IRRODL

THE INTERNATIONAL REVIEW
OF RESEARCH IN OPEN AND
DISTRIBUTED LEARNING

Vol 23
No 3

September 2022

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 23, Number 3

September – 2022

Editorial – Volume 23 Issue 3

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This edition of IRRODL kicks-off with four articles written in response to the reaction of educators and the educational community to the COVID epidemic. The first article, *Educational Processes and Learning at Home During COVID-19: Parents' Experiences with Distance Education*, by **Demir and Yildizili**, investigates the views of parents who were charged with helping their school-aged children adjust to not only the digital technology, but also to online learning.

Nguyen and Tang, in their paper *Students' Intention to Take E-Learning Courses During the COVID-19 Pandemic: A Protection Motivation Theory Perspective*, propose a new model to integrate Protection Motivation Theory with the Technology Acceptance Model (TAM) in the pandemic context. The various intentions of students in different educational settings were carefully examined to elicit suggestions for policy makers.

In the third COVID-related article, *Emergency Online Learning: The Effects of Interactional, Motivational, Self-Regulatory, and Situational Factors on Learning Outcomes and Continuation Intentions*, **Lei and Lin** investigated the effects of interactional, motivational, self-regulatory, and situational factors on university students' online learning outcomes and continuation intentions. They studied the differential effects of various factors and provided predictors for facilitating emergency online learning.

Also referring to the pandemic, **Sen-Akbulut, Umutlu, and Arikan's** *Extending the Community of Inquiry Framework: Development and Validation of Technology Sub-Dimensions* add technology for teaching, interaction, and learning using a factor analysis.

The Community of Inquiry (CoI) is also the focus of the following paper, *Validating the Community of Inquiry Instrument for MOOCs and other Global Online Courses* by **Borup, Shin, Powell, Evemenova, and Kim**. They revised the CoI Framework, expanding its usability by rendering it more accessible to users whose native language is not English.

Perifanou and Economides also address the MOOC theme with their paper, *The Landscape of MOOC Platforms Wordwide*. Using data from directories and through exploration, they analysed 35 MOOC platforms. Their recommendations include speeding up the websites, increased marketing, and visibility.

Drawing on the research of the Digital Open Textbooks for Development initiative at the University of Cape Town (UCT). **Cox, Wilmers, and Masuku's** paper, *Open Textbook Author Journeys: Internal*

Conversations and Cycles of Time reveals aspects of social injustices experienced by teachers. They claim that open textbooks hold promise in terms of more open access and inclusivity.

Following the theme of openness, **Truan and Dressel** look at the students' views in their paper, Doing *Open Science in a Research-Based Seminar: Students' Positioning Towards Openness in Higher Education*. Using a qualitative analysis, they studied students' apprehensions and motivations in publishing academic posters. Their research suggests that open educational practices can be used in seminars successfully.

The perceptions of student teachers are the focus of *Examining Pre-Service Teachers' Perceptions About Virtual Classrooms in Online Learning* by **Debbag and Fidan**. They provide insights into the opinions of students on teacher visibility, the physical environment, student-centered practices, and other issues.

Cakıroğlu, Saylan, Çevik, and Özkan look at examinations in their paper, *Qualifying with Different Types of Quizzes in an Online EFL course: Influences on Perceived Learning and Academic Achievement*. They studied multiple-choice, open-ended, and mixed type questions. The results indicated that the academic achievement of the students in both multiple-choice and open-ended groups increased. Significantly, they found only a weak relationship between perceived learning and actual examination scores.

Latent Profiles of Online Self-Regulated Learning: Relationships with Predicted and Final Course Grades by **Mindrila and Cao** uses structural equation modeling to shed light on four self-regulation factors: goal setting, environment management, peer help-seeking, and task strategies. Their findings support the thesis that when students anticipated obtaining a higher course grade, they were less likely to engage in peer help-seeking.

Unleashing Adult Learners' Numeracy Agency Through Self-Determined Online Professional Development by **Walsh, Bragg, Muir, and Oates** describes a resource that incorporates consistent design elements, double-looped learning, online learning, self-reflection, and metacognition through experiential learning. There are also several recommendations to parents on everyday authentic activities for learning.

Duckworth and Halliwell, in their paper, *Evaluation of Higher-Order Skills Development in an Asynchronous Online Poster Session for Final Year Science Undergraduates*, investigated an online poster session to assess evidence of higher order skills development. This asynchronous poster format provides a pragmatic and easy to implement alternative to synchronous online conferences.

The final review and research notes section includes three reviews and a research note. The first book reviewed focuses on closing the gap on sustainable development as does the research note, looking at development using micro-credentials, that I have authored with other UNESCO Chairs. Another book review introduces readers to the seventh edition of the popular text: *Teaching and Learning at a Distance*. There is also a review of a report based on an ICDE workshop on developing a framework for open innovation.

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 23, Number 3

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Educational Processes and Learning at Home During COVID-19: Parents' Experiences with Distance Education

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Abstract

Due to the lockdown measures and severe restrictions taken to reduce COVID-19 transmission, which has globally been inflicted on people since March 2020, a new type of education in the form of online homeschooling has brought the role of parents to the forefront. Using online semi-structured interviews, this study aimed to investigate parents' views on the implementation of distance education during COVID-19 in Istanbul, Turkey. The data obtained from parents with different socioeconomic backgrounds and whose children were at public and private schools were coded using initial, process, and emotion qualitative coding techniques. The data were categorized into three main themes: beginning of distance education, process of distance education, and outcomes of distance education. The beginning theme was further analyzed under three subcategories: problems related to the child, problems related to parents, and problems related to public schools. The problems encountered during the process of distance education were investigated under three subheadings: problems related to the child's academic and social life, problems related to parents, and problems related to parent–child relationships. Data under the main theme, outcomes of distance education, were defined as positive or negative outcomes in terms of the child and parents. Results revealed that at the beginning of the process, during the process, and during the outcomes of distance education, parents experienced problems with digital technology, the new education model, teachers, themselves, and their children, as well as economic, social, and psychological problems. Parents also had various constructive suggestions about distance education during COVID-19.

Keywords: COVID-19, educational process, parents, child, distance education, qualitative coding

Introduction

As another pandemic is recorded in the history of humankind, we are again in the midst of a global catastrophe that has been rapidly and deeply inflicted on the people of the whole planet, and the consequences of it are getting worse by the day (World Health Organization [WHO], 2021). From March 2020 onward, states have been choosing one or more remote education facility option in line with the changing circumstances and their education policies (Barnett et al., 2021; Carpenter & Dunn, 2020; Pozas et al., 2021). While most countries have opted for remote and online teaching (Greenhow et al., 2020), hybrid learning and face-to-face instructions have been among other options (Barnett et al., 2021; Pozas et al., 2021).

The shift from regular school-based learning to home-based learning has made parents' role more apparent in children's education. Struggling to balance between their own work and their children's education for more than a year, parents have cooperated in implementing distance education (DE) processes with their children, as well as with teachers (Bozkurt, et al., 2020). Not surprisingly, this unprecedented lifestyle has brought about some conflicts and problems.

With the great impact of the COVID-19 pandemic on social, economic, and psychological factors, and the field of education on a global scale, the volatility–uncertainty–complexity–ambiguity (VUCA) world has been receiving growing attention from other fields to explain multidimensional phenomena by broadening its scope, meaning, and reflection (Hadar et al., 2020; Lepeley et al., 2021). Focusing on the relationship between the pandemic and education, the most remarkable aspects of the problem are precisely about coming face-to-face with VUCA processes. Focusing on the pandemic–child–parent–online learning relationship, researchers have approached the process in regard to barriers (Abuhammad, 2020); inadequacies (Garbe et al., 2020); resilience (Koskela et al., 2020; Lepeley et al., 2021); parental approaches (Wang et al., 2020); coping strategies (Aznar, 2021; Hadar et al., 2020; Parczewska, 2020); psychological approaches addressing addiction, stress, fear, anxiety, and self-blame (Aznar, 2021; de Araújo et al., 2020; Dong et al., 2020; İyimaya & Irmak, 2021; Jeffs et al., 2021; Patrick et al., 2020; Spinelli et al., 2020); educational approaches and learning processes (i.e., readiness) (Cahapay, 2020); homeschooling (Bubb & Jones, 2020; Pozas et al., 2021); and the home learning environment and digital parenting (Lucas et al., 2020). Leaving aside the controversy regarding the function of schools in education, which has been popular in recent times (Nóvoa & Alvim, 2020), all stakeholders in general and parents in particular have deeply experienced the absence of a physical school environment. Interpreting and evaluating such discovery processes under the light of a systems approach (beginning–process–outcome) and from the viewpoints of holistic approaches supported by different disciplines (Frye & Hemmer, 2012) may help us face, grasp, and solve ongoing complex problems of VUCA worlds.

In Turkey, DE during COVID-19 started in March 2020, just as in much of the rest of the world, and remote education has been utilized either in complete or partial lockdown. The ministry's education platform, Educational Informatics Network (EIN), TV-based DE (TRT-EBA TV), and online teaching conducted by teachers have all had been positively received (Cakin & Kulekci Akyavuz, 2021; Fiş Erümit, 2020). However, it is well known that there have been recurrent complaints about the problems teachers, parents, and educators have experienced during this process (Adıbelli & Sümen, 2020; Akbulut et al., 2020; Hebebci et al., 2020). The underlying reasons for these complaints can be related to the varying experiences students enrolled in education have based on the type of school (i.e. public or private), region, and students' profiles; differences in socioeconomic structures; and teachers' practices.

In delivering DE during COVID-19, parents' constructive educational interventions may prevent children from possible future deep learning losses. In addition to being informed by the perspectives of parents in Turkey, information about the implementations of, and approaches toward, DE in other parts of the world during the pandemic might also enrich researchers' points of view on local and global scales.

The current study aimed to investigate parents' and their children's experiences with educational processes conducted between March 2020 and January 2021 in Turkey during complete and partial lockdowns caused by the COVID-19 pandemic. Within this framework, this study responded to the following research question: How did parents with school-age children experience the beginning (March 2020), middle (two consecutive school terms), and end (January 2021) of DE during the COVID-19 pandemic?

Method

This study was conducted to explore parents' experiences with DE in Istanbul, Turkey, during COVID-19. Semi-structured online interviews were implemented with parents. Designed within the paradigm of qualitative research, the current study coded the data with eclectic methods. In eclectic coding, two or more first-cycle coding techniques are used simultaneously to explore the data (Saldana, 2012). The present study used initial, process, and emotion coding techniques in an eclectic manner (Saldana, 2012). During initial coding, participants' responses were coded sentence by sentence, which allowed the data to be coded holistically. This was significant because the coded data revealed the problems parents experienced and the solutions they found differed based on their socioeconomic status (SES) levels. Similarly, the holistic data set also revealed that some parents had the same experiences. Additionally, process coding was used to provide a detailed account of the problems that parents experienced as well as the solutions they found. This is because process coding accounts for the instances of hesitation and/or stops when they start interacting in order to reach a goal or solve a problem (Corbin & Strauss, 2014). Last, it was observed that parents had intense emotions in relation to their children's education during the COVID-19 pandemic, which was a difficult period. To provide a detailed account of those intense emotions experienced by parents, the researchers used the emotional coding strategy.

Twenty parents whose children were enrolled at private or public schools were included in the current research. One of the most important criteria used to construct the study group was the parents' varying SES levels. A purposive sampling strategy was used when recruiting the participants. This decision was used because most international reports providing information about the reflections of COVID-19 on education remarked on the SES levels of parents as an important dimension (Di Pietro et al., 2020; OECD, 2020). Details about the characteristics of the participants are provided in Table 1.

Table 1

Participants' Characteristics

Mother's education level	*n*	Father's education level	*n*	Devices with Internet connection at home	*n*
Primary school	1	Primary school	1	1 (mobile phone)	1
High school	2	High school	1	2 (mobile phone + tablet)	2
Vocational school	3	Vocational school	1	3 (mobile phone + tablet + TV)	2
Bachelor's (ongoing)	2	Bachelor's	6	4 (mobile phone + tablet + computer)	5
Bachelor's	6			5 (> 1 mobile phone + computer + TV + tablet)	1
Master's	2	Master's	5	6 devices	2
PhD	4	PhD	6	7–9 devices	7
Total	20	Total	20	Total	20
No. of children at home	*n*	Family income	*n*	Child's grade level/Type of school	*n*
1	7	No answer	1	Elementary school/Public school	12
2	12	3,000–6,000 TL	7	Middle school/Public school	6
3	1	6,000–9,000 TL	3	Elementary school/Private school	3
		9,000–12,000 TL	3	Middle school/Private school	4
		12,000+ TL	6		
Total	20	Total	20	Total	20

Note. TL = Turkish lira.

Data Collection Tools

Data were gathered through online semi-structured interview forms. After preparing the interview questions, content experts were consulted regarding the questions' clarity and suitability in line with the aim and conceptual framework of the current study. Considering these experts' opinions, interview questions were revised and finalized. Since the interviews were semi-structured, the questions were elaborated on if the interviewee needed any clarification. Furthermore, probes were used in instances where the researchers felt further details were necessary to gather in-depth data. The following samples were among the questions included in the interview form: (a) Have your opinions of DE changed? If yes, can you elaborate on these changes? (b) Have you ever attended online courses at home? What are your observations? (c) How did you help your child when s/he was not able to grasp the topic? Who helped her/him during such situations? (d) What kind of attitudes and values do you think your child needed to acquire during his/her absence from the physical school environment? How did you understand this? Can you give an example?

Data Analysis

Online semi-structured interviews were implemented with parents toward the end of the fall 2021 term because online teaching was fully grounded at this time, whereas it was not during the spring term following March 2020.

Data gathered from parents were transcribed on a computer. The following details the stages of data coding:

- Text segmentation: Prior to starting data coding, the interview transcripts were divided based on answers.

- Codebook creation coding: Each researcher created a codebook for himself in the first coding cycle. A sample first cycle coding is displayed in Table 2. The researchers independently coded some answers eclectically with the abovementioned initial and process coding methods. During emotional coding, on the other hand, the notes that were kept during the interviews were used by the researchers. To ensure consistency, the researchers compared and contrasted the texts that were coded for similar emotions.

- Coding stage: During the coding stage notes that revealed the participating parents' SES levels were kept.

- Coding assessment of reliability: One condition that increases the reliability of coding in the analysis of in-depth semi-structured interviews is consistency, which indicates whether the coders' use of codes changes over time (Krippendorff, 2004). Therefore, the researchers revised the codes that they had labeled independently. Afterward, the researchers met and used the following questions to review their codes:

a. To what extent are the codes related to the aims of the study?

b. Does the created code really represent the information included in the labeled text?

c. What are the codes generated by the researchers?

d. What is the extent to which the codes generated by the researchers are compatible?

Inter-coder reliability, a measure used to make sense of the way the coders coded the data, was used to test the level of coherence between the coders. It can be used to calculate the reliability of the coding stage and/or establish the validity of the emerging coding structure. While not providing a specific level of reliability, Miles and Huberman (1994) underline that inter-coder reliability should be as close to 0.90 as possible. The inter-coder reliability in the present study was over 0.80.

- Codebook modification: Problematic codes were discussed by researchers and revised.

- Final coding: Once the researchers completed the final version of first-cycle coding. They worked together during the stages of second and third cycle coding. In this phase, the codes formed in the second cycle were recoded as the final codes taking the questions in the interview form into consideration as shown in Table 3.

Table 2

Sample Coding from the First Cycle

Summary of interview	Codes
We did not encounter any significant problem, for we have necessary technological equipment and a devoted teacher. We faced some connections problems due to technical matters at the beginning, but they were resolved in time.	Advantages of possessing necessary technical equipment. Initial adaptation process. Technical problems. Resolution in time.

Table 3

Codes in the Second and Third Cycles

1. Beginning of DE
    - 1.a. Problems related to child
    - 1.b. Problems related to parent
    - 1.c. Problems related to public school
2. Process of DE
    - 2.a. Child
        - 2.a.1. Problems related to child's academic life
        - 2.a.2. Problems related to child's social life
    - 2.b. Parent
        - 2.b.1.Problems related to parent
    - 2.c. Parent–child
        - 2.c.1. Problems related to parent–child relationship
    - 2.d. Parents' solutions and practices after class hours at home
        - 2.d.1 High-SES parents' way of increasing academic skills
        - 2.d.2 Low-SES parents' way of increasing academic skills
        - 2.d.3 Practices related to social skills
3. Outcomes of DE
    - 3.a Child–parent
        - 3.a.1 Positive outcomes
        - 3.a.2 Negative outcomes

4. Parental suggestions
4.a. Suggestions for teaching system
4.b. Suggestions for teacher

Note. DE = distance education; SES = socioeconomic status.

Results

The results of the current study about parents' views on DE during COVID-19 in Istanbul, Turkey, are displayed in Table 4. There were some problems from the beginning of DE. Analyzing the data collected from parents, this process was divided into three main categories: beginning, process, and outcome of DE.

Table 4

Codes and Themes Emerging from Parents' Interviews

1. Beginning of distance education		
Problems related to child	Problems related to parents	Problems related to public school
• Unwillingness to attend online courses • Perception of semester break—coping with it • Time management • Difficulty in perceiving online homeschooling process • Difficulty in adapting to online learning	• Meeting technological tools and equipment needs • Inadequacy of domestic resources • Increase in the cost of education • Change in domestic economy	• Disorganization in the system • Delay in authorities' actions • Delay in online courses • Infrastructure problems • Shortcomings in EIN (EBA) • Teacher's or parent's limited or lack of Internet access
2. Process of distance education		
Child	Parent	Parent–child
Problems related to child's academic life	Problems related to parents	Problems related to parent–child relationship
• Increase in anxiety about online courses • Lack of interest in assignments • Loss of trust in online courses • Lack of motivation for online courses • Learning losses • Denying or relaxing responsibility • Intensive online courses • Excessive workload • Difficulty in combining home and school • Shouldering heavy responsibility • Teacher not giving sufficient feedback • Teacher not evaluating student work sufficiently	• Feeling of inadequacy as parents • Not having sufficient academic knowledge or education level in compliance with the course • Time management • Mixing of roles (parent-teacher at home) • A desire to be alone • Decrease in time allocated to individual life • Bored and tired • Not being able to focus on their own jobs	• Anxiety experienced in family members • Feeling of boredom with family members • Feeling of unhappiness with family members • Loss of toleration and respect • Repeating instructions each day • Attending the class • Listening to the course • Responding to the teacher • Completing assignments • Too much screen exposure • Reading books

Problems related to child's social life • Feeling isolated • Yearning for friends and playing games • Decrease in emotional sharing with peers • Restrictions in movement—deteriorations in physical fitness • Too much screen exposure • Longing to work in a group	• Decrease in the quality of their own undertakings and the effect of this anxiety on household	
Parents' solutions and practices after class hours at home		
High-SES parents' ways of increasing children's academic skills	Low-SES parents' ways of increasing children's academic skills	Practices related to social skills
• Parents' individual support • Having their children get private lessons • Making children do more exercises • Making children study more • Making children read more • Revising online sources more often • Increasing the number of supplementary books	• Individual efforts to improve their teaching (e.g., asking teachers how to teach a topic or self-studying the subject before teaching) • Making their children do more exercises • Making children study more • Reading more books • Reviewing online sources • Following various educational channels • Asking for help from teacher friends	• Meeting with friends through online social platforms • Digital games • More parent–child communication • Focusing on enjoyable activities
3. Outcomes of distance education		
Positive results		Negative results
In terms of child		
• Increase in academic success • Providing more successful learning with access to many resources • Increase in self-regulation skills • Increase in academic self-confidence • Being more aware of the availability of interactive resources		• Lacking a sense of responsibility • Increase in learning gaps • Wasting time • Being distant from school discipline • Screen addiction • Increased distrust of teachers • Inadequate time for exam preparation • Students alone in the academic process • Unable to meet student's infrastructural needs • Students' desire to show themselves but an obstacle of distance education • Anxiety over many things to be done • Deficiencies in advanced cognitive skills arising from the constant didactic method of teaching

	● Unpleasant communication habits ● Deterioration in physical health (weight gain, deteriorating eye health)
In terms of parent	
● Professional teacher perception ● Teacher finding solutions to the problems ● Teacher giving healthy feedback ● Teacher supporting student ● Teacher appreciating her/his profession ● The perception that online education is not different from offline education ● Parents with a high level of satisfaction in online teaching process ● Self-confident parent ● Being aware of the availability of interactive resources more ● More online research ● More involvement by parents in the education process of their children ● Learning to observe his/her child's lessons better ● Better revealing the shortcomings of his/her child	● Unwillingness to turn his/her home to a school environment ● Academically inadequate perceptions of parents ● Perception of insufficient teachers ● Teacher not responding to students' inquiries ● Teacher not able to lead the course efficiently ● Teacher not caring for students ● Teacher not appreciating her/his profession ● Teacher not assessing work adequately ● Increase in search for teachers giving private courses ● Increase in educational expanses of family income ● Increase in distrust in school and teacher ● Increase in distrust in education system ● Perception of insufficiency of online teaching (e.g., time, classroom activities) ● Parents not satisfied with teacher and school administration ● Putting excessive pressure on children to study more ● Economic fatigue
Parents' suggestions	
Suggestions for system	Suggestions for teachers
● Free Internet access for all children ● Enriching e-resources and providing easy access to these resources ● Continuing online teaching during long vocation periods ● Improving online tracking system	● Developing empathy skills ● Making the course clearer ● Developing the ability to communicate effectively (with parents, students, etc.) ● Having a sufficient level of technological knowledge and capabilities ● Improving their researcher, innovator, and difference-making sides ● Having appropriate teaching knowledge and skills for online teaching ● Happy teacher loving his profession ● Being a role model for students in innovative technological domains ● Gaining the ability to prepare e-content and to enrich online interaction.

Note. EIN = Educational Informatics Network; EBA = Egitim Bilisim Agı

Beginning of Distance Education

Beginning of DE was analyzed under three subtopics, namely, problems related to child, problems related to parents, and problems related to public school.

Problems Related to Child

The fact that the children were at home during COVID-19 created a feeling of holiday or a break for the children, so they found it difficult to conceive of DE. During the pandemic's early phase, children stepped into the world of DE for the first time and had to wait at home before switching to this new system.

This disruption in regular school-based learning during the COVID-19 crisis caused schoolchildren to face many problems with academic and social life, such as increases in anxiety about online courses, learning losses, lack of motivation for online courses, constant changes in course schedules, excessive workloads, denying or relaxing their own responsibility, teachers not giving sufficient feedback and not evaluating student work properly, and difficulty in combining home and school life**.**

Children suffered from problems in the social domain as well: namely, staying alone because of too much exposure to online teaching, yearning for friends and to play games with them, decreasing emotional sharing with peers, longing for group activities, and poorly managing time in social activities.

One of the most crucial problems that all children confronted was time management. Respondent K9 touched upon this point: "They say that there is still much time but they postpone their responsibilities, behaving in a relaxed manner."

Problems Related to Parents

Lack of DE resources at home and the increase in the cost of education changed the nature of the home economy, so parents started the process with economic fatigue. K7 referred to this: "When we fell short of technologically needed knowledge and technological facilities, the students could not join into online classes, which in effect caused them to lag behind and led to breakaways from the process."

Problems Related to Public Schools

Parents of private school children were found not to experience any systemic problems; private schools started teaching via DE immediately. In public schools in Istanbul, on the other hand, experienced problems due to various reasons such as the disorganization in the national system, insufficiency in teachers' own resources, economic problems of schools in disadvantaged regions, and authorities' delay in taking precaution actions were present. K11 expressed that "although EIN was established many years ago, we realized that it was not designed appropriately for this current system."

Process of Distance Education

Similar to the analyses about the beginning of the DE process, the problems confronted during DE were divided into three distinct themes: problems related to the child, problems related to the parent, and problems related to parent–child relationships.

Problems Related to the Child

The problems related to the child were divided into two subthemes: academic and social life. In relation to academic life, it is reported that some learning losses occurred because children could not successfully merge home life with school life. Teachers' inadequate feedback and insufficient evaluation aggravated this problem further. These problems led to increases in children's anxiety levels, decreases in children's motivation to take part in online courses, and losses in children's self-confidence. Being stuck at home for a long period caused children to experience social problems, such as feeling isolated. Unable to spend time with their peers and play games, children also lost physical fitness due to long screen exposure times and movement restrictions.

Problems Related to Parents and to the Parent–Child Relationship

Results show that DE during COVID-19 changed the roles and responsibilities of not only students but also parents. Staying together all the time polluted the communication between parent and child. Parents often stated that they desired to be left alone. Repetitive instructions about the child's online courses (e.g., "participate in class," "listen to the course," "do your assignment," "answer your teacher") harmed the relationship between them.

The fact that parents stayed at home for such a long time and lacked private time produced many negative consequences. The most frequently mentioned complaint was the intermingling of roles. Parents became both parents and teachers simultaneously, which decreased the quality of their usual roles. K15 changed her mind about the direction of her life: "Everybody should do her/his own job; I think I will turn back to mothering."

Parents were not able to help their children learn at a satisfactory level at home due to their own educational inadequacies. K8 pointed out, "I do not have as much knowledge as the teacher of a course, so I have difficulty in helping my daughter with her lessons." Parents with higher levels of education and income supported their children through private tutoring, buying more educational resources, and using interactive Web resources. K13 mentioned, "We hired a private math tutor, and we sometimes took our child to school physically. Furthermore, we struggled to reach e-sources."

Outcomes of Distance Education

Results demonstrated that DE did not produce the same outcomes for everyone. The data collected from parents were divided into two categories and are presented separately: (a) the analysis of positive and outcomes for students and parents, (b) the analysis of negative outcomes for students and parents.

Positive Outcomes

Positive Outcomes for the Child

Results revealed an increase in the children's levels of academic success, better learning achievements with the help of more interactive sources, an increase in children's self-regulatory skills, and an increase in their academic self-confidence.

Positive Outcomes for Parents

The results regarding positive outcomes for parents indicated that DE was welcome because parents not only helped their children in their studies by becoming more sensitive and more self-conscious but were also satisfied with teachers' management skills during this process. Parents expressed that they better observed their children and also better identified the points of improvements in the learning process in this period.

Negative Outcomes

Negative Outcomes for the Child

Focusing on negative outcomes of DE on child's part, it appeared that parents thought that children's sense of responsibility deteriorated and that they suffered from learning gaps, screen addiction, wasted time, distance from school discipline, increased distrust of their teachers, inadequate exam preparation time, and witnessing of teachers' teaching failures (constant didactic method of teaching). Furthermore, deteriorations in children's physical health were observed, such as problems with eyes due to excessive exposure to digital screens and weight gain due to immobility and long periods of time spent sitting in front of screens.

Negative Outcomes for Parents

On the part of parents, the most highlighted negative issues were either that the "teachers could not manage the process" or that "they did not support their students." The following is a significant result that needs to be underlined: parents whose children were in public schools complained that teachers were not interested, could not teach effectively, and did not make adequate evaluations. K7 claimed, "We have noticed how bad the education system is," and K11 declared, "We understand better the difference between teachers who love their profession and those who do not." As mentioned above, the DE process was economically exhausting for some parents. They stated that this system would increase academic gaps between children and that it was suitable for children who had more opportunities.

