta_2 \text{Active}_j + \beta_3 \text{Inputs}_{ijt} + \psi t + \varepsilon \qquad (1)$$

The dependent variable $\log(\text{Cites}_{ijt} + 1)$ represents the natural logarithm of the number of citations (plus one) for journal article i published in journal j at time t. The results are similar when $\log(\text{Cites}_{ijt})$ is used as the dependent variable. In Equation 1, Authors_{ijt} is a continuous measure of the number of authors for journal article i published in journal j at time t; Active_j is an indicator variable that equals 1 if the journal is

still actively publishing journal articles at the end of 2022 or 0 otherwise; ψ_t is a vector of year fixed effects controlling for the year when the article was published; and Ɛ is an error term. Finally, Inputs$_{ijt}$ is a vector of indicator variables for research inputs identifying whether the article is open access, the research was funded, and there was international collaboration. Previous studies have shown that these variables influence citation metrics (Morillo, 2020), and therefore, they were chosen for this study; however, the validity of bibliometric indicators remains ambiguous due to individual paradigms and rapid advancements in bibliometric methodologies (Aksnes et al., 2019).

After demonstrating that the research inputs significantly impact how often a journal article is cited, the variables were used as controls in a second regression, which includes an indicator variable for open universities, Open$_{ijt}$, that equals 1 if at least one author on the article *i* published in journal *j* at time *t* was affiliated with an open university or 0 otherwise. As a result, the updated specification takes the following form:

$$\log(Cites_{ijt} + 1) = \beta_1 Authors_{ijt} + \beta_2 Active_j + \beta_3 Inputs_{ijt} + \beta_4 Open_{ijt} + \psi_t + Ɛ \qquad (2)$$

After running the second regression to control for year fixed effects, additional specifications were run in R with additively separable year and subject area controls. The Scopus database assigns subject area levels to every serial publication (i.e., journal) with an International Standard Serial Number (ISSN) and the subject area controls align with the All Science Journal Classification (ASJC) code list. The subject area data by ISSN was accessed and downloaded from the Scopus Website to control for types of sciences and subjects. Scopus refers to the first subject area control as the supergroup, classifying the journal into one of three groups: life sciences, social sciences, or physical sciences. The second subject area control uses the first two digits of the ASJC code, with 27 ASJC parent codes. The third subject area control uses the complete four-digit ASJC code, of which there are 334. Finally, the subject area was controlled for with the inclusion of journal fixed effects.

Results and Discussion

Based on the empirical methodology, results indicate positive and statistically significant indicators of research outputs that are open access, receive sponsorship funding, and participate in international collaboration. Results suggest that international research collaboration is a statistically significant variable for all universities and does not uniquely affect open universities. The findings are categorized into two themes: publication factors and the effects of international research collaboration.

Publication Factors

The first finding concerns citation indicators with publication factors. Three research input indicators—open access, sponsored, and international coauthor—were examined due to their interrelationships to amplify the visibility and impact of research. Research has demonstrated that open access and funded research factors are often related, as scholars and their affiliations are more willing to pay publishing fees to expand to a broader audience (Pinfield et al., 2016; Solomon & Björk, 2012). Building on these two factors is international coauthorship, similarly used for funding purposes and potentially for increasing readership

globally (Abramo & D'Angelo, 2023). From this conceptual framing, Table 2 displays results examining the effect of research inputs on citation counts from Equation 1. Each column in Table 2 includes controls for the number of authors on each paper, an indicator variable identifying whether the journal is still actively publishing, and year fixed effects to control for the length of time since the article was initially published.

Table 2

Effect of Research Inputs on Citations

Variable	Open access (1)	Sponsored (2)	International coauthor (3)	All research inputs (4)
Author count	0.018*	0.016*	0.015*	0.012*
	(0.001)	(0.001)	(0.001)	(0.001)
Active	0.828*	0.740*	0.806*	0.721*
	(0.023)	(0.018)	(0.020)	(0.018)
Open access	0.245*			0.154*
	(0.035)			(0.028)
Sponsored		0.641*		0.556*
		(0.050)		(0.044)
International coauthor			0.501*	0.400*
			(0.031)	(0.022)
Time FE	Year	Year	Year	Year
Observations	609,365	609,365	609,365	609,365
R^2	0.315	0.350	0.333	0.367

Note. FE = fixed effects.

* $p < .01$

Author Count and Active Journals

The coefficient estimates on the author count and active journal variables are positive and statistically significant in every column of Table 2. Also, the coefficient estimates for the continuous author count variable indicate that the number of citations increases as the number of authors on a paper increases. This finding is intuitive because an increased author count helps increase the article's exposure and reach (Acedo et al., 2006). Moreover, authors have more opportunities to self-cite their publication in their future work (Aksnes, 2003). The coefficient estimates on the active journal indicator variable in Table 2 suggest that articles published in active journals at the end of the study period (i.e., 2022) received, on average, 72.1% to 82.8% more citations than articles published in the same year in journals that are no longer active. Again, this finding is also intuitive as active journals likely have a higher readership than inactive journals (James et al., 2018).

Open Access

The first column of Table 2 includes the open access indicator variable identifying whether the journal article was an open publication. The open access coefficient estimate indicates that, on average, open publications received 24.5% more citations than non-open articles published during the same year. This

result diverges from those of previous studies (Davis, 2011; Sotudeh & Estakhr, 2018) that have questioned a citation advantage to openly accessible articles and found no significant difference.

Sponsored Research

The second column of Table 2 includes the sponsored indicator variable identifying whether the journal article was funded. The analysis results indicate that, on average, studies that received funding have 64.1% more citations than non-funded articles published during the same year. This result aligns with prior research demonstrating that funded studies are cited more often (Larivière et al., 2010; Roshani et al., 2021).

International Collaboration

The third column of Table 2 includes an indicator variable identifying whether the journal article included international collaboration among authors. The international coauthor coefficient estimate indicates that, on average, articles with international collaboration have 50.1% more citations than articles without. This result is consistent with the literature (Alamah et al., 2023; Onyancha, 2021); international research collaboration yields more citations worldwide.

Finally, the fourth column of Table 2 includes all three research input variables from Equation 1 simultaneously. Again, the coefficient estimates remain positive and statistically significant. However, the magnitude of the coefficient estimates decreases.

International Research Collaboration

The second finding addresses the effect of open university affiliation on citation counts using the regression framework presented in Table 3. Each column in Table 3 includes the same controls and the three research input variables explored in Table 2. The variable of interest, open university, indicates whether one of the authors is affiliated with an open university. The indicator variable equals 1 if one of the authors is affiliated with Anadolu University, the Open University in the UK, or the University of South Africa; otherwise, the indicator variable equals 0.

Table 3

Open Universities and Citation Counts

Variable	Baseline (1)	Supergroup (2)	Parent (3)	ASJC (4)	ISSN (5)	ISSN (6)
Open university	−0.307*	−0.238*	-0.248*	-0.216*	-0.049*	-0.043*
	(0.027)	(0.018)	(0.020)	(0.015)	(0.009)	(0.008)
Author count	0.012*	0.011*	0.012*	0.013*	0.008*	0.008*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.0004)	(0.0004)
Active journals	0.715*	0.707*	0.705*	0.650*		
	(0.017)	(0.017)	(0.020)	(0.019)		
Open access	0.149*	0.086*	0.092*	0.096*	0.117*	0.117*
	(0.027)	(0.018)	(0.018)	(0.019)	(0.016)	(0.016)
Sponsored	0.545*	0.490*	0.467*	0.428*	0.113*	0.113*
	(0.043)	(0.040)	(0.038)	(0.036)	(0.015)	(0.015)
International coauthor	0.393*	0.349*	0.319*	0.296*	0.122*	0.123*
	(0.022)	(0.018)	(0.017)	(0.016)	(0.006)	(0.007)
Open university: International coauthor						−0.022
						(0.031)
Time FE	Year	Year	Year	Year	Year	Year
Observations	609,365	609,365	609,365	609,365	609,365	609,365
R^2	0.370	0.381	0.398	0.417	0.600	0.600
Adjusted R^2	0.370	0.381	0.398	0.417	0.585	0.585

Note. ASJC = All Science Journal Classification; ISSN = International Standard Serial Number; FE = fixed effects.

*$p < .01$.

Open University

The first column of Table 3 introduces the open university variable with no additional fixed effects outside of the year fixed effects included in every column of Table 2. The open university coefficient estimate in column one indicates that journal articles authored by faculty at an open university in this study received, on average, 30.7% fewer citations than journal articles published in the same year by faculty at comparison universities. These results do not control for the faculty at the comparison universities, which may differ in research disciplines, sciences, and journals in which they publish. Therefore, columns two through six attempt to control these differences using increasingly granular subject area fixed effects.

Sciences

The second column in Table 3 includes fixed effects for the supergroup, classifying the journal into one of three groups: life sciences, social sciences, or physical sciences. After controlling for this high-level classification, journal articles authored by faculty at an open university in this study received, on average, 23.8% fewer citations than journal articles published in the same year and supergroup by faculty at the comparison universities.

114

Subject Area

The third column of Table 3 includes fixed effects for the ASJC parent codes. Interestingly, the open university coefficient estimate in column three increases slightly, to 24.8%, relative to the less granular supergroup fixed effects estimates in column two.

The fourth column includes fixed effects for the ASJC codes. Including the more granular subject area controls has the expected impact in that the open university coefficient estimate in column four decreases relative to the previous three columns. The coefficient estimate suggests that journal articles authored by faculty at one of the three open universities in this study received, on average, 21.6% fewer citations than journal articles published in the same year and ASJC code by faculty at the comparison universities.

Journal

The fifth column in Table 3 reports the results, including fixed effects for the journal in which the article was published. Including journal fixed effects allows the comparison of citation counts for articles published in the same year and the same journal, thereby alleviating concerns about journal quality, distribution, and readership. However, the active journal indicator variable in column five is not included because it perfectly correlates with the journal fixed effects. The open university coefficient estimate in column five indicates that journal articles authored by faculty at an open university in this study received, on average, 4.9% fewer citations than journal articles published in the same year and journals by faculty at the comparison universities. Further, the R^2 increased considerably in column five relative to the previous columns. This suggests that the journal in which an article is published is a crucial determinant of how many citations that article will receive. It also highlights the need to carefully control for differences in faculty research interests and subject areas when evaluating the effect of research inputs and university affiliations on citation counts.

International Collaboration

Finally, the sixth column in Table 3 addresses the research question: How does international research collaboration affect knowledge production and dissemination in open universities compared with non-open universities? The results suggest that international coauthorship matters, and there is little effect on the type of university. The international coauthor coefficient estimate in column six indicates that journal articles that include international coauthorship received approximately 12.3% more citations than journal articles without international coauthorship published in the same year and in the same journals. However, the coefficient estimate on the open university–international coauthor interaction term is negative; it is not statistically significant. This finding indicates that international collaboration similarly affects citation counts for faculty at open universities and their comparisons.

Although previous studies on international research collaboration have not explicitly examined the impact on open universities, scholars have found that international research collaboration positively influences academic excellence and high-quality research outcomes (Li & Yin, 2022; Velez-Estevez et al., 2022). Therefore, this study contributes to the growing body of literature suggesting the influence of international research collaboration with the inclusion of open university research outputs.

Conclusion

Today's knowledge society is evolving, and the role of internationalization in higher education is gaining universal importance as a form of knowledge diplomacy (Knight, 2022) and as a proxy for quality and academic excellence (Knobel et al., 2013). The outputs of international research collaboration can serve as a quality indicator to measure the globalization of knowledge. This study aimed to understand the effects of international research collaboration on three open universities by examining the relationship between national comparative universities through citation metrics between 2000 and 2022.

The findings suggest that open institutions actively produce knowledge with fewer active researchers and research funding sponsors than comparative universities. Furthermore, results from the multiple regression analysis indicate that the number of authors, activeness of a journal, open publishing, international coauthors, and sponsorship support citation advantages by year across sample universities.

Unlike previous studies regarding the effects of open access on citations (Langham-Putrow et al., 2021), this examination found that open access publication offers a 24.5% citation advantage when compared with articles published in the same year that are not openly accessible. Open access publishing has increased worldwide; however, publishing openly often comes at a cost. Interestingly, this study found that comparative institutions receive more funding than open universities, and their sponsored research articles typically receive a 64.1% increase in their citation margins. Although studying the relationship between open access and funding is outside the scope of this study, more research is needed to examine the impacts of these variables on articles published by researchers affiliated with open universities, given their institutional missions for educational access.

Researchers affiliated with open universities are less often cited than their comparative peers in this sample; however, once the fixed effects were applied and compared against international research collaboration indicators, the difference in citation rates between the two groups was reduced to only 4.3%. This finding demonstrates the significance of international research collaboration and the degree to which scholars affiliated with open universities participate in globalized knowledge production and dissemination. Additionally, the results suggest a strategic shift in the functions and outputs of open universities in a relatively short period. This study indicates that open institutions have evolved from providing educational access for workforce development to institutions engaging in internationalization and demonstrating academic excellence at national and international levels through collaborative research and publication.

Finally, more research is needed to examine journal and subject-level attributes that appear to affect the number of citations that open university researchers create. This study suggests that open university researchers publish in journals or subject areas with less impact. Future studies should consider other measurable outputs, outcomes, and impact factors from international research collaboration with open universities, including the economic effects of knowledge spillover and transfer at localized levels and the international mobility of open university researchers as a result of their publications.

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Shifting Conversations on Online Distance Education in South Korean Society During the COVID-19 Pandemic: A Topic Modeling Analysis of News Articles

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Abstract

This study explored the dominant discourses on online distance education (ODE) that emerged in South Korean society before, during, and after the COVID-19 pandemic. The authors conducted a topic modeling analysis of 8,865 news articles published by 24 South Korean media outlets between 2019 and 2021. Using the Latent Dirichlet Allocation (LDA) algorithm and social network analysis software (NetMiner), the top five topics and the top ten words associated with each topic were identified from each period. The authors observed significant changes not only in the number of news articles but also in the depth of the conversations published each year. The results have revealed several key points. First, ODE, previously considered marginal and abnormal, gained in normality across all educational levels in Korean society. Second, ODE discourses have been shaped by the unique cultural, historical, and technological infrastructure in South Korea. Third, a clear division between social-justice-oriented and business-oriented ODE discourses reflect a persistent inequality in Korean society. Finally, ODE discourses matured in 2021, with more critical and realistic perspectives on both the positives and negatives of ODE. The useful implications of such insights for post-pandemic ODE research and practice are further discussed.

Keywords: distance education, online education, COVID-19, topic modeling, news Big Data, South Korea

Introduction

Online distance education (ODE) is a well-established educational phenomenon that originated decades ago alongside the advent of the Internet (Lee, 2017). Since then, there has been a significant increase in online courses and student enrolment worldwide (Palvia et al., 2018; Seaman et al., 2018). ODE proponents have highlighted its accessibility and flexibility, citing "anyone, anytime, anywhere" as a slogan; the potential of online communications for enhancing pedagogical relationships has been celebrated (Lee, 2021a). However, in the broader social context, where face-to-face instruction is believed to be the gold standard for education, ODE has been regarded as unconventional, abnormal, and inferior (Stapleford & Lee, in press). Online degrees have often been viewed less favourably than traditional degrees by various stakeholders (Fain, 2019; Wilkes et al., 2006). As well, high drop-out rates and low learner engagement have been noted in many poor-quality online courses, particularly those mass produced by for-profit institutions (Baum & McPherson, 2019).

Despite the increased academic discussion and practice-oriented efforts among scholars and practitioners to improve ODE quality and make it equal (or superior) to face-to-face education, the public was never particularly interested in nor substantially engaged with ODE. Thus, the deficit views on ODE remained unchallenged for decades until the recent COVID-19 pandemic brought ODE to the forefront of public debate. With social distancing measures in place, educational institutions turned to ODE (Bozkurt & Sharma, 2020; Lederman, 2020; Lee et al., 2021a; Rapanta et al., 2020). Many institutions benefited from adopting ODE, sustaining their business as usual; however, their experiences were not necessarily satisfactory or successful, as they were unprepared for the sudden online shift (Bozkurt et al., 2020). Such experiences rapidly evoked conversations on ODE in the public domain.

In the UK, for example, ODE was generally well-received by the public during the pandemic, mainly due to its flexibility and accessibility, as well as the necessity of its adoption (e.g., Brassington, 2022; Owen, 2022; Woolcock, 2021). However, one of the dominant discourses surrounding ODE for the same period was focused on its value for money, with university students expressing dissatisfaction with their online learning experiences (e.g., Coughlan, 2021; Cursino & Coughlan, 2021). This dissatisfaction brought about a nation-wide petition with over 270,000 signatures calling for the UK government to intervene and make universities refund student tuition fees (UK Government and Parliament, 2020). While almost half of UK students found ODE did not provide good value for their money, most universities reported that providing ODE was not any cheaper or easier than providing face-to-face education (e.g., Adams, 2021).

Concerned about the growing criticism, some scholars tried to differentiate ODE in normal circumstances from ODE during the pandemic by referring to the latter as emergency remote teaching (e.g., Bligh & Lee, 2022; Hodges et al., 2020). However, the public appeared unaware of these conceptual distinctions, resulting in an unprecedented level of public discussion about ODE as a unified subject, through which many previously disinterested in ODE changed, developed, and consolidated their opinions of ODE. In the post-pandemic context, most institutions have returned to face-to-face education; ODE has become more integrated into all educational practices. While ODE gained normality as a legitimate mode of educational provision, the heightened interest in ODE quickly waned and diffused in many societies. Unsure about the next opportunity for the public to re-engage with ODE, the current perceptions of ODE set during the pandemic may assumably remain unchanged until then.

Therefore, despite the unique contextual conditions of emergency remote teaching, it is worthwhile to revisit the public conversations on ODE and understand how and which aspects of ODE were discussed during the pandemic. Since the pandemic lasted long enough, tracing the changes in public perceptions throughout the period can also be beneficial. Such knowledge can effectively facilitate ongoing efforts in the ODE field to envision a more transformative and democratic educational future. We systematically collected 8,865 news articles published and circulated in South Korea between 2019 and 2021 and conducted a topic modeling analysis of the news Big Data. The article reports what has (not) been discussed in those media texts before, during, and after the COVID-19 outbreak, tracing the meaningful ruptures in dominant discourses about ODE.

Research Questions

Aiming to develop a clear understanding of the public perceptions of ODE, this study sought answers to the following research questions:

- What were the main topics of ODE discourses in Korean newspapers published in 2019, 2020, and 2021?

- What were the meaningful changes in ODE discourses in Korean newspapers between 2019, 2020, and 2021?

Literature Review

This section highlights historical changes in general perceptions towards ODE.

General Perspectives on ODE Before the Pandemic

ODE was positively perceived as an educational alternative for students with disadvantaged and marginalised backgrounds or conditions (Lee, 2017; Zawacki-Richter & Naidu, 2016). However, it had not gained legitimacy as mainstream education (Lee, 2021). Historically, distance learners in higher education were demeaned as "back-door learners" (Wedemeyer, 1981, p. 20), since university education was primarily for children of the elite (Bower & Hardy, 2004; Xiao, 2018). From the pre-Internet period, distance education (DE, the predecessor of ODE) struggled to validate its values and earn respect equivalent to the brick-and-mortar educational provision (Garrison & Anderson, 1999; Sewart et al., 1983). Comparative studies dominated early DE literature, resulting from scholarly efforts to prove the effectiveness (or ineffectiveness) of DE compared to on-campus education (Zawacki-Richter & Anderson, 2014).

In the 2000s, the advent of the Internet highlighted the great potential of ODE for providing education to diverse student groups at a large scale (Johnstone & Tilson, 1997). New technological possibilities for group communication and collaboration offered potential solutions to the pitfalls of DE—a sense of isolation and a lack of interaction. Advanced Internet-based communication tools and increased social connectedness gradually penetrated on-campus teaching and learning activities, suggesting transformative potential not only for DE but for face-to-face education, resulting in the popularity of ODE over the past two decades (Seaman et al., 2018).

Even so, many universities (and students and teachers) did not fully accept ODE as their primary pedagogical modality for different reasons (Bower & Hardy, 2004). While on-campus education had firmly established itself as the normal and gold standard (Lewis, 2002; Nichols, 2022), ODE had to crawl in and perch on the marginalised patch of so-called, or erroneously-called, conventional education (Xiao, 2018). ODE was seen as unconventional, abnormal, and, thus, inferior to face-to-face education despite research demonstrating no significant difference between the two modalities when adequate pedagogy was applied (Russell, 1999). Nevertheless, the deficit arguments persisted until the pandemic (e.g., Baum & McPherson, 2019).

General Perspectives on ODE During the Pandemic

The pandemic forced educational institutions worldwide to adopt ODE (Arnold & Bassett, 2021, as cited in Tilak & Kumar, 2022). However, new studies during the pandemic largely repeated pre-existing conclusions. Scarce examples acknowledged the long history of ODE and its scholarship; the exception includes Pregowska et al. (2021) who stated that "surprisingly, distance education is quite an old concept" (p. 1). In this new research climate, like deja vu, the pandemic literature increasingly included studies comparing the effectiveness of face-to-face and online instruction (e.g., Aristovnik et al., 2020; Müller et al., 2021).

Unsurprisingly, there were few new insights gained; the same conclusions previously drawn by the pre-pandemic literature were repeated. For example, it has been well-known in the field that student and educator readiness is a critical factor for the acceptance of ODE (e.g., Junus et al., 2021; Rashid & Yadav, 2020). Isolation, anxiety, and the digital divide have been cited as significant hindrances to successful ODE experiences. Students and teachers both found that student academic progress was impeded in unprepared and unsupported ODE contexts (Al-Mawee et al., 2021).

On the other hand, the pandemic noted the advantages of ODE, such as flexibility and convenience (Lee et al., 2021b; Stevanović et al., 2021). These positive perceptions have also been shared among teachers and students from the disciplines where ODE was never considered a legitimate option, as when face-to-face instruction was deemed necessary (e.g., Al-Balas et al., 2020). The aspiration to innovate and transform higher education through ODE has become more vital than ever (Bower & Hardy, 2004).

(New) ODE Terminologies

Efforts to distinguish terminologies in ODE have been ongoing. For example, Singh and Thurman (2019) traced 46 terms relevant to ODE. The pandemic introduced terms like emergency remote education (ERE) or emergency remote teaching (ERT) to distinguish it from normal ODE (see, Bozkurt et al., 2020; Hodges et al., 2020). Many have accepted ERT to signify the unprepared transition from face-to-face to online instructional modality without careful curriculum, instruction, and organisational planning (Hodges et al., 2020; Radovan & Makovec, 2022).

However, ERT and ODE share similarities in practice, leading some researchers to argue that ERT is a branch of ODE that emerged as a response to a crisis (Bligh & Lee, 2022; Smalley, 2021). ERT shares both positive (e.g., flexibility and accessibility) and negative (e.g., a sense of isolation and a lack of self-regulated learning skills) aspects of ODE. New terminologies are continuously and rapidly coined, reflecting the interest in the field. Following the upgraded status of ODE from abnormal to normal, a conversation about the convergence of face-to-face and online instructional modalities has given rise to terms like hybrid learning and HyFlex learning (e.g., Bozkurt et al., 2022). Both blended and flipped learning have distinctive design features regarding their instructional elements, sequences, and

approaches. Nevertheless, even before the pandemic, it was frequently observed that they were interchangeably used without clear distinction in ODE literature (Hew et al., 2019; Zawacki-Richter et al., 2019). Unsurprisingly, they are now all used as the same in the public domain.

Despite the increased conceptual confusion in ODE (Johnston, 2020), the integration of ODE into the mainstream educational sectors has been welcomed (Bhuwandeep & Das, 2020; Bond et al., 2021) as what Lewis (1997) envisioned a division between conventional and unconventional education has gradually blurred.

Research Methods

Data Collection

This study utilised BIGKinds to collect news articles from 24 media outlets in South Korea. Korea Press Foundation (KPF), a public organisation established as Korea Newpaper Center in 1962, has led rapid transformations in the news media environment in Korea. In 2016, KPF built BIGKinds, a news Big Data research solution drawing from the news to support the public in effectively collecting, storing, and analysing news content for different purposes. To date, BIGKinds has provided about 80 million items of news content published by all major media outlets in Korea ($N = 54$) since 1990. Following BIGKinds' user guidelines for news Big Data research, we further selected 24 media outlets to include in our study to make our analysis feasible. The inclusion criteria were devised to consider each outlet's domestic influence and number of publications. First, we selected nine regional newspapers with the most extensive readership in each of the nine regions in South Korea to reflect nation-wide public discourses. We further chose nine newspapers with nationwide readership, equal to the number of regional newspapers and based on the order of their publication and subscription numbers. We also included two newspapers specialising in business news, and four TV news outlets to cover different topical and media characteristics of those outlets.

Table 1

Media Outlets Chosen for Data Collection

Media type	No.	Selected media outlets
National newspaper	9	Kyunghyang Shinmun, Dong-A Ilbo, Munhwa Ilbo, Seoul Shinmun, Segye Ilbo, JoongAng Ilbo, Chosun Ilbo, Hankyoreh, Hankook Ilbo
Regional newspaper	9	Joongboo Ilbo, Kangwondomin Ilbo, Jungbu Maeil, Chungcheong Today, Maeil Shinmun, Busan Ilbo, Jeonbukdomin Ilbo, Jeonnam Ilbo, Jemin Ilbo
Business newspaper	2	Maeil Business, Korea Economic Daily
TV news outlet	4	KBS, MBC, SBS, YTN

To establish a comparative perspective, we collected news articles published before and after the COVID-19 outbreak and divided them into three separate annual periods—2019, 2020, and 2021. We

searched all news articles that included "online distance education" or equivalent search terms in their titles, as follows:

- distance education, distance learning, distance teaching, distance course, online education, online learning, online teaching, online course, cyber education, cyber learning, cyber teaching, cyber course, e-learning, remote education, remote learning, remote teaching, remote course, untact education, untact learning, untact teaching, and untact course[i].

The initial search resulted in a total of 10,157 news items. After removing duplicates, personal affairs, and event announcements, we first reviewed 9,600 news titles. An additional 735 articles that focused on foreign news or the following content were excluded:

- specific stock items, corporate products, advertisements, and promotions

- individual celebrities' and companies' announcements and events

- student recruitment and job advertisements

- representations of celebrities' posts on social networking sites

- issues and accidents unrelated to distance education (e.g., school lunch).

The selection process, following the above exclusion criteria, resulted in 8,865 news articles—239 for 2019, 6,504 for 2020, and 2,122 for 2021, with a noticeable increase in the number of articles published in 2020 compared to 2019. The first and second authors of this article (who speak Korean as their first language) were responsible for the initial search and selection process, and all results were cross-checked between the two.

Data Analysis

We performed a topic modeling analysis to identify key topics in the collection of news articles and their changes across the three periods. Based on the assumption that the composition of topics is a latent variable to be inferred, topic modeling analysis uses a set of observed variables to infer the desired latent variables. Using social network analysis software NetMiner, we first filtered out all the words in the selected news texts, not in the noun form, via the programme's morphological analysis function. We also removed single-word expressions whose meaning could not be reliably defined without further context.

A series of pre-processing measures made the analysis more reliable. For example, term frequency-inverse document frequency (TF-IDF) value for each word is calculated by retrieving the frequency of the term in each document and the scaled inverse fraction of the frequency of documents containing the term. A high TF-IDF value indicated a strong relationship between the term and the associated documents, whereas a low value denoted commonly used expressions (e.g., distance, education, COVID, spread) that were less useful in distinguishing one document from another. Thus, all the words with the TF-IDF value of 0.1 or less—stop words—were removed.

We first extracted all keywords frequently included in the collected news articles and reviewed them from the 1st keyword (i.e., class) mentioned 54,017 times across the 8,865 news articles, to the 500th keyword (i.e., group) mentioned 474 times. We created three keyword lists based on the review results

(i.e., synonyms, exclusions, definitions) to refine our topic modeling analysis method. We used the Latent Dirichlet Allocation (LDA) algorithm ($\alpha = 0.1$, $\beta = 0.01$), a statistical text processing method that identifies the proportion of topics in the collected texts and the probability of each word belonging to any given topic. In the process of identifying the latent topics, re-sampling frequencies were set as 1,000, resulting in five as the optimal number of topics to be discovered from each of the three periodic datasets.

To evaluate the clustering performance of the analysis, we calculated the silhouette coefficients, which were 0.910, 0.924, and 0.882 for the three periods, respectively. A silhouette coefficient close to 1.0 indicates effectiveness; the coefficients decreased gradually as we increased topic numbers. We repeated the topic modeling analysis and reviewed the results—five identified topics and fifty top keywords most probably associated with each topic—three times to further refine our analysis by updating the keyword lists. We identified and named the top five topics from each period and extracted the top ten words with the highest weights for each topic.

Results

In 2019: Discourses Before the COVID-19 Outbreak

Figure 1

Five Topics Extracted From 2019 News Articles (N = 239)
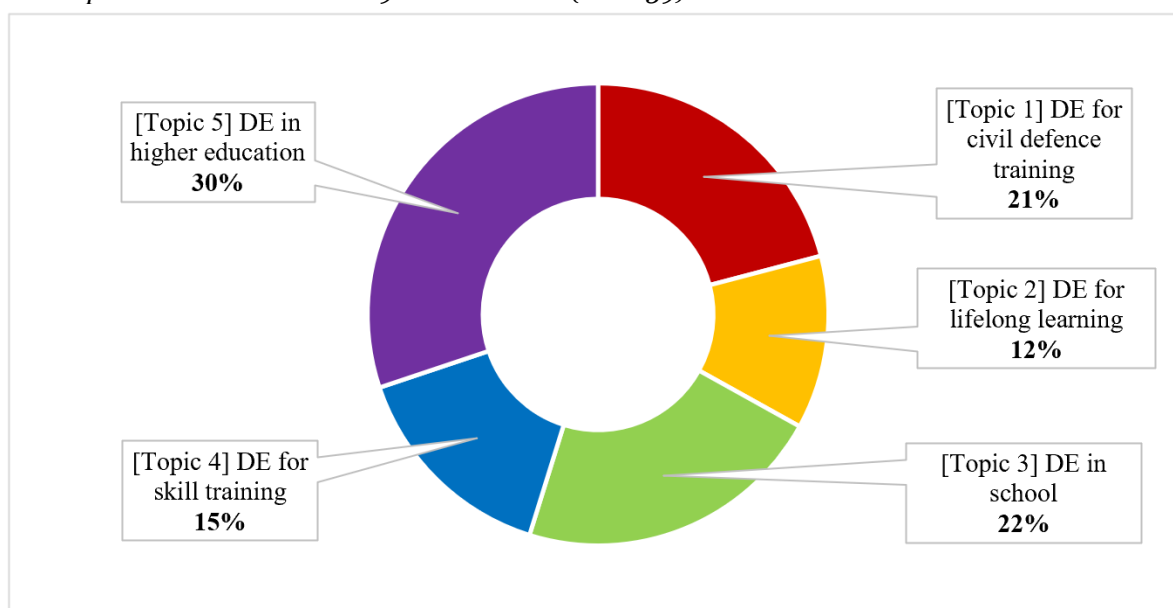
The adoption of DE for civil defence training was the first topic identified in 239 news articles concerning ODE published in 2019. In South Korea, historically and consistently exposed to the political tension and threat posed by the North Korean government, there has been an ongoing effort to increase national civil defence capabilities, with an annual budget of 43 trillion won ($40 billion) allocated in 2018. Some regional civil defence training programmes that had long been operated using physical facilities were moved online in 2019. The top 10 keywords associated with the topic (Table 2) suggested that it was aimed to increase the *cost-effectiveness* of such programmes and relieve the *burden* of both

training organisers and participants. Subsequently, the ID *authentication* of participants in the online *assemblies* appeared to be one of the major interests discussed in the related news. These results showed the importance of monitoring trainee attendance in those newly set online programmes. A total of 21% of the 239 news articles (*n* = 50) on DE published in 2019 dealt with this topic.

Table 2

Extracted Topics and Keywords in 2019

Category	Topic 1		Topic 2		Topic 3		Topic 4		Topic 5	
Topic	DE for civil defence training		DE for lifelong learning		DE in school		DE for skill training		DE in higher education	
1	Civil defence	0,066	Certificate	0,027	Student	0,047	Safety	0,026	University	0,033
2	Training	0,048	Free of charge	0,027	Class	0,035	Health	0,02	Agreement	0,015
2	Authentication	0,024	Psychology	0,022	School	0,032	Society	0,016	Cyber university	0,014
3	Emergency call	0,01	EdTech	0,02	Ministry of Education	0,014	Certificate	0,014	Foreign	0,011
4	Cost-effectiveness	0,009	Counsellor	0,019	Professional training	0,013	Welfare	0,012	Platform	0,01
5	Burden relief	0,009	Personal	0,016	Teacher	0,011	Drone	0,012	Start-up	0,008
6	Subject	0,008	Leakage	0,011	Office of Education	0,01	Medical	0,011	Business management	0,008
7	Safety	0,007	Member	0,011	English	0,009	Exam	0,01	Investment	0,008
8	Assembly	0,006	Employment	0,01	Subject	0,009	Hospital	0,007	Internationalisation	0,007
10	Place	0,006	International	0,007	Innovation	0,007	Risk	0,007	Collaboration	0,007

Topics 2 to 5 were concerned with ODE provisions at different levels of education—Topic 2, lifelong learning; Topic 3, school learning; Topic 4, advanced skill training; and Topic 5, higher education. The extracted keywords and associated news articles on each topic revealed the meaningful differences in the public discourses concerning ODE provisions in different educational contexts. For example, in lifelong learning contexts, participating in ODE often provided *internationally* recognised *certificates* (a *psychological counsellor* certificate being the most frequently mentioned in the news articles). Along with the increased number of open courses, there were conversations about some of the DE programmes being *free of charge* though those programmes experienced security problems, including *leakage* of the *personal* information of their *members*.

Regarding ODE in school settings, the *Ministry of Education* and the regional/local *Offices of Education* appeared to be leading parties in the adoption and implementation of ODE. *Students* and *teachers* also appeared as the main subjects in ODE, and the need for teachers' *professional training* was much discussed. In 2019, *English* was the main *subject* using ODE, which was perceived as an *innovative* and exceptional practice. In the context of ODE for advanced skill training in *safety*, *health*, *medical*, as well as *social welfare* subjects, more advanced technology such as small *drones* was mentioned. Managing and reducing associated *risk* to practical skill training at workplaces like *hospitals* appeared to be one of the core concerns.

There are 19 *cyber universities* specialising in (and competing for) ODE provisions across the Korean higher education sector. In 2019, most news articles concerning ODE featured the business-oriented achievements and promotional information of those for-profit universities. As keywords suggested, setting up an *international collaboration* or *agreement* with *foreign* organisations like universities was reported as top news. *Investments* in new online learning platforms (often *start-up* edtech companies) were considered important for *business management*. The largest number of new articles on ODE published in 2019 (*n* = 72, 30%) were categorised into this topic group, indicating that the for-profit nature of ODE was salient in the Korean higher education context before the pandemic. Such ODE business was exclusively the concern of and operated by those special universities, given the absence of conventional universities in the discourses.

In 2020: Discourses During the COVID-19 Outbreak

Figure 2

Five Topics Extracted From 2020 News Articles (N = 6,504)
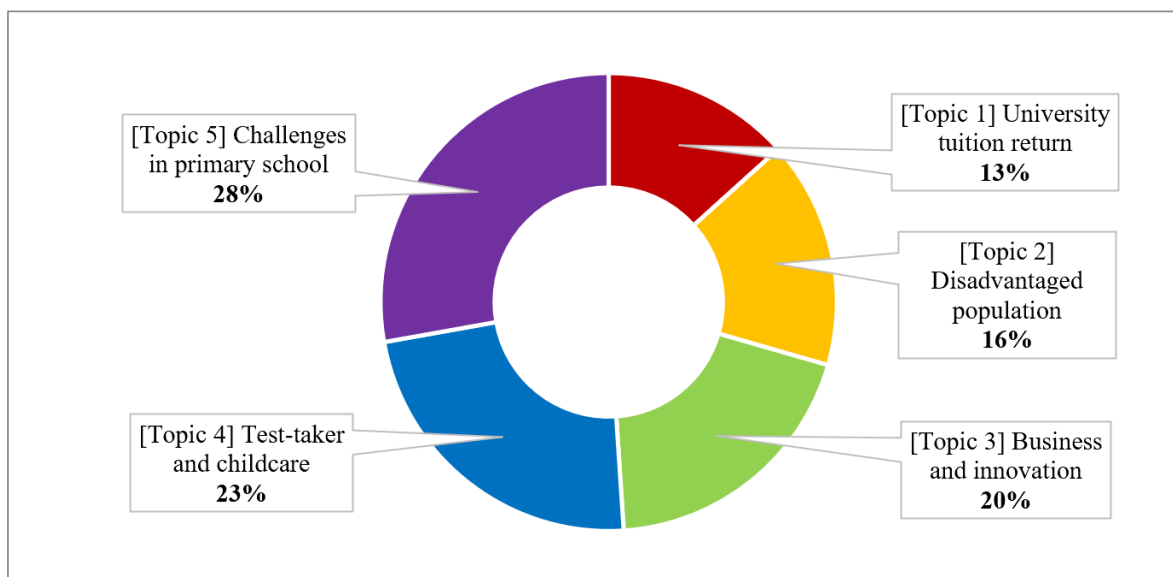
Unsurprisingly, with the outbreak of COVID-19 in January 2020, the number of news articles concerning ODE provisions increased dramatically (from 239 in 2019 to 6,504 in 2020). ODE quickly gained its normality, legitimacy, and necessity across all educational sectors in Korea. The five topics identified in the 2020 news articles can be found in Table 3—university tuition return (movement), disadvantaged population, business and innovation, test-taker and childcare, and challenges in primary school.

Table 3

Extracted Topics and Keywords in 2020

Category	Topic 1		Topic 2		Topic 3		Topic 4		Topic 5	
Topic	University tuition return		Disadvantaged population		Business and innovation		Test-taker and childcare		Challenges in primary school	
1	Professor	0,034	Child	0,013	Business	0,012	Private institute	0,025	Connection	0,012
2	Semester	0,019	Adolescent	0,012	Company	0,012	College entrance test	0,02	Two-way	0,009
2	Tuition fees	0,017	Disabled student	0,009	Future	0,01	Pre-school	0,02	Teacher	0,009
3	Term start	0,015	Multicultural family	0,008	Digital	0,008	Test	0,013	Professional training	0,009
4	Extension	0,011	Welfare	0,008	Era	0,007	(social distancing) Stage	0,013	Device	0,008
5	Practical training	0,011	Social class	0,006	Innovation	0,006	Superintendent	0,011	Primary school	0,008
6	University	0,01	Disadvantaged	0,005	EdTech	0,006	Emergency	0,009	Divide	0,008
7	Subject	0,008	Special education	0,005	Collaborative	0,006	Densely populated	0,007	Attendance	0,008
8	Return	0,006	Support	0,005	Market	0,005	Test site	0,007	Internet	0,007
10	Exam	0,006	Family	0,005	Solution	0,004	Test-taker	0,006	Concentration	0,004

The most salient issue was university students' dissatisfaction with the poor quality of ODE provided by their university during the pandemic, especially during the spring 2020 *semester*. Since most campus-based universities (unlike cyber universities) did not have previous experience as well as the required skills and infrastructures for ODE, students perceived the quality of ODE provision during the first semester immediately after the COVID-19 outbreak as particularly poor. In fact, most Korean universities postponed the *start of the term* from March to April, *extending* the winter break for a few

weeks hoping that the spread of the virus would soon cease (see Lee et al., 2021b). Subsequently, there was student protest and movement for *return* of *tuition fees*. Students in specific disciplines that required much *practical training* and hands-on learning were more vocal. Some complaints were directly towards particular *professors* and their practice. Although this topic, among the selected five, was least frequently featured in the 2020 news articles about ODE (*n* = 868, 13%), it was considered the most powerful. It resulted in actual changes in the Korea's higher education sector—many Korean universities refunded at least a small portion of the tuition fees in the first semester. Table 3 also shows that the clustered keywords of Topic 1 were clearly associated with the coherent idea of a university tuition return movement.

The second most frequently discussed topic in 2020 concerned the challenges experienced by disadvantaged populations while engaging with ODE. Diverse groups of *disadvantaged children* and struggling *adolescents* were featured in news articles, including students (a) from *multicultural families* (in Korean settings, this typically refers to families in which one or both parents are recent immigrants, often without financial, social, and cultural capital); (b) with *disabilities*; and (c) from low *social class*. Given that school lunches and dinners are free of charge in all public schools in Korea, moving classes online caused significant damage to these groups of students—not only academically and physically. Many news articles argued for effective *welfare* measures and *social support* for such families.

Ironically, the tone of news articles associated with Topic 3, Business and innovation, was rather positive and optimistic despite being published at the same time as Topics 1 and 2 above. Many articles discussed the opportunities the COVID-19 pandemic had provided in terms of the rapid development of the *edtech business* and *market*, and edtech-driven *innovation* in education. It was proclaimed that the new *digital era* (and the *future* of education) had opened. Specific *companies* (a) leading the *changes*, (b) *collaborating* with government organisations and educational institutions, and (c) providing new *solutions* were mentioned in those articles.

Topic 4 concerned the specific impacts of ODE on the experiences of college entrance test-takers and pre-school kids. The implications of the continuous shifts in *social distancing* measures and policies on these two learner groups were discussed and reported as frequently as (or as soon as) national emergency stages changed. The college entrance test is notoriously high-risk in Korean society, in which about 80% of high school graduates go to universities. Issues related to educational concerns created by the closure of *private institutes* and how to organise *test sites* that were usually *densely populated* were frequently discussed. In addition, the closure of pre-schools, which are common and affordable childcare providers in Korea, caused a range of social issues, especially for working parents and low-income families. Many news articles pointed out that infants (unlike other student groups) were unlikely to benefit from ODE provisions.

The largest number of news articles that discussed ODE during 2020(*n* = 1,808, 28%) specifically focused on primary school contexts, reporting a range of challenges experienced by primary school students and teachers. The two most frequently mentioned challenges were related to *Internet connection* (or Internet disconnection) and the *digital divide*. Following the Ministry of Education's guidance, all primary schools in Korea adopted a *two-way* communication model for their ODE provisions, using telecommunication tools such as Zoom and Google Classroom during the pandemic. In this synchronous learning context, a lack of Internet connection (absence of *devices*) at home appeared to be a significant educational and social problem—subsequently, many primary schools faced low attendance rates among students from economically and socially disadvantaged families. A great

deal of news also reported a lack of teacher professional training and a decrease in student concentration levels. Thus, the pessimistic discourse of ODE was quickly circulated throughout Korean society during the pandemic.

In 2021: Discourses After the COVID-19 Outbreak

Figure 3

Five Topics Extracted From 2021 News Articles (N = 2,122)
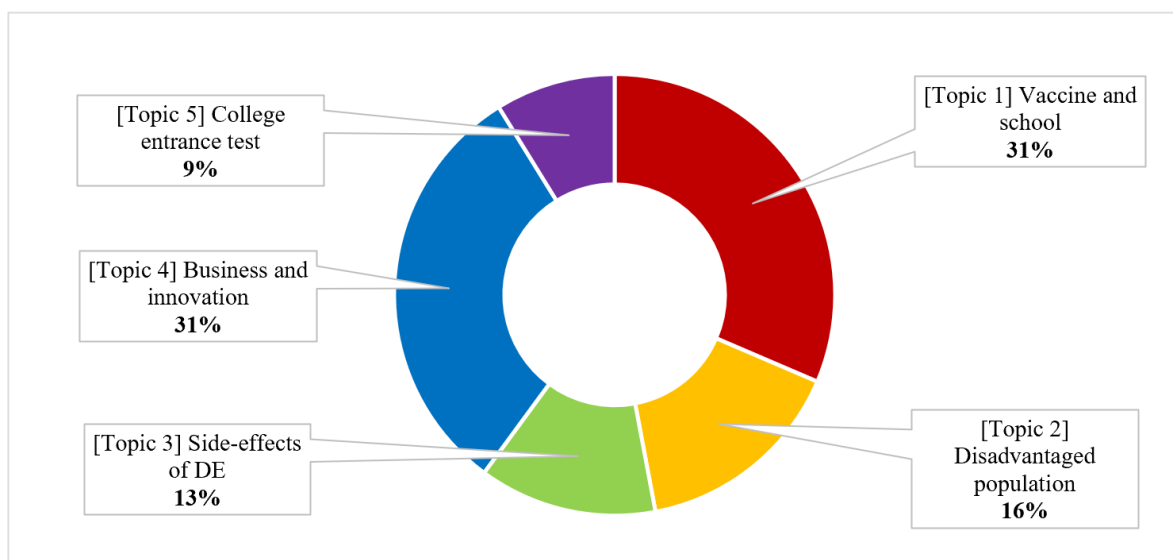
While the COVID-19 pandemic continued, most educational institutions maintained online elements at least partially in 2021. Subsequently, issues and concerns about ODE practices similar to 2020 were still discussed in the 2021 news articles, indicating that they were unresolved. Nevertheless, new topics emerged alongside serious attempts to re-open schools and businesses in Korea. As Table 4 demonstrates, *vaccine and school* was the most frequently discussed topic in 2021 (*n* = 667, 31%). The new availability of *vaccines* enabled different educational institutions, including *private institutes*, *middle schools* (i.e., high schools), and *pre-schools*, to resume in-person classes and childcare services in a more sustainable and consistent manner. Thus, the social distancing *measures* were continuously updated and reported in the news articles. The challenges experienced by disadvantaged populations while engaging with ODE remained the second most frequently discussed topic in 2021. However, one noticeable shift from the discourse of 2020 was the appearance of keywords such as *budget* and *Internet* in the 2021 discourse. This suggested that there had been some improvement in the welfare policies for these groups, evident in the specific budget conversations and the strategies to provide *devices* and *Internet*—in most cases, free of charge.

Table 4

Extracted Topics and Keywords in 2021

Category	Topic 1		Topic 2		Topic 3		Topic 4		Topic 5	
Topic	Vaccine and school		Disadvantaged population		Side-effects of DE		Business and innovation		College entrance test	
1	Private institute	0,014	Child	0,014	Cyber	0,023	Company	0,011	College entrance test	0,033
2	Pre-school	0,012	Adolescent	0,011	Safety	0,018	Digital	0,01	Test site	0,02
2	Vacation	0,011	Welfare	0,008	Invasion	0,016	Information	0,008	Test	0,018
3	Vaccination	0,011	Device	0,007	Teacher authority	0,012	Future	0,008	Test-taker	0,015
4	Middle school	0,01	Disabled student	0,007	Bullying	0,008	Innovation	0,007	Test identification	0,011
5	Infection	0,009	Social class	0,007	Information	0,007	Industry	0,006	Test taker	0,008
6	Vaccine	0,008	Internet	0,006	Protection	0,006	Smart	0,006	Test preparation	0,008
7	School starts	0,007	Support	0,005	Policy	0,006	Collaboration	0,005	Hospital	0,006
8	Measure	0,006	Difficulty	0,005	Personal	0,005	Market	0,005	Isolation	0,006
10	In-person class	0,006	Budget	0,005	Damage	0,005	BigData	0,005	COVID test	0,005

Another new topic emerged, that of the side effects of ODE. A large number of social and criminal incidents like *cyberbullying* among students in online platforms (including social networking sites) and *invasion* of *teacher authority*, including verbal and sexual insults towards teachers during online classes, were reported. *Personal information* leaks and subsequent adoption of information *protection policies* were also mentioned. Unlike 2020, in 2021, there were more long- and medium-term damages created by the prolonged period of ODE provision.

The topic of *business and innovation* remained relatively unchanged except for the appearance of new keywords *smart* and *big data*, which suggested the maturity of the discourses. While such business-oriented discussions in 2020 were still reacting to the COVID-19 outbreak, the same discussions in 2021 sounded more progressive and proactive—that is, more future-oriented. The topic of the college entrance test also remained one of the five topics in 2021. However, as both the COVID-19 vaccine and testing were made available in 2021, the conversations were more specifically concerned with the measures for COVID-19 patients who had to self-isolate on the test day. Subsequently, ways to organise test sites at hospitals and identify test-takers were discussed.

Discussion

Our analysis has led us to four key discussion points. First, our findings aligned with the existing literature, which suggested that ODE (and DE) had typically been viewed as an unconventional and abnormal educational delivery method, with in-person education seen as the norm and often considered more effective (Garrison & Anderson, 1999; Stapleford & Lee, in press; Xiao, 2018). Our analysis of news articles from 2019 supported this, as ODE was considered useful for specialised educational contexts, including civil defence training and lifelong learning, due to its accessibility and flexibility. ODE in schools and higher education was still considered uncommon—with emphasis on innovative or commercial aspects. In contrast, during the pandemic, DE became the primary (and only) educational delivery method, with the normality of ODE quickly established across all educational levels and contexts.

Second, the study demonstrated that ODE was context-specific, influenced by the unique cultural, historical, and educational characteristics of South Korea. Before the pandemic, there was a focus on using ODE for civil defence training, a major training provision in Korea not found in other countries. During the pandemic, there were ongoing discussions about the implications of ODE for the college

entrance test, which is of great importance in Korean society. Korea's advanced technological infrastructure and national-wide Internet connectivity facilitated the rapid adoption of ODE across all levels of education. The Ministry of Education's decision to guide all primary schools towards a fully synchronous modality on platforms like Zoom reflected the specific technological conditions in Korea. Therefore, while ODE as a new normal may have seemed like a global phenomenon during the pandemic, it is crucial to acknowledge that historically, its practices have been shaped and influenced by the social, educational, and technological contexts of each society (see Lee, 2018).

The third discussion point highlighted the bias present in ODE discourses during the pandemic. The division between disadvantaged learners and business-oriented actors was prominent in 2020 and 2021, with the discourse on each side distinctly different, emphasising the ongoing societal inequality. The negative impact of the pandemic-induced adoption of ODE was evident for some, while others seized the opportunity to generate profit. Previous studies have criticised the social inequality stemming from the digital divide in various countries (e.g., Azionya & Nhedzi, 2021; Azubuike et al., 2021) and the market-driven nature and consequences of ODE adoption during the pandemic (e.g., Teräs et al., 2020; Williamson et al., 2020). While this study's focus was limited to a national level, the literature has suggested that the partiality of ODE discourse is a global issue as long as social and educational inequality persists. Therefore, it is crucial to maintain a critical awareness of this division and make an effort to reduce the gap, primarily to address the negative impact on the disadvantaged, even after the pandemic ends.

By 2021, discussions on ODE had become more mature compared to the previous year. In 2019, conversations were superficial and only highlighted the positive aspects of ODE, such as its accessibility, innovation, and being free of charge. There was also an overemphasis on the for-profit and business-oriented nature of ODE provided by certain institutions such as cyber universities. There was a lack of critical analysis and consideration of the challenges associated with ODE practices. The immaturity of ODE discourses before the pandemic was likely due to a lack of public interest in ODE, with perspectives based on insufficient information rather than intentional propaganda. However, the 2021 discussions were more sophisticated and balanced, with more in-depth discussion of both merits and limitations of ODE. In particular, the challenges faced by disadvantaged student groups and the required welfare policies and support strategies were extensively reported. The negative consequences of prolonged ODE adoption were also discussed, such as the potential long- and medium-term damages caused by a lack of in-person teaching and socialisation in different educational settings.

Conclusion

The COVID-19 pandemic was an unprecedented and unique opportunity for ODE to attract public interest and engagement. The present study demonstrated that the genuine merits of ODE have been noted, and a long-existing blind suspicion and deficit discourse toward ODE, primarily rooted in ignorance and inexperience, have diminished during the pandemic. Enjoying the newly gained normality, more institutions than ever are offering ODE programmes to increase enrolment and revenue, nationally as well as globally. The integration of ODE into mainstream education is currently a global phenomenon, converging face-to-face and online modalities in everyday pedagogical practices. While the field celebrates its achievements, it is also important to remember that not everyone's ODE experiences have been positive, and subsequently, more sophisticated criticism towards ODE has

appeared. As in the post-pandemic situation, where ODE is no longer imperative, one rarely hears about ODE in the public domain; thus, the public perceptions of ODE, set through pandemic experiences, will likely stay unchanged, which was the departing point of this study.

The four discussion points above have valid implications for post-pandemic ODE practices. Most important, the field has learned that ODE practices are inherently biased and specifically bounded by participants' cultural and educational conditions—cultural and contextual sensitivity should be increased in both ODE research and practice. The results also revealed that the pandemic has left unresolved issues of the increased digital divide and misconduct, as well as hampered pedagogical relationships and outcomes. Similarly, the division between the social-justice-oriented and business-oriented discourses deserves more in-depth investigation and critical reflection to ensure that ODE is used ethically for a more democratic and inclusive educational future (rather than for-profit agendas). Given the maturity of the public understanding of ODE, it may be even harder to challenge and change them now, which requires more focused attention from ODE researchers and policymakers.

The study had some clear limitations that should be acknowledged. For example, the choice of dividing the time period into 2019, 2020, and 2021 (before, during, and somewhat after the COVID-19 pandemic) may be arbitrary. Additionally, the study only focused traditional media outlets in a single country, which limited its scope. Future studies could overcome these limitations by adopting a broader temporal lens, including more countries, and analysing non-traditional media outlets. The authors hope that the detailed methodology and discussion points presented in this paper can serve as a useful guide for future research in this area.

Acknowledgement

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[i] 'untact' was the popular term emerged in Korea, referring to the absence of physical contact during the pandemic.

Effects of Using WhatsApp: Iranian Intermediate EFL Learners' Vocabulary Learning and Autonomy

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Abstract

The current study was designed to determine if the use of blended learning (combining face-to-face instruction and mobile-assisted language learning using WhatsApp) contributed to the vocabulary learning and autonomy of Iranian English as a foreign language (EFL) learners, compared to the traditional method. To assess their English skills, the Preliminary English Test (PET) was given to 80 homogenous intermediate learners at the beginning of the study. The study's intended participants were 50 EFL learners whose scores were within the intermediate competency level. Then, the participants were divided randomly between experimental and control groups. One-way between-groups analysis of covariance was run. Findings from post-test scores indicated a statistically significant difference between the experimental and control groups. Another one-way between-groups analysis of covariance was performed to assess the impact of two distinct blended learning versus traditional teaching treatments on EFL learners' autonomy. In the post-test results, a significant difference between the control and experimental groups' performance was observed. This study provided insights into how technology may be applied to teach language components and skills.

Keywords: autonomy, blended learning, Iranian intermediate EFL learners, vocabulary learning, WhatsApp

Introduction

With the rapid development of new types of online technologies and applications, language teaching and learning has entered a new stage. Most learners from around the world have tried learning languages through Websites, online applications, and Internet-based technologies. Undoubtedly, the COVID-19 pandemic has highlighted the vital role of online learning; learner-teachers and learner-learner interaction has been one of the most important issues when considering the quality and availability of online platforms for academic instruction. Although many studies have advocated the use of online applications in teaching the English language, it was the COVID-19 pandemic that forced English language teachers to use different types of applications and platforms in place of face-to-face classes (e.g., Mardiah, 2020; Wu & Miller, 2020; Yulia, 2020).

Vocabulary is the backbone of language classes (Torki, 2011). It is a significant key to teaching English because without adequate vocabulary, students cannot comprehend others or declare their opinions. According to Nation (2006), vocabulary knowledge forms the basis for developing communicative competence in English. Lack of vocabulary knowledge in second and foreign language learning contexts may be a significant barrier to learners' development of reading and listening skills. Grabe and Stoller (2018) asserted that a wide variety of important issues are typically grouped under the topic of vocabulary learning, including (a) learners' specific vocabulary demands and wishes, (b) word saliency as well as word frequency, and (c) learning burden. However, in the past, the role of vocabulary in language teaching has been overlooked; it was assumed that vocabulary would take care of itself. Insufficient vocabulary knowledge not only leads to communication breakdowns in language learners, but it also makes the acquisition of other language skills more challenging (Liu et al., 2014). As a result, the study of vocabulary teaching has become increasingly important in language teaching research (Milton & Alexiou, 2012). Furthermore, due to changes in learners' needs and the appeal of new technologies, new methods have emerged. The use of new digital technologies, computers, and the Internet have become the most appealing and widely accessed tools for language teaching and learning.