Parents' Suggestions

DE gave parents the opportunity to observe how the education system functioned in more detail. Parents wanted free Internet and suggested that long holidays increased learning losses, and to avoid these losses, teachers should support their students during these holidays.

The parents involved in the teaching process and who observed the teachers live also offered suggestions for teachers, such as better adapting to technology, developing knowledge and skills in DE, learning and being able to use methods and techniques suitable for remote online teaching, making use of activities to make lessons clearer, preparing interactive materials, increasing effective communication skills with students and parents, and assuming the roles of researcher, innovator, and one who makes a difference.

Discussion

The results of the current research clearly highlight the significance of parents' demographic characteristics as well as the quality of their home environments during DE. While homeschooling practices during DE are not seen as an academic loss by all parents, they were referred to as being a "complete collapse" by others. Results in general reveal that the home learning environment, parental engagement (Montacute, 2020), and online support given by schoolteachers—important problems of the whole world—are issues coming into the fore.

The results of the study indicate that parents who do not have a shortage of resources at home survive the DE process with fewer problems, while parents without sufficient resources experience more negativity. Some find guiding their children difficult due to their limited academic capabilities. These conditions have created socio-emotional and financial stress for many families.

The sudden spread of COVID-19 caught public schools and teachers unprepared for DE, and the short amount of time for taking precautions made the process even more troublesome (Carpenter & Dunn, 2020; Koskela et al., 2020). UNESCO's reports (2020) revealing the rates of students being affected when schools were globally shut down during COVID-19 have crystallized that in low-income and lower-middle-income countries, over 80% of students were negatively affected by the process. Likewise, the Organisation for Economic Co-operation and Development (OECD)'s Programme for International Student Assessment (PISA) findings (2018) show that many students did not have sufficient e-resources for online learning. What is more, European Eurostat data (2019) have demonstrated striking differences between low- and high-income families regarding Internet access (Di Pietro et al., 2020).

Economic problems, as well as socioeconomic issues, are possible for counties in the long term, resulting from the fact that students who had insufficient resources during DE did not gain sufficient knowledge or skills and because their learning was not assessed appropriately (Burgess & Sievertsen, 2020; Haeck & Lefebvre, 2020). As parents stated in this study, children have suffered from many problems during the time of COVID-19, such as relaxation in responsibilities for learning, learning losses, time being wasted, being away from school discipline, being alone in the academic process, inadequate evaluation processes, and inadequate preparation time for exams. Also, since these parents did not receive sufficient support from teachers, they developed negative attitudes and beliefs toward both teachers specifically and the education system in general.

In parallel, as reported by the European Union, DE may negatively affect students' learning through four main channels: less time spent in learning, stress symptoms, a change in the way students interact, and lack of learning motivation (Di Pietro et al., 2020). Some common perspectives are that DE cannot meet the needs of the students (Abuhammad, 2020), that students' motivation toward learning in DE in the homeschooling period decreases (Pozas et al., 2021), and that negative psychological effects emerge from isolation and an inactive life leading to anxiety, stress, fear, and screen addiction in children (de Araújo et al., 2020; İyimaya & Irmak, 2021; Jeffs et al., 2021). This is in addition to other possible health issues caused by DE, such as vision and eye disorders (Dong et al., 2020) and weight gain (Adıbelli & Sümen, 2020).

Low-income and less educated parents think that face-to-face education is better. Another remarkable result of the current study is that academically and economically competent parents are satisfied with DE. To exemplify, their children demonstrate better learning achievement and an increase in self-regulation skills, academic achievement, and academic self-confidence with the help of more interactive resources. Among these latter parents, there is more awareness of academic resources, more parental help for children, better observation of children, and improved identification of learning deficiencies in children.

Similar results have been found in other countries facing this dilemma. The reasons why DE is not desired are stated as follows: professional knowledge in supporting children's online learning (Dong et al., 2020), lack of parents' content knowledge or pedagogy (Garbe et al., 2020), and an inability to adapt to the new teaching environment. Thorell et al. (2021) demonstrate that some parents have experienced anxiety, stress, and great difficulties during the homeschooling period. Nevertheless, the success of students coming from disadvantaged backgrounds and lacking adequate parental support depends on their maintaining a close relationship with their teachers (Reimers & Schleicher, 2020). On the contrary, because students in DE are not confined to a classroom (Weaver & Swank, 2020), DE processes enable better progress, enable students to receive more useful feedback, and help them be more independent (Bubb & Jones, 2020). Online education supports parent–child relationships, improves children's educational insights, and enables them to participate more in activities in different types (Dong et al., 2020). Finally, OECD's study indicates that "an increase in the autonomy of students to manage their own learning" produced an unexpected benefit of homeschooling (Reimers & Schleicher, 2020, p. 18).

Parents agree that DE creates physical and social problems in children. As highlighted in the results of this study, children suffered from longing for friends, desires to play with peers, lack of emotional sharing, being alone due to long screen time, and lack of collaboration with friends.

The COVID-19 school closures caused various problems for parents in balancing their jobs, household chores, and teaching responsibilities. While simultaneously caring for children and helping them with their education, they could not manage to work at home. In this situation, parents' capacity to manage their time was decreased (Garbe et al., 2020). Therefore, parents' suppressive behaviors (warnings about delivering DE appropriately, and time management in the homeschooling routines and daily routines) naturally increased. Parents experiencing high levels of stress were more likely to use harsher and more frequent discipline tools. This negatively affected the parent–child relationship. Children's poor time management skills created disruptions to their daily routines, and, consequently, parents' physical and psychological well-being was negatively affected by this situation (Di Giorgio et al, 2020). Parents' mental health is said to have deteriorated, while their behavioral health also worsened (Patrick et al., 2020). Parental stress was closely related to children's emotional suffering, and parental stress affected children's emotional problems (Spinelli et al., 2020).

The fact that parents are one of the important stakeholders of DE has enabled them to offer several suggestions for the system and for teachers. Parents suggest increasing e-resources and providing economic support to access these resources, continuing DE during long holidays, and developing online tracking systems for students. They suggest that teachers should better adapt to technology; develop their knowledge and skills in this field; use learning methods and techniques suitable for DE; employ activities to make the course content clearer; prepare interactive materials; develop their research, innovation, and difference-making abilities; be a role model for students in these areas; and increase their ability to communicate with students and parents effectively.

Conclusion

Parents feel uncomfortable and anxious about the inequality in accessing educational resources created by economic conditions. Therefore, the increasing inequality in education will pose serious problems for countries in the long run. For this reason, a more innovative type of education that is more target-oriented and in harmony with universal values, and one that enables children take on learning responsibilities, should be provided (Zhao, 2020). The researchers think that views about educational practices and schools will change as a result of DE experiences. It is necessary to improve the school system with flexible need- and place-oriented practices that involve cooperative family participation after COVID-19 (Iyengar, 2021). This cooperation needs to be organized with a perspective aiming to develop an understanding of families' lives and values and to share decision-making mechanisms with them (Koskela et al., 2020).

The results of this study show that children and parents have developed many social, emotional, and behavioral problems since the COVID-19 outbreak, that they have been affected by traumatic events during COVID-19, and that schools might need to provide services to overcome such problems. By establishing various social ties and connections, further studies can be conducted about how parents can use online and technological resources effectively post-pandemic (Iyengar, 2021). It may be possible to prepare training programs on the use of different online platforms for families to support DE process and on strengthening family–child–teacher communication (Garbe et al., 2020). One way to alleviate this issue is by better readying teachers to use digital technologies. Improving teachers' competencies in this area could make the process of dealing with problems caused by COVID-19 and possible unpredictable events that disrupt face-to-face learning activities more efficient.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 23, Number 3

September – 2022

Students' Intention to Take E-Learning Courses During the COVID-19 Pandemic: A Protection Motivation Theory Perspective

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Abstract

This study proposes a new model for integrating the protection motivation theory (PMT) with the technology acceptance model (TAM) to explore factors affecting students' intention to attend e-learning courses during the COVID-19 pandemic. A total of 432 valid responses to an online questionnaire were received from freshmen students studying in universities in Vietnam and Taiwan. Structural equation modeling was used to evaluate the proposed research model and test the hypotheses, and model evaluation reflected a good fit between the data and the proposed research model. Differences between perceived vulnerability, perceived severity, and intention to take e-learning courses across two countries were also established, suggesting that both the TAM and the PMT should be considered for use in studies related to technology adoption in the pandemic context. The factors influencing students' intentions to take online courses can be quite varied when different educational settings are considered; therefore, a more contextual understanding of students' e-learning intentions during pandemic times should be carefully examined. Suggestions for governments and policy makers are also proposed.

Keywords: e-learning, COVID-19, protection motivation theory (PMT), technology acceptance model (TAM), Vietnam, Taiwan

Introduction

E-learning refers to "web-based learning which uses web-based communication, collaboration, knowledge transfer, and training to add values to the individuals and the organizations" (Kelly & Bauer, 2003, p.511). It is considered one of the most effective forms of distance learning and an effective solution for lifelong learning because it is based on modern technology using the Internet (Gurcan et al., 2021; Ho et al., 2020). Not only are lectures provided in e-learning, as they have been via previous platforms, such as distance learning through DVDs/video CDs or television, but e-learning also allows teachers and learners to interact with one another online (Rana & Lal, 2014).

When COVID-19 occurred, use of e-learning was widely considered worldwide (Favale et al., 2020). In the education sector, e-learning has increasingly become one of the mandatory requirements for educational institutions in many countries during the pandemic (Pham & Ho, 2020; Radha et al., 2020) because authorities assume that in COVID-19 time, teaching and learning methods need to be adjusted to satisfy social distancing requirements (Gohiya & Gohiya, 2020). E-learning has thus become a key method for teaching and learning in many education systems (Pham & Ho, 2020), and information technology—including medical declaration applications and electronic vaccination certificates—has been one of the most effective tools for fighting the pandemic (Sathish et al., 2020).

Studies of e-learning domains have been quite diverse, including some on the impact of information infrastructure (Adejo et al., 2018; Alsabawy et al., 2013), some on instrument development (Martin et al., 2021), and some on student adoption of and satisfaction with e-learning courses (Hammouri & Abu-Shanab, 2018; Tarhini et al., 2017). Such studies often take place in a normal context based on the technology acceptance model (TAM) (Davis, 1985) and its expanded versions, such as the theory of planned behavior (Ajzen, 1991) and the theory of reasoned action (Fishbein & Ajzen, 1977). Moreover, they mainly focus on exploring the direct effects of factors such as ease of use (Hammouri & Abu-Shanab, 2018), course design (Goh et al., 2017), performance expectations, effort expectations, hedonic motivation, habits (Tarhini et al., 2017), and technology adoption intentions or behaviors.

While some recent studies have taken place in a COVID-19 context, they have focused only on aspects such as technology products (Alqahtani & Rajkhan, 2020), government policy adjustment (Pham & Ho, 2020), students' satisfaction with e-learning (Gohiya & Gohiya, 2020), parents' perceptions and students' experiences of e-learning (Hamaidi et al., 2021), and barriers and challenges (Favale et al., 2020; Radha et al., 2020). For example, Pham and Ho (2020) studied the post COVID-19 "new normal" with e-learning in Vietnamese higher education, focusing on reviewing the Vietnam government's response and policies seeking to put e-learning at the center of higher education in the future.

Ho et al.'s study (2020) is to our knowledge the only study that has explored factors of students' attitudes toward e-learning in the COVID-19 context. The theoretical framework adopted in that study is still TAM, and while TAM can be appropriate for studies on technology adoption or e-learning behavior, at the critical time of the COVID-19 pandemic, other theoretical frameworks are likely be necessary for exploring other potential antecedents for e-learning. Protection motivation theory (PMT) is one such framework to be considered (Wang et al., 2019). Based on PMT, van der Weerd et al. (2011) argue that a community's inclination to accept protective measures can be influenced by a high level of risk perception. Therefore, the current study incorporated PMT and TAM concurrently to expand our current understanding of e-learning motivational factors. To shed more light on the complex dynamic of the antecedent of students' e-learning intentions, this study compared the perspectives of higher education students from Vietnam and Taiwan who had experienced different COVID-19 conditions and histories of e-learning in higher education.

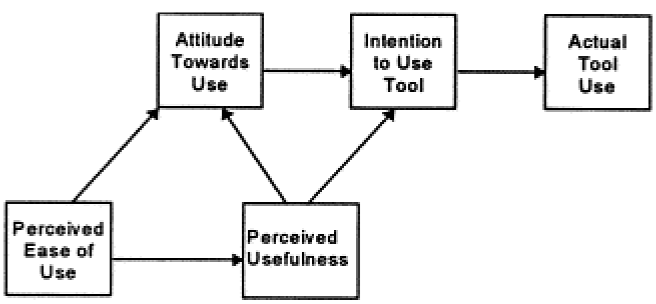
Literature Review

The Technology Acceptance Model

The TAM was developed by Davis in 1985. In this model, two personal beliefs—perceived usefulness (PU) and perceived ease of use (PEOU)—affect both attitude about and behavioral intention to use a new technology. PU, defined as the degree to which a person believes that their work performance or quality of life will be enhanced by using a particular system (Davis et al., 1989), mediates relationships between PEOU and attitude toward technology. E-learning is the particular system examined in this study, and the degree to which a user believes that using a specific system will be simple is defined as the PEOU (Davis et al., 1989). Attitude toward technology consists of a user's degree of interest in a particular system that directly affects the intention to use that system and mediates the association between PU and the intention to use technology (Davis et al., 1989). In this study, this refers to students' attitude toward e-learning (ATEL). The version of TAM advanced by Dishaw and Strong (1999; Figure 1) consists of four main constructs: PEOU, PU, attitude toward technology, and intention to use technology.

Figure 1

The Technology Acceptance Model



Note. From "Extending the Technology Acceptance Model with Task–Technology Fit Constructs," by. M. T. Dishaw and D. M. Strong, 1999, *Information & Management*, *36*(1), p.10 x (https://doi.org/10.1016/S0378-7206(98)00101-3). Copyright 1999 by Elsevier Science B.V.

Because of its significant implications, TAM has become a popular model for use in studies on adoption of new technology system in various contexts and domains, including education and e-learning (Cheng, 2011; Ho et al., 2020; Liu et al., 2009). Al-Qaysi et al. (2020) provide a systematic review revealing that this model has brought about more significant benefits than others. Prior studies on educational technology acceptance suggest that we can predict users' willingness to adopt technology by application of the TAM to their perceptions. For example, the mediation effect of PU on the interaction between PEOU and attitude, as well as the mediation of attitude on the effect of PU and intention, has also been established in previous studies (Lee et al., 2009; Liu et al., 2009; Ngai et al., 2007; Zhang et al., 2014). The TAM and several other studies also indicate that PU directly affects both attitude and intention to take e-learning courses (ITTELC) (Cheng, 2011; Liu et al., 2009). This study aims to examine whether these effects occur similarly in an e-learning context in the presence of COVID-19. The following hypotheses were proposed:

- H1.1: PEOU has a positive effect on PU.
- H1.2: PEOU has a positive effect on ATEL.
- H2: PU mediates the relationship between PEOU and ATEL.
- H3.1: PU has a positive effect on ATEL.
- H3.2: PU has a positive effect on ITTELC.
- H3.3: ATEL has a positive effect on ITTELC.
- H4: ATEL mediates the relationship between PU and ITTELC.

E-Learning in the COVID-19 Context: The Relevance of PMT

PMT was first advanced by Rogers in 1975 to explore fear-based appeals and how individuals cope with them. The main content of the theory is that protection motivation stems from cognitive appraisal of a threatening situation as dangerous, serious, and likely to happen, combined with the belief that a recommended coping behavior can contribute to effectively preventing this risk. This theory has been regarded as the most useful in predicting people's intentions to engage in protective action (Anderson & Agarwal, 2010). In the original model, PMT includes both coping appraisal and threat appraisal, with threat appraisal involving both severity and vulnerability (Meso et al., 2013).

This theory was initially used extensively in studies in the health sector, in social cognition, and in social psychology (Ifinedo, 2012), and it was subsequently expanded for predicting human behavior intention in areas such as information systems (Hanus & Wu, 2016), food science (Pang et al., 2021), and education (Meso et al., 2013; Singh et al., 2011). In studies on human behavioral intention, the cognitive appraisal process, including determination of perceived severity and perceived vulnerability, was considered the source of protective motivation: a change in attitude seen first as protection motivation (Conner & Norman, 2015) followed by intention to perform the behavior (Chenoweth et al., 2009).

Perceived vulnerability (PV) refers to the probability that the threat will occur if there is no change in existing behavior or no application of adaptive behavior (Lee & Larsen, 2009). In this study, PV reflects student assessment of the possibility of COVID-19 infection if e-learning is not available. Perceived severity (PS), defined as students' assessment of the severity of the threat, in this study refers to student assessment of the severity of the COVID-19 pandemic.

Several prior studies that used PMT to understand human behavior during pandemics and epidemics have indicated a situation's severity as being one of the main motivators that creates protection motivation (Bish & Michie, 2010), and protection motivation leads to adopting avoidance behaviors (Sharifirad et al., 2014). Especially in the COVID-19 context, many scholars have taken PMT as a foundation theory for their own work (e.g., Al-Rasheed, 2020; Bashirian et al., 2020; Prasetyo et al., 2020; Rather, 2021). In a study related to the COVID-19 pandemic, Prasetyo et al. (2020) demonstrate that PV and PS have direct effects on individual attitudes, with their subsequent attitude influencing their related behavioral intention. Scholars have suggested benefits of applying the aforementioned behavioral change principles to motivate people toward desirable behavior to help control the COVID-19 pandemic (West et al., 2020). In this study, we applied PMT theory in an e-learning context, assuming both PS and PV influence student ATEL and ITTELC. Consequently, we further proposed the following hypotheses:

- H5.1: PV has a positive effect on ATEL.
- H5.2: PS has a positive effect on ATEL.
- H5.3: PV has a positive effect on ITTELC.
- H5.4: PS has a positive effect on ITTELC.
- H6.1: ATEL mediates the relationship between PV and ITTELC.
- H6.2 ATEL mediates the relationship between PS and ITTELC.

The COVID-19 Pandemic and E-Learning in Vietnam and Taiwan Higher Education

Vietnam and Taiwan have both been regarded as successful models in the fight against COVID-19 in Asia (Shokoohi et al., 2020). Specifically, between March 2020 and May 2021, Vietnam reported 5,306 COVID-19 cases (Ministry of Health, 2021a), while Taiwan reported 1,244 cases. However, during the current study period, Taiwan was facing a violent outbreak of COVID-19. According to the Taiwan Centers for Disease Control (2021), as of June 27, Taiwan reported 14,634 cases (about 0.061% of the population) and 632 deaths, an approximate 12 times increase since those recorded in May 2021. For various reasons, Taiwan also encountered many difficulties obtaining vaccines. At this time, the Taiwan government decided to establish a nationwide Level 3 alert, after which the general public began to take the pandemic more seriously. Also, under Ministry of Education instruction, nationwide schools for the very first time exclusively adopted online learning in May 2021. Influence of the national program for e-learning meant that e-learning had been a familiar tool in Taiwanese higher education since 2003 (Chang et al., 2009). In short, although appropriate equipment and teacher knowledge of e-learning had been established before the pandemic, in-person classes were preferred until the May 2021 COVID-19 outbreak.

Conversely, during the same period, although the COVID-19 pandemic in Vietnam had begun to explode as of June 27, 2021 with Vietnam reporting 15,643 cases (approximately 0.016% of population), an approximate three times increase in cases occurred since those reported in May 2021. Nationwide, the situation was perceived as being under control, and the general public was relatively incautious about the pandemic (Ministry of Health, 2021b). While distance learning was also required in Vietnam by the Ministry of

Education and Training during this period, e-learning had not become a widely accepted method of teaching and learning, and higher education institutions (HEIs) were not well-prepared to apply e-learning in the emerging COVID-19 context (Ho et al., 2020).

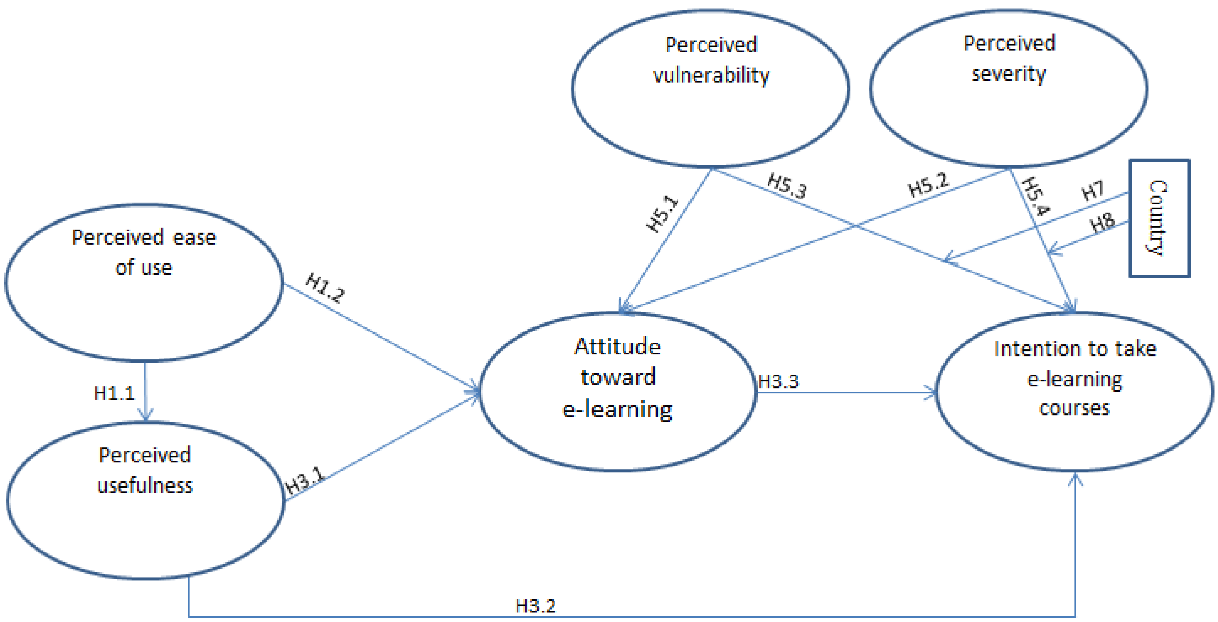
According to PMT, given the difference with respect to the COVID-19 situation in the two countries as illustrated above, students in Taiwan perceived the pandemic as more serious and thus increased their ITTELC. The following hypotheses were proposed:

- H7: PV affects ITTELC more for Taiwanese students than Vietnamese students.
- H8: PS affects ITTELC more for Taiwanese students than Vietnamese students.

Figure 2 illustrates the research model.

Figure 2

Research Model



Note. PV = perceived vulnerability; PS = perceived severity; PEOU = perceived ease of use; PU =perceived usefulness; ATEL = attitude toward e-learning; ITTELC = intention to take e-learning courses.

Methodology

A questionnaire survey of students studying in universities in Vietnam and Taiwan was conducted. SurveyCake was used as a platform for data collection, and the questionnaire was distributed between June 10 and the July 4, 2021. Data were processed and analyzed via SPSS version 20 and AMOS version 20.

Participants

Data were collected from first-year students studying in Vietnamese and Taiwanese universities. Convenience sampling was used; two top-ranked universities, with total student populations of 7,000 to 9,000, were selected from each country. The online questionnaire was distributed to the undergraduate students individually by e-mails by each university's office of academic affairs. After careful data cleaning (removal of outliers and those with incomplete answers), 432 out of 462 responses were deemed usable. Participant information is summarized in Table 1.

Table 1

Participants' Demographic Information

Measure	Items	Frequency	%
Gender	Male	176	40.7
	Female	256	59.3
Country	Vietnam	224	51.9
	Taiwan	208	48.1
Total		432	100.0

Measure

A survey questionnaire with six subscales was developed. The first subscale, PV of COVID-19, included five items adapted from Prasetyo et al. (2020) and Boyraz et al. (2020). The PS of the COVID-19 pandemic subscale consisted of six items adapted from Li et al. (2020) and Prasetyo et al. (2020). The PU subscale comprised four items adapted from Cheng (2011) and Ho et al. (2020). The remaining sections measuring PEOU (4 items), ATEL (4 items), and ITTELC (4 items) were revised from Khan et al. (2021) and Cheng (2011). All six sections measure constructs of this study employed an item scale ranging from 1 (strongly disagree) to 5 (strongly agree), and these six constructs reflected original Cronbach's alpha (α) values exceeding the threshold of 0.7 (PV [α = 0.908], PS [α = 0.84], PU [α = 0.93], PEOU [α = 0.84], ATEL [α = 0.92], ITTELC [α = 0.97]).

Findings

Measurement Model Evaluation

To evaluate the measurement model, we checked the reliability and convergent and discriminant validity of measures using criteria and methods proposed by Fornell and Larcker (1981). To check for convergent validity, an individual item factor loading should be greater than 0.50, the average variance extracted (AVE) should be greater than 0.50, and the composite reliability (CR) of all constructs should be greater than 0.80. Table 2 shows that all three conditions were met, establishing the measurement model's convergent validity. Cronbach's α was also used to confirm data reliability, and as indicated in Table 2, the α value for all constructs exceeded the permissible minimum value of 0.7 (Mortelmans et al., 2008).

Table 2

Results of Confirmatory Factor Analysis, Reliability Test, and Convergent Validity Analysis

Construct	Items	Estimate	Average variance extracted (AVE > 0.5)	Composite reliability (CR > 0.8)	Cronbach's α (> 0.7)
Perceived vulnerability	PV1	0.694	0.510	0.839	0.838
	PV2	0.683			
	PV3	0.737			
	PV4	0.716			
	PV5	0.740			
Perceived severity	PS1	0.723	0.503	0.858	0.857
	PS2	0.779			
	PS3	0.715			
	PS4	0.669			
	PS5	0.732			
	PS6	0.627			
Perceived usefulness	PU1	0.666	0.602	0.857	0.853
	PU2	0.809			
	PU3	0.774			
	PU4	0.842			
Perceived ease of use	PEOU1	0.777	0.546	0.824	0.801
	PEOU2	0.516			
	PEOU3	0.801			
	PEOU4	0.821			
Attitude toward e-learning	ATEL1	0.739	0.582	0.847	0.843
	ATEL2	0.835			
	ATEL3	0.676			
	ATEL4	0.792			
Intention to take e-learning courses	ITTELC1	0.745	0.653	0.883	0.881
	ITTELC2	0.830			
	ITTELC3	0.842			
	ITTELC4	0.813			

Note. PV = perceived vulnerability; PS = perceived severity; PU =perceived usefulness; PEOU = perceived ease of use; ATEL = attitude toward e-learning; ITTELC = intention to take e-learning courses.

To test discriminant validity, we applied the method of comparing the square root of the AVE for each given construct with the associated correlation values proposed by Fornell and Larcker (1981). The diagonal values in Table 3 are the square roots of AVE higher than the values in their respective rows and columns, indicating a good level of discriminant validity. This suggests that the measurement model is of satisfactory reliability and validity.