Developing learner independence is a crucial factor in the language teaching process. The concept of learner independence or learner autonomy refers to a notion in which learners can direct and monitor their own learning. It indicates the types of activities that happen with no immediate supervision from the teacher. Autonomous learners determine their own activities and strategies to foster independent learning. Therefore, learners alone are responsible for their learning. This independence requires learner engagement which may lead to better and more comprehensive learning. Autonomy is initiated in the class and extends beyond the classroom walls.

Learners who begin and take responsibility for their learning, as well as share their learning with teachers and peers, may benefit from mobile devices (Vavoula & Sharples, 2008). Mobile gadgets can also provide a more independent learning environment (Benson & Chik, 2010; Fisher & Baird, 2006). Consequently, mobile learning complements the more traditional methods and approaches to education.

The growth of the Internet, software, and mobile applications and devices has resulted in the rise of social media programs built for electronic devices (Karpisek et al., 2015). WhatsApp, the most popular mobile communication program, is a free messaging and calling program that also allows users to share material

such as audio, video, photos, location, and contacts. Because of the popularity of such applications, many language instructors are interested in seeing how they may use WhatsApp to teach aspects of second language teaching. As a result, it is worthwhile to investigate the possibility of enhancing language students' vocabulary learning outside the classroom in order to accelerate learners' vocabulary acquisition (Schmitt, 2019).

While many researchers have investigated vocabulary teaching through using the Internet and different applications, very few studies can be found that have discussed the advantages of applying WhatsApp in vocabulary teaching in Iranian English as a foreign language (EFL) contexts. This study examined the use of blended learning with WhatsApp with Iranian women learning EFL at an intermediate level. This study was framed by two research questions:

1. Compared with conventional approaches, is there any significant difference in Iranian women's EFL vocabulary acquisition at an intermediate level when blended learning via WhatsApp is used?

2. Compared with conventional approaches, is there any significant difference in autonomy for Iranian women learning EFL at an intermediate level when blended learning via WhatsApp is used?

Literature Review

To learn a language, building a comprehensive vocabulary reservoir is a must. Because of the large number of words involved, understanding the meaning of a second language vocabulary is a substantial learning difficulty for second language learners (Schmitt, 2014), and learners must grasp as well as connect the form and meaning of a term (Nation, 2013).

Blended learning (BL) was introduced to bring a more active and student-centered style to instructional situations. By presenting course content online, instructors were able to implement varieties activities before and after class; this provided learners an opportunity where both teachers and students were actively engaged in language learning activities. Application of new online technology has enhanced students' willingness to participate in vocabulary learning and decreased teachers' authoritative role (Wang & Young, 2014).

Blending traditional instruction with technology-mediated instructional methods satisfied learners' needs and increased their learning levels. This new approach is called "hybrid or blended learning" (Rogers, 2018, p. 11). It mixes face-to-face with virtual learning and teaching experiences to bring about interactive textual exchange in learning networks. According to Picciano (2009), blended classes are those in which face-to-face and online activities are joined, with both contributing to instruction. Moreover, he asserted that in blended classes, online activities substituted for part of traditional face-to-face sessions. Similarly, Tomlinson and Whittaker (2013) asserted that "blended learning is the term most commonly used to refer to any combination of face-to-face teaching with computer technology (online and offline activities/materials" (p. 12). Anthony et al. (2019) indicated that blended learning had a positive effect on the development, assessment, methods of knowledge transmission, and encouragement of teaching instructors. In short, for both teachers and learners, blended learning has provided different benefits and

eradicated the constraints of time and place. Teaching and learning can occur wherever and whenever students need and want to learn.

WhatsApp, a free downloadable program, is an instant messaging application compatible with almost all smartphone operating systems. WhatsApp has gained popularity around the world as a social network application able to satisfy many people's communication needs (Bouhnik et al., 2014). WhatsApp is capable of sending different kinds of media like pictures, video, and audio, among others. Moreover, recording and sending voice files immediately to other users is one of the outstanding characteristics of WhatsApp. It also allows users to form a group of individuals with whom they may wish to talk.

Figure 1

The WhatsApp Logo

WhatsApp can be a powerful application to support foreign language learning; many teachers use it in online classes because of its capacity to enhance interaction between teachers and learners (Cifuentes & Lents, 2010). WhatsApp allows teachers to save time and better manage the classroom while also keeping students informed about what is going on in class (Lauricella & Kay, 2013), increases learners' language abilities and technical skills (Rambe & Chipunza, 2013), and enhances learners motivation (Abdullah & Al Khateeb, 2021). Moreover, WhatsApp promotes active learning through informal communication between students (Smit & Goede, 2012) and the development of strong communication standards; it also improves learners' engagement in EFL classrooms (Baffour-Awuah, 2015). For example, WhatsApp enhances peer communication and student-instructor engagement, (Bouhnik et al., 2014), and second language development (Andujar-Vaca & Cruz-Martnez, 2017), both of which create a feeling of belonging to a learning community (Doering et al., 2008). Because their comments in a WhatsApp group are public, students may take assignments more seriously (Sweeny, 2010) and be more diligent in doing their homework (Cifuentes & Lents, 2010). Researchers have investigated the impact of WhatsApp for vocabulary learning (Barhoumi, 2015; Basal et al., 2016; Church & De Oliveria, 2013; Lawrence, 2014). As a result, WhatsApp has established itself as a superior option for vocabulary development, particularly for weak pupils. Therefore, many language teachers have selected WhatsApp as the venue for language learners to obtain and submit their assignments.

Learner autonomy combines concepts from different perspectives. At first, learner autonomy was characterized as "ability to take responsibility for one's own learning" (Holec, 1981, p. 3), Holec (1981) believed that language learners need opportunities to be responsible for making decisions regarding specific learning methods, needs, and capabilities. Thus, learner autonomy refers to the ability to learn actively in a self-contained environment (Little, 1991). Cotterall (1995) characterized autonomous learners as those who

solve the difficulties which cultural criteria, educational background, and previous experience might have created. These learners realize their educational and personal needs, and are also able to plan the aims and targets for their own learning. Furthermore, Little (2012) stated that learner autonomy is "the product of interdependence rather than independence" (p. 20) which alludes to the synergy between whole and individual activities. Serdyukova and Serdyukov (2013) believed that learner autonomy is crucial for a learner's continuous development and learning efficiency.

A variety of perspectives and principles have emerged from the literature on learner autonomy. For instance, Benson (2007) classified learner autonomy into four categories—psychological, technical, socio-cultural, and political-critical. Furthermore, Benson (2007, 2011) presented five principles for gaining autonomy in learning. The first was active involvement in student learning; students should be discouraged from too much dependence on teachers, who should act as facilitators. The second principle was to provide options and resources, and the third was to present selection and decision-making opportunities. As a result, students will be motivated to decide what they wish to learn about. The fourth and the fifth principles were supporting learners to improve their learning strategies and providing sufficient motivating reflection.

According to Little (1991), autonomy is a "capacity for detachment, critical reflection, decision-making, and independent action" (p. 4). Learning can be "more focused and more purposeful and thus more effective both immediately and in the longer term" (Little, 1991, p. 8). Little (2012) also argued that learners can determine their own learning purpose and the content they wish to study. Moreover, he believed meta-cognitive awareness was crucial in accelerating learner autonomy. Nearly all definitions of learner autonomy have included the idea that learners' own learning process is the pivotal point in learning. Learners bring their own beliefs and thoughts to their engagement with the world outside of the physical classroom. Particularly for foreign language learning, this means not merely practicing the target language in the classroom. Learning extends beyond the time when classes finish and is more than simply rote memorization. As proposed by Reeve (2016), the main purpose of supporting autonomy is to clarify and sustain the learning process, class environment, and relationship between teacher and student in ways that encourage autonomy. Shirzad and Ebadi (2019) claimed that learners should be encouraged to collaborate with peers in the classroom to achieve higher levels of autonomy in the language learning process.

Hamilton (2013) stated that technology improved the accessibility and availability of the second or foreign language environment and provided learners with independence necessary for self-directed learning. Furthermore, it offered "structured unpredictability," believed to be crucial to the development of learner autonomy (Little & Throne, 2017, p. 20). According to Little and Throne (2017), current technology helped create and mediate social learning environments which supported learners. In the context of EFL, the use of mobile technologies enhanced learners' autonomy. In the Saudi EFL setting, Almekhlafy and Alzubi (2016) discovered that students gained a sense of independence by choosing what to converse about on WhatsApp. In India, Ramamuruthy and Rao (2015) claimed that the use of mobile phones encouraged EFL undergraduates to learn independently. Similarly, learners in Japan, according to Leis et al. (2015), had a propensity to be autonomous in terms of investing their spare time and taking care of their own learning.

In formal learning environments, study of the interplay of technology and autonomy has mostly focused on the extent to which technology impacted learners' performance and growth of autonomy. For example, Pellerin (2017) argued that learners had more independence in online learning environments, and their

digital identities were reinforced through technology. Recently, several studies (Alshammari et al., 2017; Hashemifardnia et al., 2018; Kartal, 2019; Kholis, 2020) focused on the effect of applying WhatsApp, and all agreed that this application played an effective role in facilitating language teaching and learning by increasing learners' autonomy.

On the other hand, technology may create roadblocks to the establishment and implementation of learner autonomy (Reinders & Hubbard, 2013). These authors asserted that for some learners, real language communication via technology may be difficult in practice. Also, Lai and Zheng (2018) believed that some technological instruments and the contexts of their use (e.g., tiny displays, loud locations, limited time for mobile phone use) may limit learners' ability to utilize them for independent behaviors.

Methodology

Participants

Fifty Iranian EFL learners were the participants of this study. They were registered in an English institute in Kermanshah province (Iran) at an intermediate level of language proficiency. All participants were women, with ages ranging between 16 and 19 years with an average mean age of 17.5 years. Based on a convenience sampling method, they were selected for their availability and ease of access. All the learners completed a consent form and agreed to the use of their test data for the current study. Participants were assured that their test scores would be kept confidential and never associated with their names.

Data Collection Instruments

The Preliminary English Test (PET) was used to ensure that the participants were homogeneous concerning their level of language proficiency. The vocabulary knowledge scale (VKS; Paribakht & Wesche, 1999) was applied to assess how well learners knew each word. Although, Paribakht and Wesche (1999) confirmed the practicality of the VKS and asserted that it may be applied with any selected series of words, the reliability of VKS using Cronbach's alpha was estimated to be 0.91. In order to measure students' knowledge of words, a vocabulary achievement test was constructed. Forty items were taken from vocabulary lists the students had previously studied. First, 100 words were chosen from their course book, Touchstone 4. Then, drawing on the scale developed by Paribakht and Wesche (1999), these words were administered to the learners in order to select the 40 words that none of the students knew. Finally, the selected words were used as the items of the vocabulary test to measure the students' vocabulary achievement.

The test items were reviewed by experts; modifications and revisions were done after piloting the test with learners who were similar to the study sample. Using Cronbach alpha, the reliability of this test was estimated to be 0.76, which is acceptable. The vocabulary test was administrated twice to evaluate vocabulary achievement, first as a pre-test and later as a post-test. Since it aligns with the definition of language learner autonomy discussed above, the learner autonomy questionnaire (LAQ; Zhang & Li, 2004) was used at the beginning and end of the experiments to account for the participants' autonomy. Zhang and Li (2004) reported that the questionnaire had high validity and estimated its reliability to be 0.80.

Learner Resources

The *Touchstone* series (2nd ed.) was designed for adult learners to encompass four language skills and components. There are 12 units in each of four student books which cover a broad range of topics. Each unit consists of four lessons.

The WhatsApp application was included in this study as it had the capability to send messages from one person to another or to a group. A whole class, typically a teacher and a group of students, might participate in activities through WhatsApp's content sharing and messaging functions. This made it possible to have classroom activity or language study outside of school time. Users could easily monitor the operation; anytime and anywhere, they only needed to open their WhatsApp application.

Procedure

At the beginning of the study, the researcher administered the PET to 80 intermediate learners to measure their English proficiency. Then, 50 female learners were selected as the intended participant sample. These participants' scores fell within the range of intermediate proficiency. The selected participants were divided into two groups, an experimental and a control group. The Learner Autonomy Questionnaire and vocabulary knowledge test were given to these learners before and after the treatment to determine their autonomy and vocabulary proficiency at the beginning of the study.

To create the vocabulary knowledge test, the researcher created a list of words from the material taught in face-to-face instruction and attempted to include vocabulary from different parts of speech. These words were administered to the learners using the Paribakht and Wesche (1999) scale to select the 40 words students were unfamiliar with, to be used as elements of the test to assess the students' vocabulary.

The researcher then created the blended learning course, a mixture of face-to-face and WhatsApp-mediated instruction for the experimental group only. The same teacher taught the face-to-face group using the same curriculum, from the Touchstone 4 resources (McCarthy et al., 2014). The treatment lasted 15 sessions; each session was 90 minutes in duration. Prior to implementation, the researcher created a WhatsApp chat group for the teacher and students from the experimental class. For each vocabulary word, the teacher created an information message that included an English explanation, pronunciation, synonyms and antonyms, and a single example sentence. These messages were based on the vocabulary parts of the students' English coursebook. Information messages in the WhatsApp group were exchanged at random times between 09:00 and 21:00 every day. To ensure that all the messages were received and read by the learners, the messages were tracked and monitored. Participants were asked to use the words to make a sentence and share them in groups. If any errors were made, participants were expected to address their peers' sentences. The control group used only the traditional method (i.e., coursebook, classroom interaction, classroom participation, and activities). After the instruction was completed, the post-test of vocabulary achievement was given to all participants to check the impact of the instruction on developing learners' vocabulary knowledge. Additionally, the learners completed the Learner Autonomy Questionnaire to highlight the probable contribution of blended instruction in developing learners' autonomy.

Results

Participant Selection

The practical phase of this study began with selecting the participants by employing convenience sampling and random assignment. To do so, the PET was administered to a group of 80 students, which enabled the researcher to draw a sample of 50 homogenous learners and randomly assign them to one of the two groups in the study (i.e., experimental and control groups).

Table 1

Descriptive Statistics of Initial and Selected Participants' PET Scores

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Pet	80	141.00	169.00	154.86	6.72	-.051	.269
	50	150.00	160.00	154.78	2.40	-.22	.33
Valid N (listwise)	50						

As reported in Table 1, the initial group of 80 participants had a mean of 154.86 and a standard deviation of 6.72 in their PET. Accordingly, participants whose scores fell within the range of Mean ± 1 SD (148.14 and 161.58) were selected as homogenous participants. The results of descriptive statistics for selected participants showed that their minimum score was 150 and their maximum score was 160 with a mean of 154.78 and a standard deviation of 2.40.

Addressing the First Research Question

To investigate the contribution of blended learning via WhatsApp to Iranian intermediate EFL learners' vocabulary learning, ANCOVA was applied to the vocabulary knowledge data. First, the Kolmogorov-Smirnov Test was run to check the normal distribution of scores.

Table 2

Vocabulary Knowledge: One-Sample Kolmogorov-Smirnov Test

Data source	n	Normal parameters[a,b]		Most extreme differences			Kolmogorov-Smirnov Z	Asymp. sig. (2-tailed)
		Mean	SD	Absolute	Positive	Negative		
Pre-test	50	21.9200	2.07846	.158	.142	-.158	1.120	.163
Post-test	50	28.8800	5.72371	.191	.191	-.167	1.351	.052

[a]Test distribution is normal. [b]Calculated from data.

The results in Table 2 showed that participants' scores on pre- and post-instruction vocabulary knowledge tests were normally distributed (p = .16, .052; p > .05).

Table 3

Descriptive Statistics of the Vocabulary Post-Test

Group	Mean	SD	Number
Experimental	34.20	2.00	25
Control	23.56	1.98	25
Total	28.88	5.72	50

As illustrated in Table 3, the mean score for vocabulary knowledge among participants who were exposed to a blended learning course was 34.20; however, the mean score for vocabulary knowledge among participants who were exposed to traditional instruction was 23.56.

Table 4

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1455.88a	2	727.94	229.01	.00	.90
Intercept	152.92	1	152.92	48.10	.00	.50
Pre-vocabulary	40.76	1	40.76	12.82	.00	.21
Grouping	1271.57	1	1271.57	400.03	.00	.89
Error	149.39	47	3.17			
Total	43308.00	50				
Corrected Total	1605.28	49				

To determine the effectiveness of blended learning versus conventional instruction on learners' vocabulary knowledge, one-way between-groups analysis of covariance was run. The independent variable was the type of instruction (blended learning and conventional instruction), the dependent variable was learners' scores on the vocabulary knowledge post-test, and participants' scores on the vocabulary knowledge pre-test were used as the covariate in this analysis. The results revealed a significant difference between the control and experimental groups in terms of their post-test scores.

Addressing the Second Research Question

To address the effectiveness of the application of WhatsApp on Iranian intermediate EFL learners' autonomy, ANCOVA was applied. The Kolmogorov-Smirnov Test was used to determine the normal distribution of data.

Table 5

Learner Autonomy: One-Sample Kolmogorov-Smirnov Test

Data source	n	Normal parameters[a,b]		Most extreme differences			Kolmogorov-Smirnov Z	Asymp. sig. (2-tailed)
		Mean	SD	Absolute	Positive	Negative		
Pre-test	50	55.72	3.194	.115	.065	-.115	.813	.524
Post-test	50	66.64	10.69	.233	.233	-.214	1.645	.069

[a]Test distribution is normal. [b]Calculated from data.

The results in Table 5 indicated that learners' scores on the pre- and post-instruction autonomy scale had a normal distribution (p = .52, .06; p > .05).

Table 6

Descriptive Statistics Post-Instruction Administration of Autonomy Scale

Grouping	Mean	SD	Number
Experimental	76.88	3.018	25
Control	56.40	2.466	25
Total	66.64	10.69	50

Table 6 illustrates the descriptive statistics for the control and experimental group's scores on the post-instruction administration of the autonomy scale. For the experimental group, the mean was 76.88 with a standard deviation of 3.01, while for the control group, the mean was 56.40 with a standard deviation of 2.46.

Table 7

Tests of Between-Subjects Effects

Source	Type III sum of squares	df	Mean square	F	Sig.	Partial Eta squared
Corrected model	5358.146a	2	2679.073	504.930	.000	.956
Intercept	248.664	1	248.664	46.866	.000	.499
Pre-autonomy	115.266	1	115.266	21.724	.000	.316

Grouping	4965.782	1	4965.782	935.91	.000	.952
Error	249.374	47	5.306			
Total	227652.000	50				
Corrected total	5607.520	49				

The control and experimental groups' post-test performances revealed a statistically significant difference. As Table 7 indicates, blending WhatsApp into teaching activities showed a positive effect on students' autonomy in learning vocabulary. Also, the findings confirmed that learner autonomy had a significant effect on these Iranian EFL learners and paved the way for them to learn vocabulary more effectively.

Discussion

The present study investigated how the impact of using WhatsApp contributed to the development of vocabulary learning and autonomy of Iranian intermediate EFL learners. The first research hypothesis postulated that applying blended learning via WhatsApp to Iranian intermediate EFL learners' vocabulary learning would make no difference. The results rejected this hypothesis. Applying WhatsApp in the process of language teaching significantly developed Iranian EFL learners' vocabulary knowledge. Hence, the findings show that using WhatsApp interaction to improve learners' vocabulary learning was more successful than traditional education alone. Similarly, the same results were reported by Kholis (2020) whose results indicated that WhatsApp was an effective and efficient tool for facilitating foreign language learning. Furthermore, the results of this current study align with Kartal (2019) who asserted that WhatsApp positively enhanced vocabulary learning. The results of this study were also consistent with Hashemifardnia et al. (2018) who argued that the application of WhatsApp greatly improved Iranian EFL learners' vocabulary learning.

The findings of the current study showed that the achievement of students in the WhatsApp group improved considerably when compared to the other group, which is comparable to similar studies. For example, Ashiyan and Salehi (2016) investigated the influence of WhatsApp on the learning and retention of English collocation knowledge and found that using WhatsApp was a considerable help for learners in this regard. Similarly, Wang and Shih (2015) as well as Jafari and Chalak (2016) revealed that WhatsApp had a significant influence on students' vocabulary development. The present study's findings were consistent with several prior investigations that determined that using technology enhances vocabulary development (Naraghizadeh & Barimani, 2013; Thornton & Houser, 2005).

Similar to previous research, this current study found that the use of blended learning via WhatsApp increased EFL learners' level of autonomy (Alshammari et al., 2017). The findings of this current study reflected thos of Hazaea and Alzubi (2018) who asserted that a boost in a sense of autonomy was found among the learners who applied WhatsApp. Furthermore, they said that learners were not limited to the

classroom, rather they extended their learning outside the classroom walls. Also, the findings of this study correspond with Plana et al. (2013) who discovered WhatsApp enhanced students' interest in reading autonomously in foreign language learning.

Conclusion

This study's findings showed that the blended learning course was effective and helped students learn English. The learning context of this study encouraged students to learn at their own speed while providing rich resources that were available and convenient to use. It also provided traceable learning progress that enhanced students' awareness of autonomy and its significant role in their learning, and encouraged them to work at developing learner autonomy. The blended course extended limited class time and allowed students to learn in a constructive, supportive, and immersive learning environment.

This study determined the impact of using WhatsApp for vocabulary learning in Iranian contexts. Compared to face-to-face instruction, the findings demonstrated that using WhatsApp greatly enhanced learners' vocabulary learning. Furthermore, for most participants, using WhatsApp as a learning tool enhanced their autonomy, which was a pleasant experience. This study highlighted the importance of blending WhatsApp in teaching to boost learners' vocabulary knowledge and increase their autonomy. Students were interested in using this platform. Access to educational resources without barriers of time or space encouraged them to work on their studies. In addition, the feeling of virtual community that was formed among students and teachers via the use of WhatsApp group chat might also have encouraged them in their efforts.

The accessibility of WhatsApp and awareness of applicable features improved students' vocabulary learning. In this regard, Church and de Oliveira (2013) stated that easy access and affordability of WhatsApp made it more helpful and efficient than other social applications. WhatsApp may also be used as a discussion platform, so it allowed language instructors and pupils to start conversations that boosted learning and gave students more autonomy. WhatsApp also supported an anxiety-free environment, which enhanced students' sense of belonging. Using WhatsApp to teach vocabulary allowed learners and teachers to exchange data, as well as speed up cooperation among students. Similarly, WhatsApp can facilitate interaction between students and instructors. Overall, the findings provided empirical support for claims in the literature that synchronous blended learning positively affected students' autonomy in the context of technology-based instruction.

This study offered some beneficial pedagogical implications for instructors, educators, and learners. One recommendation from the findings is to use WhatsApp to compensate for time constraints. Another is to share a range of information (e.g., photos, text, audio, video), thereby providing genuine resources for various language skills and components. Instructors should consider using WhatsApp as a guide to conduct and create a responsible learning environment for students. Thus, educational policymakers should devote more time to developing an English language curriculum that includes various forms of social educational networks to improve students' language abilities, and the use of WhatsApp should be prioritized.

It is important to note that this study had some limitations. Since the participants were all women, findings may not be generalizable to different populations such as men only or heterogeneous groups. The second limitation of the study is the inclusion of Iranian EFL learners from a province in the west of Iran who may not be representative of EFL learners from all provinces in Iran. A similar study should be reproduced with other learners in various cultural situations, at various ages, and at various language levels. Finally, the study's focus was confined to vocabulary learning. Therefore, it is proposed that broader studies include additional language components and skills.

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Who Gets the Highest Return to Distance Higher Education?

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Abstract

The economics of distance higher education have not attracted enough attention. Few studies have analyzed the different returns to distance higher education at various income levels. Based on empirical analysis of data from China Family Panel Studies (CFPS), this study explored the differences of return to distance higher education at different income levels by using Mincer earnings function and quantile regression. Compared with face-to-face education, the study found that distance higher education brought considerable benefits to learners. While the return to face-to-face higher education has continued to decline, return to distance higher education has risen. Comparing the returns to distance education at different income levels showed that low-income groups obtained greater benefits from distance higher education, which can help to improve the income of vulnerable groups and promote social equality. China's distance education institutions should promote the idea that distance higher education can improve the income growth of low-income groups, and increase the financial support for low-income groups to access distance higher education.

Keywords: distance higher education, return to education, quantile regression, low-income group

Introduction

Distance higher education has a long history, and students all over the world have received education at a distance. In 2013, there were more than 21 million distance education learners in developing countries alone (Bates, 2013). In China, for example, every year, nearly one million students have received nationally recognized junior college and university degrees through distance higher education. In 2019, there were about 2.32 million undergraduate and junior college graduates of online education in China, which accounted for 19.30% of the total number of universities and college graduates that year.[1] Since much adult education is available via distance education, with online learning just one part of the whole, the proportion of graduates of distance higher education in China far exceeded the 19.30% that was online. Even though the scale of distance education in Chine is large, it has long been underestimated by the public.

The rate of return to education is an important indicator for evaluating the economic value of education at different levels, in various categories, and for a range of academic majors. In turn, studies on return to education can promote the development of education (Psacharopoulos & Patrinos, 2004). Many studies have focused on return to conventional face-to-face education. For example, the 2021 Nobel Prize in Economic Sciences recognized the prominent contribution of three experts—Joshua Angrist, David Card, and Guido Imbens—who accurately evaluated the rate of return to education (National Bureau of Economic Research, 2021).

Most studies on return to education have focused on face-to-face education; a few have looked at return to distance education (Li & Wang, 2021). In many countries, distance education has been seen as subordinate and low-quality education (Chen & Wang, 2010; Gaskell & Mills, 2014). The lack of research in this field may lead to seriously underestimating the return to distance education, and ignoring the development of distance education, leading to a cycle of negative feedback regarding distance education. Since the outbreak of the global COVID-19 pandemic, distance higher education has attracted wider public attention and discussion.

Psacharopoulos (1985, 1994) compared the returns to higher education in different countries. In the countries from the Organization for Economic Cooperation and Development, as a representative of high-income countries, the return to higher education was 12.3%, and in upper-middle-income countries, the rate was 14.8%. Is the phenomena of return to higher education in high-income countries being lower than in upper-middle-income countries applicable to distance higher education?

Based on previous research, this study explored the differences of return to distance higher education at various income levels to identify which group obtained the higher return by using quantile regression and representative household survey data in China. This study sought to fill a gap in the literature and advise distance education institutions on ways to reduce income inequality.

Literature Review

Return to Face-to-Face Higher Education

Since the emergence of human capital theory in the 1960s, empirical research on return to education has attracted considerable attention (Carnoy, 1995; Heckman et al., 2006; Johnes et al., 2017). The research on return to higher education has mainly focused on two aspects of face-to-face education—measuring return to higher education and the differences of return to higher education among various groups.

Previous studies mainly focused on the differences of return to face-to-face higher education for (a) different genders, (b) urban and rural areas, (c) different regions, (d) different sectors, and (e) different disciplines. Regarding urban and rural areas, most research showed that the return to education was higher for urban areas than rural (Johnson & Chow, 1997; Liu & Liu, 2020; Zhang & Jin, 2020). Most analysis of the differences among regions showed that the return to education was higher in developed regions in east China than western underdeveloped areas (Li, 2017; Shen & Zhang, 2015). Overall, face-to-face higher education in economically developed regions has had higher returns.

Return to Distance Higher Education

Little research has focused on the measurement and comparison of distance higher education. Woodley and Simpson (2001) measured the return to investment in distance higher education and found that the return for graduates of distance higher education was higher than average. Carnoy et al. (2012) compared the return to distance higher education in terms of different degrees and academic majors. Some scholars have found that the investment in distance higher education was not worthwhile, since the return was relatively low (Hoxby, 2017).