Table 3

Results of Discriminant Validity Analysis for Measurement Model

Construct	PV	PS	PU	PEOU	ATEL	ITTELC
PV	**0.714**					
PS	0.119	**0.709**				
PU	0.154	0.331	**0.776**			
PEOU	0.209	0.190	0.183	**0.739**		
ATEL	0.206	0.340	0.445	0.610	**0.763**	
ITTELC	0.347	0.375	0.479	0.423	0.640	**0.808**

Note. The bolded diagonal values in Table 3 are the square roots of AVE. PV = perceived vulnerability; PS = perceived severity; PU =perceived usefulness; PEOU = perceived ease of use; ATEL = attitude toward e-learning; ITTELC = intention to take e-learning courses.

Results of the Structural Model

As indicated in Table 4, the model fit statistics are all at satisfactory levels, indicating a good fit between the data and the proposed research model.

Table 4

Summary of Model Fit Statistics for Structural Models

Model fit statistics	Suggested value	Observed value
Chi-square/*df*	< 2.00	1.823
Comparative fit index	> 0.90	0.955
Goodness of fit index	> 0.90	0.914
Normed fit index	> 0.90	0.906
Non-normed fit index	> 0.90	0.949
Root mean square error of approximation	< 0.05 or < 0.08	0.044

Results of Hypotheses Testing

Table 5 summarizes the results of path analysis and hypothesis test results. Each proposed direct effect was significant except for H5.1. The results indicate that PV affects students' intentions to take e-learning courses but not their attitudes toward e-learning.

Table 5

Results of Hypothesis Testing for Direct Effects

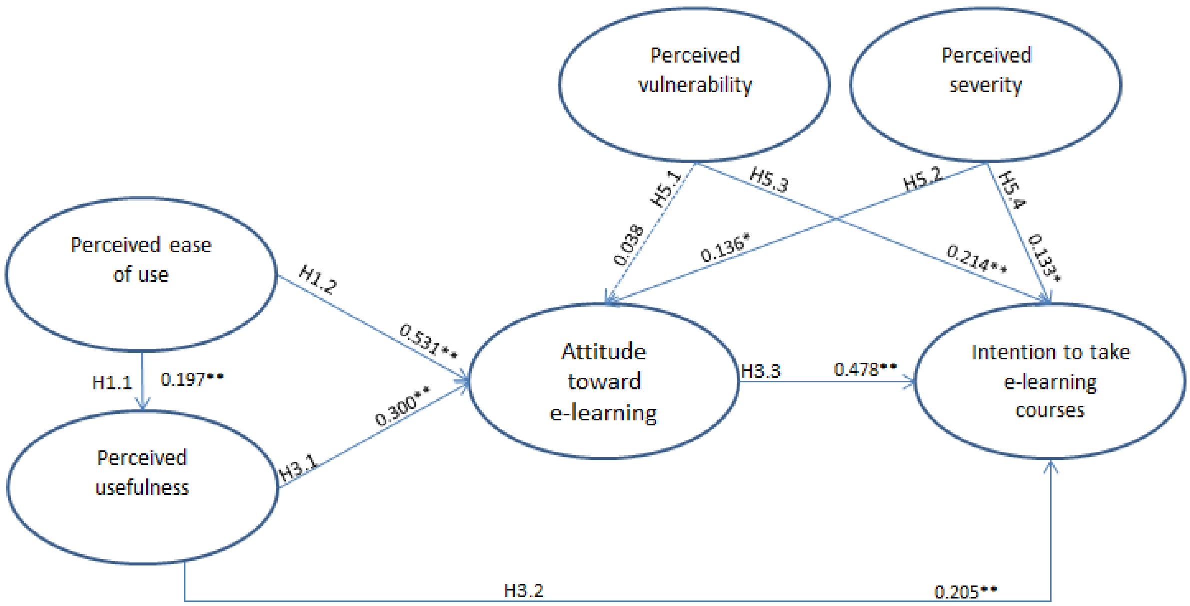
Hypotheses (direct paths)	Standardized path coefficients	*t*	*p*	Result
H1.1: PEOU → PU	0.197	3.470	< 0.001	Accepted
H1.2: PEOU → ATEL	0.531	9.212	< 0.001	Accepted
H3.1: PU → ATEL	0.300	5.964	< 0.001	Accepted
H3.2: PU → ITTELC	0.205	4.035	< 0.001	Accepted
H3.3: ATEL →ITTELC	0.478	7.989	< 0.001	Accepted
H5.1: PV → ATEL	0.038	0.824	> 0.05	Rejected
H5.2: PS → ATEL	0.136	2.890	< 0.01	Accepted
H5.3: PV → ITTELC	0.214	4.549	< 0.001	Accepted
H5.4: PS → ITTELC	0.133	2.853	< 0.01	Accepted

Note. PEOU = perceived ease of use; PU =perceived usefulness; ATEL = attitude toward e-learning; ITTELC = intention to take e-learning courses; PV = perceived vulnerability; PS = perceived severity.

Significant structural relationships between the variables in the research model and the standardized path coefficients are shown in Figure 3.

Figure 3

Structural Model



Note. * $p < 0.01$. ** $p < 0.001$.

To examine the significance of the proposed mediation effect, a bootstrapping approach using 1,000 resamples with a 95% confidence interval was used. As shown in Table 6, only H6.1 was rejected, suggesting that PV only directly influences individual intentions to take e-learning courses, and attitudes toward e-learning do not play a mediating role in the association.

Table 6

Results of Hypothesis Testing for Mediation Effect

Hypotheses (indirect paths)	Standardized path coefficients	*p*	Result
H2: PEOU → PU → ATEL	0.059	< 0.01	Accepted
H4: PU → ATEL → ITTELC	0.143	< 0.01	Accepted
H6.1: PV →ATEL → ITTELC	0.018	> 0.05	Rejected
H6.2: PS →ATEL → ITTELC	0.065	< 0.05	Accepted

Note. PEOU = perceived ease of use; PU =perceived usefulness; ATEL = attitude toward e-learning; ITTELC = intention to take e-learning courses; PV = perceived vulnerability; PS = perceived severity.

Table 7 shows that the total effect of three TAM factors on ITTELC (ATEL = 0.478, PU = 0.348, PEOU = 0.322) was slightly higher than that of the PMT factors (PV = 0.232, PS = 0.198). For TAM factors, the total effect of PU on ITTELC is larger, while for PMT factors, the total effect of PV is stronger than that of PS.

Table 7

Antecedents' Effect on ITTELC

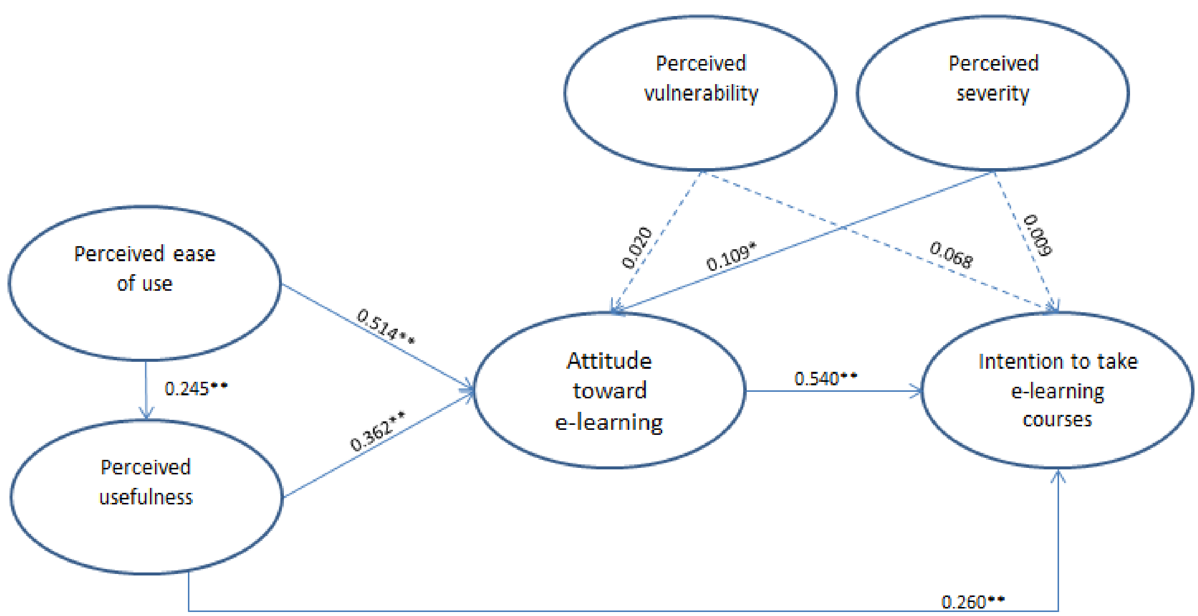
Antecedents		Direct effect	Indirect effect	Total effect
TAM factors	PEOU	n.s.	0.322	0.322
	PU	0.205	0.143	0.348
PMT factors	PS	0.133	0.065	0.198
	PV	0.214	0.018	0.232

Note. ITTELC = intention to take e-learning courses; TAM = technology acceptance model; PEOU = perceived ease of use; n.s. = nonsignificant; PU = perceived usefulness; PMT= protection motivation theory; PV = perceived vulnerability; PS = perceived severity.

The structural model results for the two countries are shown in Figures 4 and 5. Taiwan's model shows greater PS and PV effects on ITTELC but lower PU effect on ITTELC. Table 8 shows the effect of PU, PS, PV, and PEOU on ITTELC in the two countries. Specifically, as the "Total effect" column suggests, two PMT factors (PS, PV) have stronger effects on ITTELC in Taiwan than they do in Vietnam. In contrast, PU affects ITTELC more significantly in Vietnam than in Taiwan.

Figure 4

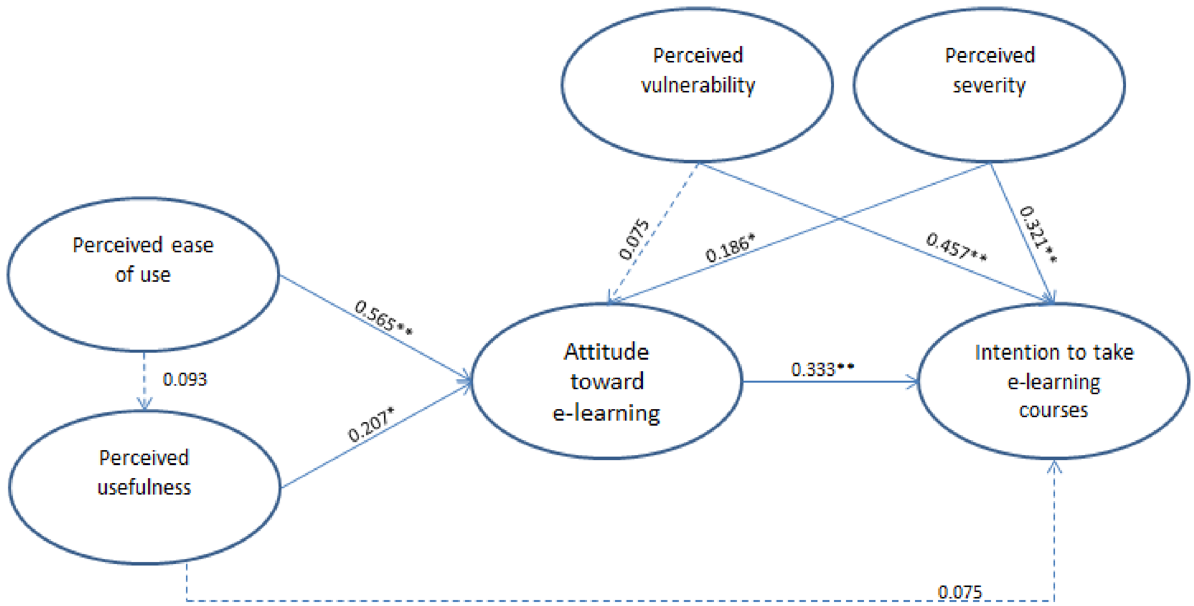
Structural Model of Vietnam



Note. * $p < 0.05$. ** $p < 0.001$.

Figure 5

Structural Model of Taiwan



Note. * $p < 0.05$. ** $p < 0.001$.

Table 8

Antecedents' Effect on ITTELC Between Vietnam and Taiwan Model

Antecedents		Direct effect	Indirect effect	Total effect
TAM factors	PEOU	n.s. (n.s.)	0.389 (0.202)	0.389 (0.202)
	PU	0.260 (0.075)	0.195 (0.069)	0.455 (0.144)
PMT factors	PS	0.009 (0.321)	0.059 (0.062)	0.068 (0.383)
	PV	0.068 (0.457)	— (—)	0.068 (0.457)

Note. Coefficients for Taiwan are in parentheses. ITTELC = intention to take e-learning courses; TAM = technology acceptance model; PEOU = perceived ease of use; n.s. = nonsignificant; PU =perceived usefulness; PMT = protection motivation theory; PS = perceived severity; PV = perceived vulnerability.

To further test H7 and H8, a chi-square difference test was used to examine whether the hypothesized path coefficients were significantly different. As Table 9 indicates, there is a significant difference in the path coefficients between PV, PS, and ITTELC in the Taiwan and Vietnam models. Specifically, the path coefficients of these effects are significantly higher for Taiwan; thus, H7 and H8 were supported.

Table 9

Multigroup Analysis of Paths from PV and PS to ITTELC Between Taiwan and Vietnam

Paths to compare	X^2	*df*	ΔX^2 from base model	Path coefficients	Result of hypothesis testing
Unconstrained base model[a]	896.925	576			
Constrained paths[b]					
H7: PV → ITTELC	915.574		18.649*	0.068 (0.457*)	Accepted
H8: PS → ITTELC	909.101		12.176*	0.007 (0.321*)	Accepted

Note. [a] Paths for the two countries groups were allowed to be freely estimated. [b] The path specified was constrained to be equal across the two countries groups. Coefficients for Taiwan are in parentheses. * $p < 0.001$.

Discussion and Conclusion

The TAM has long been seen as a valid theoretical framework for explaining students' attitudes and intentions with regard to e-learning (Al-Qaysi et al., 2020; Baby & Kannammal, 2020; Cheng, 2011; Mohammadi, 2015), but one recent study conducted in the COVID-19 context reflects a contradictory result (Ho et al., 2020). It seems that in the context of the current pandemic, in addition to TAM factors, other influential factors also require attention.

To shed more light on the complexity of students' online learning intention, this PMT-based study incorporated two additional factors—PV and PS—along with TAM factors. The researchers chose two countries with different COVID-19 pandemic situations for study. Our findings echo those of previous studies on relationships between PV, PS, and human behavioral intention in other noneducational settings (Chenoweth et al., 2009; Prasetyo et al., 2020). If perceived risk of the disease is higher, people will more easily accept protection measures such as adopting e-learning courses. This suggests that it is essential to build people's awareness of the serious nature of the disease. To this end, governments should strengthen and diversify forms of advertising about the dangers of COVID-19 as well as other emergency situations in the future; they should also enumerate prevention measures to boost people's awareness and caution. Educators and policy makers should enhance student risk perception in terms of severity and vulnerability of the pandemic or other emergent situations, so they are more spontaneous and cooperative in accepting e-learning classes.

Our analysis also shows that the dynamics of the study variables evolved when we separately examined the whole data set and the two countries using the proposed model. While the TAM and PMT factors were significant in predicting ITTELC, PS also had a positive effect on ATEL and ITTELC, while PV only had a positive direct effect on ITTELC and did not affect attitudes toward e-learning. While the total effect of TAM factors was also slightly higher than that of the PMT factors, the picture changed when we compared the results from Vietnam and Taiwan. In Vietnam, TAM factors worked quite well in explaining ITTELC, but PMT factors were either insignificant (PV) or had an indirect effect on ITTELC (PS). Conversely, the Taiwan results presented a completely different picture. Specifically, TAM factors had only an indirect effect on

ITTELC, while PMT factors had a much stronger effect on ITTELC. As Denzin (2017) has argued, nuances in data might be different if collected at different times, in different places, and from different people, with such differences possibly due to a different pandemic condition and information and communication technology education traditions in the two countries.

As mentioned in the literature review section, this study was conducted after a more violent outbreak of COVID-19 in Taiwan but not in Vietnam. This was exacerbated by the fact that the number of new cases in Taiwan was on the rise, coupled with difficulties encountered in accessing vaccines during this period. Another factor was that Taiwanese students seemed to be more cautious about the COVID-19 pandemic because of their previous experience with the SARS outbreak in 2003 (Liang et al., 2021). Prasetyo et al. (2020) shows that when the levels of PV and PS increase, people tend to change their attitudes and behaviors with respect to adopting protective measures. Similarly, while the COVID-19 situation in Taiwan was more serious than it was in Vietnam during the research period, the effect of PS and PV on ITTELC was higher for Taiwanese students than for Vietnamese students.

On the other hand, differences in the level of e-learning readiness between the two countries also played a role in the results. E-learning had become a popular method in HEIs; it had become a familiar tool in teaching and learning in Taiwan since the national program for e-learning was initiated in 2003 (Chang et al., 2009). On the other hand, since incorporating e-learning into formal courses was less common for HEIs in Vietnam (Ho et al., 2020), the need to enhance Vietnamese students' perceived view of e-learning's ease and helpfulness had a greater effect on their ITTELC than it did for Taiwanese students. Therefore, more focus should be placed on the Vietnam Ministry of Education and Training broadcasting the benefits of e-learning through a variety of channels and in different contexts. Moreover, to establish students' e-learning usage habits, HEIs should also consider expanding the use of online courses in their academic programs even under normal circumstances. Governments should also invest in technology infrastructure to improve e-learning use in HEIs so that students can become accustomed to using e-learning and comfortably take e-learning courses when necessary.

In summary, the theoretical implication of this study is that it provides a new perspective for integrating PMT and TAM and exploring factors affecting student intentions to take e-learning courses in an emergency situation such as the COVID-19 pandemic. This responds to the call of Ho et al. (2020) for further research to determine whether other factors have a stronger impact on attitudes and intentions to use e-learning throughout the COVID-19 era. In addition, the mediating role of student ATEL with respect to relationships between PS and ITTELC was also established by our study.

Our cross-country comparison also shed light on the condition of PMT and TAM factor effects on students' ITTELC, and this is also important as a practical implication of our findings. Our analysis shows that a more contextual understanding of students' e-learning intentions should be carefully examined during a pandemic and that factors for ITTELC can vary in different educational settings. Therefore, educators and policy makers should clearly define the context of e-learning implementation to identify the necessary antecedents that contribute to improving an individual's intention to accept e-learning. Accordingly, educators and policy makers in Vietnam, Taiwan, and other countries are advised to develop strategies with variable emphasis among TAM and PMT factors that have different roles in different countries' settings.

Limitations and Suggestions for Further Study

There are some limitations to this study. First, since we employed the convenience sampling method, the study reflects limitations in sample representation. Second, since this study did not consider external factors to TAM that could also be relevant in predicting students' intension for e-learning, we suggest that future studies could adopt random sampling methods to make samples suitably representative. The current research model could also be tested with participants from other countries that represent varied contexts in order to generate more insights. Multigroup analysis could also be applied to examine whether other important demographic variables could be used in interpreting the model, such as type of education, level of education, students' major, and so forth. Finally, a more theoretical framework might complement the TAM and PMT and provide a more comprehensive picture of our understanding of the factors influencing students' inclinations toward e-learning.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 23, Number 3

September – 2022

Emergency Online Learning: The Effects of Interactional, Motivational, Self-Regulatory, and Situational Factors on Learning Outcomes and Continuation Intentions

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Abstract

This study investigated the effects of interactional, motivational, self-regulatory, and situational factors on university students' online learning outcomes and continuation intentions during the COVID-19 pandemic. Data were collected from 255 students taking a business course at a university in southern China. Hierarchical multiple regression analyses revealed that while family financial hardship caused by COVID-19 was a marginally significant negative predictor of students' learning outcomes, learner–content interaction; instructors' provision of e-resources, course planning, and organisation; and students' intrinsic goal orientation and meta-cognitive self-regulation were significant positive predictors with the latter two sets of predictors mediating the effects of learner–instructor and learner–learner interactions, respectively. Multinominal logistic regression analyses showed that learner–instructor interaction, learner–content interaction, and private learning space were significant positive predictors of students' intentions to continue with online learning, but learner–learner interaction was a significant negative predictor. These findings point to the differential effects of various types of interactional and situational factors on learning outcomes and continuation intentions, and the instructor- and learner-level factors that mediate the effects of learner–instructor and learner–learner interactions on learning outcomes. They contribute to our understandings of emergency online learning and provide implications for facilitating it.

Keywords: emergency online learning, motivation, self-regulation, learning outcomes, continuation intention

Introduction

The spread of COVID-19 plunged the world into a health crisis and has had profound impacts on almost every sector. The higher education sector, for example, responded to the crisis by transitioning to online learning (Greenhow & Lewin, 2021). This transition has fostered the continuation of learning during the pandemic. However, emergency online learning tends to feature inadequate instructional design and insufficient institutional support, which may pose grave challenges to students and instructors transitioning to online learning (Rehm et al., 2021; Wang et al., 2021). Aguilera-Hermida (2020), for instance, has identified three types of COVID-19-related challenges: situational, online educational, and emotional. While the situational and the online educational challenges refer to "distractors and financial hardship" and "students' lack of access to supporting resources and lack of prior online learning experience," respectively, the emotional challenges include mainly "a lack of motivation and negative emotions" (p. 5). These purported challenges notwithstanding, how they may influence students' learning outcomes, and intentions to continue online learning remains largely unknown. Moreover, while a large body of research has examined online learning and its influencing factors in higher education, previous research has focused primarily on "the technology dimension and individuals' experience" and has paid less attention to social and affective factors (Li et al., 2021, p. 3). Thus, this study investigates the effects of interactional, motivational, self-regulatory, and situational factors related to the COVID-19 on students' perceived online learning outcomes and continuation intentions. The findings of this study contribute to our understanding of the differential effects of different types of interactional and situational factors on learning outcomes and continuation intentions in emergency online learning settings, as well as the instructor- and learner-level factors that mediate the effects of learner–instructor and learner–learner interactions on learning outcomes.

Interaction in Online Learning

Wagner (1994, p. 8) defines interaction as "reciprocal events that require at least two objects and two actions." According to Moore (1989), three types of interaction come into play within distance or online learning, namely, learner–instructor, learner–learner, and learner–content. The literature has long acknowledged "the critical role of interaction in supporting and even defining education," including enhancing the effectiveness of and continuation intentions for online learning (Anderson, 2003, p. 2; see also Juwah, 2006). In a meta-analysis of the three types of interactions in distance education, Bernard et al. (2009) find the interactions to have a positive effect on achievement outcomes.

Learner–instructor interaction refers to "interaction between the learner and the expert who prepared the subject material, or some other expert acting as instructor" (Moore, 1989, p. 2). As an integral part of both face-to-face and online education, learner–instructor interaction can provide learners with feedback, stimulate their interest, and enhance their engagement with learning (Anderson, 2003; Moore, 1989). Research has shown that learner–instructor interaction tends to impinge on students' perceived learning (Arbaugh, 2000; Marks et al., 2005). Marks et al. (2005), for example, found a significant effect of learner–instructor interaction on perceived learning in graduate online courses. Moreover, research has shown that learner–instructor interaction is positively associated with learners' satisfaction with and continuation intentions for online learning (Huang et al. 2017; Lin et al., 2017a). For example, in a study of students' intentions to revisit massive open online courses (MOOCs), Huang et al. (2017) found that the degree of learner–instructor interactions had a positive influence on students' intentions to revisit MOOCs.

Learner–learner interaction refers to interaction "between one learner and other learners, alone or in group settings, with or without the real-time presence of an instructor" (Moore, 1989, p. 4). The literature has reported various benefits of leaner–learner interaction in online learning, including, among others, boosting motivation (Wagner, 1994), fostering the learning process (Anderson, 2003), tackling learners' loneliness (Weiner, 2003), and reducing dropout rates (Johnston et al., 2014). However, in synthesizing research on the effects of different types of interaction, Miyazoe and Anderson (2010) have found that although all three types of interactions had moderate effects on achievement outcomes, learner–instructor and learner–content interactions had greater effects than learner–learner interaction, despite learners' more positive attitudes towards the latter. Similarly, in a study of predictors for student satisfaction in online learning, Kuo, Walker, Schroder et al. (2014) have found that while both learner–instructor and learner–content interactions were significant predictors of student satisfaction, learner–learner interaction was a nonsignificant predictor. They concluded that "learner–learner interaction may be negligible in online course settings" (p. 35).

Finally, as "a defining characteristic of education," learner–content interaction refers to "interaction between the learner and the content or subject of study" (Moore, 1989, p. 3). Learner–content interaction has been found to have a positive effect on student perceived progress (Kuo, Walker, Schroder et al. 2014; Lin et al., 2017a). In a study on the relationship between interactions and learning outcomes in online language courses, for example, Lin et al. (2017a) find that only learner–content interaction significantly predicts students' perceived progress. However, the effect of learner–content interaction on student satisfaction and continuation intentions has been ambivalent. In Lin et al.'s (2017a) study, for example, both learner–instructor and learner–content interactions are found to be significant predictors of student satisfaction, with the latter being the stronger predictor. In contrast, Luo et al. (2017) have examined the effects of different types of interactions on students' sense of community and continuation intentions for e-learning, finding that only learner–learner and learner–instructor interactions had significant effects on learners' satisfaction and "stickness with the e-learning platform" (p. 153).

Motivation and Self-Regulation in Online Learning

Motivation and self-regulation are crucial for online learning success (Aguilera-Hermida, 2020; Wagner, 1994). According to the social-cognitive model of motivation, there are three general motivational constructs, namely, expectancy, value, and affect (Pintrich & De Groot, 1990, Pintrich et al., 1993). The value components deal with students' rationales for engaging in a learning task, including intrinsic goal orientation, extrinsic goal orientation, and task value beliefs. In particular, intrinsic goal orientation or intrinsic motivation focusing on learning and mastery has been found to significantly contribute to learning in both traditional and online learning settings (Eom & Ashill, 2016; Zhou, 2016). Cho and Shen (2013) examine the effect of goal orientation on academic achievement in online learning and find students' intrinsic goal orientation to be a significant predictor of students' academic achievement. In addition, research (e.g., Ifinedo, 2017; Park et al., 2012) has shown that intrinsic motivation (e.g., enjoyment) is a significant factor influencing students' continuation intentions to learn online. For instance, Abdullatif and Velázquez-Iturbide (2020) explore the relationship between motivations, personality traits, and intentions to continue MOOCs, finding a significant positive relationship between intrinsic motivation and intentions to continue MOOCs.

Self-regulation refers to "self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals" (Zimmerman, 2000, p. 14). Research has long identified self-regulation as a significant contributor to academic success in traditional contexts (Pintrich & De Groot, 1990; Zimmerman, 1989, 2000). Given the nature of online learning, it is even more crucial (Kuo et al., 2013). In a meta-analysis of the relationship between self-regulated learning strategies and academic achievement in online higher education contexts, Broadbent and Poon (2015) have found a significant association between meta-cognition, time management, effort regulation, and critical thinking, on the one hand, and academic achievement on the other. In particular, Lin et al. (2017b) find self-regulated learning (SRL) strategies to have a significant positive effect on student learning outcomes, including student satisfaction, perceived progress, and final grades.