Compared with other countries and regions, there have been more studies on the return to distance higher education in China. Zheng et al. (2009) calculated the individual return to distance higher education in a network college of a university compared to return to education in different disciplines. Li and his collaborators conducted a constant study on the return to distance higher education (Li, 2018; Li, Li, & Zhang, 2015; Li & Wang, 2020; Li & Wang, 2021). Based on the analysis of samples from Radio and TV University of China and the representative samples of the country, they compared the returns between distance higher education and face-to-face higher education. They also compared the differences of return to distance higher education in terms of (a) changing trends, (b) genders, (c) urban and rural areas, and (d) different disciplines. Studies of the labor market in China have verified that distance higher education brought considerable individual returns for learners, which is consistent with Carnoy et al. (2012) and Castaño-Muñoz et al. (2016).

Literature Review in Summary

Previous studies have mainly used quantitative methods to explore the return to distance higher education. Qualitative methods have been used to analyze the issues of distance learners or the quality of distance education (Esfijani, 2018; Yang & Cornelius, 2004). So far, no empirical analysis has been made on the differences of return to education among different income groups of distance higher education graduates.

Abdullah et al. (2015) and Qazi et al. (2018) pointed out that education was particularly effective in reducing income inequality in Africa and Pakistan. Does distance higher education also play a role in increasing the income of low-income groups and promoting educational equity? By using quantile regression method, this study measured the returns to distance higher education of different quantiles, to determine which income group received higher returns through distance higher education, and to compare these with face-to-face higher education. This study sought to address gaps in the literature on return to distance higher education.

Research Design and Data

Theoretical Framework

Human capital theory holds that receiving education is an element in the process of human capital accumulation (Gillies, 2017). At the same educational level, different people accumulate the same human capital, so there may be no differences in return between distance and face-to-face education. Similarly, there may also be no significant differences in return to education among distance education learners with the same education but different income levels.

According to screening theory, education plays a signal function. In China, distance education is inferior to face-to-face education in terms of student quality and social reputation(Chen & Wang, 2010), which sends out a negative signal in the labor market. So, the return to distance education may be lower than those to face-to-face education. With expansion in the scale of higher education, no matter what the trends in distance and face-to-face education, according to human capital theory, there may be no significant differences in return to education. But according to screening theory, in China's labor market, the return to distance education may be lower than that of face-to-face education. This study explored changing trends in return to distance higher education and face-to-face higher education. It also compared the return to distance higher education from two key aspects: (a) in different periods under the same degree, and (b) at different income levels.

Method

The Mincer earnings function is the most popular model in economics for analyzing factors that influence income (Heckman et al., 2003). Most studies use the Mincer earnings function to measure the rate of return to education; it places individual incomes, years of education, years of employments, and square of years of employed into a semi-logarithmic equation and estimates the marginal income of education through regression analysis. The Mincer earnings function is as follows:

$$Ln\ Y = a + b*S + c*EX + d*EX2 + \varepsilon \tag{1}$$

Y is individual incomes from labor, Ln Y is the natural logarithm of individual incomes, S represents the education year, X is the worker's years of employment, a is the intercept, and ε is the residual term. The term b is the increased proportion of individual incomes with an increase of one year of education—namely

Mincer rate of return to education. The Mincer rate of return to certain education levels is usually calculated by placing the sample of that education level and the sample of its lower education level into the regression equation.

Distance higher education in China only includes junior college and undergraduate. The regression equation for calculating the return to junior college and undergraduate needs to include the samples of either undergraduate and senior high school, or junior college and senior high school, respectively.

To measure the differences of return to distance higher education for various income groups, this study used the quantile regression method initially proposed by Koenker and Bassett (1978). Compared with ordinary least squares (OLS), quantile regression has two advantages. First, it is widely applied, and it is stable. The conventional regression model explores the influence of explanatory variables on the conditional expectations of dependent variables, which is a kind of mean reversion. The random error of the conventional regression model needs to comply with the basic condition of normal distribution of zero-mean, homoscedasticity, and zero covariance. The explained variables often have extreme values. In the conventional model, influences at the head end and tail end of the explained variables are difficult to measure. Quantile regression considers the influence of different extreme values, so it is more stable in analyzing extreme values and outliers. Second, it can describe the complete picture of the conditional distribution of explained variables. Quantile regression can fit the distribution information of data and make a regression analysis on explained variables based on its conditional quantile. In OLS regression model, the conditional expectation expresses the concentrated trend of the data by fitting the mean value, which cannot reflect the conditions of data at different stages. But quantile regression can describe the effect of explained variables at different stages. Therefore, this study used quantile regression rather than OLS regression. Quantile regression is the regression of whole samples, which reflects the influence of different quantiles of whole samples. It can handle comparative analysis of the data from different quantiles.

The use of quantile regression can more accurately describe the influence of distance higher education on learners' incomes at different income stages. The study took five quantiles of 10%, 25%, 50%, 75%, and 90% to explore the income distribution of distance higher education at different quantiles.

Data
This study used nationally representative data from Chinese Family Panel Studies (CFPS), a comprehensive national bank of social tracking data from a survey conducted by China Social Science Survey Center, Peking University. Most representative national data were not able to distinguish distance education samples from face-to-face samples. CFPS demonstrated diverse distribution in terms of family, geographical, and occupational features, as well as other aspects. CFPS tracks data every two years; this study analyzed data from 2010, 2012, 2014, 2016, and 2018. In mainland China, only undergraduate and junior college degree programs are available via distance higher education, so this study explored learners at these levels, and created samples whose highest degree was high school as a base line. Since the information from CFPS on years of employment was not complete, this study used age – years of education – 6, a metric that is widely used, as a replacement (Romele, 2012; Shen & Zhang, 2015).

Standard Mincer earnings function only controls for an individual's work experience. Graduates' return to education may be affected by other factors. Many studies have added a series of control variables, referred to as extended Mincer function. Based on standard Mincer earnings function, this study added control variables that may affect individual income such as gender, region, parents' education, public or non-public sector, or urban and rural areas (Johnson & Chow, 1997; Shen & Zhang, 2015). This study also compared the regression results between extended Mincer earnings function and standard Mincer earnings function.

To define and assign specific variables, the sample was drawn from the eastern region, so two dummy variables--central and western--were constructed. Dummy variables were also set for (a) geography (urban, 1; rural, 0); (b) sector (public sector, 1; non-public sector, 0); and (c) gender (male, 1; female, 0), respectively.

Table 1

Variables Defined

Variable	Description
Dependent	Logarithm of income
Independent	Years of education
	Years of employment
	Square of years of employment
	Gender (male = 1, female = 0)
	Sector (public = 1, non-public = 0)
	Geography (urban = 1, rural = 0)
	Region (two dummy variables: central region =1, eastern region=0; western region =1, eastern region=0)
	Father's years of education
	Mother's years of education

Calculating return to education for distance undergraduate and distance junior college learners required that the sample use the highest degree of high school as its base line. The samples for this study were determined according to learning level and category: high school, face-to-face junior college, distance junior college, face-to-face undergraduate, and distance undergraduate. Table 2 lists the sample sizes for each year and the distribution of the five sample types.

The income for all samples was positive, and as all were employed, their ages were less than 65 years. There were 3,098 valid samples of distance higher education, including 1,910 distance junior college samples and

1,118 distance undergraduate samples. From 2010 to 2018, the sample sizes for each year are 769, 666, 532, 581, and 550 respectively.

The most important innovation of the study was to use quantile regression to analyze the income of those in distance higher education among different income groups. A second innovation was the use of multi-year tracking samples to conduct the empirical analysis.

Table 2

Sample Sizes, 2010 to 2018

Sample type	2010	2012	2014	2016	2018	Total
High school	2,192	2,095	1,828	2,611	1,979	10,705
Face-to-face junior college	429	595	485	484	451	2,444
Distance junior college	499	416	331	354	310	1,910
Face-to-face undergraduate	384	428	394	449	489	2,144
Distance undergraduate	270	250	201	227	240	1,188
Total	3,774	3,784	3,239	4,125	3,469	18,391

The Results of Empirical Study

Table 3 and Figure 1 show the changes of return to distance higher education and face-to-face higher education obtained from standard Mincer function (without adding control variables) by using OLS and quantile regression. In Table 3, almost all coefficients of quantile regressions are significantly positive, and only one coefficient is not significant. Among all significantly positive coefficients, the vast majority have a significance level of $p < 0.01$. One reason was the quality of the data; it was sufficiently representative and the sample size was large enough. In addition, in all years and across different income groups, whether distance education or face-to-face, the fact of receiving higher education effectively predicted individual income. The following findings can be found from the Table 3 and Figure 1.

Figure 1

Changing Trends of Return to Distance Higher Education (Standard Mincer Earnings Function): 2010 to 2018 Quantiles
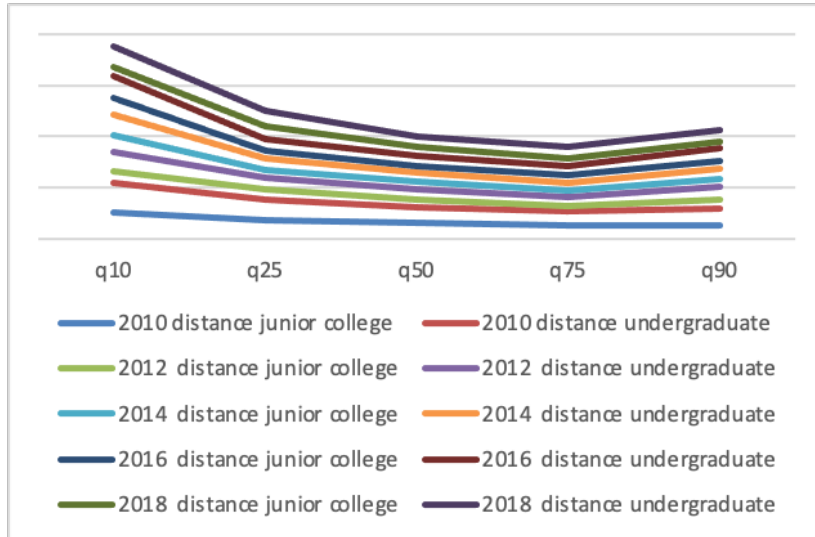
Table 3

Quantile Regression Analysis of Standard Mincer Earnings Function

Year	Sample	OLS	q10	q25	q50	q75	q90
2010	Face-to-face junior college	0.203***	0.252***	0.183***	0.158***	0.150***	0.162***
	Distance junior college	0.192***	0.254***	0.183***	0.156***	0.125***	0.128***
	Face-to-face undergraduate	0.226***	0.263***	0.212***	0.198***	0.204***	0.218***
	Distance undergraduate	0.198***	0.289***	0.195***	0.144***	0.139***	0.161***
2012	Face-to-face junior college	0.109***	0.136***	0.080***	0.080***	0.089***	0.116***
	Distance junior college	0.107***	0.120**	0.104***	0.081***	0.060***	0.091***

	Face-to-face undergraduate	0.145***	0.125***	0.122***	0.129***	0.156***	0.172***
	Distance undergraduate	0.121***	0.185***	0.109***	0.101***	0.086***	0.131***
2014	Face-to-face junior college	0.115***	0.136**	0.124***	0.079***	0.076***	0.113***
	Distance junior college	0.095***	0.165***	0.078**	0.081***	0.063***	0.068***
	Face-to-face undergraduate	0.164***	0.231***	0.151***	0.111***	0.137***	0.171***
	Distance undergraduate	0.111***	0.193***	0.111***	0.081***	0.078***	0.110***
2016	Face-to-face junior college	0.063***	0.051	0.044*	0.064***	0.100***	0.123***
	Distance junior college	0.072***	0.167***	0.081***	0.068***	0.065***	0.070***
	Face-to-face undergraduate	0.111***	0.128***	0.102***	0.098***	0.109***	0.141***
	Distance undergraduate	0.114***	0.213***	0.114***	0.098***	0.095***	0.126***
2018	Face-to-face junior college	0.067***	0.083*	0.101***	0.069***	0.059***	0.072***
	Distance junior college	0.088***	0.098**	0.120***	0.082***	0.079***	0.060***
	Face-to-face undergraduate	0.147***	0.198***	0.162***	0.125***	0.135***	0.156***
	Distance undergraduate	0.124***	0.195***	0.160***	0.101***	0.112***	0.117***

Note. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

First, distance higher education can bring considerable monetary benefits for learners. The return to distance higher education from 2010 to 2018 was considerable. This demonstrated that distance higher education in China, where higher education has shifted from massification to popularization stage (Ministry of Education of the People's Republic of China, 2019), still has considerable investment value for individual learners even though it was once ignored by the public. Considering its large scale, distance higher education has generated positive social effect, a point of pride for distance higher education practitioners.

Second, the low-income group derived notably higher incomes from distance higher education. In 2010, along with the increase of individual incomes within the samples, the return to distance junior college showed a notable decline. This trend indicated that, compared with high-income groups, the low-income groups of distance junior college learners had higher returns to education. For distance undergraduate students, the return to education tended to decline as income increased, but then increased after the 75% quantile. In general, the low-income learners still had the highest return to education. In 2012, 2014, and 2016, with the increase of income, the returns to education of both distance junior college and distance undergraduate students decreased at first and then increased after the 75% quantile. The low-income learners of these three years had the highest return to education, and the pattern was consistent. In 2018 the situation was more complicated. Along with the increase of income, the distance junior college sample showed an increase trend at first and then decreased. The highest point of return to education for distance college was at the 25% quantile level. Distance undergraduate showed a decreasing trend at first and then increased after the quantile of 50%. But the low-income learners still had the highest return to education. In most cases, low-income learners received higher returns from distance higher education. This is the same as the conclusion in many face-to-face education studies (Ginting et al., 2020; Hofmarcher, 2021) that education can effectively reduce poverty. Distance higher education can also reduce the gap between high and low income as well as promote social equality.

Third, in most cases from 2010 to 2018, within the same degree, the returns to distance higher education were lower than to face-to-face higher education. However, in several quantiles, the returns to distance higher education were not lower than to face-to-face higher education. Specifically, in 2010, the return to distance junior college and distance undergraduate at the 10% quantile was higher than to face-to-face junior college and face-to-face undergraduate. At the 25% quantile, the return to distance junior college was equal to face-to-face junior college. In 2012, at the 25% and 50% quantiles, the returns to distance junior college were higher than to face-to-face junior college. At the 10% quantile, the return to distance undergraduate was higher than to face-to-face undergraduate. In 2014, at the 10% and 50% quantiles, the returns to distance junior college were higher than to face-to-face junior college. In 2016, below the 50% quantile, the return to distance higher education was higher than to face-to-face higher education. In 2018, below the 75% quantile, the return to distance junior college was higher than to face-to-face junior college. This indicated that, for low-income learners, the return of investment for distance higher education was higher than for face-to-face higher education. This finding further verified previous research findings that distance higher education notably promoted the incomes of economically disadvantaged groups (Li, Li & Zhang, 2015).

Fourth, regardless the result of quantile regression, the OLS result shows that, from 2010 to 2018, both distance higher education and face-to-face higher education showed a notable decreasing trend. But from 2016 to 2018, compared with face-to-face education, distance junior college and undergraduate showed a dramatic increase. Further analysis is needed to determine whether the increase trend will continue.

Table 4 and Figure 2 illustrate the quantile analysis results of extended Mincer earnings function after adding factors such as gender, region, sector, urban and rural, as well as parents' education levels. Compared to Table 4 and Table 3, although more coefficients became insignificant, most coefficients, by far, were still positive and significant. This means that even after controlling for these factors, distance higher education still effectively predicted learners' income.

From Figure 2, after adding control variables, it is evident that the highest point of return to distance higher education for each year was mainly distributed at the 10% quantile. Compared with face-to-face education, after adding control variables, the returns to face-to-face education were still higher than distance higher education in most quantiles. The returns to distance higher education were higher in few quantiles, mainly concentrated at the 10% and 25% quantiles. Comparing standard Mincer earnings function and extended Mincer earnings function, there was no essential difference between the two, which indicated that the empirical results of this study were firm.

Figure 2

Changing Trends of Return to Distance Higher Education (Extended Mincer Earnings Function): 2010 to 2018 Quantiles
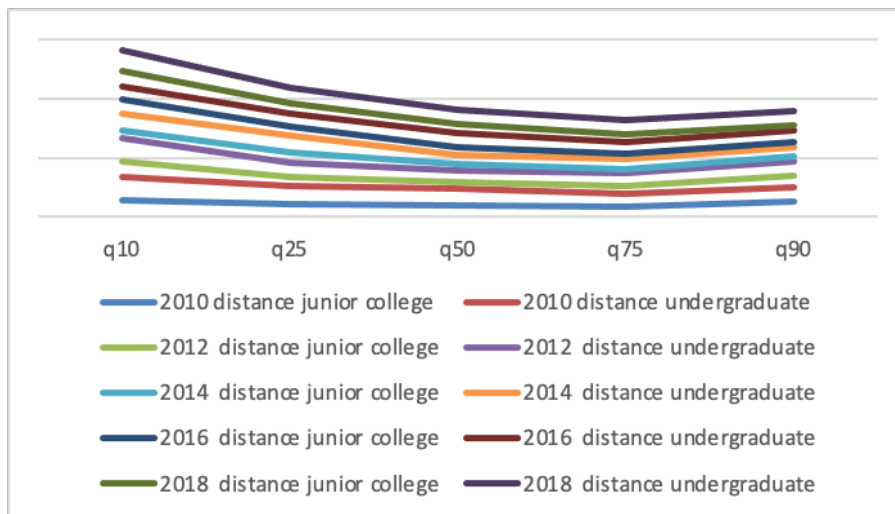
Table 4

Quantile Regression Results of Extended Mincer Earnings Function

Year	Sample	OLS	q10	q25	q50	q75	q90
2010	Face-to-face junior college	0.152***	0.153***	0.100***	0.138***	0.146***	0.125***
	Distance junior college	0.124***	0.140***	0.109***	0.093***	0.088***	0.126***
	Face-to-face undergraduate	0.186***	0.176***	0.155***	0.170***	0.188***	0.190***
	Distance undergraduate	0.150***	0.195***	0.151***	0.145***	0.111***	0.129***
2012	Face-to-face junior college	0.100***	0.149**	0.087***	0.073***	0.092***	0.095***
	Distance junior college	0.089***	0.130**	0.077***	0.055***	0.063***	0.092***
	Face-to-face undergraduate	0.135***	0.144**	0.119***	0.130***	0.151***	0.174***
	Distance undergraduate	0.108***	0.199***	0.124***	0.094***	0.105***	0.120***
2014	Face-to-face junior college	0.099***	0.020	0.098***	0.074***	0.097***	0.097***
	Distance junior college	0.063***	0.069	0.087**	0.056***	0.039**	0.042
	Face-to-face undergraduate	0.138***	0.150***	0.137***	0.108***	0.109***	0.122***
	Distance undergraduate	0.114***	0.143**	0.136***	0.077***	0.084***	0.083***
2016	Face-to-face junior college	0.054**	0.030	0.045	0.077***	0.099***	0.100***

	Distance junior college	0.075***	0.113*	0.081**	0.069***	0.044**	0.042
	Face-to-face undergraduate	0.100***	0.060	0.106***	0.084***	0.110***	0.102***
	Distance undergraduate	0.111***	0.108**	0.104***	0.112***	0.101***	0.091***
2018	Face-to-face junior college	0.068***	0.020	0.080***	0.061***	0.077***	0.083**
	Distance junior college	0.100***	0.132**	0.093***	0.083***	0.063***	0.049
	Face-to-face undergraduate	0.154***	0.212***	0.150***	0.129***	0.147***	0.151***
	Distance undergraduate	0.132***	0.175***	0.127***	0.121***	0.120***	0.120***

Note. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Discussion

The results of both standard and extended Mincer earnings function showed that low-income learners obtained a higher returns to distance higher education, with the highest point of return mainly distributed at the 10% quantile each year. As well, low-income distance higher education learners had higher returns than did face-to-face learners, mainly concentrated at the 10% and 25% quantiles. This indicated that distance higher education had the advantage of increasing returns to education for low-income groups.

This study sought to explain these two findings by considering three factors. First, most distance higher education learners were also employed. Compared with high-income groups of distance and face-to-face learners, the low-income distance higher education learners had less income. With the advantage of combining learning and employment, as well as fewer time and space barriers, the opportunity costs of distance higher education were relatively low. The Mincer earnings function only takes learners' opportunity costs into consideration, so since the low-income distance higher education learners had lower opportunity costs, they received higher returns to education.

Second, the rate of return to education reflects the influence of human capital acquired by individual education on income. Some studies have argued that the quality of distance education is not worse than face-to-face education (Allen & Seaman, 2010; Wang & Wang, 2021). Therefore, distance learners can also obtain human capital as much as those in face-to-face education. Most distance learners have on-the-job

176

experience. Since distance education graduates are more closely related to the labor market and have the advantages of work experience, this helps improve the return to distance higher education.

Third, an employee's degree is usually a key factor for employers as they determine salary. Screening theory holds that education could be used as an indicator of individuals' connate ability (Johnes et al., 2017). Junior college and undergraduate degrees are categorized as higher education. Employees provide employers with obvious signals of personal ability once they have obtained higher education (Spence, 1973), which is conductive to learners' career advancement and increased incomes. Compared to high school education alone, a distance junior college or undergraduate degree may mean promotions and higher salary, and will have great effect on increased incomes.

Regardless which of above is more reasonable, distance education, by eliminating barriers of time and space, has advantages for increasing incomes for low-income learners and promoting social equality.

Implications

This study revealed changing trends in the return to distance education. Compared with face-to-face education, the study found that the return to distance education showed an upward trend in the later years of the sample period and even higher than face-to-face education in some years. The reason may be that the opportunity cost of distance education was lower than that of face-to-face education, highlighting distinct advantages of distance education. At the same time, for low-income people, distance education provided a higher return than for high-income people. The study explained this phenomenon from the perspective of human capital theory and screening theory. With improved quality, distance education can also help learners obtain human capital no less than for face-to-face education. After they acquire higher academic qualifications, low-income groups are able to grow beyond their original educational status and exert a stronger presence in the labor market. This study used human capital theory and screening theory to analyze distance education. The empirical results filled a gap in the existing literature and enriched our understanding of the economics of distance education.

Conclusions and Suggestions

By using China's representative national tracking data, this study used Mincer earnings function and quantile regression method to conduct an empirical analysis of return to distance higher education among different income groups, investigate changing trends, and compare with face-to-face higher education. The paper achieved three findings.

First, distance higher education can bring considerable benefits for learners. With rapidly expanding higher education in China, the scale of distance higher education there is also expanding. However, after controlling for a series of factors, investment in distance higher education can still bring considerable return.

Second, while the return to face-to-face higher education has continued to decline, the return to distance higher education showed an upward trend. From 2010 to 2018, higher education in China showed an important transformation from massification to popularization, along with constant expansion of the scale of postgraduate education (Li & Meng, 2021). Therefore, the decreasing trend of return to education of face-to-face junior college and undergraduate education is understandable. However, from 2016 to 2018, the individual return to education of distance junior college and undergraduate showed a notable increase.

Third, distance higher education has the greatest effect on improving incomes for the low-income group. On the one hand, low-income groups had higher returns on distance higher education than did high-income groups. This study used human capital theory and screening theory to explain this finding—distance learners can obtain human capital as much as can face-to-face learners. After obtaining college and bachelor's degrees, low-income earners move beyond the restrictions of high school qualifications and send a more positive signal to the labor market, thereby getting better jobs and higher salaries. On the other hand, learners can have a higher return from investment in distance higher education than from face-to-face higher education. This is due to the lower opportunity costs for distance learners. This study demonstrated that distance higher education improved the income of vulnerable groups and promoted social equality.

Based on the above findings, this study puts forward the following proposals. First, it is necessary to improve the awareness that distance higher education can lead to increased income for low-income groups. Expanding education will continue to reduce inequality (Coady & Dizioli, 2018). So, it is necessary to increase awareness of the role of distance education in promoting social equity and expand the scale of distance education provisions. Information from this study, if available to potential learners through social media, would attract more low-income learners to invest in distance higher education. As well, education policy makers could use this information to build good policy.

Second, distance higher education should be used as a way to reduce poverty and promote social equality. Existing studies have shown that education can significantly alleviate poverty in underdeveloped regions. (Liu & Li, 2020). Along with comprehensive popularization of network infrastructure and reductions in related costs, it is necessary to continuously provide distance higher education learning resources for low-income groups and the population of underdeveloped areas around the world.

Third, financial support for distance higher education learners should be improved. Some studies have found that tuition fees are a barrier that keep Chinese learners from investing in human capital (Li & Yu, 2022). Currently, there have been few studies and little publicity on financial support to distance higher education students in China. Scholars, policy makers, and publicity departments should draw on the wisdom of the masses to promote financial support to low-income learners distance higher education learners (e.g., tuition remission, student loans). This would address the problem of low-income learners denied distance higher education due to lack of funds for tuition fees.

In conclusion, distance higher education is conducive to promoting social equality. However, the empirical findings of this study were not based on causal inference, which means that the relationships among distance education, and both income and equity, may be more complex. And although distance education can bring considerable benefits, there are also risks. Follow-up research should continuously track return to distance higher education, examine the risk of investment in distance education, and investigate student financial assistance and its effect on distance higher education.

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1 According to the data of National Bureau of Statistics of China (http://data.stats.gov.cn/easyquery.htm?cn=C01), learners in undergraduate and junior colleges of adult education in 2019 numbered 2,131,369, and the total number of adult education and online enrolments was 4,454,497. Adult education and online graduates accounted for 37% of total undergraduate and junior college graduates.

OXREF: Open XR for Education Framework

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Abstract

Extended reality (XR), which encompasses virtual reality (VR), augmented reality (AR), and mixed reality (MR), offers powerful affordances for improving teaching and learning experiences in a post-pandemic world. Increasingly, many governments and institutions around the world are making major investments in XR technologies to prepare education systems for the future. However, many of these investments remain isolated pilot projects which, while they attest to the potential of XR in education, are unlikely to be scaled up due to lack of sustainability and collaboration. Based on literature and empirical evidence, I have identified major barriers to the wider adoption of XR in education, including the lack of (a) open content, tools, and skills; (b) sound pedagogy and instructional design; and (c) scalability and sustainability. As a potential solution, I introduce the Open XR for Education Framework (OXREF), an empirical framework that proposes a holistic solution to XR object creation, implementation, and deployment, while covering pedagogical, technological, and policy perspectives. The contribution of the OXREF is its ability to build fit-for-purpose XR experiences in a scalable, sustainable, and collaborative manner while promoting openness, accessibility, equity, and reuse. The novelty of the proposed framework is its use of open educational resources (OER), open educational practices (OEP), as well as free and open-source software (FOSS) tools and platforms. Its cloud-based infrastructure and open licenses support viable operationalization strategies that can be implemented by educational institutions and governments.

Keywords: OXREF, open XR, XR for education, XR framework, extended reality, XR scalability, XR sustainability, VR, AR, OER, OEP, open licenses

Introduction

Extended reality (XR) is used as an inclusive term to encapsulate the three main types of immersive technologies—virtual reality (VR), augmented reality (AR), and mixed reality (MR). XR can be referred to as a collection of experiences which blur the line between real and virtual worlds using immersive visuals, audio, and haptic cues (Alizadehsalehi et al., 2020).

Steuer (1992) provided an early definition of VR, namely that "virtual reality make reference to a particular technological system. This system usually includes a computer capable of real-time animation, controlled by a set of wired gloves and a position tracker, and using a head-mounted stereoscopic display for visual output" (p. 74). In a more modern definition, Fernandez (2017) indicated that VR technology "provides the user with the opportunity to be immersed in a programmed environment that simulates a reality" (p. 1).

AR has been defined as technology which combines real and virtual worlds, wherein the real world is supplemented with computer-generated virtual objects in real-time (Khan et al., 2019). MR comprises three important aspects: (a) combining the real-world object with the virtual object, (b) real-time interaction, and (c) mapping between the virtual object and the real-world object so that they interact with each other (Rokhsaritalemi et al., 2020).