Moreover, research (e.g., Puzziferro, 2008; Kuo et al., 2013; Kuo, Walker, Schroder, et al., 2014; Zhu et al., 2020) has also found self-regulation, particularly meta-cognitive self-regulation, to be significantly and positively correlated with student satisfaction with and continuation intentions for online learning. For example, in examining the effects of technological self-efficacy and SRL strategies on student performance and satisfaction in online undergraduate courses, Kuo, Walker, Schroder, et al. (2014) found SRL to be a moderate predictor of student satisfaction with online learning. Furthermore, in a study of the effects of university students' SRL capability, online interactions, and attitudes on online learning intention in a blended learning context, Zhu et al. (2020) concludes that "students with a higher level of self-management skills tended to consider online peer interaction to be less important for them" (p. 17).

Situational Factors in Online Learning

Apart from interaction, motivation, and self-regulation, situational factors also have a role to play in online learning, especially in emergency online learning. As noted, Aguilera-Hermida (2020) has identified three types of challenges related to COVID-19, including situational, online educational, and emotional challenges. Meeting these challenges requires careful instructional design and institutional support (Aguilera-Hermida, 2020; Hodges et al., 2020). However, the design and support needed for effective online teaching and learning may not be available during emergency online education caused by crises. For example, while accessibility to the instructor, other learners, and technologies is directly related to social and cognitive engagement (Aguilera-Hermida, 2020) and learning outcomes and continuation intentions (Luo et al., 2017), it may prove difficult to guarantee in emergency online learning. In addition, students may also encounter difficulties accessing private learning space and adequate e-resources due to the constraints caused by emergencies. Some of these factors have been examined in previous studies. For example, research has shown that that prior online learning experience is positively associated with learner satisfaction with online learning outcomes (Tallent-Runnels et al., 2006) and intentions to continue online learning (Tsai et al., 2018). However, other contextual factors have received little attention, such as distractors, financial hardship, and a lack of access to supporting resources.

In summary, the literature shows that a multitude of factors may influence students' online learning outcomes and continuation intentions. It also indicates that some issues need further investigation.

First, while there seems to be consensus in the literature on the effects of interaction on learning outcomes, research on the effects of interaction on continuation intentions has yielded mixed findings. Second, the literature has paid relatively little attention to the effects of social, affective, and contextual factors on (emergency) online learning (Aguilera-Hermida, 2020; Li et al., 2021). To address these issues, this study focused on the effects of interactional, motivational, self-regulatory, and situational factors on students' learning outcomes and intentions to continue online learning during the COVID-19 pandemic and sought to answer the following two research questions:

RQ1. To what extent do interactional, motivational, self-regulatory, and situational factors predict students' perceived learning outcomes?

RQ2. What factors may predict students' intentions to continue online learning compared with traditional and blended learning?

Methodology

Participants

Participants of this study included undergraduate students taking the Intermediate Accounting course at a university in southern China. A total of 440 students from 11 classes took the course. Four instructors each taught two classes, and one instructor taught three classes. All classes adopted the same course materials, assignments, and assessment methods. More than half of the students (n = 255) participated in the study. As shown in Table 1, there were 49 male and 206 female participants, which was largely proportional to the gender distribution of students taking the course. The great majority of the respondents were between 19 and 20 years of age. They came from three majors, with 188 in business administration, 37 in accounting, and 30 in financial management. Due to the COVID-19 pandemic, all lectures were delivered online synchronously using Tencent Class, an online education platform by the Chinese tech company Tencent Holdings Ltd. About 60% of the students reported having had online learning experience before the COVID-19 outbreak.

Table 1

Participants' Demographics

Characteristic	Frequency	%
Gender		
Male	206	80.78
Female	49	19.22
Age (years)		
18	20	7.94
19	151	59.92
20	79	31.35
> 20	2	0.79
Major		
Business administration	188	73.73
Accounting (international)	37	14.51
Financial management	30	11.76
Prior online learning experience		
Yes	154	60.39
No	101	39.61

Measures

The measures used in this study included two outcome scales, seven predictor variables, and three demographic variables. The learning outcomes scale, adapted from Liu (2012), consisted of four items and assessed students' perceived learning outcomes for the course. The continuation intentions outcome variable gauged students' intentions to continue online learning and comprised three categories: continuing online learning, switching to traditional learning, and switching to blended learning.

The interactions scale was adopted from Kuo, Walker, Schroder, et al. (2014) and consisted of three subscales: the learner–instructor subscale, the learner–learner subscale, and the learner–content subscale. Both the intrinsic goal orientation and the meta-cognitive self-regulation scales were derived from Pintrich et al. (1991). The intrinsic goal orientation scale assessed the extent to which students conceived of their participation in a task for intrinsic reasons, such as curiosity, mastery, or challenge. The meta-cognitive self-regulation scale measured the extent to which students employed the planning, monitoring, and regulating strategies during learning. The course organisation and planning scale was taken from Liu (2012) and queried students' perceptions of the instructor's organisation and planning of the course. A six-point Likert scale was used in the aforementioned measures where 1 denoted "not at all true of me" or "strongly disagree" and 6 denoted "very true of me" or "strongly agree." The e-resources scale asked students to indicate on a six-point Likert scale the extent to which they perceived the e-resources provided by the instructor to be adequate. The COVID-19 impact variable assessed whether students' family financial situations were affected by the COVID-19. The questionnaire also collected students' background variables, including gender (male, female), prior online learning experience (having previous online learning experience or not), and private learning space (having private learning space for participating in online courses or not).

The Cronbach's alphas (α) for the outcome and predictor scales derived from this study ranged from 0.844 to 0.953, indicating good internal consistencies across the scales (see Table 2). A confirmatory factor analysis of the outcome and predictor scales demonstrated acceptable data–model fit, showing acceptable factorial validity of the measurement model for the sample of this study (see Table 3).

Table 2

Scales and Reliability Estimates

Scale	No. of items	*α*	KMO
Perceived learning outcomes	5	0.953	
Learner–instructor interaction	6	0.856	
Learner–learner interaction	8	0.940	
Learner–content interaction	4	0.895	0.944
Course organisation and planning	5	0.943	
Intrinsic goal orientation	4	0.849	
Meta-cognitive self-regulation	11	0.844	

Note. KMO = Kaiser-Meyer-Olkin.

Table 3

Results of Confirmatory Factor Analysis

Index	χ^2	*df*	χ^2/df	TLI	CFI	SRMR	RMSEA
Recommended thresholds			< 3.000	> 0.900	> 0.900	< 0.080	< 0.080
Models	1632.160	829	1.969	0.907	0.915	0.050	0.062

Note. TLI = Tucker–Lewis index; CFI = Comparative fit index; SRMR = Standardized RMR; RMSEA = Root Mean Square Error of Approximation. Recommended thresholds from "Reporting Structural Equation Modeling and Confirmatory Factor Analysis Results: A Review," by J. Schreiber et al., 2013, The Journal of Educational Research, p. 323-338, (https://doi.org/10.3200/JOER.99.6.323-338). Copyright 2013 by Taylor & Francis.

Data Collection and Analysis

All students taking the Intermediate Accounting course were invited to complete an online questionnaire about their online learning experience immediately after the semester ended. They were informed and assured that anonymity and confidentiality were guaranteed, that their participation was completely voluntary, and that declining to participate would not affect them in any way. One week after sending the invitation, we sent a reminder to those who had not completed the questionnaire.

A five-level hierarchical multiple regression model was employed to address the first research question. The outcome variable was the mean score from the four-item learning outcomes scale. The background variables (i.e., gender, prior online learning experience, private learning space) were entered in the first step of the hierarchical regression analyses. The three types of interactions were entered in the second step. The student variables (i.e., intrinsic goal orientation, meta-cognitive self-regulation) and the instructor/course variables (i.e., course organisation and planning, provision of e-resources) were entered in the third and fourth steps, respectively. Family financial hardship caused by the COVID-19 was entered in the last step.

To address the second research question, a multinominal regression was run on students' intentions to continue online learning. The outcome variable was students' intentions regarding three learning modes (i.e., continuing online learning, switching to traditional learning, and switching to blended learning). The predictor variables included gender, prior online learning experience, private learning space, family financial hardship caused by COVID-19, three types of interactions, intrinsic goal orientation, meta-cognitive self-regulation, provision of e-resources, and course organisation and planning.

Results

Regression Analyses on Learning Outcomes

Table 4 presents descriptive statistics for the variables, and Table 5 shows the correlations among all the interval variables. As shown in Table 5, the correlations among the interval variables were significant and moderate (ranging from 0.473 to 0.825). Except for the correlation between learner–content interaction and learning outcomes, all other correlations were less than 0.80, which suggests that multicollinearity was not a serious concern.

Table 4

Descriptive Statistics

Variable name	Mean	*SD*	Range
Learning outcomes	4.43	0.883	1–6
Learner–instructor interaction	4.49	0.783	1–6
Learner–learner interaction	4.34	0.890	1–6
Learner–content interaction	4.42	0.905	1–6
Adequacy of e-resources	4.66	0.890	1–6
Course organisation and planning	4.82	0.824	1–6
Intrinsic goal orientation	4.44	0.774	1–6
Meta-cognitive self-regulation	4.13	0.610	1–6
Gender (male = 0)	0.81	0.395	0–1
Prior online learning experience (no = 0)	0.60	0.490	0–1
Private learning space (no = 0)	0.91	0.281	0–1
Family financial situation (not affected = 0)	0.45	0.499	0–1

Table 5

Correlations Among the Outcome Variable and Continuous Predictors

Variable	1	2	3	4	5	6	7	8
1. Learning outcomes	1							
2. Learner–instructor interaction	0.615*	1						
3. Learner–learner interaction	0.632*	0.678*	1					
4. Learner–content interaction	0.825*	0.610*	0.629*	1				
5. Provision of e-resources	0.497*	0.404*	0.319*	0.487*	1			
6. Course organisation and planning	0.654*	0.613*	0.541*	0.624*	0.401*	1		
7. Intrinsic goal orientation	0.663*	0.527*	0.614*	0.580*	0.318*	0.600*	1	
8. Meta-cognitive self-regulation	0.635*	0.526*	0.563*	0.552*	0.298*	0.473*	0.569*	1

Note. * $p < 0.01$.

Table 6 presents the effects of demographics, interactions, learner and instructor variables, and family financial situation on students' perceived learning outcomes. As shown in Table 6, in model 1, only prior online learning experience ($\beta = 0.138$, $t = 2.196$, $p = 0.029$) was significantly and positively associated with student learning outcomes. This means that students with prior online learning experience reported significantly higher learning outcomes than their counterparts without prior online learning experience. However, the model just approached statistical significance ($F[3, 252] = 2.349$, $p = 0.073$), and the variance explained by the model was only 1.6% (Adj. $R^2 = 0.016$).

Table 6

Regressions on Perceived Learning Outcomes

	(1) M1	(2) M2	(3) M3	(4) M4	(5) M5
Gender (male = 0)	−0.095	−0.033	−0.040	−0.015	−0.015
	(−1.518)	(−0.962)	(−1.215)	(−0.480)	(−0.471)
Prior online learning	0.138**	−0.009	−0.012	−0.042	−0.039
experience (no = 0)	(2.196)	(−0.266)	(−0.356)	(−1.303)	(−1.217)
Private learning space	0.003	−0.026	−0.024	−0.010	−0.011
(no = 0)	(0.043)	(−0.739)	(−0.710)	(−0.327)	(−0.361)
Learner–instructor		0.113**	0.038	0.014	0.026
interaction		(2.283)	(0.748)	(0.304)	(0.541)
Learner–learner		0.134***	0.127**	0.031	0.027
interaction		(2.636)	(2.582)	(0.636)	(0.552)
Learner–content		0.673***	0.571***	0.505***	0.503***
interaction		(14.434)	(11.436)	(10.572)	(10.570)
Provision of			0.102***	0.098***	0.092**
e-resources			(2.632)	(2.710)	(2.533)

Course organisation and planning			0.164*** (3.566)	0.101** (2.247)	0.095** (2.114)
Intrinsic goal orientation				0.165*** (3.668)	0.163*** (3.647)
Meta-cognitive self-regulation				0.165*** (3.993)	0.167*** (4.042)
Family financial situation (not affected = 0)					−0.055* (−1.749)
Constant	4.446*** (19.376)	4.576*** (36.143)	4.587*** (37.305)	4.534*** (39.379)	4.577*** (39.047)
N	255	255	255	255	255
Adj. R^2	0.016	0.703	0.725	0.760	0.762

Note. *t* statistics appear in parentheses. M = model. * $p < 0.1$. ** $p < 0.05$. *** $p < 0.001$.

The variance explained by model 2 reached 70.3% ($F[6, 248] = 101.063$, $p < 0.001$) after learner–instructor, learner–learner, and learner–content interactions were added in step 2. Learner–instructor ($\beta = 0.113$, $t = 2.283$, $p = 0.023$), learner–learner ($\beta = 0.134$, $t = 2.636$, $p = 0.009$), and learner–content ($\beta = 0.673$, $t = 14.434$, $p < 0.001$) interactions were all significant and positive predictors of student learning outcomes. Prior online learning experience was no longer a significant predictor. The effect size of the learner–content interaction ($\beta = 0.673$) was over five times greater than those of the other two types of interaction ($\beta = 0.113$, $\beta = 0.134$).

After perceived adequacy of e-resources and course organisation and planning were added in model 3, learner–learner ($\beta = 0.127$, $t = 2.582$, $p = 0.010$) and learner–content ($\beta = 0.571$, $t = 11.436$, $p < 0.001$) interactions remained significant predictors of student learning outcomes, but the learner–instructor interaction ($\beta = 0.038$, $t = 0.748$, $p = 0.455$) was no longer a significant predictor. The effect sizes of learner–learner interaction and learner–content interaction decreased from 0.134 and 0.673 to 0.127 and 0.571, respectively. Moreover, both perceived adequacy of e-resources ($\beta = 0.102$, $t = 2.632$, $p = 0.009$) and course organisation and planning ($\beta = 0.164$, $t = 3.566$, $p < 0.001$) were significant and positive predictors of student learning outcomes. These findings indicated that learner–instructor interaction was mediated by perceived adequacy of e-resources and course organisation and planning. The model was significant ($F[8, 246] = 84.626$, $p < 0.001$) and explained 72.5% of the variance in perceived student learning outcomes.

Following the addition of intrinsic goal orientation and meta-cognitive self-regulation in model 4, learner–content interaction ($\beta = 0.505$, $t = 10.572$, $p < 0.001$), perceived adequacy of e-resources ($\beta = 0.098$, $t = 2.710$, $p = 0.007$), and course organisation and planning ($\beta = 0.101$, = 2.247, $p = 0.026$) remained significant predictors of student learning outcomes, but learner–learner interaction was no longer a significant predictor ($\beta = 0.031$, $t = 0.636$, $p = 0.525$). The effect sizes of learner–content interaction, perceived adequacy of e-resources, and course organisation and planning decreased from 0.571, 0.102, and 0.164 to 0.505, 0.098, and 0.101, respectively. Moreover, both intrinsic goal orientation ($\beta = 0.165$, $t = 3.668$, $p < 0.001$) and meta-cognitive self-regulation ($\beta = 0.165$, $t = 3.993$, $p < 0.001$) were significant and positive predictors of student learning outcomes. These findings indicate that learner–learner interaction was mediated by intrinsic goal orientation and meta-cognitive self-regulation. The model was significant ($F[10, 244] = 81.548$, $p < 0.001$) and explained 76% of the variance in perceived student learning outcomes.

Finally, the impact of COVID-19 on family financial situation ($\beta = -0.055$, $t = -1.749$, $p = 0.082$) was found to be a marginally significant and negative predictor of student learning outcomes in model 5. This means that students whose family financial situations were affected by the COVID-19 pandemic reported significantly lower perceived learning outcomes than did their peers whose family financial situations were not affected by COVID-19. The significant predictors identified in model 4 remained significant, and their effect sizes did not change much. The model was significant ($F[11, 243] = 75.039$, $p < 0.001$) and explained 76.2% of the variance in perceived student learning outcomes.

Multinominal Regression Analyses on Intentions to Continue Online Learning

The multinominal logistic regression performed to model the relationships between the predictors and the students' intention to continue online learning was significant ($\chi^2[22, N = 255] = 40.868$, Nagelkerke's $R^2 = 0.185$, $p = 0.009$) and correctly classified 64.7% of the cases.

As shown in Table 7, three factors had a significant parameter for comparing the online group with the traditional group. The odds ratio shows that with a one-unit increase in learner–learner interaction, the change in the odds of switching to traditional learning as opposed to continuing online learning is 3.485. This means that students with higher reported learner–learner interaction were more likely to switch to traditional learning. In contrast, with a one-unit increase in learner–content interaction, the change in the odds of switching to traditional learning was 0.294. In other words, students with higher reported learner–content interaction were less likely to switch to traditional learning. In addition, the odds ratio also shows that as private learning spaces changes from no (0) to yes (1), the change in the odds of a student with private learning space switching to traditional learning was 1 in 6.086. This shows that students with a private learning space were much less likely to switch to traditional learning than their counterparts without a private learning space.

Table 7

Multinominal Logistic Regression on Intention to Continue Online Learning

Predictors	Online vs.	*B*	*SE*	Wald	Exp(B)	*p*
Intercept	Traditional	2.475	0.692	12.776		< 0.001
	Blended	3.456	0.674	26.256		<0.001
Learner–instructor interaction	Traditional	−0.831	0.506	2.694	0.436	0.101
	Blended	−1.254	0.498	6.345	0.285	0.012
Learner–learner interaction	Traditional	1.248	0.450	7.687	3.485	0.006
	Blended	1.228	0.423	8.443	3.415	0.004
Learner–content interaction	Traditional	−1.225	0.556	4.856	0.294	0.028
	Blended	−0.554	0.536	1.070	0.575	0.301
Provision of e-resources	Traditional	−0.378	0.415	0.830	0.685	0.362
	Blended	−0.299	0.405	0.544	0.742	0.461
Course organisation and planning	Traditional	0.341	0.446	0.583	1.406	0.445
	Blended	0.504	0.431	1.364	1.655	0.243
Intrinsic goal orientation	Traditional	0.287	0.416	0.477	1.333	0.490
	Blended	0.152	0.396	0.146	1.164	0.702
Meta-cognitive self-regulation	Traditional	0.410	0.404	1.030	1.507	0.310
	Blended	0.349	0.389	0.805	1.418	0.370
Gender (male = 0)	Traditional	−0.556	0.714	0.607	0.573	0.436

	Blended	−1.061	0.692	2.352	0.346	0.125
Prior online learning	Traditional	1.091	0.795	1.885	2.978	0.170
experience (no = 0)	Blended	1.254	0.775	2.621	3.505	0.105
Private learning space	Traditional	17.924	0.539	1,106	6.086	< 0.001
(no = 0)	Blended	18.239	0.000		8.335	
Family financial situation	Traditional	−0.875	0.742	1.388	0.417	0.239
(not affected = 0)	Blended	−1.252	0.723	2.996	0.286	0.083

Note. N = 255. Reference group = online. $\chi^2(22, N = 255) = 40.868$, Nagelkerke's $R^2 = 0.185$, $p = 0.009$. 64.7% of the cases were correctly classified.

Two factors had a significant parameter for comparing the online group with the blended group. The odds ratio shows that with a one-unit increase in learner–learner interaction, the change in the odds of switching to blended learning rather than continuing online learning was 3.415. This indicates that students with higher reported learner–learner interaction were more likely to switch to blended learning as opposed to continuing online learning. In contrast, with a one-unit increase in learner–instructor interaction, the change in the odds of switching to blended learning was 0.285. This suggests that students with higher reported learner–instructor interaction were less likely to switch to blended learning.

Discussion

With regard to RQ1, factors influencing students' learning outcomes, our findings show that all three types of interaction were significantly related to students' perceived learning outcomes after controlling for demographic variables. Specifically, the effect of learner–content interaction was five times greater than those of learner–learner and learner–instructor interactions. This finding is largely consistent with findings from previous research (Kuo et al., 2013; Lin et al., 2017a). In an investigation of factors affecting students' perceived progress in online language courses, for example, Lin et al. (2017a) find only learner–content interaction to be a significant predictor of students' perceived progress. However, the present study found that the effect of learner–instructor interaction on perceived learning outcomes disappeared after the instructors' provision of e-resources and course organisation and planning were added to the regression model. This indicates that the effect of learner–instructor interaction was mediated by instructors' provision of e-resources and course organisation and planning. Similarly, the study also revealed that the effect of learner–learner interaction was mediated by students' intrinsic goal orientation and meta-cognitive self-regulation. This echoes Zhu et al.'s (2020) finding that students with high levels of self-regulation strategies are inclined to attach less importance to learner–learner interaction. After controlling for the instructor and learner factors, only learner–content interaction was significantly associated with students' perceived learning outcomes. These instructor- and learner-level factors, as well as other similar factors, might explain why some studies found learner–content interaction to be the only significant predictor of learning outcomes, whereas others found all three types of interaction to be significant predictors (Kuo, Walker, Schroder, et al., 2014). This finding highlights the need for "a comprehensive perspective" to analyse and understand interaction in online learning (Garrison & Cleveland-Innes, 2005, p. 144). Indeed, from the community of inquiry perspective, "simple interaction, absent of structure and leadership, is not enough" to promote deep learning (Garrison & Cleveland-Innes, 2005, p. 145). Likewise, according to the theory of transactional distance, interaction is closely intertwined with design or structure in distance or online education

(Moore, 1989, 1997).

Furthermore, both intrinsic motivation and meta-cognitive self-regulation significantly predicted students' perceived learning outcomes. The finding about intrinsic motivation is consistent with that of Eom and Ashill (2016, p. 185), who also found that "intrinsic student motivation affects learning outcomes." However, the finding about meta-cognitive self-regulation is inconsistent with that of Eom and Ashill (2016), who found that students' self-regulation was not significantly associated with their learning outcomes. Finally, we also found that family financial hardship due to the COVID-19 pandemic had a marginally significant effect on students' perceived learning outcomes. In a similar vein, Chu (2010) finds that tangible family support significantly predicts adult learners' perceived effects of e-learning. These findings point to the important roles of interactional, affective, and situational factors in emergency online learning (Aguilera-Hermida, 2020). Specifically, they demonstrate the differential effects of different types of interaction on student learning outcomes as well as the mediation of learner–instructor and learner–learner interaction effects by instructor- and learner-level factors.

Regarding RQ2, factors influencing students' intentions to continue online learning, the study found that private learning space, learner–instructor interaction, and learner–content interaction were significant and positive predictors of students' intentions to continue online learning, but learner–learner interaction was a significant and negative predictor. These findings are only partially consistent with the findings from previous research. For example, both Kuo et al. (2013) and Lin et al. (2017a) have found learner–instructor and learner–content interactions to be significant predictors of student satisfaction with online learning but learner–learner interaction to be a nonsignificant predictor. However, Luo et al. (2017) found both learner–learner and learner–instructor interactions to be significant predictors of learners' satisfaction and "stickness with the e-learning platform" (p. 153). Unlike typical online learning, the emergency online learning examined in this study was characterized by intact class instruction and provision of e-resources that might not be available in other contexts. Therefore, both learner–instructor and learner–content interactions were found to be significant predictors of student intentions to continue online learning. In a similar vein, because the students in this study knew each other and the course had been taught in person, they might have missed the face-to-face interaction after the pandemic started. Hence, the higher the learner–learner interaction, the more likely they would wish to switch back to traditional face-to-face learning. Alternatively, these findings may also mean that learner–instructor and learner–content interactions are easier to transfer to an online setting than learner–learner interactions.

However, contrary to some previous studies (e.g., Abdullatif & Velázquez-Iturbide, 2020; Ifinedo, 2017; Park et al., 2012; Zhu et al., 2020) that have identified intrinsic goal orientation and meta-cognitive self-regulation as significant predictors of students' continuation intentions, this study found neither to be a significant predictor. This might be attributed to the emergency nature of this course—delivered synchronously to intact classes in which learners already knew each other—which differs from typical online education where learners are likely to be strangers. As Lou et al. (2006) point out, "synchronous undergraduate DE [distance education] is simply a form of simulated classroom experience that is not overly affected by distance from the host site and the use of a medium of communication such as videoconferencing" (pp. 162–163). Finally, the study also showed that students with access to a private learning space were significantly more likely to continue online learning compared with their peers without access to a private learning space. These findings underscore the importance of interaction and private learning spaces in shaping students' intentions to continue online learning.

Conclusion

This study set out to investigate the influencing factors on students' learning outcomes and continuation intentions in emergency online learning. It has yielded several noteworthy findings. First, it revealed that while learner–content interaction was positively associated with both learning outcomes and continuation intentions, learner–instructor and learner–learner interactions were only significantly related to continuation intentions. Second, it was found that while learner–content and learner–instructor interactions were positively associated with continuation intentions, learner–learner interactions were negatively related to continuation intentions. Third, intrinsic goal orientation and meta-cognitive self-regulation mediated the effect of learner–learner interactions on learning outcomes and were only significantly related to learning outcomes. Fourth, the study showed that while family financial hardship caused by COVID-19 was a marginally significant negative predictor of students' learning outcomes, access to private learning space was a significant positive predictor of students' continuation intentions. These findings contribute to our understanding of the differential effects of various types of interaction, instructor-, learner- and situation-level factors on learning outcomes and continuation intentions in emergency online learning settings. Given the context and scope of this study, caution should be exercised in generalising these findings to other contexts. Nonetheless, they provide several implications for facilitating emergency online learning.

First, the significant effects of learner–content interaction, provision of e-resources, and course organisation and planning on perceived learning outcomes point to the importance of providing adequate learning materials and organising them in ways that facilitates learner–content interaction. Second, the significant association between students' intrinsic goal orientation and meta-cognitive self-regulation and their learning outcomes suggests the need to cultivate students' intrinsic goal orientation and develop their meta-cognitive self-regulation strategies. Third, the significant effect of family financial hardship on students' perceived learning outcomes indicates the need to provide financial support for students facing financial hardships during crises. Fourth, since learner–instructor and learner–content interactions were significant predictors of students' continuation intentions, it is important to strengthen learner–instructor and learner–content interactions if we are to enhance students' intentions to continue online learning. However, this study was not able to tease out the mechanisms that link learner–learner interactions and continuation intentions. More research is needed to unravel these relationships. Finally, the study also points to the need to secure private learning space to bolster students' intentions to continue online learning.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 23, Number 3

September – 2022

Extending the Community of Inquiry Framework: Development and Validation of Technology Sub-Dimensions

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Abstract

Since the mandatory switch to online education due to the COVID-19 outbreak in 2020, technology has gained more importance for online teaching and learning environments. The Community of Inquiry (CoI) is one of the validated frameworks widely used to examine online learning. In this paper, we offer an extension to the CoI framework and survey, arguing that meaningful and appropriate use of technologies has become a requirement in today's pandemic and post-pandemic educational contexts. With this goal, we propose adding three technology-related sub-dimensions that would fall under each main presence of the CoI framework: (a) technology for teaching, (b) technology for interaction, and (c) technology for learning. Based on exploratory and confirmatory factor analyses, we added 5 items for technology for teaching sub-dimension, 4 items for technology for interaction sub-dimension, and 5 items for technology for learning sub-dimension in the original CoI survey. Further research and practice implications are also discussed in this paper.