The Gartner Hype Cycle for Education (Yanckello, 2022) placed XR and immersive technology at the beginning of the trough of disillusionment, which suggested it will become mainstream within the next 5 to 10 years. Increasingly, many governments and institutions around the world have been making major investments in XR technologies and preparing education systems for the future (Schwaiger, 2021). EDUCAUSE (2018) has stated that "new and more affordable XR technologies provide promising directions and opportunities to immerse learners in the curriculum, offering deeper and more vivid learning experiences and extending the learning environment" (para.1). Another example from United Nations Virtual Reality (UNVR, 2017) indicated that "with the support of the UN SDG Action Campaign, delegates and OECD staff were able to immerse themselves in the world of Sidra, a 12-year-old Syrian Refugee living in Za'tari refugee camp in Jordan" (para. 3). According to the UNESCO Mahatma Gandhi Institute of Education for Peace and Sustainable Development (MGIEP):

> It definitely beats just using textbooks. MGIEP believes in transforming education for building peaceful and sustainable societies. It sees immersive experiences such as VR as an integral part of socio emotional learning for our younger generations as they face 21st century challenges to build a peaceful and sustainable planet. (India Blooms News Service, 2017, para. 11)

However, many of these investments remain isolated pilot projects. As such, they provide a glimpse into what the potential future of education could be, but one that is unlikely due to issues of scalability, sustainability, and a lack of institutional collaboration (Doolani et al., 2020; Garcia Estrada & Prasolova-Førland, 2022).

At an institutional level, pedagogy and instructional design remain barriers to teaching and learning using the XR medium. According to Yang et al. (2020) "while XR is getting used more in education, many XR practitioners (e.g., technology designers and developers) may not be intimately familiar with educational

theory and instructional design; so most reviews could have limited use in practice" (p. 2). Lai and Cheong (2022) considered the lack of alignment between pedagogy and technology infrastructure to be a major barrier to XR adoption. Further, they stated that lack of (a) teacher training, (b) educational experience, (c) conceptual foundation, (d) educational research, and (e) institutional support were specific contributing factors.

Lack of technical skills in using XR tools and technologies has been cited as another barrier to wider adoption. According to a Norwegian study "it takes time and effort to learn the setup, control, and navigate the software, and even more time to learn to customize it to suit one's individual teaching" (Simon-Liedtke et al., 2022, p. 552). In the same study, the authors stated that due to high workloads, educators were unable to dedicate time to learn, experiment, and practice XR skills during normal working hours.

Based on literature and empirical evidence, I have identified that the lack of (a) open content, tools, and skills; (b) sound pedagogy and instructional design; and (c) scalability and sustainability have been major barriers to the wider adoption of XR in education. As a potential solution, I introduced the Open XR for Education Framework (OXREF), an empirical framework that proposes a holistic solution to XR object creation, implementation, and deployment, while covering pedagogical, technological, and policy perspectives. The contribution of the OXREF is its ability to build fit-for-purpose XR experiences in a scalable, sustainable, and collaborative manner that promotes openness, accessibility, equity, and reuse. The novelty of the proposed framework is its use of open educational resources (OER), open educational practices (OEP), as well as free and open-source software (FOSS) tools and platforms. Its cloud-based infrastructure and open licenses support viable operationalization strategies that can be implemented by educational institutions and governments.

The Open XR for Education Framework in Detail

The OXREF comprises three layers: (a) open XR object creation, (b) pedagogy and instructional design input, and (c) scalability and sustainability for a holistic approach to creating fully fledged open XR experiences, from conceptualization to deployment and beyond. The three layers of the OXREF are shown in Figure 1.

Figure 1

The Open XR for Education Framework (OXREF)
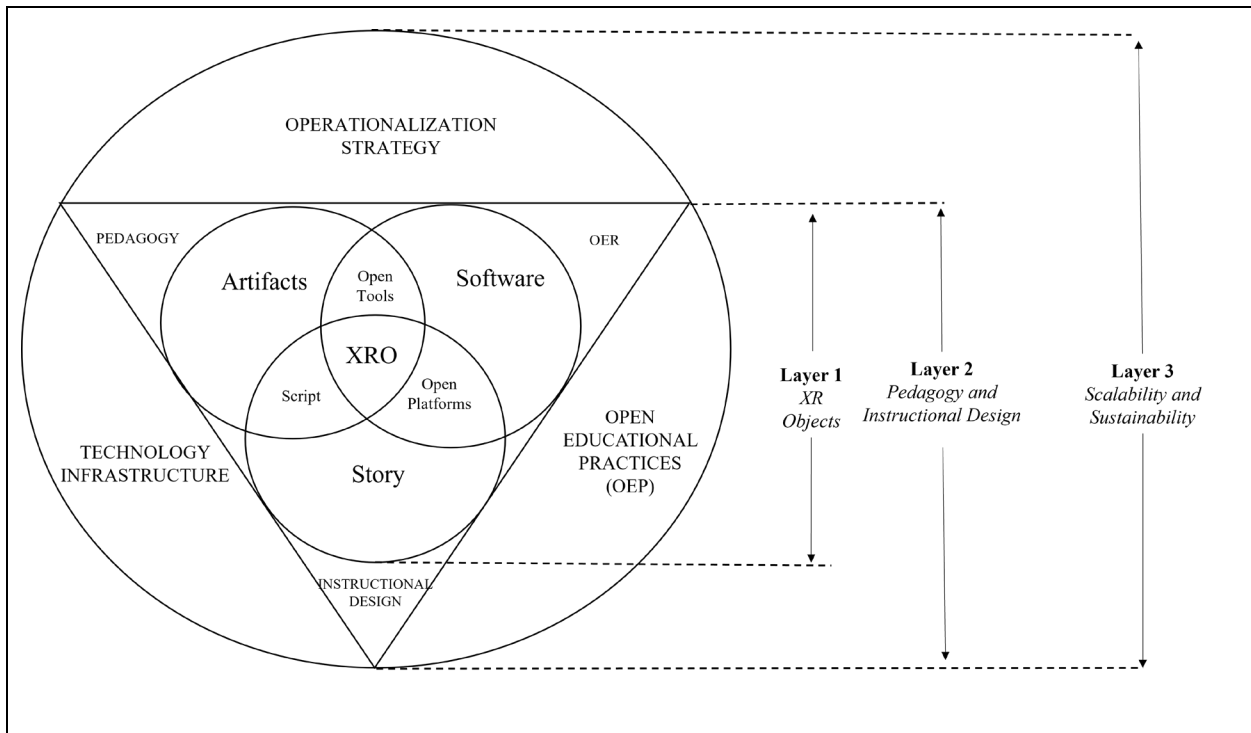
For the purposes of this paper, I will explore each layer of this empirical framework using the Voyager VR simulation (The Shady Bunch, 2018) (The Shady Bunch, 2018)as an example. An overview of the Voyager VR simulation is shown in Figure 2.

Figure 2

The Four Main Scenes of the Voyager VR Simulation

Scene 1: Spaceship leaving the base

Scene 2: Spaceship entering solar system

Scene 3: Spaceship flying through the solar system

Scene 4: Spaceship docking at the space station
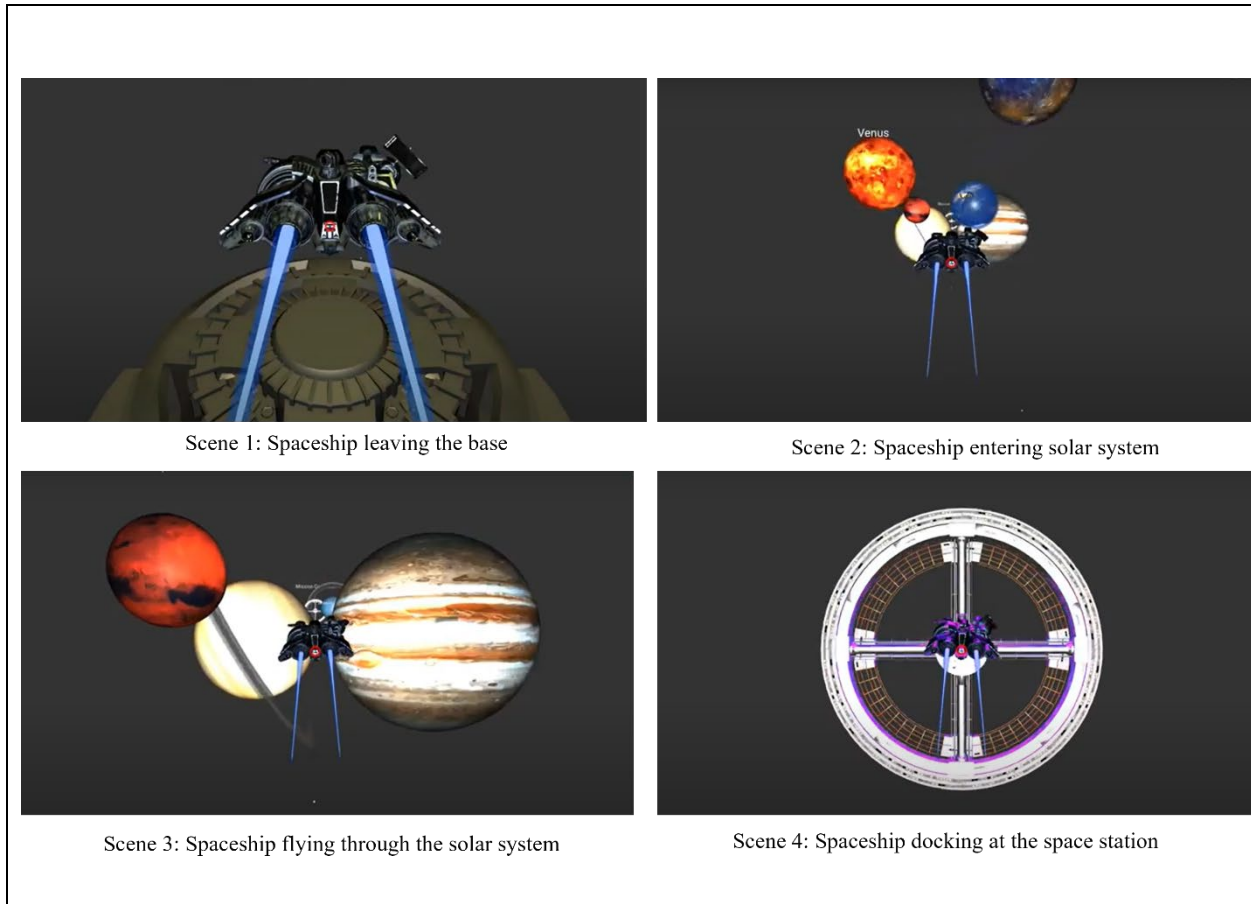
Note. Adapted from "Voyager Virtual Reality (VR) Journey Through Space" by The Shady Bunch, 2018, (https://youtu.be/Tn1TqYHPrUM). CC BY 4.0.

The Voyager is a simple WebVR simulation bult using A-Frame, which is a FOSS VR development platform using HTML5 and JavaScript, originally created by Mozilla VR. The simulation depicts an animated spaceship leaving a base, flying through space and the solar system, and docking at a space station at the end of the journey. A video of the Voyager VR simulation can be found on YouTube. Although I have used a VR simulation to explain the various components of the framework, the OXREF is applicable to all XR including VR, AR, and MR.

Open XR Object Creation

Layer 1 of the OXREF deals with creating individual XR objects including a story, artifacts, and design/development software. These, in turn, intersect to inform a script, open tools, and open platforms for the XR objects. Layer 2 provides the pedagogical and instructional design for the XR development within the guidelines of OER, which include reuse, revision, remixing, redistribution, and retention (Abeywardena, 2017). It should be noted that Layers 1 and 2 interact in a complementary manner throughout the XR development process.

The Story

The development of all XR objects begins with the story. The story details the requirements of the XR simulation with respect to the specific teaching and learning scenario or need. In the case of the Voyager VR simulation, the story provided learners a glimpse into the various shapes, colors, and sizes of the planets in our solar system.

The Script

Based on the story, a script (Mourchid et al., 2018) is created to identify how the story can be narrated in a virtual environment achieving the intended competencies or learning outcomes. The main components of the script are (a) who? (the characters); (b) where? (the locations); (c) what? (the subjects talked about); (d) when? (the scenes); and (e) how? (the process to achieve the story). The how? component is formulated using the artifacts and the software.

The script for the Voyager VR simulation contained the following elements:

- Who? Spaceship, base station, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and docking station.

- Where? Outer space.

- What? Various shapes, colors, and sizes of the planets in our solar system.

- When? (a) Scene 1: spaceship leaving the base; (b) Scene 2: spaceship entering the solar system; (c) spaceship flying through the solar system; and (d) spaceship docking at the space station.

Pedagogy and Instructional Design

Pedagogical and instructional design input helps shape the script in alignment with the expected competencies or learning outcomes. From a pedagogical perspective, the XR simulations should foster (a) self-empowerment/self-efficacy, (b) critical thinking and decision making, (c) technical knowledge and problem solving, and (d) inclusive excellence and community of practice (Guilbaud et al., 2021). From an instructional design perspective, the XR simulations should consider several key factors (Meccawy, 2022) as detailed in Table 1.

Table 1

Instructional Design Factors to be Considered in XR Simulations

Instructional design factor	Questions to be addressed in the XR experience
Technical expertise	How technically adept are the team members?
	How fast could they learn a new programming language or navigate a new developing environment?
Time	How quickly is this immersive learning environment needed?

Budget	How much is management willing to invest in creating an immersive learning environment?
	Would creating an in-house solution be cheaper than subscribing to a readily available solution?
Scalability (number of participants)	What is the cost per classroom?
	Is there a maximum user capacity limit?
	What is the feasibility/cost of expanding beyond maximum capacity?
Level of control	What are the trade-offs when using an off-the-shelf solution compared to developing in house?
Configuration and maintenance	What investments are needed in terms of funds, time, resources, and capacity building to configure and maintain the solutions?
Availability of suitable XR learning content	Is there learning content already available which can be adapted to this learning scenario?
	Are the XR learning content compliant with accessibility requirements and guidelines?
Pedagogical alignment	Do the XR content align with existing curriculum?
	Will introducing XR yield the desired learning outcomes?
	Do we have the depth of knowledge in the subject matter in addition to software design/development skills?
	Is the XR solution designed for educational purposes rather than a retrofitted or modified industry solution?
Security and privacy	Does the XR solution deal with sensitive information?
	Does the XR solution comply with national, provincial, and institutional privacy and security requirements?
Degree of immersion and output tools	Does the XR simulation need to be fully immersive or will it achieve the same learning outcome using partially or non-immersive approaches?
	Will students need special equipment (e.g., VR headsets, VR controllers, smartphones) to access the content?
	Who will provide the output tools for students to interact with the content?
	Are there accessibility, inclusivity, and equity concerns in using a particular output tool?

Note. Adapted from "Creating an Immersive XR Learning Experience: A Roadmap for Educators," by M. Meccawy, 2022, *Electronics, 11*(21) (https://doi.org/10.3390/electronics11213547). CC BY 4.0.

Artifacts and Software

The artifacts of an XR simulation include (a) 3D modeling such as wireframes and virtual objects; (b) 2D graphic designs such as textures and backgrounds; (c) video elements such as 360-degree videos; (d) animations; and (e) audio content such as sound effects and voiceovers, among others.

The artifacts for the Voyager VR simulation included the following:

- 3D models—spaceship, base station, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and docking station.

- 2D graphics—textures for the planet surfaces, planet names, and background space.

- Video elements—not used.

- Animations—rocking motion of the spaceship, exhaust coming out of the spaceship engines, spaceship flying forward in space, and flashing lights at docking station.

- Audio—spaceship engine noise and voiceover narrations.

When considering software, there are numerous commercial tools and platforms which can be used to create artifacts and XR objects. However, to develop open XR content which can be reused, revised, remixed, redistributed, and retained in keeping with the freedoms allowed through OER, using FOSS should be considered the primary option (Abeywardena, 2012). While selecting the FOSS tools and platforms to be used for a particular project, ALMS parameters (Abeywardena et al., 2012) consisting of (a) Access to editing tools, (b) Level of expertise required to revise or remix, (c) ability to Meaningfully edit, and (d) Source file access should be used to identify the most fit-for-purpose tools based on the project's requirements (Table 1).

Scalability and Sustainability

Layer 3 deals with scalability and sustainability, which remain major barriers to the wider adoption of modern educational technologies (Renz & Hilbig, 2020), through the lenses of OEP, technology infrastructure, and operationalization strategy. Although there is significant interest from governments and institutions which have given rise to exemplary pilot XR project, the majority remain as pilot projects and do not scale beyond their original scope (Kluge et al., 2022). Furthermore, Kluge et al. (2022) stated that ongoing funding, lack of IT support, integration issues, and non-sustainable implementation strategies were the major barriers for ongoing use of XR. According to Wang et al. (2020) "currently, there is still lack of global collaboration on the research and development of AR and VR tools and applications" (p. 542). A potential solution to these issues is the adoption of OEP including (a) supporting the production and (re)use of OER through institutional policies; (b) promoting innovative pedagogical models; (c) open technologies; (d) open licensing; and (e) respecting and empowering learners as co-producers on their lifelong learning path (Koseoglu & Bozkurt, 2018). Many case studies from the OER movement have attested to the ability of OEP to increase scalability and sustainability in education (Cronin, 2017; Friesen, 2009; MacKinnon et al., 2016; McGreal, 2017; Tlili et al., 2021). Figure 3 provides an XR operationalization readiness checklist for educational institutions, adapted from Abeywardena (2017) and guided by the principles of OEP.

Figure 3

XR Operationalization Readiness Checklist for Educational Institutions

Process		Management	Academic staff	Pedagogy, ID and EdTech	Library	Systems development	Learners	Mainstreaming task	
1.	Change in mindset	✓	✓	✓	✓	✓	✓	1.1	Decided to produce and/or (re)use XR for teaching and learning?
								1.2	Is XR a good fit-for-purpose in my institution?
								1.3	Is open good?
2.	Build capacity		✓	✓	✓	✓	✓	2.1	What are XR and XR concepts?
								2.2	What are the types of XR?
								2.3	What is open and accessible XR?
								2.4	What is copyright and open licensing?
								2.5	What FOSS tools, technologies, and platforms are available for developing XR?
								2.6	How to create, reuse, revise, remix, and retain XR?
3.	Strategize	✓	✓	✓	✓	✓	✓	3.1	Identified the need for XR in terms of cost, quality, and access?
								3.2	Identified short-, medium-, and long-term goals for XR?
								3.3	Identified representatives from each stakeholder group for task teams?
4.	Adopt an open license	✓	✓	✓	✓		✓	4.1	How open is the institution?
								4.2	How open are current learning content?
								4.3	Allow commercial use?
								4.4	Enforce ShareAlike?
								4.5	Allow derivatives?
								4.6	No rights reserved?
5.	Technology infrastructure	✓			✓	✓		5.1	Have sufficient technology infrastructure?
								5.2	Have sufficient technical personnel?
								5.3	Invest in cloud-based technologies and services?

193

| #	Category	1	2	3	4	5		
							5.4	Setup a FOSS repository?
6.	Policy	✓					6.1	Adopted an institutional XR policy?
							6.2	Updated HR policies to recognize and reward XR related activities?
							6.3	Recognized additional work in integrating XR into teaching and learning?
							6.4	Made the integration of XR a key performance indicator (KPI)?
							6.5	Developed a system for remuneration and encouragement?
							6.6	Mainstreamed open educational practices?
7.	Practice	✓	✓	✓	✓	✓	7.1	Which courses will use XR?
							7.2	Developed a systematic approach to integrating XR into learning content?
							7.3	Formed XR development teams?
							7.4	Identified XR fit-for-purpose in terms of competencies/learning outcomes?
							7.5	Developed pilot XR content?
							7.6	Successfully integrated XR into teaching and learning scenario?
							7.7	Built a catalogue of reusable open XR objects?
8.	Quality assurance (QA)	✓	✓	✓	✓	✓	8.1	Formed an XR QA team for teaching and learning content?
							8.2	Developed procedures for systematic software quality assurance (SQA) of the XR content?
							8.3	Is this content suitable for our learners (user acceptance testing)?
							8.4	Is it pedagogically sound?
							8.5	Is it open and accessible?
							8.6	Do we have ongoing tech support?
							8.7	Is it scalable and sustainable beyond this implementation?
9.	Competencies and learning outcomes	✓	✓			✓	9.1	Have strategy for assessing XR content against competencies/learning outcomes?
							9.2	Are XR based assessments correctly mapped against the learning outcomes?
							9.3	Have a continuous quality improvement (CQI) strategy?

Note. Adapted from "An Empirical Framework for Mainstreaming OER in an Academic Institution" by I. S. Abeywardena, 2017, *Asian Association of Open Universities Journal, 12*(2), p. 233 (https://doi.org/10.1108/AAOUJ-11-2017-0036). CC BY 4.0.

Technology Infrastructure

When considering technology, both scalability and sustainability of educational technology projects heavily depend on (a) establishing productive partnerships among stakeholders, (b) identifying research-informed approaches to technology integration that are sustainable and scalable, and (c) developing sustainable and scalable approaches to technology integration (Niederhauser et al., 2018). XR content, including the artifacts, software code, and scripts among others, should be hosted and served using a FOSS architecture that adheres to OEP and open licensing. This enables the XR content to be reused, revised, remixed, redistributed, and retained for multiple projects within the same institution as well as collaborative projects across multiple institutions. Figure 4 identifies a technology infrastructure architecture which will be used for open XR content hosting, content reuse, content delivery and content consumption in the OXREF.

Figure 4

Technology Infrastructure Architecture for OXREF
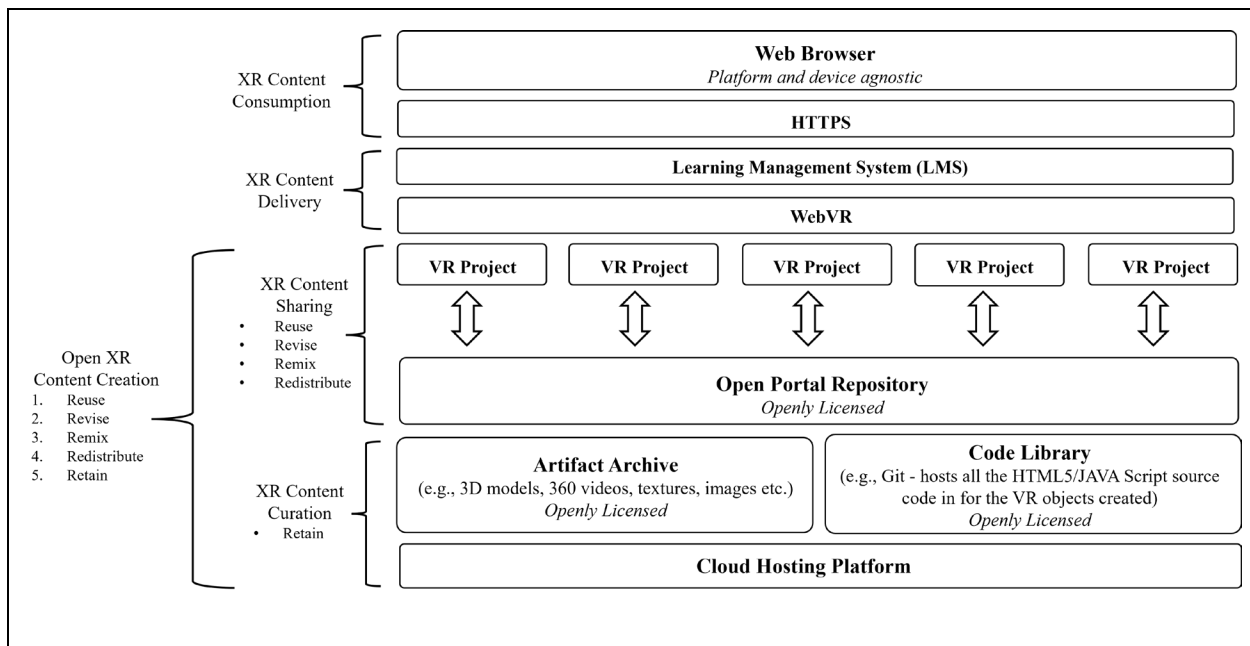
Content Curation

Cloud Hosting Platform. Opting for managed cloud hosting infrastructure rather than setting up and maintaining on-premises hosting infrastructure is the prudent choice when considering medium to longer term scalability and sustainability of the XR initiative. Among the many benefits of cloud infrastructure, Dash and Pani (2016) highlighted (a) reduced costs, (b) promoting economic development, (c) enhanced transparency and accountability, (d) improved service delivery, (e) improved public administration, and (f) facilitating an e-society.

Artifact Archive. The artifact archive is an indexed and searchable storage space within the cloud infrastructure in which to curate all the artifacts, including script, 3D models, 2D graphics, video elements,

and audio. Each element is tagged using an open metadata schema (Garnett et al., 2017; Taibi & Dietze, 2016) and is released under an open license.

For the Voyager VR example, the artifact archive consisted of the following.

- Script:

- Who? Spaceship, base station, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and docking station.

- Where? Outer space.

- What? Various shapes, colors, and sizes of the planets in our solar system.

- When? (a) Scene 1: spaceship leaving the base; (b) Scene 2: spaceship entering the solar system; (c) spaceship flying through the solar system; and (d) spaceship docking at the space station.

- 3D Models—spaceship, base station, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and docking station.

- 2D graphics—textures for the planet surfaces, planet names, and background space.

- Audio—spaceship engine noise and voiceover narrations.

Code Library. The code library is a distributed version control system commonly used in the software development industry to manage source code changes and version histories. It allows multiple programmers to work on a single project without compromising the integrity of the source code. Further, these systems are used widely for curating and archiving source code for reuse, revision, remixing, redistribution, and retention. A popular FOSS solution is Git (Spinellis, 2012), which can be set up on the cloud infrastructure, with an attached open license, allowing the reuse of source code.

From the Voyager VR example, the HTML and JavaScript source code used to animate the rocking motion of the spaceship, exhaust coming out of the spaceship engines, spaceship flying forward in space, and flashing lights at docking station will be stored in the code library.

Content Sharing

Open Portal Repository. The openly searchable repository is a portal repository (Beça et al., 2020) which allows stakeholders to search for artifacts and source code using a metadata or semantic search (Abeywardena & Chan, 2013). Once the user has located the artifacts and source code that are the best fit-for-purpose, they can download and reuse, revise, remix, redistribute, and retain depending on their teaching and learning needs. Further, depending on the open licenses used in the artifact archive and code library, the derivations will need to be shared alike back into the repositories, thereby promoting organic and sustainable growth. This, in turn, addresses the current lack of XR material for reuse, which is a major barrier to XR propagation in education (Murray & Johnson, 2021).

VR Projects. By remixing artifacts and code found through the open repository using open tools and platforms identified in Layer 1 and Layer 2 of the OXREF, users are able to rapidly develop derivative open XR objects fit-for-purpose for their teaching and learning needs.

The following is a new derivation of the Voyager VR example:

- Story (new)—provide learners a glimpse into the giant storms on the surface of the planet Jupiter.

- Script (revised):

- Who? Spaceship, base station, Jupiter, and docking station.

- Where? Outer space.

- What? A glimpse into the giant storms on the surface of the plane Jupiter.

- When? (a) Scene 1: spaceship leaving the base; (b) Scene 2: spaceship entering the solar system; (c) spaceship circling Jupiter; (d) spaceship flying close to the great red spot; and (d) spaceship docking at the space station.

- 3D models—spaceship, base station, Jupiter, and docking station.

- 2D graphics—textures for the planet Jupiter surfaces, planet names, and background space.

- Audio—spaceship engine noise and voiceover narrations (new).

- Animations—rocking motion of the spaceship, exhaust coming out of the spaceship engines, spaceship flying forward in space, flashing lights at docking station, spaceship circling Jupiter (new), and spaceship flying close to the great red spot (new).