Keywords: Community of Inquiry framework, extending the CoI framework, technology sub-dimensions, exploratory factor analysis, confirmatory factor analysis

Introduction

As a result of the coronavirus outbreak in the beginning of 2020, most educational institutions were forced to switch to fully-online education. Face-to-face instruction was rare, and most teachers had to offer classes online. This brought about a tremendous transformation in education as both teachers and students became dependent on online technologies to either offer or to have access to instruction. Under these circumstances, the matter of how proficient teachers and students are in using technologies for educational purposes gained more importance.

The role of educators in 21st century classrooms has been changing, particularly when moving from traditional to more technology-enhanced learning environments. These changes were taking place long before the pandemic began. However, the rapid shift due to the pandemic underlined the importance of educational technologies to support and/or transform teaching and learning in distance and online learning environments. Many researchers have been investigating how learning theories can be used to improve the quality of learning and teaching in online learning environments (Mayer, 2019). Frameworks and models, such as technological pedagogical content knowledge (TPACK; Mishra & Koehler, 2006) and the Community of Inquiry model (CoI; Garrison et al., 2000), have been used extensively to design teaching and learning processes in online education (Ní Shé et al., 2019).

Up to now, the CoI framework has been used in several empirical studies (e.g., Choo et al., 2020; Horzum, 2015) to examine online learning environments and enhance learners' learning experiences. Yet, the contexts where previous studies were conducted were mostly blended learning environments, and online learning activities were mostly based on asynchronous tasks. The CoI framework was originally developed to analyze asynchronous online class discussions (Garrison et al., 2000). Although the framework has been revised on various occasions and several extensions were suggested (Pool et al., 2017; Shea & Bidjerano, 2010), it had not been used to examine fully-online courses until the coronavirus outbreak. After the COVID-19 pandemic started, a combination of synchronous online classes and asynchronous tasks were implemented in many schools in the academic year 2020–2021. Although the original CoI survey is a validated instrument that includes three main presences and 10 sub-dimensions to examine online learning and teaching, the recent developments entailed bringing other sub-dimensions into consideration: how both instructors and students use technology purposefully to teach and learn in a community of inquiry for both synchronous and asynchronous parts of a course. The CoI framework, its presences, sub-dimensions, and previous extensions of the framework are described in the next section.

The Community of Inquiry Framework and Its Presences

The CoI (Garrison et al., 2000) is an extensively-used framework for analyzing inquiry processes among learners and instructors and supporting the learning process in online and blended environments (Garrison et al., 2000; Maddrell et al., 2017). The framework is defined as "a group of individuals who collaboratively engage in purposeful critical discourse and reflection to construct personal meaning and confirm mutual understanding" (Garrison, 2017, p. 2). Researchers have been arguing that the CoI framework supports learners' engagement and communication by providing deep and meaningful learning in online and blended learning environments (Garrison et al., 2000; Maddrell et al., 2017).

The CoI framework includes three main presences: teaching presence (TP), social presence (SP), and cognitive presence (CP). Leveraging these presences, the CoI framework aims to create meaningful and constructive learning experiences for learners in online education (Cleveland-Innes et al., 2018). Within the framework, TP involves skillful orchestration and facilitation of learners' cognitive and social presences to provide meaningful learning processes. CP refers to how learners are cognitively engaged to construct their own knowledge from the discourse generated within the online community. SP represents learners' identifying themselves with the online learning community through active participation and communication. Design and organization, facilitation, and direct instruction are the three sub-dimensions of TP. CP has four sub-dimensions: triggering event, exploration, integration, and resolution. SP includes three sub-dimensions: affective expression, open communication, and group cohesion.

Validation of the CoI Framework With Different Samples

Several recent studies (e.g., Caskurlu, 2018; Dempsey & Zhang, 2019; Heilporn & Lakhal, 2020; Ma et al., 2017;Şen-Akbulut et al., 2022)) focused on validating the structure of the CoI framework along with its three presences. In the systematic review that Stenbom (2018) conducted, 103 CoI papers published between 2008 and 2017 were examined. Stenbom (2018) found that the CoI survey was reported to be valid and reliable in all the reviewed studies. Out of 103 studies, 83 included the original three presences, whereas 20 studies included either only one or two presences. Ma et al. (2017) validated the Chinese version of the CoI survey with 350 Chinese undergraduate students. They implemented a revised version of the CoI survey that included learning presence. They accepted a 47-item model as the final version (χ^2/df = 2.29, NNFI = 0.933, CFI = 0.936, RMSEA = 0.067). Reliability values of the four dimensions were acceptable (all Cronbach's $\alpha > .765$). Ma et al. (2017) also found that how learning presence, a partial mediator, is perceived is predicted directly by TP and CP. In another study, Heilporn and Lakhal (2020) investigated reliability and validity of sub-dimensions within each presence. Participants were 763 French-speaking university students taking online courses. They concluded that the sub-dimensions within each presence were reliable (Cronbach's α ranged from 0.80 to 0.94) and student data supported the structure (CFI = 0.94, RMSEA = 0.050).

Caskurlu (2018) conducted a confirmatory factor analysis on the CoI survey with 310 graduate students at a large university in the midwestern United States and found that each presence had a valid factor solution as the data fit very well with the nine item-three factor SP, thirteen item-three factor TP, and twelve item-four factor CP. Similarly, Kozan (2016) examined the relationships between the CoI presences and investigated which structural equation model fit better with the data. The study was conducted with 320 graduate students at a public university in the midwestern United States. The results showed that there was a statistically higher level of TP than cognitive and social presence, as well as a statistically higher level of CP when compared to SP. The results further revealed that there was either a direct or indirect relationship between TP and CP, and that SP was a mediator between TP and CP. Kozan and Richardson (2014) also conducted confirmatory factor analysis to evaluate the structure of the CoI survey. The data collected from 178 students in the USA resulted in an adequate fit to the data (CFI = 0.980, RMSEA = 0.079).

Studies That Extend the CoI Framework

One of the critiques of the CoI framework is that the model needs additional presences or sub-dimensions to be more comprehensive (Castellanos-Reyes, 2020). Several studies have aimed to revise and extend the CoI framework and have suggested numerous new presences to be included for the refinement of the framework (Anderson, 2016; Pool et al., 2017; Shea & Bidjerano, 2010). Kozan and Caskurlu (2018) conducted a literature review in order to identify the proposed contributions to the CoI framework and arguments behind those suggestions. The researchers included peer-reviewed journal articles written in English from 1996 to 2017 and selected 23 studies for the review. Their study identified suggestions of four types of additional presence and seven types of expansion of the existing presences. Suggested new presences were categorized as *autonomy presence*, *learning presence*, *emotional presence*, and *instructor presence*. However, Kozan and Caskurlu (2018) further recommended that arguments for the proposed presences and the validation and reliability of the studies should be clearly presented because revising the framework would damage its integrity.

Richardson et al. (2015) conducted a multiple-case study to conceptualize instructor presence and to explore how instructors incorporate instructor presence into their courses. Several further studies supported that within online and blended courses, instructor presence made a difference in engagement and learning (Hanshaw, 2021; Ng & Przybyłek, 2021; Ní Shé et al., 2019; Stone & Springer, 2019). Regarding teaching and social presence, some other studies included presences as instructor social presence and teacher engagement. However, these studies lacked discussion on how these new presences could be validated and how they would bring any additional research-based contributions to the CoI framework. Some other studies adapted the CoI survey for extending the CoI framework to conceptualize, implement, and evaluate K–12 or graduate-level programs (Kumar & Ritzhaupt, 2014; Wei et al., 2020). These adaptations included rewording, removing, and adding items to the survey so that it could be applied in the specific context of the study. Referring to the studies which used revised versions of the CoI survey, Castellanos-Reyes (2020) stated that although additional presences have been inserted within the CoI framework since the survey was first developed in 2008, none of these new presences has been validated as of 2020.

A large amount of research has indicated that online learning requires both instructors' and students' technology competencies more than is the case in traditional settings (Hanshaw, 2021; Ibrahim et al., 2021). However, the original CoI survey does not include any elements related to how technology is used pedagogically for teaching and learning processes and how its use is supported in the original three presences within the framework. To date, none of the aforementioned studies that suggested the expansion of the framework included elements related to technology use within a CoI. To fill this missing component, we suggest that the CoI survey needs a revision in order to include sub-dimensions related to technology use. In this study, we propose the expansion of the existing three presences to include one new sub-dimension under each presence: *technology for teaching*, *technology for interaction*, and *technology for learning* under TP, SP, and CP, respectively.

Purpose and Significance of the Study

So far, several technology competency surveys have been developed and implemented to measure educators' and students' technology use in educational settings (e.g., Christensen & Knezek, 2017). However, the constant introduction of new technological tools necessitates the expansion of technological competencies that mostly focus on technical skills (Şen-Akbulut & Oner, 2021; Tondeur et al., 2017). Thus, the current study proposes that expansion of the CoI framework should be grounded in approaches and theories that argue technology integration should be made in pedagogically-sound ways because the CoI framework aims to create collaborative-constructivist learning environments (Cleveland-Innes et al., 2018).

To address this need, we adopted a holistic and integrated approach while designing the revised survey with the new sub-dimensions. The formation of these new items related to new sub-dimensions was informed by the original CoI presences, the TPACK (Mishra & Koehler, 2006) framework, and the International Society for Technology in Education (ISTE) standards for students (ISTE, 2016). According to the standards published by ISTE, educators are individuals who design learning experiences for the 21st century, facilitate students' learning, and exhibit 21st-century skills such as collaboration and critical thinking (ISTE, 2016). Along with Mishra and Koehler's (2006) seven-construct TPACK framework, other surveys focusing on the aspects of constructivist-oriented TPACK have been used as a theoretical basis for developing the current items (Chai et al., 2012; Graham et al., 2009; Schmidt et al., 2009). To achieve the goal of creating an integrated survey, we inserted the technology for teaching (TFT), technology for interaction (TFI), and technology for learning (TFL) sub-dimensions within the original three presences. Also, we followed the TPACK framework's integrative approach of interrelated knowledge types and ISTE standards to form the items in these new sub-dimensions. We conceptualize these new sub-dimensions (TFT, TFI, and TFL) as the use of technology by the instructors and students as a tool to create meaningful learning experiences.

Methodology

Sample

The extended CoI survey was sent to undergraduate and graduate students at two public universities in Turkey where the medium of instruction is English. From these two universities, 653 students (44% male, 56% female; 94% undergraduate, 6% graduate) responded. There were no missing responses among the completed surveys. The data were collected at the end of the 2020–2021 fall semester when all courses at these two universities were fully online due to the pandemic. Course activities included both synchronous and asynchronous tasks. Instructors used learning management systems (e.g., Moodle) and video conferencing tools (e.g., Zoom) for course activities. Ethical consents were granted from the universities' institutional review boards, and students voluntarily completed online questionnaires. Therefore, the sampling method of the current study was convenience sampling. Participants represented a wide range of faculties including architecture, arts and sciences, economics and administrative sciences, education, engineering, and the school of applied disciplines.

Original CoI Survey

The original CoI survey was developed by Arbaugh et al. (2008) to measure three presences (TP, SP, and CP) having a total of 10 sub-dimensions. The researchers conducted exploratory factor analysis (EFA) to develop 34 items for inclusion in the survey. The internal consistency of the survey was 0.94 for TP, 0.91 for SP, and 0.95 for CP.

In the original survey, TP had three sub-dimensions: design and organization (DO; 4 items), facilitation (F; 6 items), and direct instruction (DI; 3 items). SP had three sub-dimensions: affective expression (AE; 3 items), open communication (OC; 3 items), and group cohesion (GC; 3 items). CP included four sub-dimensions: triggering event (TE; 3 items), exploration (E; 3 items), integration (I; 3 items), and resolution (R; 3 items).

Extending the Survey

Item-Writing Procedure

To extend the CoI survey based on the TPACK framework (Mishra & Koehler, 2006) and the ISTE standards (ISTE, 2016), we developed 35 new items measuring technological components of online education: 12 items for the TFT sub-dimension under TP, 12 items for the TFI sub-dimension under SP, and 11 items for the TFL sub-dimension under CP. These new items were written in English.

We aimed to meet three criteria while generating the new items: (a) whether the item aligned with the target presence, (b) whether the item was distinctive enough from the items under the target presence of the original survey, and (c) whether the item was clear enough to understand. These 35 new items along with the original CoI survey were sent to two experts. Based on their feedback, some items were revised. The revised 35 items along with the original survey were sent to three undergraduate students from different programs. These student reviews resulted in 32 items for the TFT, TFI, and TFL sub-dimensions. The expert and student review processes are explained elaborately below.

Expert Reviews

For the review, two experts were selected: a scholar from the educational technology field who was well-versed in the CoI framework and a scholar from the assessment and evaluation field. Three prompts were given to the expert reviewers: (a) “Is this item clear?” (b) “Is this item relevant to the target presence?” and (c) “Is this item distinctive enough from other original items of related sub-dimensions?” First, the educational technology scholar scrutinized all items based on the three prompts. After getting that reviewer’s comments, we revised five items, mostly through clarification and simplification. For instance, with the item “The instructor used collaborative tools (e.g., Google documents, Padlet) to create meaningful, real-world learning experiences in class,” the reviewer found that the item had two layers, task design and use of collaborative tools, and recommended they be kept separate. Thus, the item was changed to “The instructor successfully incorporated collaborative tools (e.g., Google documents, Padlet) into the course activities.” Afterwards, revised items were sent to the reviewer with expertise in the assessment and evaluation field who recommended changes to wording and sentence structure to make items clearer. For example, the item “Group work during online live class sessions enhanced my participation and engagement" was changed to "I felt more engaged during live class sessions when we had group work." As a result of the second expert review, 9 items in total were revised.

Student Reviews

Following the two expert reviews, we met with three students from different departments to review the items. The meetings were held online using a video-conferencing tool. We asked students to read the items and express what they understood. We also asked the students to give possible examples related to the items to make sure that the students captured the intended meaning. Based on the students' reviews, some clarifications and simplifications were made to 14 items. For example, the item "The instructor used video-conferencing tools effectively for live classes" was changed to "The instructor used video-conferencing tools (e.g., Zoom and GoogleMeet) effectively for live classes." Examples of technological tools or online activities were added in parentheses to three items since students indicated it was difficult to understand those. Several items were simplified by changing the sentence structure or wording. For instance, the item "I was able to communicate complex ideas clearly and effectively with my peers by creating or using a variety of digital tools (such as presentations, visualizations, or simulations)" was simplified by deleting the words "clearly" and "creating."

The survey including 32 new items (see Appendix A) along with the original 34 CoI items (66 in total) was administered to participants within the scope of this study. During the survey administration, items were randomized to avoid any bias due to ordering.

Data Analysis

Reliability

In this study, the reliability of the collected data was evaluated based on Cronbach's alpha coefficient. A Cronbach's alpha value between 0.70 and 0.80 is considered "acceptable"; between 0.80 and 0.90 is considered "good"; and above 0.90 is considered "excellent" (George & Mallery, 2003). IBM SPSS Statistics (Version 25.0) was used to estimate the alpha coefficients for the original and extended surveys.

Exploratory Factor Analysis

In order to select items for new sub-dimensions, EFA, using principal axis factoring with direct oblimin rotation, was conducted. Items that had 0.400 or less item loading to a primary factor and items that were loaded to at least two factors at the same time (cases in which a factor loading difference of an item to a primary factor and other factor was less than 0.100) were to be discarded (Field, 2013). Then, items that were highly loaded to the TP, SP, and CP were selected to be included in the final form of the survey by keeping content representation.

Second-Order Confirmatory Factor Analysis

After deciding the final form of the extended survey as a result of the EFA, a second-order confirmatory factor analysis (CFA) was conducted to evaluate whether the extended CoI survey's proposed structure fit students' responses. Both EFA and CFA were conducted using the same dataset from 653 participants. As a first step, Arbaugh et al.'s (2008) original structure with three presences and ten sub-dimensions was tested using weighted least squares means and a variance adjusted estimation method (WLSMV) as questionnaire items were ordinal. Then, the extended framework structure, including three presences and thirteen sub-dimensions was tested. The model fits to the student responses were evaluated by estimating root mean square error of approximation (RMSEA), comparative fit index (CFI), and Tucker–Lewis index (TLI). A good fit for the data was evaluated with an RMSEA value of less than 0.06, and CFI and TLI values higher than 0.95 (Browne & Cudeck, 1993; Hu & Bentler, 1999 Kline, 2010). Mplus 7.2 (Muthén & Muthén, 2013) was used to conduct the second-order CFA.

Results

The Reliability of the Survey Data

In this study, the reliability coefficients of the original survey and the extended survey were estimated by Cronbach's alpha. For the original survey with 34 items, the Cronbach's alpha was calculated to be 0.96 for TP, 0.92 for SP, and 0.94 for CP. For the new survey with 66 items, the Cronbach's alpha coefficients were 0.97, 0.95, and 0.97 for TP, SP, and CP respectively. These values indicate excellent internal consistency of the data (George & Mallery, 2003). All corrected item-total correlations were above 0.400, indicating the items were related to each other in related presences.

Exploratory Factor Analysis

EFA was conducted with a total of 66 items (34 original and 32 new items; see Table 1). EFA results showed a Kaiser-Meyer-Olkin measure of sampling adequacy value of 0.977, indicating that the sampling was marvelous. Bartlett's test of sphericity ($p < .05$) showed that the correlation matrix was different from an identity matrix. Therefore, the questionnaire data was appropriate for conducting the EFA. Additionally, there were 8 factors that had eigenvalues higher than 1. These factors explained 69% of the total variance in the dataset.

Factors 1, 2, and 3 consisted mainly of TP, SP, and CP items, respectively. These three factors explained 59% of the total variance. Although factors 4, 5, 6, and 7 explained lower percentages of variance, these factors also clearly represented remaining parts of CP, SP, TP, and SP respectively. Factor 8 did not provide a unique factor as factor loadings were less than 0.40 or factor loading difference of an item to a primary factor and other factor was less than 0.100. As the purpose of the study was to extend the COI framework with new items measuring technological presence subdomains for TP, SP, and CP, new items that were highly loaded to TP, SP, and CP were selected based on both EFA results and our content evaluations.

To add a new technology sub-dimension under the TP domain, items TFT44, TFT45, TFT41, and TFT43 (see Appendix A for all technology-related items) were selected, as these items were highly loaded to factor 1. Additionally, TFT36 was selected as this item also represented the technological sub-dimension of TP. TFT36 was the highest loaded item of factor 6 which also consisted of TP items. Therefore, TFT36 was included in the final form, and we named this new sub-dimension *technology for teaching*.

For the new technology sub-dimension under the SP domain, items TFI55, TFI56, TFI49, and TFI50 were selected, as these items highly loaded to factor 2. Content evaluation supported that these items represented a wide range of the technology sub-dimension under the SP domain. We named this the *technology for interaction* sub-dimension.

For the new technology sub-dimension under the CP domain, items TFL61, TFL59, TFL60, TFL66, and TFL65 were selected, as these items were highly loaded to factor 3. Content evaluation supported that these items were related to the technology sub-dimension under the CP domain. We named this the *technology for learning* sub-dimension.

Table 1

Exploratory Factor Analysis of 66 Prospective Items for the Extended CoI Survey

Item	Factor							
	1	2	3	4	5	6	7	8
DI12	.575							
TFT44	**.570**							
TFT45	**.539**							
TFT41	**.508**					.334		
F10	.502							
DI13	.496							
TFT43	**.489**					.333		
TFT42	.467					.383		
F8	.456							
F7	.454							
F5	.448							
TFT38	.444					.352		
DI11	.405							
F9	.394							
F6	.377							
E28	.325							
TFI55		**.604**						
TFI56		**.520**						
TFI49		**.508**						
AE14		.503						
AE15		.485						
TFI50		**.472**						
TFL63		.464	-.309					
TFI48		.451						
TFL62		.380	-.371					
AE16		.378						
TFI47		.357						
TFL61			**-.854**					
TFL59			**-.837**					

TFL60			**-.817**					
TFL66			**-.772**					
TFL65			**-.726**					
TFL58			-.711					
TFL64			-.698					
TFL57			-.624					
R33			-.577					-.307
R32			-.533					-.339
R34			-.450					-.326
E26			-.367					
E27	.305		-.356					
I29	.343		-.350					
I30			-.321					
TE24				-.582				
TE25				-.539				
TE23				-.522				
TFI53					.852			
TFI52					.842			
TFT36						**.871**		
TFT35						.821		
TFT37						.599		
DO1						.564		
DO4						.559		
DO2						.510		
DO3						.444		
TFT40						.390		
TFT39	.351					.381		
OC18							-.857	
OC17							-.777	
OC19							-.722	
TFI54					.453		-.528	
TFI46							-.430	
GC21							-.411	-.336
GC22		.355					-.401	
TFI51								
GC20							-.378	-.416
I31								

Note. *N*=653. The extraction method was principal axis factoring with oblique (direct oblimin) rotation.AE = affective expression; DI = direct instruction; DO = design and organization; E = exploration; F = facilitation; GC = group cohesion; I = integration; OC = open communication; R = resolution; TE = triggering event; TFI = technology for interaction; TFL = technology for learning; TFT = technology for teaching. Items selected for inclusion in the extended survey are in bold.

Second-Order Confirmatory Factor Analysis

After constructing the final form of the extended CoI survey, two second-order CFAs were conducted. In the first, CFA was conducted on the original CoI survey (3 presences, 10 sub-dimensions, 34 items) and in the second, CFA was conducted on the extended CoI survey (3 presences, 13 sub-dimensions, 48 items). The CFA results of both are presented in Table 2 and Figure 1. The results show that the proposed second-order structure of the extended framework was supported by the student responses (CFI > .950; TLI > .950; RMSEA around .060). Compared to the original survey, the extended survey structure provided a better value in terms of the RMSEA and χ2/*df* values. Standardized factor loadings are provided in Table 3. All standardized factor loadings were adequately high. These findings support the claim that technological sub-dimensions added under TP, SP, and CP were distinct.

Table 2

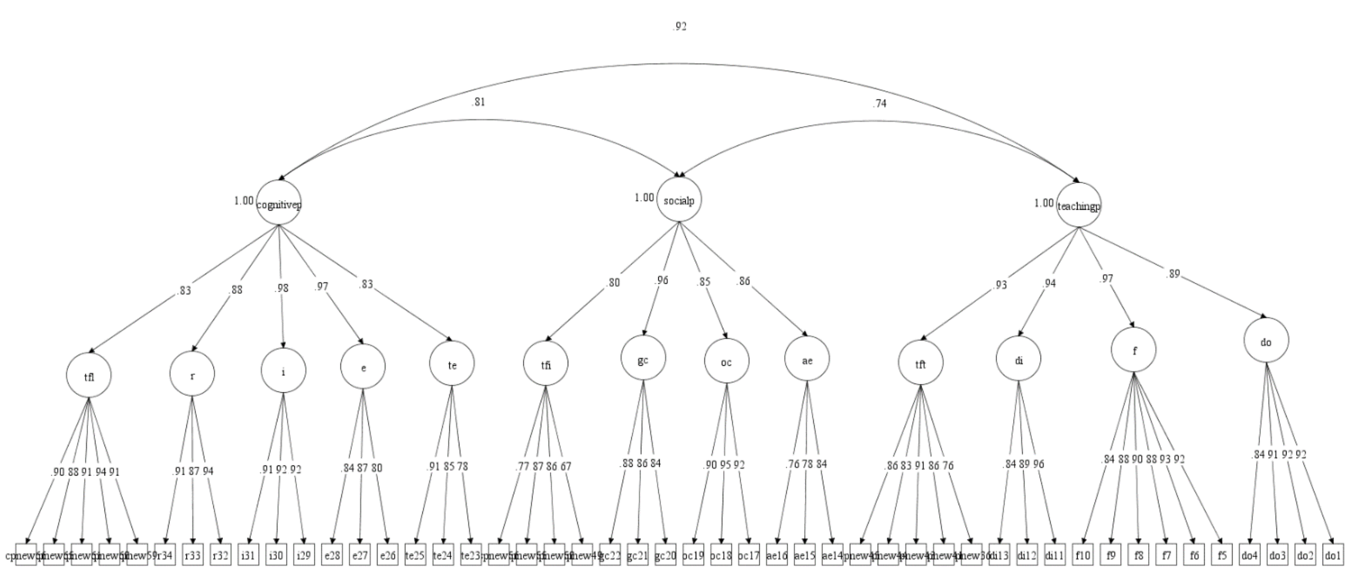
Results of Second-Order Confirmatory Factor Analysis for the Two Frameworks

Framework	χ2	*df*	χ2/*df*	CFI	TLI	RMSEA	
						Value	90% CI
Original	2177.618***	514	4.24	.966	.963	.070	[.067, .073]
Extended	3775.517***	1064	3.55	.955	.953	.062	[.060, .065]

Note. CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root-mean-square error of approximation; CI = confidence interval. ***p < .001

Figure 1

Second-Order Confirmatory Factor Analysis for the Extended CoI Framework



Note. AE = affective expression; cognitivep = cognitive presence; DI = direct instruction; DO = design and organization; E = exploration; F = facilitation; GC = group cohesion; I = integration; OC = open communication; R = resolution; socialp = social presence; TE = triggering event; teachingp = teaching presence; TFI = technology for interaction; TFL = technology for learning; TFT = technology for teaching.

Table 3

Standardized Factor Loadings of All Items Included in the Extended CoI Survey

Presence	Sub-dimension	Item	Standardized loading
Teaching	Design and organization	DO1	.924
		DO2	.921
		DO3	.905
		DO4	.839
	Facilitation	F5	.918
		F6	.929
		F7	.883
		F8	.901
		F9	.882
		F10	.841
	Direct instruction	DI11	.962
		DI12	.887
		DI13	.836
	Technology for teaching	TFT36	.759
		TFT41	.864
		TFT43	.906
		TFT44	.832
		TFT45	.860
Social	Affective expression	AE14	.841
		AE15	.781
		AE16	.758
	Open communication	OC17	.924
		OC18	.946
		OC19	.896
	Group cohesion	GC20	.845
		GC21	.860
		GC22	.877
	Technology for interaction	TFI49	.673
		TFI50	.862
		TFI55	.866
		TFI56	.766
Cognitive	Triggering event	TE23	.778
		TE24	.853
		TE25	.908
	Exploration	E26	.795

	E27	.867
	E28	.840
Integration	I29	.917
	I30	.922
	I31	.911
Resolution	R32	.941
	R33	.867
	R34	.910
Technology for learning	TFL59	.906
	TFL60	.943
	TFL61	.912
	TFL65	.883
	TFL66	.895

Note. AE = affective expression; DI = direct instruction; DO = design and organization; E = exploration; F = facilitation; GC = group cohesion; I = integration; OC = open communication; R = resolution; TE = triggering event; TFI = technology for interaction; TFL = technology for learning; TFT = technology for teaching.