Content Delivery and Consumption

WebVR is a non-immersive specification (Höhl, 2020) which allows XR content to be consumed using a Web browser (e.g., Microsoft Edge, Google Chrome, Mozilla Firefox, iOS Safari) without the use of specialist hardware or software such as VR headsets, Google Cardboard, or VR controllers. Due to the platform and device agnostic nature of WebVR, the user can interact directly with the XR content on the Web browser through a computer, keyboard-mouse or via a mobile device. With the current penetration rates of mobile devices and mobile Internet across the globe (Afzal et al., 2022), WebVR remains the most equitable and affordable method of consuming XR content. Further, as Dibbern et al. (2018) stated, "the best way to drive content creation is to get more creators invested. Integrating VR into the web gives us the opportunity to tap into the vast pool of web developers to design VR content" (p. 378). The studies by Rocha Estrada et al. (2022) and Glasserman-Morales et al. (2022) on virtual campuses claimed high satisfaction by teachers and learners when using WebVR, leading to increased uptake.

Among the key features of WebVR are its ability to (a) be served to end users through HTTPS; (b) be easily embedded in the learning management system (LMS), content management system (CMS), or webpage;

(c) be developed faster and cheaper using open tools and platforms; (d) avoid the need for additional apps or software downloads; and (e) facilitate quick and agile updates to the XR content which are instantly reflected to the end users; and (f) accommodate a do-it-yourself approach, thus empowering instructors to create more content themselves.

Operationalization Strategy

Ensuring XR initiatives are scalable and sustainable beyond the pilot phase requires a collaborative effort among many stakeholders. Ziker et al. (2021) stated that "optimizing the use of XR in higher education requires the support and resources of an interdisciplinary community of committed professionals from education, government, and industry who will work together with researchers to overcome the existing challenges that limit adoption" (p. 74). The OXREF looks at operationalization at the educational institution and the government levels.

Educational Institutional Level

Based on the work by Abeywardena (2012) and Abeywardena et al. (2019), Figure 5 outlines a four-stage operationalization strategy for the OXREF in an educational institution. Stages 1 to 3 have been discussed in detail in the preceding sections. Stage 4 addresses the need for institutional policy governing the use of XR in teaching and learning from several perspectives.
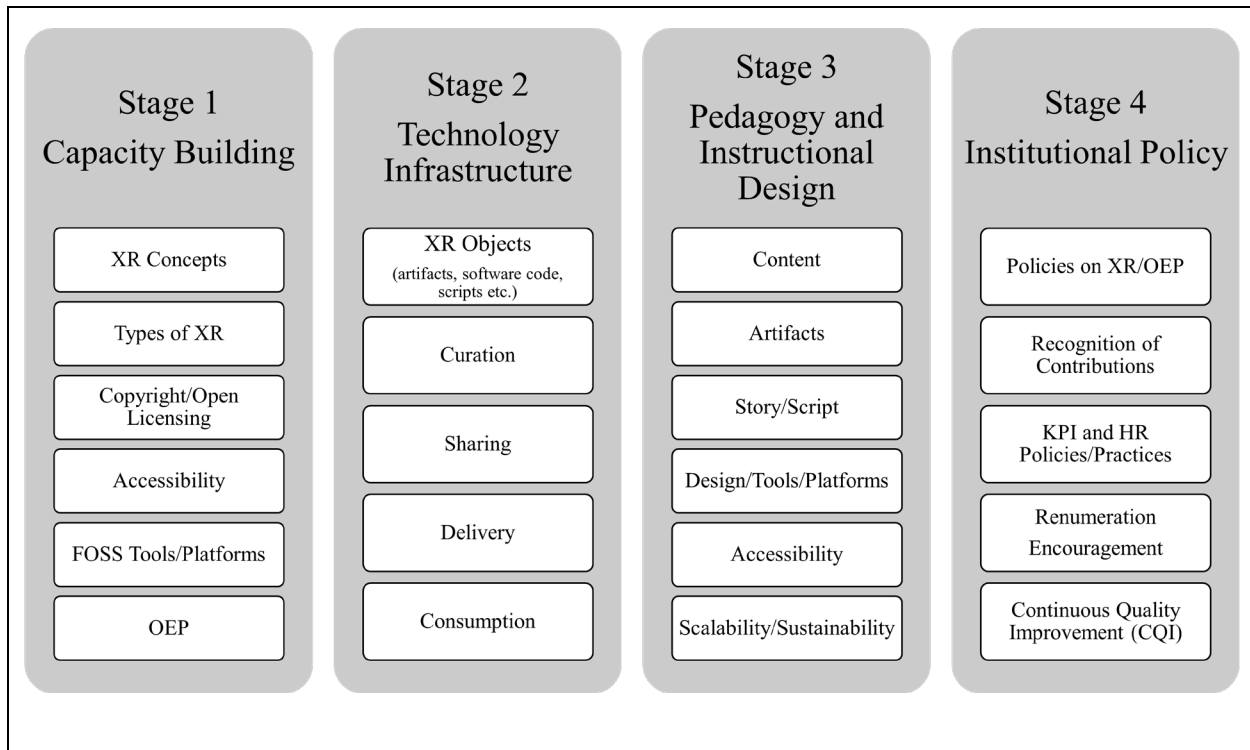
First, the institution needs to create policies, procedures, and guidelines around the use of XR in teaching and learning with respect to (a) the type of XR to be used—fully immersive, partially immersive, and/or non-immersive; (b) the type of open license to be used—use only one license across the institution or allow content creators to assign the license; and (c) the extent to which the institution will encourage OEP.

Second, the institution should revise their criteria for performance evaluation in order to consider impactful contributions made to teaching and learning through integrating XR into the curriculum. This could result in some form of recognition or renumeration which will encourage more uptake of XR within the institution.

Third, the institution should invest in formal processes for continuous quality improvement (CQI). Hogg and Hogg (1995) defined CQI in higher education as "teaching people in an organization to view themselves as part of a larger systematic operation" (p. 37). They also recommended "continually serving customers better and more economically, using the scientific method and teamwork, and focusing on removal of all forms of waste" (p. 1). CQI implies that the use of XR in teaching and learning requires periodic and consistent evaluation by soliciting feedback from all stakeholders and evaluating whether the XR is contributing to the expected competencies and/or learning outcomes.

Figure 5

OXREF Operationalization Strategy for Educational Institutions

Stage 1 Capacity Building	Stage 2 Technology Infrastructure	Stage 3 Pedagogy and Instructional Design	Stage 4 Institutional Policy
XR Concepts	XR Objects (artifacts, software code, scripts etc.)	Content	Policies on XR/OEP
Types of XR	Curation	Artifacts	Recognition of Contributions
Copyright/Open Licensing	Sharing	Story/Script	KPI and HR Policies/Practices
Accessibility	Delivery	Design/Tools/Platforms	Renumeration Encouragement
FOSS Tools/Platforms	Consumption	Accessibility	Continuous Quality Improvement (CQI)
OEP		Scalability/Sustainability	

Note. Adapted from "A Report on the Re-use and Adaptation of Open Educational Resources (OER): An Exploration of Technologies Available" by I.S. Abeywardena, 2012, Commonwealth of Learning, p. 52 (http://hdl.handle.net/11599/233). CC BY-SA 4.0.

Government Level

In an EDUCAUSE report, Pomerantz and Rode (2020) identified some of the major barriers hindering the wider adoption of XR including (a) the need for more educational XR apps, (b) not having students as innovation drivers, (c) rapid pace of change, (d) lack of collaboration, (e) limited external partnerships, (f) lack of community building, and (g) looking beyond the pandemic. Based on design thinking principles of experiment, create, and prototype models, then gather feedback and redesign (Razzouk & Shute, 2012). Table 2 provides a usable operationalization plan for governments to address the key issues of XR addressed through the OXREF.

Table 2

OXREF Operationalization Strategy for Governments

XR areas of need	Government support			
	Understand the case for XR	Design potential XR solutions	Build XR prototypes, test, refine	Implement XR solutions
Content, tools, and skills	Organize capacity building and skills development workshops on XR use in education.	Provide expert consultations; help identify industry partners and/or vendors.	Provide technical support and/or initial funding for specific technologies/ tools to instructors and learners using the XR technologies.	Provide consultation, user training, technical support, and/or funding for licenses aimed at large scale deployment.
Pedagogy and instructional design	Offer tailored suggestions on how to integrate XR into a particular curriculum.	Deliver training and support for instructors to use the technology.	Organize capacity building and skills development workshops for instructors and instructional designers on the integration of XR competencies/ learning outcomes.	Organize capacity building workshops on assessment of competencies/ learning outcomes in XR integrated courses.
Technology infrastructure	Act as the intermediary and/or liaison between partner institutions and industry partners/ vendors to provide access to XR technologies and platforms.	Negotiate and/or collaborate with industry partners/vendors on behalf of partner institutions to secure access to XR technologies and platform sandboxes.	Give education and training providers access to XR platforms and shared applications and content.	Give stakeholders access to XR technology (e.g., VR headsets, high-end computers), applications and content.
Scalability and sustainability	Conduct province, institution, community, industry, and	Assist institutions in developing roadmaps, policies, and procedures for	Negotiate longer term scalability and sustainability goals with	Make content available to constituents through public infrastructure.

| sector specific studies on areas of need in XR. | mainstreaming XR use. | industry partners/vendor. |

Conclusion

The OXREF facilitates the creation of XR experiences for education in a scalable and sustainable manner using OER, OEP, FOSS, and open licensing. Further, the empirical framework outlined here promoted collaboration in XR reuse, revision, remixing, redistribution, and retention—both within the institution and across institutions—anchored by a robust technology infrastructure architecture. For example, if one institution develops an XR simulation of the human heart, another a human brain, and another a human lung using the OXREF, all of them and many others will be able to combine multiples of these simulations, under open licenses, to create robust XR simulations of the human anatomy. Such simulations would support the competencies or learning outcomes of an entire course or program. Further, the share alike conditions of using open XR content would contribute to organic growth of the XR content available for reuse. Acknowledging the importance of pedagogy and instructional design in integrating XR into curricula, the OXREF provides a set of instructional design factors to be considered in XR simulations. Further, it includes an XR operationalization readiness checklist along with strategies for educational institutions and governments. I am working towards the implementation of the OXREF at the University of Waterloo in the future.

Acknowledgements

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Book Review: (*Open*) *Educational Resources Around the World: An International Comparison*

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The open educational resources (OER) movement is almost two decades old. It started with MIT's announcement in 2001 that it would upload course content on the internet as "MIT OpenCourseWare," accessible to the world for free, with a UNESCO forum in 2002 coining the term "open educational resources" for this generous sharing. Since that time, governments, educational institutions, subject-matter experts, and not-for-profit organisations across the globe have shown a great deal of interest in this endeavour. A UNESCO General Conference that includes 193 countries from around the world adopted the "Recommendation on Open Educational Resources (OER)" in 2019. The COVID-19 pandemic further boosted the creation, adoption, and sharing of educational resources. The term OER has become ubiquitous. Interest in OER has led to the development of best practices in using them.

(*Open*) *Educational Resources around the World* addresses the question of how OER has fared within the educational ecosystem. Members of the Centre for Open Educational Research, created in 2018, contributed to this project—entitled "Digital educational architectures: Open learning resources in distributed learning infrastructures – EduArc Research"—funded by the German Federal Ministry of Education and Research. The volume contains country reports, working papers, and status reports from countries such as Australia, Canada, China, Germany, Japan, South Korea, South Africa, Spain, Turkey, and the United States. The authors have applied the 3M framework (macro, meso, and micro) to study issues related to OER with specific reference to (i) national policies and frameworks for the design of a cross-university (national) infrastructure to disseminate OER (macro-level); (ii) the provision of OER in higher education institutions, for example, technical and support infrastructure, professional development, and quality assurance (meso level); and (iii) the creation and use of OER in higher education teaching and learning and the sharing between faculty members (micro-level).

The volume is divided into three parts. The first ("Context") sets the tone of the discussion in four chapters. Chapter 1 ("Introduction") provides details of the project that forms the foundation of this book and introduces the main concepts authors deal with in their respective chapters. For example, it addresses the authors' use of the term "(O)ER" to denote both open and non-open educational resources as well as with reference only to resources that are OER. Chapter 2 ("Understanding (O)ER") defines the concept of OER from different perspectives and discusses the different available forms and levels of OER. Chapter 3

("Digital Transformation in the World") touches upon the different aspects of digital transformation such as ICT infrastructure, readiness, and availability/access happening in the countries under report. Context and culture are important catalysts for digital transformation. Chapter 4 ("Higher Education Systems and Institutions in Their Contexts") discusses the higher education context as the starting point for the reported countries. China has been reported to be the largest country in terms of both population and number of university students; however, the United States houses the largest number of higher education institutions. The countries have been placed on a spectrum from the "Private Higher Education System" to the "Public Higher Education System."

Part two of book ("The Country Studies") presents studies from select countries across the world in eight chapters. The chapters present the discussion at three levels: macro, meso, and micro.

Chapter 1 ("The Case of Australia"), by Melissa Bond, presents the digital transformation trajectory of Australia. Most universities in Australia use institutional repositories funded by the Australian Research Repositories Online to the World (ARROW) project to "manage and disseminate research outputs and learning resources." The chapter provides a comprehensive account of the status of IT infrastructure. At the macro level, it presents a policy perspective at the national level. At the meso level, it presents insights on initiatives taken at the state and the institutional levels. Finally, at the micro level, the author discusses the initiatives taken by the institutions, and knowledge and awareness of OER at the level of stakeholders. The chapter concludes that changes in the OER ecosystem at the meso and micro levels are predominant.

Chapter 2 ("Digital Transformation in Canada"), by Dianne Conrad and George Veletsianos, examines the digital transformation process in Canada. Library organisations in Canada are at the forefront of digital transformation. Some institutions maintain their own OER repositories. As part of decentralisation practices, each province and territory take care of its educational systems, resulting in a fragmented and individualised effort to promote OER at the institutional level. Key factors impacting digital transformation in Canada are timely funding and political persuasion.

In Chapter 3 ("China's Approach to Digital Transformation of Higher Education"), Junhong Xiao and Jingjing Zhang discuss the process of digital transformation in China. The country has adopted a national strategy to digitalise education. This approach is visible in digital transformation at the macro, meso, and micro levels. The authors caution that in a top-down approach, the higher-level policies should be flawless, otherwise they could be expensive and disastrous. The major areas of digital transformation in China are "digital infrastructure construction, staff capacity building, technology-enhanced learning and teaching, and developing and sharing of high-quality educational resources" (p.116). The authors suggest that "providing funding, incentive or subsidy; strengthening leadership and coordination; creating a favourable innovative atmosphere; and promoting international cooperation" (p.118) have been quite helpful in the successful implementation of digitalisation policies.

Chapter 4 ("Open Educational Resources within the Digital Transformation of German Higher Education"), by Svenja Bedenlier and Victoria I. Marín, examines the German higher education system. The country is yet to see effective use of OER at the pedagogical level in higher education. The authors see incentivisation, support, and knowledge transfer as the prime issues in bringing the OER initiatives to the forefront at the

micro level. They argue there is a need "to integrate the institutional perspective more strongly between the state and national policies and the individual instructors" (p. 208).

Chapter 5 ("The Case of Japan and Korea"), by Insung Jung, presents the case of the digital transformation of higher education in Japan and Korea. In Japan, OER initiatives have not attracted educational institutions at large, primarily because individual institutions are responsible for their digital initiatives and thus need to support the infrastructure, resources, and services without funding from the government. In contrast, in Korea, initial financial support from the government has allowed educational institutions to establish a centre for teaching and learning on their premises to support OER initiatives. As part of the national initiative, educational institutions collaborated with international organisations—such as the World Bank's Open Learning Campus, Creative Commons, and prominent MOOC providers—to boost digital transformation initiatives in Korea. The author considers three factors to be important for the smooth and efficient digital transformation of higher education in a country: "1) the development and implementation of the government's policy and action strategy in digital transformation, 2) the existence and effective operation of supporting agencies at the national level, and 3) the provision of competitive funding and incentives to universities for their high accomplishment in digital transformation" (p.268).

Chapter 6 ("Analysis of Higher Education (HE) Systems' Approach in South Africa"), by Paul Prinsloo and Jennifer Roberts, presents the case of distributed learning infrastructure in South Africa. The authors suggest that the main focus of the national policies of South Africa is the "transformation of the higher education landscape." This new educational philosophy is expected to result in the development of "new economic, social and political structures" in the country. Some prominent challenges higher education will have to address in the country include the "increasingly competitive higher education landscape, funding constraints, competing narratives about graduate attributes, the growing phenomena of the casualisation of faculty, and the disruptive role of technology" (p. 275).

In Chapter 7 ("The Case of Spain"), Victoria I. Marín describes the digital transformation process at Spanish universities as quite advanced. While libraries are important agents of digital transformation at the university level, duplication in the creation of digital educational resources is a common factor. Some educational institutions maintain their educational repositories. At times, OER used by the institutions and students is not integrated into any mainstream system that could facilitate sharing of resources. The process of integration of resources could be comparatively easy since the Spanish universities follow international standards for the creation of OER and its metadata. Heavy teaching workloads, lack of incentives, and non-permanent faculty are some of the constraints hindering the promotion of OER at the institutional level.

Chapter 8 ("Digital Transformation and Openness in the Turkish Higher Education System"), by Aras Bozkurt, Yasar Kondakci, and Cengiz Hakan Aydin, discusses the extent of usage of OER and openness in education in Turkey. A negative public perception of educational resources is one of the biggest challenges hindering the promotion of OER and open educational practices. Despite this, at the government level, the higher education system has seen much progress in the direction of digital transformation. However, at the macro level, the authors point to a "need for an overarching policy to enrich OER and ensure the effective use of OER." Without this, "OER is not recognized as an item for assessment within the framework of quality assurance." Perhaps the philosophy of openness is not appropriately understood by scholars in Turkey.

"Building the skills of the academic leaders, academics, and students to build key skills to operate under digitalisation and openness would be an important step towards widening the use of OER" (p. 432).

Part three ("International Comparison") compares the initiatives and status of the creation and use of OER internationally in four chapters. The first three present a comparison of digital transformation at the macro, meso, and micro levels, and the final chapter in this section concludes the discussion on international comparison.

Chapter 1 ("Macro Level: The Situation at the National or Federal Level") covers the comparison at national and state levels. The three indicators selected by the authors—for this and all the chapters in this section— are infrastructure, quality, policy, and change. They observe that "countries with a highly decentralized HE system do not have (O)ER infrastructures or have underdeveloped infrastructures at the macro level" (p.446). On the other hand, many countries with a "rather centralized HE system have national infrastructures, but most of them are not specifically targeted at HE or (O)ER" (p.447). Chapter 2 ("Meso Level: The Situation at the Institutional Level") focuses on developments at the institutional level. The authors use illustrations and examples for clarity and comprehension and observe that institutional libraries have played a vital role as agents in institutional change. Chapter 3 ("Micro Level: The Situation at the Level of Teaching and Learning") looks at the pedagogical aspects at the grassroots level. It finds that in some countries, faculty have raised the concern of copyright while taking up OER practices—showing that the perception of the faculty is crucial in promoting their participation in OER initiatives. Chapter 4 ("Conclusions of the International Comparison") presents the concluding remarks from the editors, who emphasize that without understanding the dynamics of culture and differences in contexts, it will not be possible to "understand national and institutional (O)ER infrastructure and the associated support elements. "While many common aspects to digital transformation exist, each country demonstrates different dynamics at the macro, meso, and micro levels, and there is a need to deeply understand the connections and relations among them.

The different chapters in the book provide the status of digital transformation that has taken place in different countries. The book also provides an overall understanding of the issues related to OER and digitalisation at the macro, meso, and micro levels. The authors not only discuss what has been done and how it has been achieved, but also flag the constraints and challenges in educational digitalisation in higher education. This contribution will help to guide practitioners, administrators, and researchers and will provide a solid overview of developments in OER at different levels to those interested in this trajectory.

Can Online Short Courses Foster Business Education for Sustainable Development?

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Abstract

The COVID-19 pandemic challenged the practice of traditional higher education providers (HEPs) and highlighted the need for innovative approaches to education for sustainable development. This research note focuses on online short courses (OSCs)—micro-credentials geared at upskilling or reskilling learners with a competitive application process and cost. It conducts (a) a rapid bibliometric analysis of literature on the nexus between OSCs and sustainable development and (b) an environmental scan of OSCs offered in Australia with a lens of sustainable development. An exploratory approach was adopted to analyze publicly available secondary data on scholarly literature and the courses offered. Findings reveal two key trends: (i) the nascent nature of literature on OSCs and sustainable development globally and (ii) the limited availability of sustainable development related OSCs in Australia. This research note makes broad analytical contributions to posit OSCs as an e-learning innovation to advance business education for sustainable development.

*Keyword***:** business education for sustainable development, COVID-19, e-learning innovation, environmental scan, rapid bibliometric analysis

Introduction

The COVID-19 pandemic not only disrupted the operating environment of traditional higher education providers (HEPs) (Dhakal et al., 2022; Mavroudi & Papanikolaou, 2022) but also opened up new opportunities for developing flexible short-term education and training packages (Schleicher, 2020). For example, Pokhrel & Chhetri (2021) highlight the renaissance of specialized short-term online courses during the pandemic. In this context, two contemporary trends concern HEPs in Australia.

First, in the early months of the pandemic, the government announced a higher education relief package aimed at assisting university and non-university HEPs to design and deliver online short courses (OSCs) (DESE, 2020). OSCs are micro-credentials geared at upskilling or reskilling learners from all walks of life. They are similar to what Kaplan & Haenlein (2016) call short private online courses with a competitive application process and fees paid directly by the student or subsidized by the government.

Second, the need for higher education to contribute to the United Nations (UN) 2030 Sustainable Development Agenda has become critical in the current state of global affairs (see Miotto et al., 2020). For instance, leading accreditation standards such as the Association of Advanced Collegiate Schools of Business (AACSB) have been advocating for business education for sustainable development (BESD) to align courses with the United Nation's Principles of Responsible Management Education (UNPRME) in producing graduates capable of resolving broader societal challenges (Ulbrich, 2020; UNPRME Secretariat, 2021). However, the nexus between OSCs and sustainable development remains unexplored, and this research note responds to this gap with two specific objectives:

1. To conduct a rapid bibliometric analysis of literature on the nexus between OSCs and sustainable development.

2. To carry out an environmental scan of OSCs in Australia with a lens of sustainable development.

This research note uses an exploratory approach that is suitable in emerging areas of inquiry because (a) it allows researchers "to scope out the magnitude or extent of a particular phenomenon" (Bhattacherjee, 2012, p. 6) and (b) it does not require researchers to control the events being studied (Yin, 2009). While the outcomes of exploratory studies may not necessarily influence the education and training processes and products immediately, they help researchers make informed propositions (Parida et al., 2023). Publicly available secondary data on scholarly literature and courses being offered are analyzed to address the specific objectives outlined above. This research note makes broader analytical contributions to posit OSCs as an e-learning innovation to advance BESD.

Background

This research relies on two theoretical foundations: BESD and e-learning innovation (e-LI).

Business Education for Sustainable Development

According to the UN (2015), the 2030 Agenda, with 17 Sustainable Development Goals (SDGs), provides a shared blueprint for peace and prosperity for people and the planet, now and into the future (para. 1). The notion of sustainable development, often used as a synonym of sustainability, captures a balanced viewpoint and argues that "fragmented emphasis on economic gains, at the expense of social and or

environmental costs, is detrimental to the overall well-being of the society" (Dhakal, 2012, p. 8). This understanding drove the UN Decade of Education for Sustainable Development initiative (2005–2014) (Alonso & Dhakal, 2009; Buckler & Creech, 2014). More importantly, enabling reskilling and upskilling different types of learners are particularly pertinent to the fourth SDG (UN, 2015), which aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (p. 18) so that "all learners acquire the knowledge and skills needed to promote sustainable development" (p. 21).

UNESCO (2017) has been particularly active in disseminating SDGs-related educational resources to inform offline and online courses offered by HEPs. Drawing on Storey et al. (2019) and Miller (2020), BESD can be characterized as purposeful teaching and learning initiatives of business and management faculties with a focus on ensuring the economic bottom line and simultaneously on commitment toward socio-environmental well-being. This characterization aligns with the sentiment that "business schools should do more to provide research and teaching for the next generation of students with a greater focus on sustainability, ethics, and social purpose" (Jack, 2019, para. 1). However, although the literature has highlighted the value of e-learning for sustainable development education (Azeiteiro et al., 2015; Zhang et al., 2020), e-learning innovations to foster BESD remain limited (Hueske et al., 2021).

E-Learning Innovation

E-learning primarily uses information and communication technologies (ICTs) to connect teachers and students; that is, it enables teachers to design and deliver educational/training content and facilitates learning across multiple segments of learners (Castro & Zermeno, 2020). Therefore, learning technologies, instructional strategies, and pedagogical frameworks such as distributed learning are the three pillars of e-LI strategies (Oblinger et al., 2001; Dabbagh, 2005). Since e-learning concerns using educational ICTs to promote education and training (He, 2020), it relates to the construct of connectivism, which emphasizes how ICTs can mediate new teaching and learning opportunities. The central premise of connectivism is that in the digital era, ICTs must play a significant role in how e-LI occurs within HEPs (Utecht & Keller, 2019). Serdyukov (2017) points out that most contemporary learning and teaching innovations in higher education have been technology-based tools or learning systems. More importantly, HEPs have significantly invested in e-LI–related processes and products during the pandemic (Dhawan, 2022). Since innovation has two components—formulating an idea or an invention and harnessing an idea into purposeful applications (Dhakal et al., 2013)—this paper draws on Kim & Maloney (2020) and adopts a working definition of e-LI as the interplay between the ICT-mediated processes and products aimed at improving education and training opportunities with a specific purpose such as BESD.

Literature on the OSCS–Sustainable Development Nexus

Bibliometric analysis provides an opportunity to gauge the scope and magnitude of a particular topic in a specific field. The literature on the nexus between OSCs and sustainable development was examined using a rapid nibliometrics analysis (RBA) approach. RBA "allows researchers to capture emerging research themes … in an iterative and expeditious manner" (Dhakal et al., 2022, p. 357). A reproducible code "online short courses" AND "sustainable development" OR "sustainability"—was used to search literature in the Scopus database (01/01/2023). The search yielded a total of 37 research outputs between 2001 and 2022, with no outputs recorded between 2002 and 2008.

Figure 1

*Number of Research Outputs on Sustainable Development and Online Short Courses*
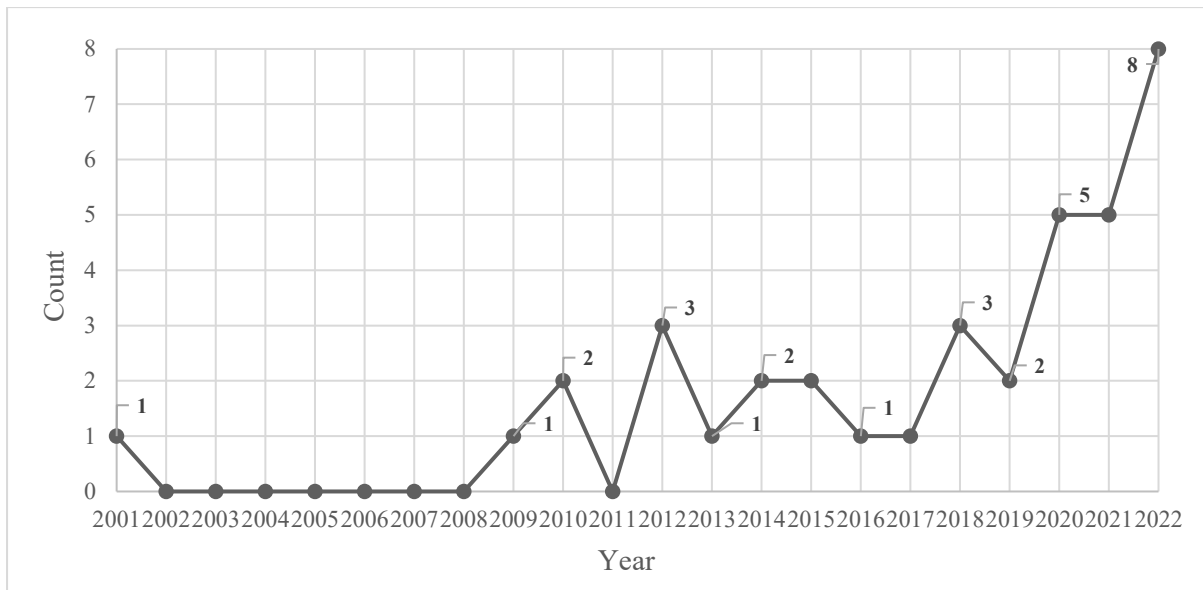
The RBA found approximately 1.6 outputs per year in the last two decades, indicating the slowly emerging nature of the research topic. Figure 1 shows the gradual output increase in the past 20 years, with noticeable growth after the onset of the COVID-19 pandemic. The two most dominant outputs were journal articles (62%, $n = 23$) and conference proceedings (22%, $n = 8$). In terms of disciplines, social sciences (62%, $n = 23$) topped the list, followed by computer science (35%, $n = 13$) and engineering (27%, $n = 10$). The top keywords ($n \geq 5$) were curricula, e-learning, and sustainable development ($n = 9$ each); sustainability ($n = 8$); and education, learning, higher education, human, students, and teaching ($n = 6$ each).