Discussion

The capacity to use technology is becoming an increasingly important skill because of expectations of 21st-century students and the growth of learning technologies. In online environments, purposeful, meaningful, and pedagogical use of technology should be an indispensable component for teaching and learning processes. Resonating with this perspective, we added technology components as distinct sub-dimensions to the CoI framework after extensive investigation.

In their efforts to extend the CoI framework, some studies focused on proposing new dimensions whereas others suggested new presences. We developed these new items as sub-dimensions for the three original main presences. It is important to examine how technology can be used to support TP, SP, and CP effectively for online learning since the use of technology is a vital component that connects all three types of presence (Hanshaw, 2021; Thompson et al., 2017).

The current study aimed to extend the CoI framework by adding technology related sub-dimensions to the original presences as follows: the TFT sub-dimension for TP, the TFI sub-dimension for SP, and the TFL sub-dimension for CP. This study is novel since none of the previous CoI surveys assessed meaningful use of technology for teaching and learning. Following strictly the guidelines of scale development, we added 5 new items to the TFT sub-dimension, 4 new items to the TFI sub-dimension, and 5 new items to the TFL sub-dimension. In this way, the original CoI survey structure (3 presences, 10 sub-dimensions, and 34 items) was extended to 3 presences, 13 sub-dimensions, and 48 items.

Implications for Practitioners and Researchers

This study shows that with the suggested technology sub-dimensions, the CoI framework provides a research-based theoretical model for systematically selecting tools and effectively incorporating them into our teaching practices in online learning environments (Thompson et al., 2017). By exploring meaningful use of technology through the CoI framework, we expect that instructors and practitioners would have an in-depth understanding of how to make the most of technology to promote student learning in an online environment. We argue that the technology sub-dimensions suggested in this study will be useful for fully online, blended, or hybrid learning environments, both for synchronous and asynchronous tasks, since the sub-dimensions can be applicable to different types of interaction between instructors and students, students and students, and students and content. Communicating and interacting with students and content by using technology tools is crucial not only for creating a strong instructor presence (Hanshaw, 2021) but also to promote meaningful learning especially through online activities.

In this study, the data were collected from two universities where the medium of instruction is English. Both universities accept students who are quite successful in the national university entrance examination. Therefore, the sample does not represent all university students. It is suggested to test the new extended CoI structure with other samples in this as well as in other countries.

Conclusion

The original CoI survey is an instrument that has been in use for more than ten years. It has functioned properly in terms of exploring teaching and learning in online environments as processes of collaborative inquiry. In this study, a new version of the CoI survey that adds items related to meaningful use of technology under three new sub-dimensions (TFT, TFI, and TFL) has been introduced and has demonstrated a good level of reliability and validity, specifically 0.97, 0.95, and 0.97 for TP, SP, and CP, respectively. This shows that there is a high level of consistency among items in each presence. Second-order confirmatory factor analysis confirms that TFT, TFI, and TFL sub-dimensions added under TP, SP, and CP are distinct sub-dimensions (CFI > .950; TLI > .950; RMSEA around .060). Thus, the data collected supports the newly proposed factor structure. All 32 new items for the technology sub-dimensions in the extended CoI survey are shown in Appendix 1.

With this extension, the maximum sub-score from the TP category is 90 points, based on a 5-point Likert scale. In SP, the maximum sub-score is 65, while it is 85 for CP. To sum up, the items in the TFT sub-dimension highlight the instructor's technology use to enhance course management, student learning, communication and interaction among students, and to provide feedback on student work. TFI items demonstrate how students use technology to communicate and interact with their peers to be socially present in online environments. The items in the TFL sub-dimension include how technologies can be used by students to be involved in higher-order thinking and active learning.

Since the beginning of the COVID-19 pandemic, evidence that online classes will be a permanent part of our educational systems has been accumulating. Research suggests that educators generally have basic sets of technology skills and that meaningful use of technology is still a complex process in all types of learning environments (Christensen & Knezek, 2017). In this sense, the extended CoI survey appears to be a valid instrument for designing and assessing online learning experiences with meaningful use of technology.

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Appendix A

Items for Technology Sub-Dimensions

Technology for Teaching (TFT) under TP

TFT35: The instructor clearly set up the course page on the learning management system (e.g., Moodle, Canvas, Blackboard, itslearning).

TFT36: The instructor clearly kept the course page updated on the learning management system (e.g., Moodle, Canvas, Blackboard, itslearning).

TFT37: The instructor used video-conferencing tools (e.g., Zoom, GoogleMeet) effectively for live classes.

TFT38: The instructor successfully incorporated collaborative tools (e.g., Google documents, Padlet) into the course activities.

TFT39: The instructor facilitated synchronous class activities (e.g., live class discussions) effectively.

TFT40: The instructor facilitated asynchronous class activities (e.g., Moodle/Blackboard forum discussions) effectively.

TFT41: The instructor used digital tools and resources to maximize student learning.

TFT42: The instructor successfully used technology to assess our learning.

TFT43: The instructor effectively communicated ideas or information via digital tools.

TFT44: The instructor used technology to support interaction among course participants.

TFT45: The instructor effectively used technology to provide feedback on our tasks or assignments.

Technology for Interaction (TFI) under SP

TFI46: I was able to express my ideas through chat during live class sessions.

TFI47: Use of digital tools (such as Kahoot and Mentimeter) during live sessions encouraged me to participate in classes.

TFI48: I was able to communicate complex ideas clearly with my classmates by using a variety of digital tools (such as presentations, visualizations, or simulations).

TFI49: I used collaborative technologies (e.g., Google documents, Zoom) to work with my classmates outside of class time.

TFI50: Being able to communicate and collaborate with classmates anywhere and anytime digitally is an advantage for me.

TFI51: Features of video-conferencing tools (e.g., “raise virtual hand” option and chats) helped me to speak up and participate in online live classes.

TFI52: I felt more comfortable sharing my ideas during live classes when my camera was on.

TFI53: I felt more comfortable sharing my ideas during live classes when other course participants’ cameras were on.

TFI54: It was easy for me to share my ideas during online live classes.

TFI55: Working with my classmates outside the live class time on digital platforms motivated me to prepare for course-related tasks.

TFI56: I felt more engaged during live class sessions when we had group work.

Technology for Learning (TFL) under CP

TFL57: Exploring course topics via digital tools/resources increased my interest in the course.

TFL58: I was able to build up my knowledge by actively exploring real-world problems via digital tools/resources.

TFL59: Digital tools/resources helped me to examine problems from multiple viewpoints.

TFL60: Digital tools/resources helped me brainstorm ideas to complete course tasks.

TFL61: Digital tools/resources helped me to further investigate course topics.

TFL62: Online forums where I was able to explore my classmates’ ideas enhanced my learning in the course.

TFL63: Peer interaction on online platforms helped me construct my knowledge better.

TFL64: I was able to collect information from resources using a variety of digital tools.

TFL65: Digital tools/resources helped me generate new information to answer questions raised during classes.

TFL66: Digital tools/resources helped me think deeply about the course content.

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 23, Number 3

September – 2022

Revising and Validating the Community of Inquiry Instrument for MOOCs and Other Global Online Courses

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Abstract

Globally, online course enrollments have grown, and English is often used as a lingua franca for instruction. The Community of Inquiry (CoI) framework can inform the creation of more supportive, interaction-rich online learning environments. However, the framework and its accompanying validated instrument were created in North America, limiting researchers' ability to use the instrument in courses where participants have varying levels of English language proficiency. We revised the CoI instrument so it could be more easily read and understood by individuals whose native language is not English. Using exploratory and confirmatory factor analyses (EFA and CFA) on data obtained from global online courses and MOOCs, we found the revised instrument had good fit statistics once seven items were removed. This study expands the usability of the CoI instrument beyond the original and translated versions, and provides an example of adapting and validating an existing instrument for global courses.

Keywords: Community of inquiry, global online courses, MOOCs, teachers of English, English as a foreign language

Introduction

Online learning has grown dramatically despite relatively high attrition rates (Bawa, 2016). Garrison et al.'s (2000) Community of Inquiry (CoI) framework highlights how outcomes can improve through meaningful interactions. Arbaugh et al. (2008) developed and validated an instrument that measured CoI constructs—teaching presence, social presence, and cognitive presence—allowing researchers to better identify factors that impact outcomes. The "overwhelming majority" of research using the instrument has been conducted in North America (Stenbom, 2018, p. 24) and it is important to ensure the instrument is also appropriate for courses with a global audience. Since it is not practical to provide the survey in every language, especially in large global courses such as massive open online courses (MOOCs), it is important to develop an English version of the survey that would be easily comprehensible at varying levels of English language proficiency. In this research, we revised the CoI instrument to be comprehensible for culturally and linguistically diverse English language educators and validated it using survey responses following teacher professional development courses offered globally. Specifically, we revised the CoI instrument to be at the B1 level of the Common European Framework of Reference (CEFR) for English (i.e., lower intermediate level of English language proficiency).

We sought to answer the following research question:

- How well do revisions of the CoI survey items to the B1 level of the CEFR for English maintain the construct validity of the original CoI survey for a global audience with varying levels of English language proficiency?

Literature Review

Growth of Online Learning

At universities outside the United States, online course enrollments have been growing rapidly (Xiao, 2018), a growth likely to accelerate in the wake of emergency remote teaching during the COVID-19 pandemic (Teräs et al., 2020).

MOOCs have also impacted global online learning in the last decade because they "offer free or low-cost education to anyone, anytime, anywhere, and on a massive scale" (Lowenthal & Hodges, 2015, p. 84). MOOCs have been categorized based on learning interactions and their dominant learning strategies. Connectivist MOOCs (cMOOCs) emphasize learner-learner interaction and community, while extended MOOCs (xMOOCs) focus on learner-content interaction and a cognitive-behaviorist approach to learning (Anders, 2015). Blended MOOCs (bMOOCs) combine online learning with in-person meetings to discuss and apply learning (Yousef et al., 2015).

MOOCs have the potential to serve as scalable solutions to the challenges and demands in teacher professional learning. For instance, pre-service teachers from Israel expressed positive attitudes towards learning both the content, pedagogical, and technological knowledge after enrolling into an international MOOC for credit (Donitsa-Schidt & Topaz, 2018). Both pre-service and in-service teachers in the US have demonstrated personal and professional growth after enrolling and participating in a professional development MOOC (Phan & Zhu, 2020). In-service elementary school teachers participating in a teachers' professional development MOOC in Greece enhanced their self-efficacy beliefs compared to those teachers who did not participate in the course (Tzovla et al., 2021). As teachers are expected to adjust to rapidly evolving national education policies (Zein, 2019) and meet the increasing demands for flexible and inclusive education for diverse learners, MOOCs can become a tool for open education and teacher professional development for all (Koukis & Jimoyannis, 2019).

Language MOOCs are dedicated to online instruction in second or foreign languages. They can be effectively used to teach all aspects of language, especially for reading and listening skills (Sallam et al., 2020). MOOCs designed to improve teachers' instructional practices in teaching English as a second language are largely offered in English (Finardi & Tyler, 2015). English MOOCs are especially popular with English language learners (ELLs; see Wilson & Gruzd, 2014) who commonly enroll to improve their English language skills as well as their economic, social, and geographic mobility (Uchidiuno et al., 2018). While there are benefits to offering courses in English, those who design and develop MOOCs should take into consideration the English proficiency of their learners and adjust the language level of the MOOC without sacrificing content.

CoI Framework Supporting Online Learning Performance

Online courses tend to have attrition rates 10 to 20% higher than in-person courses (Bawa, 2016). Attrition rates are much worse in MOOCs. Fewer than 5% of participants enrolled in MOOCs offered by MIT and Harvard University passed their course. The pass rates rose to nearly 16% when students indicated they intended to pass the MOOC, and only went as high as 50% when students paid a small fee (Reich & Ruipérez-Valiente, 2019a, b). In order to improve course outcomes, many have attempted to strengthen the three presences highlighted in Garrison et al.'s (2000) CoI framework (see Figure 1).

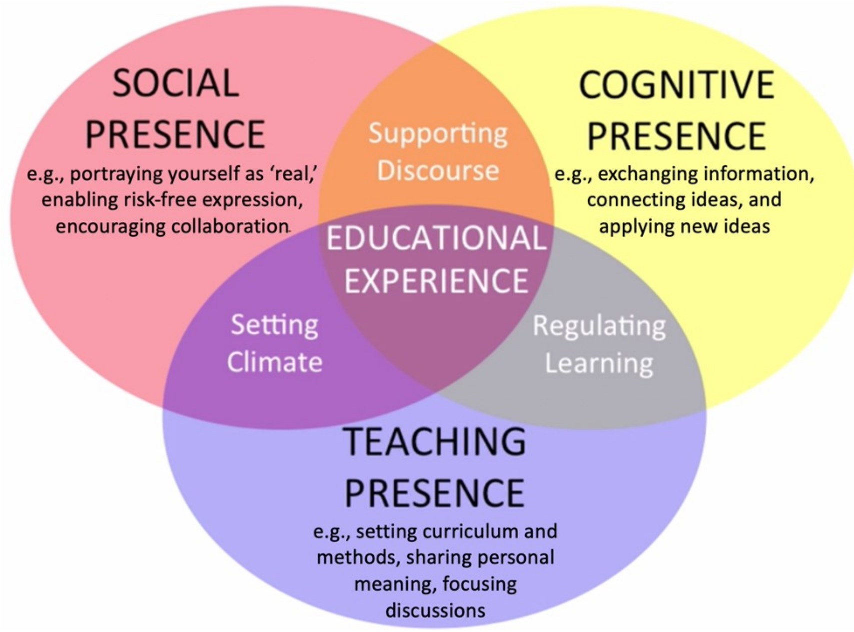
- Cognitive presence referred to "the extent to which the participants in any particular configuration of a community of inquiry are able to construct meaning through sustained communication" (Garrison et al., 2000, p. 89).

- Social presence was seen as a prerequisite for cognitive presence and defined as "the ability of participants in the Community of Inquiry to project their personal characteristics into the community, thereby presenting themselves to the other participants as 'real people'" (Garrison et al., 2000, p. 89). Social presence was indicated by affective expression, open communication, and group cohesion.

- Teaching presence was seen as the *binding element* because "appropriate cognitive and social presence, and ultimately, the establishment of a critical community of inquiry, is dependent upon the presence of a teacher" (Garrison et al., 2000, p. 96). Teaching presence was indicated by design and organization of learning activities, facilitation, and direct instruction.

Figure 1

Model for Community of Inquiry Framework



Note. Adapted from Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education, 2*(2–3), 87–105. https://doi.org/10.1016/S1096-7516(00)00016-6

The CoI framework was created following content analyses of discussion board comments. A decade later, Archer (2010)—one of the CoI original authors—suggested that "the time has come to build outwards from the firm base established by the many researchers who have applied this framework in the context of online discussions" (p. 69). Stenbom (2018) identified and analyzed 103 journal articles that used the CoI instrument and found that a primary purpose of using the instrument was to gain insight into a variety of aspects in a learning environment or even compare entire courses. Fiock (2020) also reviewed research using the CoI framework and showed that research has focused on a wide range of aspects related to designing and facilitating online courses. Kumar et al. (2011) even applied the CoI framework to the design of an entire online doctoral program. Xing (2019) summarized that the CoI framework has "been widely applied to the design of online courses" (p. 101) including MOOCs (see Thymniou & Tsitouridou, 2021).

Need for a Validated Global Survey

Using 287 online student responses collected from four North American universities, Arbaugh et al. (2008) developed and validated a widely-used survey instrument that measured each of the three presences in the CoI framework. Stenbom (2018) reviewed 103 journal articles using the CoI instrument and found that an "overwhelming majority of the studies" were conducted in North America. At the same time, there has been important work using the instrument internationally. For instance, it has been translated and validated in several languages including Portuguese (Moreira et al., 2013), Arabic (Alaulamie, 2014), Korean (Yu & Richardson, 2015), Swedish (Öberg & Nyström, 2016), Chinese (Ma et al., 2017), Spanish (Gil-Jaurena et al., 2019), and French (Heilporn & Lakhal, 2020). However, considering that many global courses such as MOOCs enroll students with many different native languages, offering a survey in the language of instruction is the most logical approach. The original CoI survey in English has been used for research in international contexts such as in Singapore (Choy & Quek, 2016), South Korea (Kim, 2017), and China (Zhang, 2020). However, in these studies, accuracy of comprehension of the survey items may have been limited due to respondent language proficiency. Because English is commonly used in international courses (Finardi & Tyler, 2015; Wilson & Gruzd, 2014), the purpose of this research was to create and validate a version of the CoI survey for use in international courses where English is used but is not students' native or primary language. This study aimed to expand the usability of the CoI instrument beyond the original and translated versions. It also provided an example of adapting and validating existing instruments without translating the language. Factor analytic techniques have been shown to provide evidence of instruments' validation (Brown, 2015; Tabachnick & Fidell, 2019).

Methods

Research Context and Background

Following a grant from the US Department of State, we developed and freely offered three versions of an online professional development course to teachers of English whose students' ages ranged from 3 to 10, in countries where English was not the dominant language. The first version was a global online course (GOC) with eight-weekly modules and an enrollment cap of 25 students, allowing for weekly facilitated discussions and personalized feedback on assignments. In total, we offered 25 sections of the GOC to 609 students from 89 countries. All students who applied were nominated by their local US embassy, and selected and enrolled by the US Department of State. We also offered the GOC's first five modules to students in more than 100 countries as two different versions of a MOOC. The first MOOC maintained a set start and end date with weekly deadlines. The second MOOC provided students with flexibility in their pacing so long as they finished the modules within the 12-week period in which it was offered. In total, the five-week MOOC enrolled 21,232 students (7,221 successfully completed the course); 8,691 students (1,494 successfully completed the course) enrolled in the more flexible MOOC. Individualized instructor feedback was not provided on submitted assignments but module discussions were facilitated by the instructors and 20 top-performing GOC students. Similar to the GOC, the instructor posted regular announcements and reminders to help motivate students. As expected, student engagement and completion varied across the three versions of the course. Table 1 outlines the completion rates for both the total students enrolled as well as those students who completed at least one activity; we defined these as active students.

Table 1

Participants Across Three Course Formats

Course type	Number. enrolled	Number active	Number completed	% Completed (enrolled students)	% Completed (active students)
Global online course (25 sections)	609	534	449	74%	84%
5-week MOOC	21,232	9,948	7,221	34%	73%
Flexible MOOC	8,691	2,379	1,494	17%	63%

The purpose of this program was for experts in the field to provide research-based professional development opportunities to English as a foreign language (EFL) teachers and teacher educators around the world who may not otherwise have access. Since the participating teachers were largely ELLs themselves, the US Department of State required that all course materials be developed at the B1 level, based on the CEFR for English, meaning a participant "can read straightforward factual texts on subjects related to his/her field and interests with a satisfactory level of comprehension" (Council of Europe, 2018, p. 60).

Data Collection

Since modules 1 to 5 were nearly identical across all three course formats, all participants were invited to voluntarily complete the CoI instrument in Module 5. A course page provided an invitation to participate in our study, a description of our survey research following IRB requirements, and a link to a Qualtrics survey. The Qualtrics survey included respondents' informed consent to participate in research, demographic information (e.g., gender, age, country, teaching position, number of years teaching), and our revised CoI survey items. The original CoI survey was developed and validated with English-speaking students from North America so understandably, as required for use in the course, it was written at a higher level than CEFR for English B1. As a result, three members of the research team worked collaboratively to revise the items. All three members had previously used the CoI framework in research. Additionally, one team member was an EFL expert and another was a non-native English speaker who had also been trained as an EFL teacher. The revised items were written at the B1 level while still addressing the intended CoI constructs. No changes were made to the response scale (see Table 2).

Table 2

Comparing the Original and Revised Items

Construct	Item label	Original item	Revised item
Teaching presence	TP1	The instructor clearly communicated important course topics.	The teacher clearly communicated about important course topics.
	TP2	The instructor clearly communicated	The teacher clearly communicated about

		important course goals.	important course goals.
	TP3	The instructor provided clear instructions on how to participate in course learning activities.	The teacher gave clear instructions on how to complete course activities.
	TP4	The instructor clearly communicated important due dates/time frames for learning activities.	The teacher clearly communicated about important due dates.
	TP5	The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.	The teacher helped explain difficult topics to help me learn.
	TP6	The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.	The teacher helped me understand my thinking about course topics.
	TP7	The instructor helped to keep course participants engaged and participating in productive dialogue.	The teacher helped students be engaged and participate in dialogue.
	TP8	The instructor helped keep the course participants on task in a way that helped me to learn.	The teacher helped keep students on task, and it helped me learn.
	TP9	The instructor encouraged course participants to explore new concepts in this course.	The teacher made me want to learn new things.
	TP10	Instructor actions reinforced the development of a sense of community among course participants.	The teacher made students feel as part of a community.
	TP11	The instructor helped to focus discussion on relevant issues in a way that helped me to learn.	The teacher set up discussions to help me learn.
	TP12	The instructor provided feedback that helped me understand my strengths and weaknesses relative to the course's goals and objectives.	The teacher provided feedback that helped me learn.
	TP13	The instructor provided feedback in a timely fashion.	The teacher provided feedback on time.
Social presence	SP1	Getting to know other course participants gave me a sense of belonging in the course.	Getting to know other students made me feel part of the course.
	SP2	I was able to form distinct impressions of some course participants.	I got to know some students.

	SP3	Online or Web-based communication is an excellent medium for social interaction.	Online communication is an excellent way to interact with people.
	SP4	I felt comfortable conversing through the online medium.	I felt comfortable communicating online.
	SP5	I felt comfortable participating in the course discussions.	I felt comfortable participating in the course discussions.
	SP6	I felt comfortable interacting with other course participants.	I felt comfortable interacting with other students.
	SP7	I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.	I felt it was OK to disagree with other students.
	SP8	I felt that my point of view was acknowledged by other course participants.	I felt that other students understood my point of view.
	SP9	Online discussions help me to develop a sense of collaboration.	Online discussions help me to collaborate with others.
Cognitive presence	CP1	Problems posed increased my interest in course issues.	Questions asked in the course increased my interest in course topics.
	CP2	Course activities piqued my curiosity.	Course activities made me curious to learn more.
	CP3	I felt motivated to explore content-related questions.	I felt motivated to explore the questions asked.
	CP4	I utilized a variety of information sources to explore problems posed in this course.	I used many resources to explore questions asked.
	CP5	Brainstorming and finding relevant information helped me resolve content-related questions.	Sharing and finding information with classmates helped me find answers to questions asked.
	CP6	Online discussions were valuable in helping me appreciate different perspectives.	Online discussions helped me see different perspectives.
	CP7	Combining new information helped me answer questions raised in course activities.	Combining all of the new information helped me answer questions asked in course activities.
	CP8	Learning activities helped me construct explanations/solutions.	Course activities helped me create explanations/solutions.
	CP9	Reflection on course content and discussions helped me understand fundamental concepts in this class.	Thinking about the course content and discussions helped me understand course topics.

CP10	I can describe ways to test and apply the knowledge created in this course.	I can describe ways to use the knowledge created in this course.
CP11	I have developed solutions to course problems that can be applied in practice.	I developed solutions that I can use in my teaching.
CP12	I can apply the knowledge created in this course to my work or other non-class related activities.	I can apply the knowledge created in this course to my work.

Note: Participants used the response scale: 1 = *strongly disagree*, 2 = *disagree*, 3 = *neutral*, 4 = *agree*, 5 = *strongly agree*.

To achieve the B1 level, items were revised to use more familiar terms and grammatical structures that would also be less ambiguous for participants coming from diverse linguistic and cultural backgrounds. For example, we switched out instructor for teacher, a term more familiar to teachers working in classroom contexts. Some verbs were simplified, such as changing conversing to a more familiar verb, communicating. Some original items had complex sentences, such as "The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking." We adapted this item by making it more personalized and simplifying the sentence structure: "The teacher helped me understand my thinking about course topics." In addition, we avoided using words that have a different meaning in other contexts (e.g., the word fashion). These types of revisions from the original versions still preserved the meaning and intent of the survey items while making them more comprehensible to global course participants.

Data Analysis

We randomly divided data into two samples. The first half (n = 744) was used to conduct exploratory factor analysis (EFA). The second half (n = 743) was used to confirm the factor structure with confirmatory factor analysis (CFA). Gorsuch (1983) explained that EFA determines "factors that best reproduce the variables under the maximum likelihood conditions, [while CFA] tests specific hypothesis regarding the nature of the factors" (p. 129). We first conducted an EFA to determine the items that best described the construct. EFAs are used to assess the factor structure of a set of variables (data). Whenever these data are measured at a categorical level (e.g., ordinal, polytomous), Brown (2015) proposed the use of a robust weighted least square (WLSMV) estimator. An oblique rotation method (geomin) was applied, assuming the extracted factors were correlated. Rotating the factor matrix allowed for a more interpretability solution (Tabachnick & Fidell, 2019). The correlations matrix for correlation and sample adequacy is assessed using Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO; Kaiser, 1970) measure. KMO values greater than .5 are acceptable and greater than .9 are superb (Field, 2009). A significant Bartlett's test indicates adequate correlations within the matrix.

Several pieces of information were needed to identify the number of factors to extract in an EFA model. EFA is a descriptive and exploratory tool; therefore, to determine the number of factors to retain, we relied on (a) item-factor correlations (loadings); (b) goodness of model fit; (c) percent of variance explained by the factors; (d) and theoretical explanations. Meyers et al. (2017) recommended factor loadings of .40 and higher with sample size in excess of 200 participants. However, results in the high .3s may also be acceptable. We concentrated on five fit indices: (a) χ^2 goodness-of-fit statistic; (b) the root mean square error of approximation (RMSEA; Steiger & Lind, 1980); (c) standardized root mean square residual (SRMR); (d) comparative fit index (CFI); and (e) Tucker-Lewis index (TLI). SRMR, RMSEA, and χ^2 are considered bad fit indices; therefore, values of zero indicate perfect fit, and closer to zero reflects better fit (Brown, 2015). A model is deemed to have good fit if RMSEA ≤ 0.05 (Hu & Bentler, 1999) but acceptable once the upper bound of the confidence interval is less than or equal to 0.10 (Kline, 2011), and low values for SRMR (≤ .05; Schreiber et al., 2006). CFI and TLI are goodness-of-fit indices, where values in the range of .90 and .95 generally represent acceptable model fit (Brown, 2015).

The main premise of factor analysis is to extract common variance among items. As such, reporting the total amount of variance extracted forms an important consideration in the factor analytic process. Tabachnick and Fidell (2019) suggested that the final factor solution should explain at least 50% of the total item variance. Additionally, the amount of variance in each item, explained by the retained factors—communality—should also be reported (Field, 2009). We were guided by Tabachnick and Fidell (2019) using .50 cutoff for communality coefficients (h^2) and an average of at least .60 for all items (Field, 2009). The CFA applied the same fit indices used for EFA; the CFA model was employed to assess the empirical factor structure found through the EFA.

Findings

The WLSMV extraction method was used to conduct the EFA. Preliminary analysis yielded that the sample size was superb (KMO = .965). The correlations were also large enough for factor analysis using the Bartlett's Test [$X^2(946) = 24676.05$, $p < .001$]. We generated four models to determine the best structure for the data. The fit indices for the models are presented in Table 3. The first two models (one-factor and two-factor models) did not meet the preset criteria for model fit with CFI and TLI below the preferred .95 cutoff. SRMR and RMSEA were also out of range.

Table 3

Fit Indices for the Four Exploratory Factor Analysis Models (N = 34 items)

Model	RMSEA [90% CI]	CFI	TLI	SRMR	χ^2	Variance explained
1-Factor	0.106 [0.103, 0.109]	.894	.887	.092	(527) = 3785.52, $p < .001$	61.36%
2-Factor	0.092 [0.089, 0.096]	.925	.914	.054	(494) = 2812.86, $p < .001$	68.83%
3-Factor	0.077 [0.073, 0.080]	.951	.941	.041	(462) = 1968.22, $p < .001$	72.99%
4-Factor	0.070 [0.066, 0.074]	.962	.951	.035	(431) = 1597.24, $p < .001$	75.84%

Note. 90% CI = confidence intervals. Root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker Lewis index (TLI), standardized root mean square residual (SRMR). For the chi-square (χ^2), degrees of freedom are in parentheses.

The third and fourth models showed more acceptable fit and were further examined despite RMSEA values being greater than 0.05 for both models, but we observed the acceptable fit through the upper bound of the confidence intervals. Overall, the 3-factor and 4-factor models better represented the data. Further assessment of these models found that in the 4-factor model, several items had severe cross-loadings. As a team we discussed the wording of these items and potential reasons for the cross-loadings. We decided these items were problematic and were therefore deleted. Additionally, other items remained in the analysis that covered the theoretical representation of the constructs being measured. In an iterative process, we removed individual items to ensure we observed the correlations at each iteration. As a result of the several analyses, we removed seven items (i.e., TP2, TP13, SP1, SP2, SP9, CP5, and CP11).

Upon the theoretical removal of those items, we regenerated four models. Those fit indices are presented in Table 4. Once again, the 3-factor and 4-factor models were better representations of the data. We tabled the 27-item factor loadings of both models (Table 5). Further inspection of the 4-factor model revealed more cross-loadings between factors and no items with factor loadings greater than .40. For example, in the 4-factor solution, item CP10 could be a function of the second and fourth factors. Through discussing the two models, we opted for the 3-factor model, as its items better fit the theorized teaching presence (n = 11), *social presence* (n = 6), and cognitive presence (n = 10). This model had the simplest structure with loadings all greater than .40 (Meyers et al., 2017), adequate fit indices, and the three factors explained 73.81% of the variance in all the items (more than the 50% recommended by Tabachnick & Fidell, 2019). Additionally, the average communality across the retained items was .60, suggesting that we had explained, on average, 60% of the variances across all the items included in the three factors we retained.

Table 4

Fit Indices for the Four Exploratory Factor Analysis Models (n = 27 items)

Model	RMSEA [90% CI]	CFI	TLI	SRMR	χ^2	Variance explained
1-Factor	0.117 [0.113, 0.120]	.883	.873	.093	(324) = 3611.60, $p < .001$	62.15%
2-Factor	0.095 [0.091, 0.099]	.929	.916	.049	(298) = 2298.19, $p < .001$	70.09%
3-Factor	0.076 [0.072, 0.080]	.958	.946	.034	(273) = 1450.06, $p < .001$	73.81%
4-Factor	0.071 [0.066, 0.075]	.967	.954	.029	(249) = 1170.58, $p < .001$	76.65%

Note. 90% CI = confidence intervals. Root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker Lewis index (TLI), standardized root mean square residual (SRMR). For the chi-square (χ^2), degrees of freedom are in parentheses.

Table 5

Factor Loadings for the Three- and Four-Factor Solutions

Item	Factor solution							
	4-Factor model				3-Factor model			
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 1	Factor 2	Factor 3	h^2
TP1	.740	-.003	.010	.306	**.699**	-.104	.240	.56
TP3	.768	-.008	.031	.307	**.733**	-.109	.255	.61
TP4	.714	.064	-.028	.240	**.681**	-.024	.159	.49
TP5	.898	-.015	-.039	.055	**.897**	-.001	-.034	.81
TP6	.878	-.020	-.009	.071	**.876**	-.004	.000	.77
TP7	.882	.044	-.014	-.163	**.920**	.157	-.204	.91
TP8	.912	.015	.014	-.078	**.948**	.117	-.136	.93
TP9	.661	-.085	.325	.031	**.673**	.029	.225	.50
TP10	.641	.100	.185	-.035	**.660**	.198	.068	.48

TP11	.536	.243	.147	-.031	**.546**	.312	.062	.40
TP12	.479	.205	.131	-.084	**.495**	.280	.018	.32
SP3	.101	.693	.053	-.053	.108	**.734**	-.017	.55
SP4	.058	.810	.065	-.021	.057	**.844**	.016	.72
SP5	-.017	.905	.013	.066	-.030	**.918**	.020	.84
SP6	-.005	.975	-.051	.028	-.016	**.989**	-.060	.98
SP7	-.046	.591	.000	.111	-.065	**.572**	.060	.34
SP8	.048	.678	.071	.002	.047	**.710**	.033	.51
CP1	.036	.146	.740	-.104	.044	.312	**.560**	.41
CP2	.032	-.012	.895	-.077	.034	.193	**.699**	.53
CP3	-.019	-.053	.967	-.093	-.007	.170	**.741**	.58
CP4	.000	.149	.632	-.030	.013	.284	**.492**	.32
CP6	.033	.238	.591	.108	.029	.335	**.542**	.41
CP7	.009	.079	.768	.216	-.007	.179	**.767**	.62
CP8	-.014	.002	.834	.276	-.037	.095	**.867**	.76
CP9	.053	.031	.680	.363	.010	.061	**.817**	.67
CP10	-.035	.058	.702	.379	-.076	.084	**.845**	.73
CP12	.169	-.040	.607	.327	.132	-.017	**.732**	.55

Note. Factor loadings greater than .40 are in boldface. h^2 is communalities for the 3-Factor model only.

Finally, we conducted the CFA to assess the factor structure with a unique sample. First, we assessed the internal consistency of the subscales. We employed the Cronbach's (1951) coefficient with a traditional .70 recommendation (Nunnally & Bernstein, 1994). Higher values reflect higher internal consistency (i.e., the items share a large amount of variances). We found that items for teaching presence (a = .950, 95% CI[.945, .955]), social presence (a= .892, 95% CI[.880, .903]), and cognitive presence (a = .949, 95% CI[.943, .954]) reliably measured the constructs. The results of the CFA revealed that the factor structure from the EFA adequately represented the data: CFI = .974, TLI = .972, and RMSEA = 0.067, 90% CI [0.063, 0.070]. The factor loadings are presented in Table 6. Moderate to high relationships existed across the three factors: teaching presence and social presence (r = .614), teaching presence and cognitive presence (r = .705), and social presence and cognitive presence (r = .679).

Table 6

Factor Loadings for the Three-Factor Confirmatory Factor Analysis

Teaching presence		Social presence		Cognitive presence	
Item	Loading	Item	Loading	Item	Loading
TP1	.949 (0.02)	SP3	.926 (0.02)	CP1	.955 (0.01)
TP3	.944 (0.02)	SP4	.979 (0.02)	CP2	.984 (0.01)
TP4	.893 (0.02)	SP5	1.00 (0.00)	CP3	1.00 (0.00)
TP5	.959 (0.02)	SP6	.997 (0.02)	CP4	.826 (0.02)
TP6	.979 (0.02)	SP7	.734 (0.03)	CP6	.939 (0.01)
TP7	.949 (0.02)	SP8	.891 (0.02)	CP7	.956 (0.01)
TP8	.974 (0.01)			CP8	.977 (0.01)
TP9	1.00 (0.00)			CP9	.974 (0.01)
TP10	.977 (0.02)			CP10	.942 (0.02)
TP11	.951 (0.02)			CP12	.968 (0.02)
TP12	.868 (0.02)				

Note. Standard errors are in parentheses. Items with loadings = 1 represent items used as the scaling constant.

Implications and Conclusions

Language Considerations with Global Online Research

This study developed through the need for a CoI instrument that was written for a global audience using English as the lingua franca. The participants in our online courses were from over 80 countries and enrolled in our courses to learn more about English language teaching. Based on our grant-funded program parameters, we developed course materials—including the survey—in English at the CEFR B1 level to ensure participant understanding. This brought to light the importance of language considerations and comprehensibility when conducting global online research. Knowing that more and more students with varying levels of English language proficiency are enrolling in global courses offered in English, such as MOOCs, instructional designers and facilitators should carefully consider the language level required to participate in all aspects of their courses. This is especially true when collecting data from students for evaluative and research purposes, since important decisions are often based on these data and should be valid.

This study successfully adapted survey item to the CEFR B1 level, which was high enough to maintain the basic meaning of survey items while also being more comprehensible to respondents who were not native English speakers. More research is needed to examine processes for lowering the language level of existing survey instruments.

Using the CoI Survey in Global Contexts

Since global courses are most frequently offered in English, the CoI instrument needed to be examined critically and revised to ensure the utility and validity of the data it provided. After revising the CoI instrument to be at the CEFR B1 level, we administered it to students enrolled in one of the following three course formats: sections with reasonably low instructor-to-student ratios (1:25), a five-week MOOC, and a flexible MOOC. This study showed success in adapting survey items in the CoI instrument to the CEFR B1 level, which can be useful for other CoI studies conducted in global contexts. However, more work is needed to examine the validity of this instrument in international online learning environments.

Although there are accepted processes for translating and validating surveys (see Gavriilidou & Mitits, 2016), these are often not feasible for research in global courses or courses in multicultural contexts with a high level of linguistic diversity. For instance, the MOOCs examined in this research included participants from over 100 countries. Therefore, the most practical option was to provide a survey in the language of instruction at a level comprehensible for varying levels of language proficiency. However, we found no studies that investigated the methods and/or validation of instruments adapted from one language into the same language, making adjustments based on participants' proficiency level.

Contextual and Cultural Aspects of CoI Survey Item Analysis

Using an EFA and CFA, we found the instrument had good fit statistics once seven items (TP2, TP13, SP1, SP2, SP9, CP5, and CP11) were removed. There are some possible contextual reasons why the removed items did not load as expected. Social presence is a construct that describes student perceptions and attributes of learner-learner interactions (Garrison et al., 2000). The CoI instrument was originally developed for use in small traditional online courses with high levels of interactions within small groups of students (Arbaugh et al., 2008) allowing students to develop a level of familiarity that is unlikely to form in a MOOC. Additionally, we administered the survey to students following only five weeks of participation, and students' perceptions regarding other students may have changed if the course offerings were longer.

Based on these two contextual aspects related to class size and length of instruction between a traditional online course and short-term MOOC, it is understandable that the three social presence items that measured students' ability to form relationships or collaborate with others did not fit the model as well as the items that focused on students' comfort communicating online. Interestingly, two of those removed items, SP1 and SP2, are aligned with the social presence subconstruct affective expression. This finding supports Poquet et al.'s (2018) examination of social presence in three MOOCs that also found students tended to respond lower to SP1 and SP2. Similarly, in Kovanovic et al. (2018), EFA using student responses from five MOOCs found that the data fit best when affective expression was its own factor. As a result, additional research is needed to examine the development of affective expression in MOOCs.

Furthermore, the data from the two teaching presence items that focused on instructor-provided feedback did not fit the model as well as did the other teaching presence items. One important limitation of MOOCs is the quality of the feedback students receive. In MOOCs with thousands of students where the content experts typically do not have time to provide much feedback to individual students, it makes sense that the survey items measuring feedback performed differently than did the other items that can be accomplished in whole group interactions. However, because feedback is still important to teaching presence, we decided to keep the items TP12 and TP13 that focused on providing quality and timely feedback. Additional research is needed to explore effective ways to provide feedback in MOOCs, and keeping TP12 and TP13 will help this survey stay tied to the theory, even though its removal would have helped the data fit slightly better.

Similarly, even though SP7 (I felt it was OK to disagree with other students) was less than .5, this item was kept because is important to the concept of social presence and was not captured in other items. This was a particularly interesting item due to cultural aspects of online communication and learning. It is possible that for some of the cultures represented in the course, it was not appropriate to overtly disagree with other students. Research in intercultural pragmatics focused specifically on the speech act of disagreement in multicultural online asynchronous discussions using English as a lingua franca have showed a tendency to avoid strong disagreement, particularly with students who have lower levels of English language proficiency (Maìz-Arévalo, 2014). Therefore, this item may have cultural bias in its interpretation, particularly if public disagreement is not considered culturally acceptable. We recommend that additional research examine intercultural perspectives on disagreement as a measure of social presence in global courses, including more qualitative research with culturally and linguistically diverse learners' discourse in online synchronous discussions.

Implications for Future Research

The use of the revised CoI survey could benefit researchers examining global online courses where participants have varying levels of English language proficiency. The revised instrument's simplified language and sentence structure can help collect data that more accurately reflects students' perceived CoI in global courses as well as courses offered in multicultural contexts. We also recommend that others carefully consider the language levels of the research instruments they both create and use, particularly when using instruments in global contexts or within diverse contexts in North America where participants have varying levels of English language proficiency. If respondents are ELLs, survey items that have been written for native speakers may not be comprehensible or could result in survey fatigue due to the heavy linguistic load of each item. Improving the comprehensibility by lowering the language level will make the instruments accessible to a larger international audience. It is also important to validate surveys when using them with different audiences or when revising for language level. We recommend conducting an EFA and CFA, similar to this study.

Furthermore, researchers should consider the diverse range of cultures represented in survey respondents, which can affect participants' understanding of the survey items. For example, perceptions of disagreement as an indicator of social presence could be different because of culture and language proficiency (Maìz-Arévalo, 2014). Furthermore, the length and type of course could affect participants' perceptions of teaching, social, and cognitive presences. For example, without an instructor giving individualized feedback to students in MOOCs, it is expected that the item measuring feedback performed differently across three different formats, particularly since the original survey was designed and validated in traditional instructor-led courses rather than MOOCs.

A large portion of instructional design and technology (IDT) research has come from English speaking countries (Bodily et al., 2019). Furthermore, North America is overrepresented in the most highly cited online and blended learning research—especially at the K–12 level (Hu et al., 2019). The opportunity to design, develop, facilitate, and research global online offerings has never been greater due to improving telecommunication infrastructures and increasing support from all levels of government throughout the world (Palvia et al., 2018). The COVID-19 crisis has accelerated the growth and acceptance of online learning throughout the world. As we move into this new normal, it is important that the IDT field maintains a global perspective in our research efforts. The revised CoI instrument shared in this research can aid in those efforts.

Acknowledgement:

This publication was prepared under a grant funded by Family Health International under Grant No. S-ECAGD-16-CA-1092 funded by The U.S. Department of State, Bureau of Educational and Cultural Affairs. The content of this publication does not necessarily reflect the views, analysis or policies of FHI 360 of The U.S. Department of State, Bureau of Educational and Cultural Affairs, nor does any mention of trade names, commercial products, or organizations imply endorsement by FHI 360 or The U.S. Department of State, Bureau of Educational and Cultural Affairs.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 23, Number 3

September – 2022

The Landscape of MOOC Platforms Worldwide

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Abstract

Previous studies have mainly investigated major massive open online course (MOOC) platforms such as Coursera, edX, and Udemy. This study used 21 metrics to explore 35 MOOC platforms from across the world. Five Web analytics tools were used to analyze these MOOC platforms using data from MOOC platform directories and exploration of platform sites. The findings revealed that many universities, companies, and organizations have cooperated with the platforms and provided MOOCs through them. Major global platforms have offered thousands of MOOCs while regional platforms were more likely to have offered dozens. Some large platforms had millions of registered users while others registered just thousands. The major global platforms were established in the US to offer MOOCs mainly in English, though they offered MOOCs in other languages as well. The regional platforms offered MOOCs mainly in local languages, and to some extent in English and other languages. Some platforms engaged users for long periods while others failed to keep users after they viewed the first page of the platform. On average, a visitor stayed on a platform for 8 minutes visited 7.2 pages per visit. Major global platforms attracted users from all over the world, while regional platforms mainly attracted users from countries where the regional platform language was spoken. Some platforms had very few accessibility and contrast errors while other platforms performed poorly. Most platforms were mobile-friendly. However, administrators of almost all MOOC platforms should take actions to increase the speed of their platform. Other recommendations include undertaking marketing campaigns to increase the number of partners, the number of MOOCs offered, and the platforms' visibility.

Keywords: Massive open online course, MOOC, MOOC platform, open education, users' engagement

Introduction

The aims of many international organizations include a focus on open education for everyone. For example, the United Nations' Universal Declaration of Human Rights (United Nations, 1948) specifically cited the right of free education for everyone. Similarly, the European Commission (2016) in their agenda on open education included aims for open access and participation in education for everyone.

Massive open online courses (MOOCs) have been proposed as a tool to achieve open education for all without restrictions of time and location (Siemens, 2013). In MOOCs, massive means that a huge number of learners can access, attend, and participate. The term open means that anyone can freely access, attend, and participate in a MOOC without any restrictions (e.g., prior educational qualification, time, place). Access to, attendance at, and participation in a MOOC all happen online. Finally, describing a MOOC as a course means that it is structured into several modules and provided within a specific time frame. It may contain video lectures, educational material, assignments, self-assessment tests, quizzes, and online discussion forums. The duration of a MOOC may vary from a few hours to months. Certification can be issued for a fee after the learner has successfully passed a final exam.

There are two main categories of MOOCs—xMOOCs where the teacher delivers instruction, perhaps through video presentations and quizzes, and cMOOCs or connectivist MOOCs that emphasize knowledge creation, autonomy, collaboration, and social networking (Siemens, 2013). However, there are also several variations of these two main categories (Economides & Perifanou, 2018a; Clark, 2013; Hidalgo & Abril, 2020; Liyanagunawardena et al., 2019; Pilli & Admiraal, 2016). MOOCs are offered stand-alone on a website or together with other MOOCs in one or more MOOC platforms (Zawacki-Richter et al., 2018). A MOOC platform is an environment shared by a very large number of MOOC learners, creators, and teachers as well as providers, universities, organizations, and companies. It hosts and runs MOOCs that have been created by MOOC providers. It also offers participants tools and services such as searching, cataloguing, management, creation, hosting, sharing, and evaluation. Popular MOOC platforms include Coursera, edX, FutureLearn, Swayam, Udacity, Udemy, and so on. A MOOC provider may be a university, organization, company, or individual (e.g., instructor) that provides one or more MOOCs to learners via either private or shared platforms. Major MOOC providers include Google Cloud, Harvard University, IBM, Microsoft, MIT, Stanford University, University of California, University of Michigan, University of Pennsylvania, and others. A MOOC aggregator or directory contains a list, directory, or database of MOOC metadata and links to MOOCs. It may simply list the names of MOOCs and links to them. MOOC aggregators include Class Central, MOOC-list, CourseTalk, and MyEducationPath. Similarly, a MOOC platform aggregator or directory contains a list, directory, or database of metadata related to MOOC platforms and links to these platforms. It may simply list the names of MOOC platforms and their links.

After the first excitement about MOOCs in 2012, the COVID-19 pandemic brought MOOCs once again to the forefront (Mays et al., 2021; Purkayastha & Sinha, 2021; Salas-Rueda et al., 2022). During the pandemic, there was increased interest in MOOCs due to the quarantine measures applied in many countries. Learners wanted to access open educational material via the Internet, from any place and at any time. The number of learners registered on a MOOC platform in 2020 corresponded to one-third of all learners ever registered on such platforms (Shah, 2020). More specifically, between 2012 and 2020 (and excluding China), the number of learners increased from 2 million to 180 million. The number of courses increased from 250 in 2012 to 16,300 in 2020, and over the same period, the number of university partners in MOOC platforms increased from 40 to 950 (Shah, 2020).

In addition, there has been an increase in the number of publications on MOOCs (Alemayehu & Chen, 2021; Hidalgo & Abril, 2020). Most previous studies on MOOCs investigated learners' motivation (e.g., Hakami et al., 2017; Zhu et al., 2018), behaviour (e.g., Ferguson & Clow, 2015), and drop-out rates (e.g., Alario-Hoyos et al., 2014; Jordan, 2014). Several studies investigated characteristics of MOOC quality (e.g., Economides & Perifanou, 2018a; Gamage et al., 2015; Margaryan et al., 2015; Oh et al., 2020; Shanshan & Wenfei, 2022; Singh, 2022; Yousef et al., 2015), and the limited openness of course materials (e.g., Li et al., 2014).

However, there have been few studies investigating MOOC platforms (see Table 1), and most of these studied the few well-known MOOC platforms (e.g., Coursera, edX, Udemy, Udacity). Ayoub et al. (2020) suggested extending the investigation of platforms beyond the few well-known ones. Furthermore, a systematic literature review (Hakami et al., 2017) found that most MOOC-related studies focused only on few geographic regions. Researchers such as Li et al. (2014) and Ruipérez-Valiente et al. (2020) recommended the investigation of not only global MOOC platforms (e.g., Coursera, edX) but also MOOC platforms from different regions. Therefore, this study investigated the current state of 35 global and regional MOOC platforms from around the world.

Table 1

Previous Studies Evaluating MOOC Platforms

Study	MOOC platform	Evaluation criteria	Results
Agrawal et al. (2015)	Coursera, edX, NPTEL	Openness of content and technology, use of multimedia and social media, language support, certificate courses, responsive Web design, mobile apps, catalogue diversity	Coursera excels on most criteria except for openness
Alkaff et al. (2018)	Coursera, edX, Udacity, Udemy, FutureLearn, GetSmarter, ASU Online, 2u	Services offered to learners, instructors, universities, companies/organizations, certifiers	No platform offers services to all five types of customers Only Udacity offers certifiers the ability to create courses for technical certification and to provide technical certification exams. It offers learners technical certificates and job placement, and companies/organizations the ability to hire employees Only Udemy offers instructors the ability to create courses.
Antonova & Bontchev (2020)	Coursera, edX, Udacity, FutureLearn, Swayam, LinkedIn	Number of learners, courses, and degrees Number of mobile courses, installs, and reviews on Google Play	Coursera excels followed by edX Udemy excels on mobile installs and reviews on Google Play

Study	MOOC platform	Evaluation criteria	Results
	learning, Khan Academy		
Ayoub et al. (2020)	Coursera	Number of partner institutes, courses and instructors	United States is the top contributor followed by China.
Brahimi & Sarirete (2015)	Coursera, edX, Open2Study, FutureLearn, Udacity, FUN, Rwaq, Iversity, Edraak	Number of courses	Coursera offers the most courses (65%) followed by edX (18.3%), Open2Study (4.9%), FutureLearn (4.5%), Udacity (3.8%), FUN (3.8%), Rwaq (3.4%), Iversity (3.1%), Edraak (1%).
Cisel (2019)	Canvas Network, Coursera, edX, FUN, Futurelearn, Iversity, MiriadaX	Number of courses and partner institutes in MOOC List and Class Central Language, topic, duration, weekly workload or courses	Platforms mainly partner with institutes from their own country Institutes that offer courses in major platforms follow an industrial approach to course creation Course workload higher for courses on major platforms Course duration and workload decreased to reduce dropout rate
Conache et al., (2016)	Coursera, Udemy, Udacity, EdX	Type of MOOC, platform rank and speed, number of visits to platform, visit duration, number of pages viewed by visitors	All platforms offer both free and paid courses and, usually, paid certificates Coursera and Udemy ranked high rank and have around 40 million visits No platforms achieve good speeds for mobile access On average, visitors stay around 33 minutes and view 6.3 pages
Cornejo-Velazquez et al. (2020)	edX, Coursera, Udacity, Udemy, Codecademy	Customer segment, value proposition, communication channels, customer relationships, revenue streams, key activities, key resources, key partners, cost structure	Coursera and edX provide academic MOOCs Udacity and Udemy provide job-oriented MOOCs edX allows only universities to offer MOOCs Udemy allows anyone to offer MOOCs
Costa et al. (2018)	Coursera, edX	Number of universities offering courses, number of courses and instructors, areas of knowledge, workload, and duration of courses	Increase in the number of MOOCs and the number of universities offering MOOCs edX provides a larger variety of MOOC subjects than Coursera In general, a course is taught by two instructors for nine weeks, workload five hours per week

Study	MOOC platform	Evaluation criteria	Results
Funieru & Lazaroiu (2016)	Coursera, edX	Technical (certification verification, evaluation methods, infrastructure, integration) User perspective (structure and content, communication tools, multimedia resources, financial accessibility)	edX excels in quality of educational materials, multimedia, assessment methods, and openness
Gamage et al. (2020)	Coursera, EdX, Future Learn, OpenSAP, Open Learning, Iversity	Collaboration and interactions (learner-learner, learner-instructor, learner-platform, learner-content)	Coursera, edX, Future Learn, and Iversity offer limited collaborative opportunities The forum is the only collaboration space in the platform designs
Goglio & Nascimbeni (2021)	Italian university platforms, Coursera, OpenupEd, EduOpen, Federica, FutureLearn	Openness (language, registration, time accessibility, disability, license, download)	Most Italian MOOC providers offer course content with open licenses and do not restrict access to registered users
Li et al. (2014)	23 MOOC platforms	Licensing, support for mobile environment, course languages, accreditation	Most platforms provide courses in various subjects at the tertiary level only Most platforms reserve the rights of educational materials One-third of platforms support mobile access Different platforms provide courses in different languages Only four platforms provide personal support to users
Lin et al. (2015)	17 MOOC platforms	General (e.g., country, released date, free to register/learn/teach) Technology (mobile app, responsiveness, learning analytics) Business (for profit/non-profit, partnership model, number of university partners) Course (maximum class size, number of courses, width of courses, temporal/self-paced/mixed, course features)	FutureLearn, iversity, NovoED, and Canvas Network are the best platforms According to a survey, users prefer Futurelearn and iversity
Maldonado-Mahauad et al. (2021)	Ecuadorian university platforms based on Open edX and Moodle; Coursera, edX, MiriadaX	Number of courses offered by various Ecuadorian universities, course subject, workload, duration	Most Ecuadorian MOOCs related to applied, social, and natural sciences; humanities covered least Open edX and Moodle the most widely used On average, a student needs to spend eight hours per week Course duration four to eight weeks

Study	MOOC platform	Evaluation criteria	Results
Ruipérez-Valiente et al., (2020)	edX, Edraak	Learner characteristics	Edraak attracts local and younger learners, more females and those with lower levels of education Edraak courses suit local learners' interests and learning needs Learners in Edraak courses more engaged than those in local edX-licensed courses
Zancanaro et al. (2017)	Open Learning, CourseSites, P2PU, Versal, Udemy, Eliademy	Accreditation, accessibility, usability, security, cost information, copyright information, interaction/collaboration, report submission, content management, activity/tests, course schedule, participant management, gamification, connection with social networks, course visibility	Almost all platforms meet all criteria Open Learning and Eliademy meet most requirements.