Bibliometric data was exported to the VOSviewer software (van Eck & Waltman, 2019), and a total of 337 keywords were extracted. The software generated a network map (Figure 2) using the overlay visualization option to depict the emergence of specific topics over time. Items represented in a lighter color are embedded in more recent research outputs. For example, the internet and sustainable energy were the main focus during the mid-2010s, whereas computer-aided instructions and COVID-19 have received attention in recent years. The connections show the number of outputs in which the items appear in a cluster. For example, the diagram depicts keywords arranged in three clusters: (a) curricula, (b) higher education, and (c) medical education.

214

Figure 2

An Overlay Network Map of the Literature on the Nexus between Online Short Courses and Sustainable Development
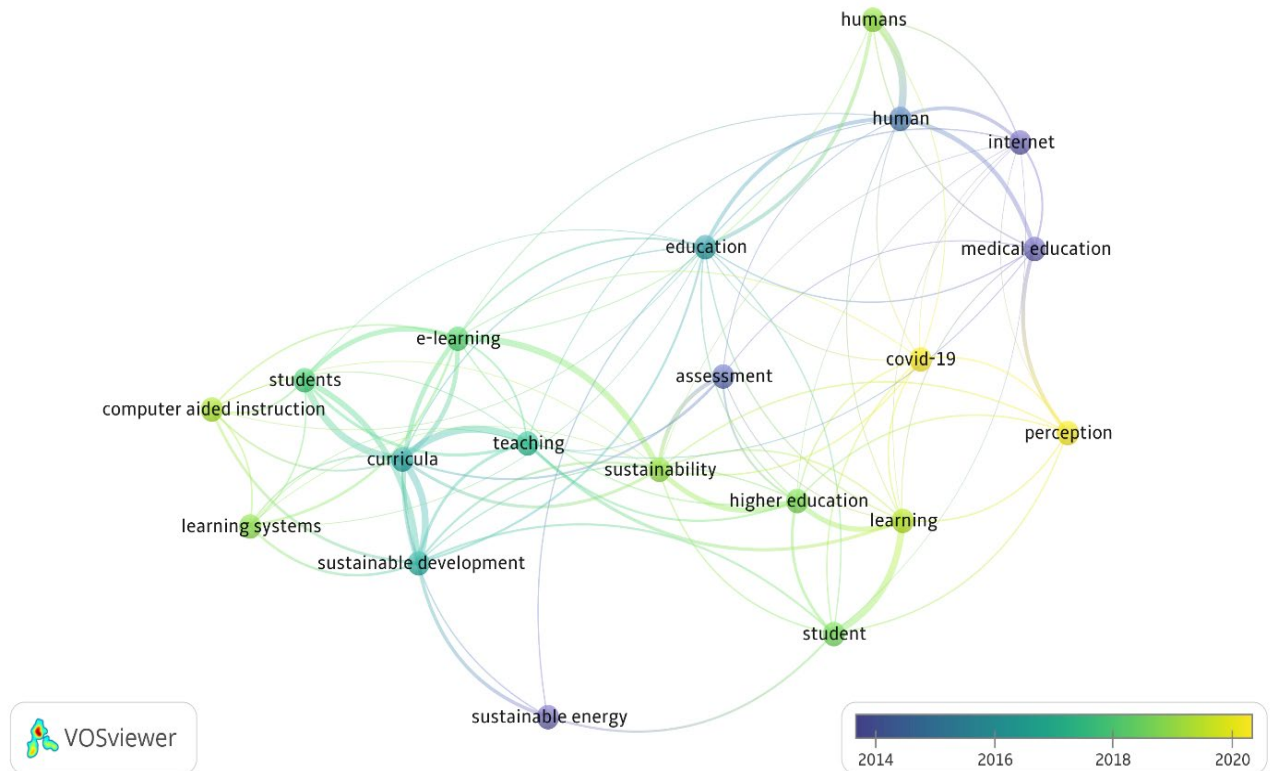
Research outputs were associated with 27 countries, of which the United States was the leader, accounting for nearly one-third (*n* = 11) of research outputs, followed by Australia (*n* = 5). Canada, Germany, Iran, Italy, Saudi Arabia, and South Africa had two outputs each. The *Sustainability* (Switzerland) journal published the most outputs (*n* = 6). Philip Jennings (Emeritus Professor, Murdoch University) had the most outputs (*n* = 2). Aljohani et al.'s (2019) article, "Predicting at-risk students using clickstream data in the virtual learning environment," was a top-cited article (citation count in Scopus = 37). Although two outputs specifically addressed sustainability in the context of business (Robertson et al., 2020; Bai et al., 2022), both focused on strategic aspects of business viability and competitive advantage rather than the BESD.

Environmental Scan of OSCs in Australia

Environmental scanning entails the process of seeking, gathering, and interpreting publicly available information (Zhang et al., 2010). According to Nagi et al. (2020), environmental scanning allows researchers to summarize existing data on a topic of interest.

First, OSCs can be characterized as formal as well as informal short-term study options. OSCs incur fees and are often designed to meet continuing professional development requirements, refresh knowledge, or reskill/upskill capabilities in specific targeted areas. For example, the Australian Institute of Management (AIM) offers one OSC titled "Manage Innovation and Continuous Improvement" with a price tag of AU$570 that has no formal recognition: "Please note that the AIM online Short Courses are non-accredited and there is no assessment" (AIM, n.d.). The University of Adelaide (2020) describes OSCs as non-credit-bearing learning opportunities to address specific learning and professional development needs. The Open Universities Australia (OUA) frames OSCs as a micro-credential pathway for learners to upskill or reskill for their future and gain credible expertise from leading Australian universities, stating, "Open Universities Australia's comprehensive range of OSCs includes undergraduate and postgraduate single subjects, micro-credentials, and continued professional development courses" (OUA, 2022: para. 1). Some OSCs are now formally recognized by the Australian Qualifications Framework (AQF). For example, according to the TEQSA (2022), an independent national quality assurance and regulatory agency for higher education in Australia, OSC qualifications "are not located at a particular level in the AQF; however, they cover AQF levels 5, 6, or 7" (para. 5).

Second, the Australian Government's initiative to support the university and non-university HEPs after the onset of the pandemic has enabled nearly 50,000 students to complete various OSCs since 2020 (DESE, 2023). OSCs currently offered in Australia are listed on the Course Seeker (2023) website (accessed January 1, 2023). The initial query yielded a total of 292 OSCs across 10 disciplines. About one-tenth (n = 32) of OSCs were associated with the business (i.e., management and commerce) discipline offered by 13 different institutions (Table 1). The graduate certificate (GC) courses (n = 17) that were under offer outnumbered the undergraduate certificate (UGC) courses (n = 15). The nature of OSCs ranged from GC in professional accounting to UGC in professional development (PD). The University of New England (UNE) had the highest number of offered courses (n = 11), which reflects UNE's track record in offering flexible and specialized courses that meet contemporary demand (Eggleton, 2022).

However, it is essential to note that 11 OSCs offered by UNE are different specialization streams under the one PD umbrella. UNE also underscores the pathways for students completing the UGC in PD to articulate into bachelor level courses such as bachelor of business (UNE, 2020). This OSC has a price tag of $3,950 and allows students to select two core and two specialization units within one or two trimesters (UNE, 2020). Table 1 also shows that only one OSC related to sustainable development was offered within the business discipline—at Charles Darwin University. It contrasts with the PRME commitments of 33 Australian universities to draw attention to the SDGs and equip current business students with the understanding and ability to deliver change in the future (UNPRME, 2023).

Table 1

Commerce and Management Graduate Certificates (GC) and Undergraduate Certificates (UGC)

SN.	Course Title	Institution
1	GC: Accounting	Australian National Institute of Management & Commerce
2	GC: Agribusiness	Marcus Oldham College

3	GC: Business	Australian National Institute of Management & Commerce
4	GC: Business (Sport Management)	Deakin University
5	GC: Business Administration	Torrens University
6	GC: Business Administration	Le Cordon Bleu Australia
7	GC: Commerce	Deakin University
8	GC: Data Analytics	Australian National Institute of Management & Commerce
9	GC: Digital Financial Technologies	Australian National Institute of Management & Commerce
10	GC: Digital Financial Technology Management	Australian National Institute of Management & Commerce
11	GC: Health Administration	Australian Catholic University
12	GC: Hospitality Decision Making	Le Cordon Bleu Australia
13	GC: Hospitality Leadership	Le Cordon Bleu Australia
14	GC: Hospitality Management	Le Cordon Bleu Australia
15	GC: Professional Accounting	Griffith University
16		Deakin University
17	GC: Project Management	University of South Australia
18	UGC: Introduction to Sustainable Business	Charles Darwin University
19	UGC: Business Essentials	University of Technology Sydney
20	UGC: Professional Development (PD) Business Studies	University of New England
21	UGC: PD Community Welfare and Well-being	University of New England
22	UGC: PD Creative Industries	University of New England
23	UGC: PD Culture and Communication	University of New England
24	UGC: PD Educational Studies	University of New England
25	UGC: PD Event Management	University of New England
26	UGC: PD Science	University of New England
27	UGC: PD General Agriculture	University of New England
28	UGC: PD Information Technology	University of New England
29	UGC: PD Sports Equine Management	University of New England
30	UGC: PD Sports Science	University of New England
31	UGC: Data Analytics	LaTrobe College Australia
32	UGC: Information Technology in Marketing	LaTrobe College Australia

Source: Course Seeker (2023). https://www.courseseeker.edu.au/courses

Discussion

The findings reported above indicate the globally emerging literature on the nexus between OSCs and sustainable development and the growth of OSCs with limited interest in BESD in Australia.

Notwithstanding the process-oriented constraints associated with the modus operandi of traditional HEPs (Ong & Dhakal, 2023) and the genuineness of intent and desire of business faculties/schools to create products that contribute to PRME (Daniel, 2019), the framework (Figure 3) posits OSC as e-LI processes and products to advance BESD.

Figure 3

Online Short Courses as e-Learning Innovation to Advance Business Education for Sustainable Development
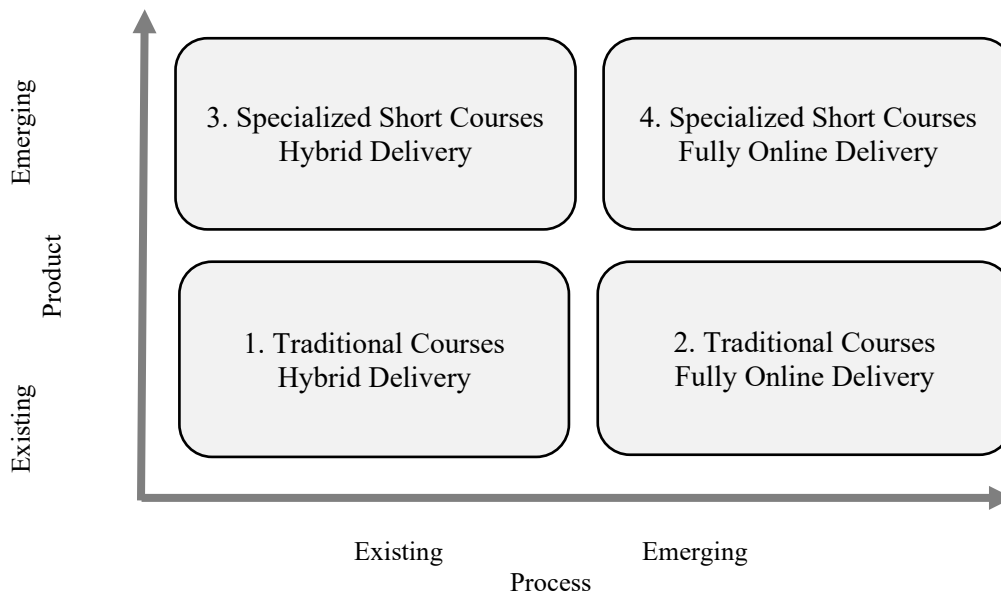
The first quadrant (existing versus existing) represents the business-as-usual approach in which faculties/schools use existing processes to offer traditional generic courses to mostly traditional students in a hybrid setting. The status quo approach is where HEPs continue to use traditional processes and products. The second quadrant (existing versus emerging) represents an analog-to-digital approach in which traditional courses are offered entirely online. Faculties/schools deliver traditional products but use new ways to deliver them. The third quadrant (existing versus emerging) represents changes to the business-as-usual approach. Faculties/schools develop specialized courses but deliver using a process that relies on existing hybrid modality. The fourth quadrant (emerging versus emerging) represents innovation in terms of processes as well as products, where specialized courses are offered in response to emerging needs, such as sustainable development-related education and training in a fully online mode. For instance, Hendy (2022) reports that HEPs have paid increasing attention to OSCs in recent years primarily to meet the demand of non-traditional learners, such as education and training towards continuing professional development or executive education that allows learners to acquire specialized skills with reasonably low investment in terms of time and resources.

As with any exploratory study, the analysis presented here has limitations. First, although the RBA captures research trends and patterns in the scholarly literature, shortcomings associated with reliance on a single search code and one database must be considered (Mahmood & Dhakal, 2022). Second, an environmental scan of OSCs currently offered in Australia does not reveal whether HEPs will continue offering these micro-credentials when government assistance ceases. For example, the disclaimer of

UGC in Sustainable Business offered by Charles Darwin University (CDU) hints at uncertainty and states, "On current advice, the Undergraduate Certificate must be completed by the end of 2025" (CDU, 2023, para. 5). Future research should build on this analysis and comprehensively evaluate OSCs-related processes and products for BESD.

Conclusion

This research note posited OSCs as an e-learning innovation geared at upskilling or reskilling learners. However, although most business faculties/schools in Australia have made PRME commitments and acknowledged the significance of BESD (Grant, 2022), the potential of OSCs to foster BESD remains largely untapped. Since micro-credentials like OSCs offered by HEPs represent disruptive forces to traditional processes (see Hood & Littlejohn, 2018) and innovative products (Gedeon, 2020), this research note makes broader analytical contributions to posit OSCs as e-LI. Given that HEPs in advanced economies are increasingly focused on ensuring the relevance of courses under offer in response to emerging socio-environmental challenges (Dhakal et al., 2019), the prospect of OSCs to advance BESD in Australia and beyond cannot be overlooked.

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An Example of Using Collaborative Online International Learning for Petroleum and Chemical Engineering Undergraduate Courses

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Abstract

This work describes an international collaboration experience carried out between our process design and petroleum property evaluation courses. This collaboration was developed as part of a partnership between the American University of Ras Al Khaimah (AURAK) in Ras Al Khaimah, United Arab Emirates, and Wayne State University in Detroit, Michigan, United States of America, using a program called Collaborative Online International Learning (COIL) from the State University of New York (SUNY) system. The COIL program provides training to faculty on engaging students in international and cross-disciplinary projects to promote skills needed in the current work force. The COIL training meetings facilitated pairing faculty of different disciplines in different parts of the world and provided a structure for developing a collaborative project. The collaborative project that we undertook in fall 2021, and which we detail throughout this article, was titled Upstream and Downstream of Petroleum Economics.

Keywords: international online learning, chemical and petroleum engineering, United States, United Arab Emirates

Introduction

A key skill in today's global work environment is the ability to work on multidisciplinary, multinational teams. This is typically not a skill that is taught in engineering courses, but it is vital that the next generation of engineers understands how to work in such a context. Doing this can be nontrivial due to the need to negotiate meeting times with time zone differences, to come to terms with different regulations in different countries when determining project management, and to understand the challenges faced in another discipline to come up with optimal solutions to engineering problems when in-person meetings are not available to hash out plans and provide greater ease of discussion between scientists with different expertise. Thus, enabling students to have experience performing work on multidisciplinary, multinational teams during their time as undergraduates and causing them to reflect on such experiences can provide them with an understanding of the challenges in accomplishing such a task and experience with trying different techniques for mitigating some of these before they hit the workforce.

The SUNY COIL Center has been training and equipping many professors at universities across the world to engage in cross-disciplinary projects with international partners in their courses. In 2021, AURAK and Wayne State University joined the list of schools participating in such programs. Collaborative online international learning programs have been successful for a variety of courses and at a variety of institutions worldwide, and examples of successful projects have been previously reported. For example, Marcillo-Gómez and Desilus (2016) reported a collaboration between courses for business administration students. They presented perspectives on the collaborative teaching experience between two faculty members, one at Saint Peter's University, Jersey City, New Jersey, USA, and one at Universidad La Salle, Mexico City, Mexico. A curriculum with course requirements had been designed based on four topics. The course's title was Communicating Between Cultures, and it was based on a textbook with the same title. Students learned about the distinctions between cultures through actual exposure to another culture without having to leave their homes as a result of this virtual partnership. Asojo, Kartoshkina, Jaiyeoba, and Amole (2019) reported a collaboration in a lighting design course at the University of Minnesota with Nigerian graduate architecture students to help students acquire global competency and offer them a real-life opportunity to experience handling design problems in cross-cultural situations. Two design projects in the lighting design course, The Store Retail Project in Nigeria and The Hotel Design Project in Owo, Nigeria, taught students in the United States how to incorporate aspects of Nigerian culture into their projects, while allowing the Nigerian students to practice giving their feedback in a specific cultural setting in any design project.

As further project examples, Munoz-Escalona, Cassier de Crespo, Olivares Marin, and Dunn (2022) performed a three-week virtual collaboration involving 82 undergraduate students from three universities in Scotland, Spain, and Venezuela. The project was a car dissection assignment in which students were to investigate car functionality, physics, materials, and manufacturing. The vast majority of students (93%) felt the project contributed to their technical understanding of the material, and the COIL activity increased their understanding of global manufacturing by allowing them to communicate with international peers. De Castro, Dyba, Cortez, and Pe Benito (2019) discussed a collaborative project in the context of a nursing program for providing nursing students in the United States and the Philippines with the training needed for working in a global context. Students at the University of Washington Bothell participated in the project through an elective course, while those at the University of Santo Tomas participated in a required course in their final year. The final part of the assignment was to create an infographic expressing the nursing

specialty area that they had researched. Appiah-Kubi and Annan (2020) reported on a collaboration between the University of Ghana and the University of Dayton that aided students participating in the international learning projects in engaging with the course material. King de Ramirez (2021) described a collaboration focused on United States-Mexico relationships between students in the United States at a four-year college and in Mexico at a two-year college in a second language course.

This article describes the project carried out between the petroleum engineering course at AURAK and the chemical engineering course at Wayne State University.

What Is COIL?

COIL, which stands for collaborative online international learning, is a program for international learning partnerships at the university level. It was facilitated by following the model taught by the State University of New York (SUNY) COIL Center. A COIL collaboration involves coordination between two university courses, often in different disciplines, in different parts of the world. Professors of these courses organize a collaborative project for their students to work on that will increase students' understanding of their own discipline, as well as prepare them for the global and multidisciplinary work environment. The projects are carried out via virtual meetings between the students, and therefore lower the barrier to global learning that would exist in, for example, a study abroad program. Students learn skills in working with individuals in other cultures and languages, building teams virtually, and learning to think about problems more comprehensively from multidisciplinary perspectives. At the end of the project, students reflect on the experience to consider what they learned and how they could implement improvements in their collaborative work in a multinational, multidisciplinary team when they encounter this in the increasingly global workplace (Rubin, 2015).

Why Is COIL Valuable for an Engineering Education?

For many students at universities throughout the world, an experience in a COIL collaboration may be their first experience working on a team with someone living, at the time of the collaboration, in another part of the world. As our world becomes more interconnected, we can expect that employers will expect recent graduates to form multinational teams in the workplace. Though professors are often used to these types of interactions due to the global nature of academia, there are many aspects of such collaborations that surprise students the first time they encounter them, such as needing to schedule meetings when time zone differences are significant. COIL thus forms a one-of-a-kind learning experience that provides students with exposure to not only practical roadblocks in forming multinational teams, but also exposes them to other cultures, and helps them to develop the intercultural competencies required to work effectively with people from other cultures. It could be argued that this is necessary to ensure future career success, and that it is therefore becoming an important requirement of the undergraduate curriculum. An effective COIL collaboration between two professors will also serve to strengthen the content of a course and could provide a foundation for future student experiences such as studying abroad. It is a process, a time for reflection, and an opportunity for both students and instructors to grow (Guth & Rubin, 2015).

One of the greatest benefits of COIL as part of an undergraduate engineering education is the workforce development that it provides. Engineers from various disciplines work together every day around the world to help each other solve problems that an engineer from one discipline does not have the capability of solving alone. A COIL project uniting students not only from different parts of the world but also from different disciplines of engineering, helps to mimic the work environment in a course and provides students with an understanding of how to work on multidisciplinary collaborative projects to come to conclusions that are best for a team. Despite this being a recognizable benefit for students and one that they could put on their resumes to stand out to employers, every engineering curriculum is often so full of content to keep students up-to-date, not only with the traditionally expected skillset of the discipline but also with emerging areas, that it can be more difficult to see how a new type of project might fit within a course in a way that is beneficial to students. This paper describes a project recently implemented between a chemical engineering course at Wayne State University (WSU; United States of America) and a petroleum engineering course at the American University of Ras Al Khaimah (AURAK; United Arab Emirates), along with a discussion of how and why this project was able to benefit students, to encourage other engineering educators to consider implementing similar programs using this example.

Courses, Project, and Universities Involved

Collaborating Courses

The COIL collaboration between AURAK and WSU was carried out between the courses Petroleum Property Evaluation at AURAK and Product and Process Design at WSU. Though there is synergy between petroleum engineering and chemical engineering as disciplines given the refining pipeline for oil, it is not immediately obvious how to fit a new, common project into both courses that would not overwhelm students or take away from the content in either class. To develop such a project, we considered first our primary goal in this collaboration: to prepare students for future jobs where they could expect to be placed on multidisciplinary, multinational teams where they need to understand the challenges faced by their colleagues enough to work together to form solutions that satisfy their colleagues' constraints as well as constraints within their own discipline. This led us to consider a model that would represent the type of framework of a team in industry—one in which people with different skill sets come together to solve a problem where each has already applied the methods of their own discipline. Their goal is to learn enough from their colleague about an alternative discipline so that they can start to see new ideas for achieving a common goal together. We therefore developed a project that would help students practice this, learn to communicate the challenges of their own discipline to colleagues in another discipline, or prepare to understand their colleagues' work. They would also practice attempting to brainstorm workable solutions to engineering issues that go across disciplines together, again replicating a job environment. As a teaching tool, since it is well accepted that individuals learn more by teaching than simply learning, this project also provides a framework for the petroleum and chemical engineering students to understand their own discipline more clearly because they have to prepare to communicate it to their team members in the other discipline.

The Project: Problem Solving in Upstream and Downstream Cost Interactions

The project developed was at the intersection of petroleum and chemical engineering, involving both oil extraction (on the petroleum side) and refining (on the chemical engineering side). Specifically, the project involved two components for both the petroleum engineers and the chemical engineers. The first part of the project focused on an individual cost analysis in the engineering discipline (i.e., the petroleum engineers performed an economic evaluation to showcase the benefits of using gas injection to maximize production efficiency from a well while reducing environmental impact and costs for extraction and refining; the chemical engineers were required to perform a cost analysis of an Aspen Plus simulation that contained an atmospheric distillation column that is commonly used in petroleum refining). In the second part of the project, students from both disciplines came together to discuss their individual results and consider how the cost and design of the overall upstream-to-downstream process might be modified to provide an improved system. The teams in the second part of the project consisted of four to five chemical engineering students from WSU and one petroleum engineering student from AURAK. There were six teams to accommodate the class sizes in the two different courses.

Project Methodology and Guidelines

The project lasted throughout the majority of the semester, though through most of the semester, no active work was required on the project. Students were assigned partners for this project early in the semester and then required to have a group meeting via software such as Zoom or Microsoft Teams within approximately the first month of the course. The goal of that meeting was for students to get to know one another and determine how they would most prefer to function together as a unified team when the group component of the project would be due two months later. The deliverable from this meeting was a statement signed by all team members, indicating that all members of the group had met once before the due date of the meeting. This statement was to have also stated the date that the first team meeting after the individual component of the project (Part I) was due would occur. Notably, some students preferred to turn in a screenshot of all of them meeting as proof of the meeting instead of a statement.

After the initial meeting, about another month elapsed during which the cost analysis for the individual part of the project (Part I) was carried out. A benefit of breaking up the project into the individual, discipline-focused component and the multidisciplinary component is that this facilitated students continuing to learn the key aspects taught in the courses in the context of the economic evaluation techniques specific to their own discipline. This provided a framework for avoiding any loss of content in the courses despite adding a new project.

After the deadline for Part I, the students were required to work together on their teams to develop a report (expected to end up around two to five pages) covering the following topics before the final deadline a month later:

1. A description, written by WSU students, regarding where the highest costs come from in the petroleum process and how these might be mitigated by changing the petroleum process alone. This should have been developed by having a second virtual call with the team where the petroleum

engineering students explained their cost analysis methods and results to the chemical engineering students, so that the chemical engineering students could summarize key points from the petroleum engineering analyses to demonstrate comprehension of the information conveyed to them by their colleagues.

2. A description, written by AURAK students, regarding where the major costs come from in the refining process and how these might be mitigated by changing the refining process alone. This should have been developed by having a second virtual call with the team where the chemical engineering students explained their cost analysis methods and results to the petroleum engineering students, so that the petroleum engineering students could summarize key points from the chemical engineering analyses to demonstrate comprehension of the information conveyed to them by their colleagues.

3. A description from all students of how changing an aspect of the petroleum process could affect the refining process cost and design, and how changing an aspect of the refining process could affect the petroleum process cost and design. This description was to have been developed through a group conversation and brainstorming session at the second virtual call of the team.

To facilitate the development of this report, students were required to have met at least one additional time after Part I was completed and then to have provided validation that they had done so (a signed statement was requested, but some students again preferred screenshots).

One of the potential pitfalls of this project was expected to be that a single student in the group might spearhead the discussion of the chemical engineering material, since there were four to five chemical engineering students on a team. To prevent a single student on the chemical engineering side from doing that work instead of it being a team collaborative effort, chemical engineering students were required to individually turn in slides that teach about the cost analysis performed in Part I and that could be used as part of a collaborative discussion in teaching the petroleum engineering student about what they did during the second group meeting. In a similar vein, to prevent one student from being involved in brainstorming the relationships between petroleum and chemical engineering during the second meeting, all students were required to turn in slides that showed thoughts they had on ways to change the petroleum process to lower the costs of the refining process and to change the refining process to lower the costs of the petroleum process. Though it was stated on the requirements for the project that the students should create this during an individual brainstorming session at their second group meeting for at least 5 minutes during the second team meeting, some students did not realize that they needed to do this and completed the slides after instead.

One of the most important aspects of the project was that by the end of the project, students were required to submit individual reflections on what they learned both professionally and technically in this project and how they would approach a collaboration of a similar nature at their jobs in the future in a different way after seeing what worked and what did not.

Results and Analysis

After splitting the two classes into six groups to apply design economics concepts in upstream and downstream projects and identify major sources of cost in a process and ways to reduce these costs, Wayne State students were individually required to cost analyze an Aspen Plus (Version 12) simulation that contained an atmospheric distillation column that is commonly used in petroleum refining. However, the AURAK students were individually required to do an economic evaluation using Oracle Crystal Ball software that proves the benefits of using gas injection in order to maximize production efficiency while reducing environmental impact and costs for extraction and production. In this section, we reflect on how the students critically thought about the problem, as well as how feedback received from student discussions and reflections indicates what they learned and what can be improved:

1. Students were able to comment on relationships that they saw between the oil extraction and refining processes, showing that they were able to recognize major technical points. They noted the primary relationship that the process "makes money" from selling the products of the refining process, while the feedstock costs of the refining process are heavily impacted by crude oil extraction. Some of the points discussed by students included enhanced oil recovery techniques and how those could impact downstream processing, or discussed non-design factors impacting costs such as taxes or trying to lower equipment costs. These types of discussions reflect that students were actively engaged in thinking about the various sources of costs and their relationships to overall metrics. It could be argued that the discussion of such points, and trying to think creatively through this problem-solving process when there is not a clear answer, is part of where the strength of this project lies from a student learning perspective. Specifically, having this type of creative brainstorming exercise with people they do not know encourages students to engage to make newcomers to the group feel welcome. It is also a lower-stakes brainstorming session, because there is no professor involved to tell them if they got the "right answer," which may help to promote creativity and deeper discussion with peers than might occur in a class environment. This provides a framework for helping students take more ownership of their work.

2. Some of the feedback included that it would be helpful if they knew a bit about the other engineers' topics before learning about them. It may be helpful to provide greater guidance to students on how to prepare a discussion for a multidisciplinary audience and prepare to hear such a talk to aid in communication.

Evaluating and Analyzing the Students' COIL

In evaluating the application of these three principles—engage students in content, promote student-student interaction, and strive for presence—we found that the students demonstrated intercultural communication knowledge, sensitivity, understanding, and competency. The COIL project was successful because of the following aspects:

1. The students had to explain tools from their discipline to one another in the COIL project, which facilitates learning and ownership of material.

2. The project had a defined timeline.

3. Despite the time difference between the two universities, the students scheduled meetings in advance with goals for what to accomplish during the meetings.

We consider that this project aided students in collaboration, teamwork, and critical thinking. For WSU, the structure of having to think about cost analysis in a rigorous way early in the course caused the students to be noticeably better at thinking about costs involved in process design compared to prior years. It is interesting to contemplate that a well-structured collaboration may not only aid in workforce development, but also help students meet new peers that they would not otherwise have met in the context of a course within the department, and thereby contribute to their wanting to engage more in group meetings.

Conclusion

Our first COIL endeavor demonstrated promise as a fruitful international learning opportunity. Students had meaningful, valued engagement with peers in another country without having to travel abroad. The designed COIL was created as part of a collaboration between the American University of Ras Al Khaimah (AURAK) in Ras al Khaimah, United Arab Emirates, and Wayne State University in Detroit, Michigan, USA. The COIL's goal was to improve students' critical thinking skills through a unique online teaching environment with students from a variety of backgrounds. The COIL approach provided a practical way to prepare students for diverse cultural work settings that are likely in their professional futures. It also assisted in the satisfaction of academic program goals at each of the two universities. Furthermore, COIL assisted us as faculty in modeling lessons that promote intercultural compassion and empathy, as well as maximizing the functionality of online learning approaches.

COIL gives students the opportunity to communicate, work together, share ideas, and enrich their educational experience. Through COIL, students can also develop intercultural awareness, discipline-specific content knowledge, and communication and teamwork abilities that are important for students to learn within an engineering education context. These experiences allow engineering educators around the world to work together to foster students' appreciation of the global context in which they work. They also require educators to be aware of potential challenges that students may face and to aid in addressing them. For example, in this COIL collaboration, although both student groups used English as a common language, the different proficiency levels between the Wayne State and AURAK students caused some communication difficulties. The groups were also not matched in terms of the number of AURAK versus Wayne State students in each group due to the class sizes, which could pose challenges for having personal interactions. As the instructors of this COIL run future versions of the program, we will take these challenges into account to improve the experience for students.

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Distance Mathematics Teaching and Academic Performance in Morocco

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Abstract

In this article, we discuss the academic performance and impact of distance teaching of mathematics in the Moroccan education system. This educational science research, based on exploratory thinking, aimed to show the impact and challenges of distance teaching of mathematics within the Moroccan education system through examining this fundamental question: How could school programs, pedagogical organization, and the performance of pupils and teachers in Morocco best address the challenges of distance teaching of mathematics? The answer is based on a qualitative analysis of the content of the documentation that frames the teaching-learning process and the evaluation of mathematics in Morocco and, on the other hand, on the projection of research hypotheses in the field through various strategies inspired by our research objectives.

Keywords: curriculum, education system, e-learning, evaluation, technology, Morocco

Introduction

This work of educational science research aimed to examine distance learning in relation to mathematics taught in the Moroccan education system. In this research, we addressed two fundamental aspects. The first aspect concerned the content of the various mathematical programs, describing and briefly analysing the teaching-learning process of mathematics in Morocco. The second aspect dealt with teachers' in-depth concept of teaching mathematics at a distance to better appreciate and understand the specificities and characteristics related to this practice.

In this context, we were interested in two school levels: secondary college and qualifying secondary education (defined in detail in the section titled The Context of Education in Morocco). In view of this, it seemed useful to ask how best to deal with distance teaching of mathematics through the delivery of the Moroccan curriculum, including school programs, pedagogical organization, and the performance of students and teachers.

Problem

The Context of Education in Morocco

In order to better understand the way in which technical education is integrated into this system, we present first an overview of the Moroccan education system.

The Moroccan education and training system falls under the supervision of the Ministry of National Education, Preschool and Sports. This system is based on educational subsystems relating to:

- preschool, elementary, secondary college, and qualifying education

- higher education

- vocational training

- literacy and non-formal education

As we considered only the first subsystem in our research, we present now a brief description of this subsystem.

Preschool education is for children aged 4 to 6. It aims, on the one hand, to facilitate the physical, cognitive, and emotional development of the child and, on the other hand, to develop a child's autonomy and socialization.

Elementary education is the initial level of education in Morocco and lasts 6 years (students aged between 6 and 12 years; grades 1 to 6). It consists of a 2-year core cycle and a 4-year intermediate cycle. Students must successfully complete a primary school certificate in order to be admitted to the college cycle of secondary education.

The mission of *secondary college education* is to sharpen the formal intelligence of young people and introduce them to basic concepts and laws in mathematics, science, and the environment. It lasts 3

years (grades 1 to 3) and welcomes pupils from primary school and holders of the primary school certificate. The end of college education is sanctioned by a college teaching certificate which allows students to continue studies in qualifying secondary education, according to their orientation and aptitudes.

Qualifying education is divided into three categories: general, technical, and vocational. It lasts for 3 years (grades 1 to 3), and it welcomes, on the one hand, students from college school and holders of a college teaching certificate and, on the other hand, people who do not hold the certificate, subject to an assessment of their skills and the prior or parallel follow-up of the necessary upgrading learning as a prerequisite. In addition, it focuses on different training courses that improve the knowledge and skills acquired from college education and diversifies the areas of learning.

The Framework of Distance Learning

Nowadays, technology occupies a central place in human activity. Some governments, decision-makers, and educational institutions treat distance learning as one of the fundamental opportunities relating to the future of societies. Indeed, various information and communication technology (ICT) tools are part of work and communication environments. Depover, Karsenti, and Komis (2006) stated that "ICT provides an opportunity to rethink and relocate, in space and time, exchanges between teachers and students, and thus promote[s] new avenues for learning or training activities" (p. 179).

During the COVID-19 pandemic, education systems in the majority of countries agreed on the importance of distance learning. However, this importance was not translated in the same way when it came to the teaching of mathematics. Moreover, any curriculum requires the development of a set of criteria and choices that justify the design and organization of the use of educational technology. The digital tool occupies a crucial place in the educational world as in other areas of human activity.

The professional adaptation of digital tools is mandatory in any training and educational practice. Technological tools play a fundamental role in the development of distance learning. The importance of this role is underlined by Sofi et al. (2017): "Mobile learning is one of the facets of the application of ICT in education. But because it relies on technology that is more affordable and easier to acquire and use yourself than the desktop computer, it requires a reconceptualization of the modalities of implementation" (p. 2).

Consequently, distance learning is defined through the use of mediated pedagogical communication that contains a combination of all traditional media including video cassettes, radio, and television, as well as digital media such as virtual classrooms, virtual campuses, and videoconferencing.

From these various considerations, our interest in distance learning grew, and we decided to explore the place occupied by distance teaching of mathematics in the first Moroccan educational subsystem and, in particular, the secondary college cycle and the qualifying cycle.

Research Questions

Interest in distance learning in Morocco has grown since the COVID-19 pandemic. In this context, the transition from face-to-face to distance learning was characterized by the absence of pedagogical guides and official documents to direct this mode of teaching. Since 2012, Morocco has emphasized the

usefulness of integrating ICT into its education system. However, ensuring good pedagogical continuity and supporting new living and working modalities during the COVID-19 pandemic required the Moroccan education system to go a step further and examine ICTs as fundamental elements.

In view of the importance accorded to distance education in Morocco, it seemed useful to ask the following research question: How could school programs, pedagogical organization, and the performance of pupils and teachers in Morocco best address the challenges of distance teaching of mathematics?

We broke down this research question into five sub-questions, allowing consideration of several aspects of our research problem:

- What is the potential of technology in distance mathematics education in Morocco?

- Do the technological practices adopted for distance learning in Morocco pose specific integration problems?

- Does distance learning in Morocco improve students' level of acquisition in mathematics?

- What are the limitations and obstacles that the teacher and student may encounter in distance teaching of mathematics in Morocco?

- What are the necessary conditions to establish a relevant relationship between distance learning devices and the process of teaching-learning mathematics in Morocco?

Theoretical Framework

Distance learning is an expression that is part of the vocabulary of expertise, so it is often complicated to study. Indeed, this expression is associated with a specific field of practice that involves the implementation of specific knowledge and concepts.

The development of learning models for each educational system is based on the implementation of different contexts of this system at political, institutional, technological, and linguistic levels. Peraya and McCluskey (1995) said that the same terms and their meanings therefore differ from one country to another and from one language to another. According to some authors, distance learning scholarship refers to *Fernunterricht* in Germany, *open learning* in England, and *multimedia teaching* in France.

To deal with our fundamental research question and the five sub-questions, we established two analytical strategies: conceptual and didactic.

Conceptual Analysis

This type of analysis addresses the specific framework of distance education compared to face-to-face teaching (traditional teaching), through an analysis of the conceptual organization and, thus, the role played by the media and new technologies for this mode of education.

The treatment of the conceptual analysis was to focus on the following objectives:

- know the definition of distance education or distance learning;

- improve general knowledge of the term distance education;

- provide an overall historical overview of distance education; learn the characteristics of distance learning;

- think about the use of different technology tools in distance education; and

- provide a general representation of distance learning practices between past and present.

In order to identify the objectives mentioned above in relation to what is achieved at the research level, we mention a few research articles in this regard. Note that these works are both international and national. Each of these works addresses the problem of distance education from a particular angle and for a specific type of education (school education or higher education):

- Deeb: "Place and Role of the Teacher Involved in Distance Learning at the University: The case of the FORSE Digital Campus at the Université Lumière-Lyon" (2016).

- Zahra Riad: "Education in Morocco: Educational Requirements and Ideological Intrusions" (2020).

- Mohamed Oudrhiri: "The Pedagogical Use of Digital Technology in Mathematics Education in Morocco" (2016).

- Kaoutar Aarab and A. Belmoudene: "Distance Education: Student Perceptions and Use of Digital Technology During the Covid-19 Lockdown" (2021).

- Driss Louiz: "Distance Education in Morocco at the Time of Covid-19" (2020).

In our analysis of these research works, we identified fundamental aspects that characterize distance learning, as well as the elements associated with them:

- definition of distance learning:

- linguistic definition

- elements of the literature for a definition of distance learning

- types of distance

- the lexical field associated with distance learning

- learning modes in the context of distance learning and support modalities

- types of distance e-learning/e-learning

- the historical context of distance learning

- the development of the distance learning system

- the comparative study of distance learning and face-to-face teaching

Through this analysis, we determined the basic elements of distance learning, as well as the different choices made in this mode of teaching.

Didactic Analysis

This analysis aimed to show how distance learning is organised in an education system. Specifically, we were interested in two elements.

- Mathematical and didactic organisations supporting distance learning, in particular, distance mathematics education. For this analysis, we borrowed tools from different frameworks based on need. We thus sometimes mobilized elements of Chevallard's (1985) anthropological theory of didactics.

- The status of distance learning in the Moroccan education system: Through this work, we sought to detect the mechanisms that manage the proper functioning of an education system. We attempted to delineate and characterize the elements that support the use of different technologies to successfully teach mathematics from a distance.

Methodology

This research had two fundamental approaches:

- the reflexive approach, consisting of delineating documents and texts which framed the research objectives, and

- the testing approach, in which we adopted a strategy based on the implementation of tools that enable critical analysis.

Consequently, our data collection strategies were grouped into two fundamental categories: the study of documentation and the study of the experimental field.

Study of Documentation

Analysis of Mathematical Content at the Learning and Assessment Level

The fundamental objective of this study of documentation was to understand teachers' discourse in an institutional setting. We performed a content analysis of official documents and referents in Morocco to classify procedures and objective descriptions in order to arrive at a set of qualitative data. Indeed, these documents and referents represented the status accorded to mathematics in Morocco. The analysis of official documents supporting both the teaching-learning and the evaluation of mathematics made it possible to:

- determine the status of the mathematics discipline in relation to other school subjects and

- establish what needs to be learned in order for the learner to be competent and able to exploit the different aspects of mathematics in different situations arising from a working life.

Official documents are produced by the Directorate of Curricula, the Ministry of National Education, the Higher Council for Education and Training, as well as the National Centre for Assessment, Examinations, and Guidance. The following documents support teaching practices in Morocco:

- CNEEO (2007), Ministerial Note No. 142-08: "Organization of the Continuous Assessment of Mathematics in the Qualifying Secondary Cycle," Ministry of National Education, Higher Education and Scientific Research;

- CNEEO (2010), Ministerial Note No. 28: "Reference Framework for the Evaluation of Standardized Examination Subjects for Obtaining the Certificate of Secondary College Studies," Ministry of National Education, Higher Education and Scientific Research;

- CNEEO (2010), Ministerial Note No. 192: "Organization of the Continuing Evaluation of Mathematics at the College Secondary Cycle";

- CNEEO (2010), Ministerial Note No. 46: "Reference Frameworks for the Subjects of the Regional Examination for Obtaining the Certificate of Secondary Education," Ministry of National Education, Higher Education and Scientific Research;

- CNEEO (2010), Ministerial Note No. 39: "Frameworks of Reference for the Standardized National Examination for Obtaining the Baccalaureate," Ministry of National Education, Higher Education and Scientific Research;

- Direction des curricula (2009): "Orientations Pédagogiques et Programmes de Mathématiques de L'Enseignement Secondaire Collégial," Ministère de l'Education Nationale de l'Enseignement supérieur, et de la Recherche Scientifique;

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Study of the Experimental Field

We also undertook a study of the experimental field, based on the discourse of different actors in the Moroccan education system (teachers, learners, and discipline-specific inspectors) through an interactive approach. This strategy consisted of projecting the hypotheses and questions of the research onto various Moroccan schools.

In addition, we addressed a set of constraints and problems encountered in distance mathematics teaching in the Moroccan education system.

This part of the research used two strategies: two focus groups and an analysis of professional practices. The strategies are described in more detail in the sections that follow.

Focus Groups

The participants in the focus groups were mainly teachers. These teachers were selected according to teaching cycles (in this case, secondary college and qualifying education). We decided to contact

teachers from rural and urban areas, teachers from public and private institutions, and teachers from disadvantaged and favoured regions. We aimed to have both female and male participants.

Our sample was composed of 15 teachers.

During the focus group sessions, we let the conversation unfold informally, after asking the following question: What do you think about teaching mathematics remotely in Morocco, based on your experience during the COVID-19 pandemic?

The first focus group was dedicated to qualifying education teachers. It was held in September 2022. The second focus group was dedicated to secondary college education teachers and was also held in September 2022. Each meeting lasted between 60 and 90 minutes. The teachers were seated in a circle to stimulate further discussion.

Prior to the focus group, participants' demographic characteristics such as number of years of work, teaching cycle, sector, and environment were collected. See Table 1.

Table 1

Sociodemographic Characteristics of Participants

Characteristic	Teaching cycle		Total
	Secondary college	Qualifying education	
Gender			
Female	5	3	8
Male	3	4	7
Years of work			
1–10	4	5	9
11–20	1	1	2
Over 21	3	1	4
Sector			
Public	7	4	11
Private	1	3	4
Environment			
Rural	3	1	4
Urban	5	6	11

Note: N = 15.

Following each focus group, we conducted a final interview with participants to question them about the conduct of distance mathematics teaching sessions for their respective teaching cycles, as well as their general achievements in distance education compared with face-to-face teaching. These interviews focused on their experiences during the COVID-19 pandemic and explored three issues:

- difficulties encountered during distance learning,

- achievement of learning objectives, and

- how the distance education sessions were organized.

While teacher participants were randomly selected, inspector participants had to be selected more purposefully in order to ensure the research represented both education cycles (secondary college and qualifying), and a variety of regions. We were interested in diverse opinions on the research subject.

Analysis of Professional Practices

In this part of the study, we focused on the practices of teaching mathematics remotely at both cycles (secondary college and qualifying education) during the COVID-19 pandemic. The main aim was to describe teachers' relationship to distance mathematics teaching. This was an informal way to evaluate distance education in mathematics and evaluate the consequences and achievements of the teaching method used by the teacher on the knowledge acquired by the learners.

This analysis aimed to better understand the personal behaviours of mathematics teachers in relation to the integration of technological tools in their pedagogical practices. It was a matter of gaining a better understanding of the situation based on a conception of the educational professional in order to share different educational reflections and critical thoughts.

The analysis of professional practices complements the results obtained in the focus groups. Indeed, the same group of teachers was involved.

The analysis of professional practices was based primarily on analysis of the communicative dimension of distance mathematics teaching during the COVID-19 pandemic. Exploring this dimension made it possible to identify the interaction between actors (teacher, learner) in the teaching-learning process, as well as the type of activities planned.

Data collection was approached according to the results obtained in the focus groups.

Thus, the data dealt with:

- conditions and constraints that affect teachers' practices during face-to-face mathematics teaching and distance learning,

- teachers' personal relationships with distance learning, and

- students' personal relationships with distance learning.

Data from the two types of analysis have made it possible to discuss the difficulties faced by teachers in teaching mathematics at a distance.

Results and Discussion

In this section, results obtained by each of the data collection strategies are shown and explained.

Study of Documentation

We began the analytical study of the official documents supporting the process of teaching-learning mathematics and the evaluative framework of this discipline with a general didactic anthropological analysis of the curricula and pedagogical orientations and, then, the ministerial notes that organize both the continuous assessments and, at times, the regional and national standardized examinations. These studies were conducted at both the secondary college and qualifying cycles.

When analyzing the official documents, we focused on a set of ministerial directions that we consider important to help in our analysis:

- Programs first focus on developments associated with mathematical knowledge taught through the implementation of the skills to be achieved, and only then do they address formalization of this knowledge;

- Ministerial notes and terms of reference set out content based on assessment situations that emphasize the relationships between types of mathematical knowledge and reasoning, in order to respond to situations.

- The adoption of the competency-based approach is often present in curricula and pedagogical orientations; however, for ministerial notes, implementation of this approach is ignored. In fact, there is an explicit absence of aspects associated with the competency-based approach in ministerial notes.

The teaching content described in official curricula and pedagogical orientations is difficult to teach using available technologies. Indeed, there is a gap between the content presented in these official programmes and orientations and the content actually projected, on a screen, to learners.

- The Moroccan education system represents evaluation as a decision-making process in which the skills and knowledge acquired by the learner are weighed against learning objectives. In this context, a teacher must plan the evaluation process to account for the type of learning targeted and the manner in which the evaluation is to be conducted.

We note that the ministerial notes reviewed for this study were adapted with the content of the curricula and pedagogical orientations; there was not a question of emphasizing mathematical organization based on didactic conditions of curriculum execution in the classroom.

The discipline of mathematics in the Moroccan education system is shaped by a progression associated with the achievements of students. This progression is based on the understanding and construction of mathematical knowledge, as well as the development of different mathematical skills.

In conclusion, the analysis carried out in this part showed the organizational and functional consequences of the teaching and evaluation of mathematics. Further development in the education system, in the teaching of mathematics in particular, will remain a difficult objective to achieve.

Study of the Experimental Field

Focus Group

We now present the opinions of some teacher participants on distance education of mathematics as expressed in the focus groups.

An early-career, female teacher working in the secondary college cycle in the public system in Marrakech said:

> In my opinion, the experience that Moroccan teachers experienced about the COVID-19 pandemic in 2020 and this of teaching remotely, showed several difficulties. From the pedagogical point of view, teachers had no training or experience of teaching by this distance method, as they had no didactic, pedagogical, or electronic logistics support to succeed in this teaching method. Most Moroccan teachers have chosen to use social media to communicate with their students. The latter had more difficulty understanding the courses in their social networks, some of them were not serious about this method of teaching; however, the majority of students in rural areas did not have the material means to be able to follow the courses remotely. Most of these students come from poor families. In short, distance education in Morocco during this period was a great disappointment.

However, another early-career, female teacher also working in the secondary college cycle but in a private school in Marrakech said:

> The COVID-19 pandemic has impacted the world negatively. However, private education was lucky to develop quality with its pupils and also teachers; courses were held online and all pupils were on their computers connected and ready to execute every teacher request via the internet. But, the latter was forced to change the classic preparation of his lessons and make them read dynamiqueen using videos and animations.

> In parallel with the courses, private schools have organized online activities to not reduce the cultural level of students. Many competitions were held at many schools, which allowed students to continue their school year.

> Finally, I supported the success of the period of private education in distancing, but, thanks to the conditions of technology that private schools provide, unlike public schools that had absolutely no means to proceed.

A more senior, male teacher, working in the qualifying education cycle in an urban private school, had this to say:

> From my personal experience of teaching mathematics remotely, it can be said that the period of confinement that forced us to follow this mode of teaching and to do so, we used several methods: applications such as Zoom that allows to communicate with students, as well as, to explain classes either through screen sharing or through video calls.

> Another means used is social networks like Facebook or WhatsApp, but, they only allow to share a few lessons and sets of exercises without having interactions between the teacher and the students.

Indeed, when we used these methods we did not see much difference between teaching mathematics at a distance and in face-to-face. The only difference is that in the distance education mode, students could not take their courses permanently because of the lack of computer resources or the lack of internet connection. In my personal opinion, if we combine the teaching of mathematics at a distance and the teaching of mathematics in face-to-face, we can have better results than that obtained by each of these modes of teaching.

Finally, a very senior, male teacher working in the secondary college cycle in a public, urban setting, expressed these views:

Today, distance learning has become a ubiquitous mode of teaching that is developing rapidly. To be successful in this mode of instruction, emphasis must be placed on:

- Generalize the Internet to all educational environments (urban and rural);

- The integration of new information and communication technologies in all educational settings;

- Improve learner self-learning.

The Moroccan kingdom experienced during the COVID-19 pandemic exceptional circumstances within the public and private education systems because of the mandatory cessation of face-to-face classes. To carry on the teaching-learning process and not deprive students of their right to education, those responsible set out to build a distance learning framework that would guarantee the transmission of fundamental knowledge for all learners through the use of accessible ICT tools such as television, computer, telephone, Internet, as well as the various computer systems. As a result, these tools have helped implement the strategy of the Ministry of Education in the field of distance learning.

In the context of the problem posed in this research, the teaching of mathematics at a distance during this period was, as stated by the first teacher quoted in this article, a great disappointment.

On the other hand, distance learning was presented as a useful tool for self-training in the computer field, for the use of communication tools, and with mathematics-specific software (such as dynamic geometry software, numerical calculation software, statistical software, spreadsheets, etc.) and computer systems devoted to mathematics. This aspect makes it possible for teachers to improve their professional skills, manage learning time, and transmit knowledge in a non-traditional way.

Private school teachers offered richer distance learning compared to public school teachers. This may have been due to the technology that private schools are able to provide, unlike public schools that are lacking the means to be able to offer more technology.

The combination of face-to-face and distance mathematics teaching improves the quality of teaching. Indeed, distance learning is considered as a complement to face-to-face teaching through the realization of exercises by the learner and problems from the various technological tools available, which allow learners to manage their fundamental knowledge in an individual way. Glikman (2003) stated that the term distance education applies to "any type of organised training, whatever its purpose, in which the bulk of knowledge transfer and learning activities are outside the direct, face-to-face … relationship between teacher and student"[1] (p. 126).

245

To conclude, more than half the teacher participants stated that the effect of distance education in mathematics in rural areas had a greater negative effect on the general level of learners when compared to urban areas.

The integration of ICT in distance mathematics teaching has created a new dynamic for the learner. This is the time for a radical change in curricula and didactic and scientific tools used in the Moroccan education system, to build a relevant distance education system, as well as to solve other problems, such as the load of school programs and class size (40 students or more).

Analysis of Teachers' Professional Practices

Distance learning was a ubiquitous choice in the Moroccan education system, just as it was in all other education systems during the pandemic. In this context, it was necessary to take into account pedagogical and technological factor and the ability of teachers to prepare learning content.

The analysis of teachers' professional practices is a complex process. Indeed, this analysis represents a research method based on description and explanation. These last two elements help to explain the consequences of distance mathematics teaching, as well as to establish teachers' behaviours and attitudes. From the selection of important elements that highlight the object of this research, this analysis makes it possible to understand the actions of teachers and the way in which these actions were executed.

Distance learning has difficulties and problems that can be grouped into three categories:

- **didactic**: Content taught remotely is less well managed than that taught face-to-face.

- **pedagogical**: The distance learning mode does not grant students the necessary attitudes that allow them to learn and assimilate their learning in an explicit way such as they do in the face-to-face teaching mode.

- **technical**: The distance learning mode does not make it possible to explicitly organize a pedagogical discourse well adapted to the teaching contents.

According to the teachers interviewed, there is a set of conflicts typically encountered during distance learning. These include:

- Teaching mathematics in distance learning courses does not correspond to the objectives associated with these courses. Indeed, these objectives are based on aspects that require the presence of both learners and teachers at the same time.

- The various resources allocated to the face-to-face teaching mode must be modified so that they can be accessed in the distance learning mode. Indeed, it is a question of digitizing these resources to be available to students remotely. This aspect is a bit difficult to manage because it requires deep knowledge of computers and software.

The teachers offered suggestions to improve the quality of distance learning in Morocco, including:

- Manage and organize a common time, planning for all students. Adapt learning schedules

according to the availability of these students. Indeed, it is a question of specifying fixed times and phases for learning at a distance and taking into account the pace of work and availability of students.

- Improve teachers' skills, teaching methods, as well as their resources in relation to distance learning and the use of information and communication technologies. The aim is to train teachers to acquire new skills adapted to new developments and changes in their career paths.

- Inform teachers and learners about the importance of distance learning and the acquisition of technological skills. This aspect makes it possible to change and renew learning methods, pedagogical practices, as well as the assimilation of new technological elements.

The COVID-19 pandemic was an opportunity to measure the relevance and value of distance learning under real-life conditions. While distance learning does not replace face-to-face teaching, it can complement face-to-face teaching.

Conclusion

The main objective of this research was to carry out an in-depth study on distance mathematics education in Morocco. This study evaluated, on the one hand, the mathematical content taught within the Moroccan education system and, on the other hand, professional practices. This makes it possible to implicitly evaluate the Moroccan education system.

The methodological framework for mathematics education within the Moroccan education system is based on a set of choices ranging from the general to the specific, from the main objectives of teaching to assessment to the desired specifications and characteristics of the learner at the end of each year of teaching. Thus, it is based on modern principles and pedagogies.

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