Table 1 illustrates that most previous studies examined well-known MOOC platforms (e.g., Coursera, edX) with respect to (a) number of courses, partner institutes, learners, and course subjects (e.g., Costa et al., 2018; Maldonado-Mahauad et al., 2021); (b) languages (e.g., Cisel, 2019; Conache et al., 2016; Goglio & Nascimbeni, 2021; Li et al., 2014); (c) course duration and workload (e.g., Antonova & Bontchev, 2020; Ayoub et al., 2020; Brahimi & Sarirete, 2015; Cisel, 2019). Other previous studies examined well-known MOOC platforms regarding their (a) business models (e.g., Cornejo-Velazquez et al., 2020; Lin et al., 2015); (b) openness (e.g., Agrawal et al., 2015; Conache et al., 2016; Funieru & Lazaroiu, 2016; Goglio & Nascimbeni, 2021); and (c) mobile access (e.g., Agrawal et al., 2015; Antonova & Bontchev, 2020; Li et al., 2014; Lin et al., 2015). In addition, Conache et al. (2016) investigated four well-known MOOC platforms to determine their (a) rank, (b) speed, (c) number of visits, (d) visit duration, (e) number of pages viewed per visitor.

However, no previous study has examined other parameters of MOOC platforms such as the (a) distribution of visits from main countries of origin, (b) distribution of visits by originating source, (c) number of Websites pointing to it, (d) number of links pointing to it, (e) age of links' (f) bounce rate, and (g) accessibility. Thus, this study analyzed 35 MOOC platforms using 21 parameters (including new and previously proposed parameters). It depicted the profiles of these MOOC platforms, their popularity, and their users' engagement.

The next section presents the methodology for this study, followed by the results. Conclusions and recommendations are also provided.

Methodology

This study took place from summer to autumn, in 2021. A five-stage methodology was followed: (a) identify major MOOC platforms around the world, (b) identify methods and tools to evaluate these MOOC platforms, (c) identify evaluation parameters and their corresponding metrics, (d) measure and record the metrics for each platform, and (e) analyze the measurements.

To begin, we located 35 major MOOC platforms as catalogued by Class Central (Shah et al., 2021). Class Central aggregates, lists, and reviews courses from many providers so learners can find appropriate courses to meet their educational objectives. The final list included major global and regional MOOC platforms from around the world. We then defined the methods and tools for evaluating these 35 MOOC platforms. Initially, we explored these platforms on Class Central. Then we collected information curated by MOOC-list, CourseTalk, and MyEducationPath.

Next, we thoroughly explored each of these platforms by visiting their Websites. We recorded the platform's (a) hosting country, (b) launch year, (c) number of registered users, (d) number of partner institutes, (e) number of MOOCs offered, and (f) the most common languages and subjects of their offered MOOCs. In cases where the platform content was in languages we did not speak, we used automatic translation tools. However, several parts of these platforms could not be translated automatically. In addition, each platform followed a different structure and provided different information regarding its content. Since it was not feasible to depend only on information found on their Websites, we resorted to five Web analytics tools in order to achieve a uniform and comparable evaluation of these platforms: SimilarWeb, OpenLinkProfiler, Google PageSpeed Insights, Google Mobile-Friendly, and WAVE.

- Using SimilarWeb, we measured each platform's (a) global rank; (b) rank in education; (c) number of visits during last six months; (d) distribution (percentages) of visits from main countries of origin; (e) distribution (percentages) of visits by direct, referral, search, and social media; (f) average visit duration; (g) average number of pages per visit; and (h) bounce rate.

- Using Google PageSpeed Insights, we measured each platform's speed.

- Using Google Mobile-Friendly, we measured each platform's mobile-friendliness.

- Using WAVE, we measured each platform's accessibility errors, contrast errors, and accessibility alerts.

- Using OpenLinkProfiler, for each platform we measured (a) the number of Websites pointing to it; (b) the distribution (percentages) of Websites pointing to it by country; (c) the number of links pointing to it; and (d) the age of these links.

Table 2 summarizes the evaluation parameters and metrics that framed the data collection for this study.

Table 2

Evaluation Parameters and Metrics for Measuring MOOC Platforms

MOOC platform parameter	MOOC platform metric (data source or tool)
Demographics	Host country Launch year MOOC languages MOOC subjects
Size	Number of MOOCs (on site, Class Central, CourseTalk, MyEducationPath) Number of partner institutions (on site)
Popularity	Global rank (SimilarWeb) Education rank (SimilarWeb) Number of registered users (on site, Class Central) Number of visits during last six months (SimilarWeb) Distribution of visits from main countries (SimilarWeb) Distribution of visits by originating source (SimilarWeb) Number of Websites pointing to it (OpenLinkProfiler) Distribution of Websites by main countries pointing to it (OpenLinkProfiler) Number of links pointing to it (OpenLinkProfiler) Age of links (OpenLinkProfiler)
Visitor engagement	Average visit duration (SimilarWeb) Average number of pages per visit (SimilarWeb) Bounce rate (SimilarWeb).
Technical characteristics	Speed (Google PageSpeedInsights) Mobile-friendliness (Google Mobile-Friendly) Accessibility, such as errors or alerts (WAVE).

The names of most metrics were self-explanatory. The metric labelled distribution (percentages) of visits by direct, referral, search, and social media corresponded to the percentages of visitors that came to the platform directly, or after visiting another Website that pointed to the platform, after using a search engine, or after visiting social media. The metric bounce rate corresponded to the percentage of visitors who left the Website after viewing just one page. Regarding platform speed, 0 to 50 was a poor score, 50 to 90 was a medium score, and 90 to 100 was a good score. The age of links metric described the distribution (percentages) of the number of new links pointing to the platform during each of the years 2016, 2017, 2018, 2019, 2020, and 2021.

Table 2 shows how we allocated the 21 metrics to each one of five main platform parameters: (a) demographics, (b) size, (c) popularity, (d) visitor engagement, and (e) technical characteristics.

- Demographics included the platform's host country, launch year, as well as the languages and subjects of its MOOCs.

- Platform size was determined by the number of MOOCs the platform offered and its number of partner institutions.

- Popularity was measured by the platform's (a) global rank, (b) education rank, (c) number of registered users, (d) number of visits, (e) distribution of visits from main countries, (f) distribution of visits by originating source, (g) number of Websites pointing to it, (h) number of links pointing to it, and (i) age of links.

- Visitor engagement was measured by the average duration of platform visits, average number of pages per visit, and bounce rate.

- A platform's technical characteristics were measured by its speed, mobile-friendliness, and accessibility.

In the final stage we measured the 21 metrics defined above. The next section presents the analysis of these findings.

Results and Discussion

Platform Demographics

The list of 35 platforms was international in scope (Shah et al., 2021). Platforms have been developed in many countries all over the world. Although the major platforms (e.g., Coursera, edX, Udacity, Udemy) are located in US, other large platforms are located in China (XuetangX), India (Swayam), UK (FutureLearn), and Spain (MiriadaX). Table 3 summarizes the data on platform demographics and size.

Table 3

MOOC Platforms: Demographics and Size

Platform	Host country	Launch year	Main language	No. of MOOCs shown at				No. of univ. partners + others
				Platform itself	Class Central	Course Talk	My Education Path	
Canvas Network	US	2012	English, other	?	607	321	470	?
CNMOOC	China	2014	Chinese, English	2,531	2,000	?	?	?
Coursera	US	2012	Multiple	?	7,870	2,890	1,120	150 + 50
Edraak	Jordan	2013–2014	Arabic	185	36	53	?	?
EduOpen	Italy	2016	Italian, English	342	67	?	?	20 + 6
edX	US	2012	English, other	3,523	4,687	2,065	1,720	160

Platform	Host country	Launch year	Main language	No. of MOOCs shown at				No. of univ. partners + others
				Platform itself	Class Central	Course Talk	My Education Path	
EMMA	EU Project	2015	Various European	?	66	55	?	33 + 11
eWant *	Taiwan	2013	Chinese	2,460	1,900	?	?	93
Federica Web Learning	Italy	2015	Italian, English, other	300	86	?	?	21
Fisdom	Japan	2016	Japanese	?	20	?	?	?
Fun-MOOC	France	2013	French, English, German	711	675	98	?	140
FutureLearn	UK	2012–2013	English, other	1,285	2,436	83	83	91 + 111
Gacco	Japan	2014	Japanese	?	95	1	?	?
JMOOC	Japan	2013	Japanese	430	?	?	?	95
iCourse163	China	2014	Chinese	?	9,228	?	?	785
IndonesiaX	Indonesia	2015	Indonesian	?	40	?	?	22
Iversity	Germany	2013	German, English, other	239	115	27	108	?
Kadenze	US	2015	English	?	164	92	88	33 + 21
K-MOOC	Korea	2015	Korean, English	1,374	858	?	?	140
MexicoX *	Mexico	2015	Spanish, English	100	13	?	?	40
MiriadaX	Spain	2013	Spanish, Portuguese, English, other	?	687	301	?	100
Open Education Taiwan	Taiwan	2015	Chinese	647	531	?	?	63
Openedu.ru	Russia	2015	Russian	759	650	?	?	?
OpenHPI	Germany	2012	German, English	?	77	60	2	?
Open Learning Japan	Japan	2014	Japanese	?	?	?	?	?
Open Universities Australia	Australia	2013	English, other	2,530	109	?	?	25

Platform	Host country	Launch year	Main language	No. of MOOCs shown at				No. of univ. partners + others
				Platform itself	Class Central	Course Talk	My Education Path	
Prometheus	Ukraine	2014	Ukrainian	200	120	?	?	?
Rwaq (Riwaq or Rewaq)	Saudi Arabia	2013	Arabic	685	85	?	?	?
Swayam	India	2017	English, Hindi	?	2,065	?	?	135
ThaiMOOC	Thailand	2017	Thai, English	527	229	?	?	87
Udacity	US	2012	English	500	330	210	197	?
Udemy	US	2010	English, other	155,000	157,000	50,497	9,812	?
XuetangX *	China	2013	Chinese	4,608	3,500	?	?	641
Xue Yin Online	China	2017	Chinese	?	6,000	?	?	?
Zhihuishu	China	2012–2013	Chinese	?	8,330	?	?	?

Note. A question mark means that data were not available. * Indicates there were connection problems in reviewing the platform.

The number of platforms increased rapidly starting in 2012, the year of the MOOCs, and numbers continued to grow for the next three years (2013–2015). In 2017, two large MOOC platforms, Swayam (India) and Xue Yin Online (China), came on the scene.

Table 3 shows that while most global platforms offered MOOCs mainly in English, they have started offering MOOCs in other languages too. For example, Coursera (a major global platform) offered 2,334 courses in English and a large number of MOOCs in other languages, including Spanish (1,064), Russian (1,005), French (948), Portuguese (869), Arabic (801), German (755), Vietnamese (755), and Italian (729). On the other hand, most local platforms offered MOOCs mainly in their local language, though many also offer MOOCs in English. For example, the French regional platform Fun-MOOC offered MOOCs in French (589), English (69), Spanish (5), Arabic (1), Japanese (1), and Simplified Chinese (1).

Most platforms covered a large variety of subjects mainly addressing adults' learning needs (e.g., higher education students, continuing education professionals). Most platforms mainly offered information and communication technologies (ICT) MOOCs followed by technical and professional development topics. For example, Coursera offered MOOCs in the following subjects (number of MOOCs): computer science (1,018), data science (667), information technology (265), language learning (248), business (151), physical science and engineering (85), social sciences (68), arts and humanities (63), and health (54). A few platforms exclusively offered ICT MOOCs (e.g., OpenHPI).

Platform Size

Thousands of MOOCs were offered by the major global platforms (Coursera, 7,500; edX, 4,000; Udemy, 150,000), Chinese platforms (CNMOOC, 2,500; iCourse, 9,000; XuetangX, 3,500; Xue Yin Online, 6,000; Zhihuishu, 8,300), as well as Indian Swayam (2,000), Taiwanese eWant (1,900), UK FutureLearn (1,500), and Korean K-MOOC (1,000). Almost all platforms have created partnerships with universities, businesses, and organizations that offer their MOOCs through the platforms. The Chinese iCourse and XuetangX have the largest number of partners, with 785 and 641, respectively. A number of platforms have over 100 partners: Coursera (200), edX (160), FunMOOC (140), FutureLearn (200), K-MOOC (140), MiriadaX (100), and Swayam (135).

Platform Popularity

Table 4 summarizes the data on the popularity of MOOC platforms. In general, platforms did not succeed in achieving high rank scores among all Websites worldwide. According to SimilarWeb, only Udemy (314) and Coursera (611) managed to be among the top 1,000 websites. However, several platforms were among the top 100 educational Websites worldwide: Coursera (26), Edraak (25), FunMOOC (81), FutureLearn (9), iCourse 163 (11), K-MOOC (65), Openedu.ru (88), Prometheus (47), Rwaq (75), Swayam (97), ThaiMOOC (28), and Udemy (16).

Table 4

MOOC Platforms' Popularity: SimilarWeb Rankings and Data on Visitors and Visits

MOOC platform	Global rank	Education rank	Registered users	No. of visits	Distribution of visits by main country (%)	Distribution of visits (%)			
						Direct	Referral	Search	Social
Canvas Network	44,267	403	?	1.35 million	US (76) Philippines (3) Mexico (2) UK (2) Australia (2)	18	1	80	1
CNMOOC					?				
Coursera	611	26	87 million	51.62 million	US (21) India (10) Mexico (4) Canada (3) UK (3)	59	4	25	6
Edraak	29,664	25	4 million	1.47 million	Saudi Arabia (26) Egypt (21) Alheria (10) Morocco (10) Jordan (6)	48	3	35	12
EduOpen		?	105,000			?			
edX	2,691	102	35 million	16.29 million	US (18) India (7) Mexico (5) Australia (4) Brazil (4)	56	7	24	6

MOOC platform	Global rank	Education rank	Registered users	No. of visits	Distribution of visits by main country (%)	Distribution of visits (%)			
						Direct	Referral	Search	Social
EMMA					?				
eWant *	177,621	110	20,000	145,000	Taiwan (93) China (2) Malaysia (2) Hong Kong (2) US (1)	59	6	28	3
Federica Web Learning	149,307	115	20,000	177,000	Italy (85) Iran (9) Germany (2) Brazil (2) Spain (1)	58	12	22	3
Fisdom					?				
Fun-MOOC	54,574	81	2 million	751,000	France (61) Morocco (4) Peru (3) Belgium (3) Cameroon (3)	74	1	17	3
FutureLearn	8,100	9	15 million	5.89 million	UK (24) US (7) India (5) Australia (5) Vietnam (3)	40	7	41	7
Gacco	746,258	343	850,000	< 50,000	Taiwan (95) China (2) Hong Kong (1) US (1)	35	20	41	3
JMOOC		?	250K			?			
iCourse163	12,310	11	?	3.59 million	China (94) Hong Kong (1) US (1)	69	4	25	1
IndonesiaX					?				
Iversity	574,719	1,877	1 million	61,000	Germany (21) Spain (10) Brazil (7) Egypt (6) China (5)	56	7	33	3
Kadenze	152,943	?	?	185K	?		?		
K-MOOC	99,587	65	1.6 million	350,000	Korea (95) Thailand (2) US (1)	59	2	37	2

MOOC platform	Global rank	Education rank	Registered users	No. of visits	Distribution of visits by main country (%)	Distribution of visits (%)			
						Direct	Referral	Search	Social
MexicoX *	80,814	156	2.5 million	523,000	Mexico (98) Costa Rica, Colombia, Ecuador, Peru (< 1)	66	3	23	5
MiriadaX	164,800	241	6 million	222,000	Spain (28) Mexico (17) Peru (11) Colombia (11) Argentina (7)	61	8	25	3
Open Education Taiwan					?				
Openedu.ru	74,272	88	1.8 million	596,000	Russia (84) Ukraine (5) Belarus (3) Turkey (2) Kazakhstan (2)	55	6	20	11
OpenHPI	?	?	?	94,000	Germany (65) Switzerland (10) Netherlands (3) Austria (2) US (2)	54	16	22	5
Open Learning Japan					?				
Open Universities Australia	103,122	?	463,000	411,000	Australia (86) Vietnam (1) US (1) Brazil (1)	?			
Prometheus	132,798	47	1.5 million	323,000	Ukraine (95) Poland (2) Germany, Czech Republic (< 1)	46	4	30	10
Rwaq (Riwaq or Rewaq)	149,863	75	1 million	244,000	Saudi Arabia (41) Egypt (14) Morocco (5)	45	4	41	9

MOOC platform	Global rank	Education rank	Registered users	No. of visits	Distribution of visits by main country (%)	Distribution of visits (%)			
						Direct	Referral	Search	Social
					Turkey (4) Algeria (4)				
Swayam	25,266	97	16 million	2.79 million	India (97) Ghana, Qatar, US, UAE (< 1)	36	15	21	1
ThaiMOOC	81,380	28	200,000	362,000	Thailand (99)	41	6	27	25
Udacity	8,017	272	14 million	5.82 million	Egypt (19) US (16) Saudi Arabia (10) India (10) Nigeria (3)	62	6	22	7
Udemy	314	16	40 million	110.27 million	US (16) India (15) Brazil (6) Mexico (7) Turkey (4)	61	3	22	7
XuetangX *	83,441	271	60 million	456,000	China (91) US (2) Hong Kong (2)	71	5	22	1
Xue Yin Online	228,571	878	?	119,000	China (97) US, Taiwan, Hong Kong, India (< 1)	76	16	8	0
Zhihuishu	63,174	191	10 million	681,000	China (98) Hong Kong, Taiwan, S. Korea, US (< 1)	71	2	26	1

Note. A question mark means that data were not available. * Indicates there were connection problems in reviewing the platform.

Data about the number of registered users were missing from many platforms and could not be found on the platforms themselves, on Class Central, or other platform directories (e.g., CourseTalk, MOOC-list, MyEducationPath). The four major US-based platforms had the most registered users worldwide, namely Coursera (87 million), edX (35 million), Udacity (16 million), and Udemy (40 million). In fact, these four platforms have managed to more than double their registered users since 2017 (Shah, 2018). However, the advent of Chinese platforms XuetangX (60 million) and Zhihuishu (10 million) have upset the status quo. In addition, India's Swayam (16 million) and UK's FutureLearn (15 million) have become serious competitors. Other platforms with over a million registered users include Spain's MiriadaX (6 million), Jordan's Edraak (4 million), MexicoX (2.5 million), France's FunMOOC (2 million), Russia's Openedu.ru (1.8 million), Korea's K-MOOC (1.6 million), Ukraine's Prometheus (1.5 million), Saudi Arabia's Rwaq (1 million), and Germany's Iversity (1 million).

Table 4 shows that the major global platforms clearly attracted the largest numbers of visitors during the last six months: Coursera (51.62 million), edX (16.29 million), and Udemy (110.27 million). Other platforms that received over one million visitors during the last six months included US's Canvas Network (1.35 million), Jordan's Edraak (1.47 million), UK's FutureLearn (5.89 million), China's iCourse163 (3.59 million), India's Swayam (2.79 million), and US's Udacity (5.82 milion)

Table 4 indicates that most regional platforms attracted visitors mainly from their local country (e.g., XuetangX, Xu Yin Online, and Zhihuishu from China; Swayame from India; Openedu.rus from Russia; ThaiMOOC from Thailand; K-MOOC from Korea; eWant and Gacco from Taiwan; and Prometheus from Ukraine). However, the major global platforms achieved a balanced distribution of visitors from many different countries. So, although Coursera, edX, Udacity, and Udemy were located in US, they attracted international visitors from all over the world. Similarly, FutureLearn (UK) and Iversity (Germany) attracted visitors from various countries. Another interesting result is that many platforms offering MOOCs in a specific language attracted visitors from countries where that language was also spoken. So, Edraak (Jordan) and Rwaq (Saudi Arabia) attracted visitors from Arabic-speaking countries, MiriadaX (Spain) attracted visitors from Spanish-speaking countries, and OpenHPI (Germany) attracted visitors from German-speaking countries.

Visitors came directly to well-known global platforms (e.g., Coursera, edX, Udacity, Udemy). These platforms had already established their brand name and MOOC learners knew them. Similarly, locals visited regional platforms directly (e.g., Edraak, eWant, Federica Web learning, Fun-MOOC, iCourse163, Iversity, K-MMOC, MexicoX, MiriadaX, Openedu.ru, OpenHPI, XuetangX, Xue Yin Online, Zhihuishu). Many visitors, perhaps not yet well acquainted with a platform, came to Canvas Network (80%), FutureLearn (41%), Gacco (41%), and Rwaq (41%) via search engine results. Another interesting observation is that a large percentage (25%) of ThaiMOOC's visitors came to it through social media. Perhaps ThaiMOOC has done a successful marketing champaign in social media, or it may be that Thai people use social media a great deal.

Table 5 presents data on the popularity of MOOC platforms. The most popular platforms, pointed to by over 100,000 Websites, were Coursera (110,000) and Udemy (124,000), followed by edX (54,000), Future Learn (27,000), and Udacity (31,000). In addition, many other platforms had become well-known enough that more than 1,000 Websites hyperlinked to each of them: Canvas Network (4,000), Fun-MOOC (7,500), Iversity (3,000), Kadenze (1,500), MiraiasX (4,500), OpenHPI (1,500), Open Universities Australia (1,500), and Swayam (3,300). The majority of Websites that pointed to most platforms were located in the US. However, for some regional platforms, the majority of Websites that hyperlink to them were located in the platform's local country. So, EduOpen, EMMA, and Federica were mainly highlighted in Italian websites; Fun-MOOC was mainly linked to by French Websites; OpenHPI was mainly referred to by German Websites; and Swayam was mainly pointed to by Indian websites. However, it was strange that the Chinese platform Xue Yin Online was mainly pointed to by Indian Websites. This may be because Xue Yin Online was established in 2017 and had not yet had time to become known; only 48 Websites pointed to it.

Table 5

MOOC Platforms' Popularity: Websites and Links

MOOC platform	No. of Websites pointing to platform	Distribution of Websites by country (%)	No. of links pointing to platform	Age of links (%)					
				2021	2020	2019	2018	2017	2016
Canvas Network	4,086	comUS (45) orgUS (13) eduUS (5) netUS (5) Spain (2) Canada (2)	76,010	6	15	22	12	13	8
CNMOOC	115	comUS (43) eduChina (12) netUS (8) orgUS (6) Taiwan (5) China (2) Hong Kong (2) eduTaiwan (2) Spain (2) India (2)	576	26	9	29	21	13	2
Coursera	109,773	comUS (51) orgUS (11) netUS (4) Brazil (2) Germany (1) Canada (1)	807,003	47	11	8	12	12	5
Edraak	310	comUS (39) orgUS (17) India (3) eduUS (3) netUS (3) coIndia (2) Netherlands (2) Spain (2) UK (1) EU (1)	1,174	0	0	20	33	24	12
EduOpen	393	Italy (45) comUS (17) eduItaly (5) govItaly (5) orgUS (5) EU (5) netUS (2) Germany (1)	15,528	19	14	24	27	14	2
edX	54,371	comUS (47) orgUS (13) netUS (5) Brazil (2) Germany (2)	1,009,643	12	18	19	16	16	5
EMMA	460	Italy (21) comUS (17)	5,018	0	0	16	25	38	12

MOOC platform	No. of Websites pointing to platform	Distribution of Websites by country (%)	No. of links pointing to platform	Age of links (%)					
				2021	2020	2019	2018	2017	2016
		govItaly (11) EU (7) orgUS (7) Netherlands (4) France (4) netUS (3) UK (3)							
eWant *	148	comUS (20) eduTaiwan (15) India (15) coIndia (11) orgUS (6) netIndia (3) Taiwan (3) infoUS (2) netUS (2)	1,234	8	50	13	5	21	0.9
Federica Web Learning	546	Italy (43) comUS (20) orgUS (6) EU (4) eduItaly (3) netUS (2) infoUS (1) govItaly (1)	15,452	8	27	16	18	8	21
Fisdom	19	comUS (58) India (11) Japan (11) netUS (5) orgUS (5)	328	0	0	45	26	22	8
Fun-MOOC	7,574	France (38) comUS (25) orgUS (13) netUS (4) EU (3) Belgium (2)	187,219	10	23	30	19	11	3
FutureLearn	27,043	comUS (39) orgUS (11) coUK (8) orgUK (5) netUS (3) Netherlands (2) acUK (1) EU (1)	544,372	19	27	17	12	11	5
Gacco	126	comUS:38 Japan (14) coIndia (6) India (6) netUS (6) orgUS (5) acJapan (4) coJapan (2)	333	0	0	20	23	31	9

MOOC platform	No. of Websites pointing to platform	Distribution of Websites by country (%)	No. of links pointing to platform	Age of links (%)					
				2021	2020	2019	2018	2017	2016
JMOOC			?						
iCourse163	511	comUS (37) eduChina (9) China (8) Palau (6) orgUS (5) India (4) coIndia (3) netUS (3) topUS (3) Taiwan (2)	4,006	41	18	21	8	11	1
IndonesiaX	0	comUS (42) Palau (8) Indonesia (8) India (5) netUS (5) ac.Indonesia (5) coIndia (5) orgUS (4) coIndonesia (3) netIndia (2)	0	11	19	21	19	19	6
Iversity	2,895	comUS (33) Germany (22) orgUS (9) netUS (4) EU (3) Italy (3) Romania (2) Spain (2) Switzerland (1) Netherlands (1)	36,335	0	0	8	18	29	9
Kadenze	1,568	comUS (50) orgUS (10) netUS (7) eduUS (3) India (2) Canada (1) Germany (1)	16,053	29	11	20	16	18	3
K-MOOC	-	-	--						
MexicoX *	721	comUS (26) eduMexico (19) Mexico (12) comMexico (7) govMexico (6) orgUS (5) netUS (4) Palau (4) India (3) orgMexico (3)	7,994	9	18	35	22	12	0.3
MiriadaX	4,534	comUS (43) Spain (15)	153,524	12	11	15	8	23	9

MOOC platform	No. of Websites pointing to platform	Distribution of Websites by country (%)	No. of links pointing to platform	Age of links (%)					
				2021	2020	2019	2018	2017	2016
		orgUS (8) netUS (5) Chile (2) Brazil (2) Mexico (1) Argentina (1)							
Open Education Taiwan			?						
Openedu.ru			?						
OpenHPI	1,573	Germany (50) comUS (19) orgUS (6) netUS (5) Austria (3) EU (2) Switzerland (2)	26,914	15	24	15	13	12	5
Open Learning Japan			?						
Open Universities Australia	1,561	comUS (39) comAustralia (17) orgUS (6) netUS (4) eduAustralia (3) orgAustralia (3) Palau (2) India (2) infoUS (1)	46,400	15	11	17	16	20	12
Prometheus	321	comUS (21) Palau (9) orgUS (9) India (7) Ukraine (6) coIndia (5) comUkraine (5) netUS (4) eduUkraine (2) netIndia (2)	2,451	49	30	6	4	6	3
Rwaq (Riwaq or Rewaq)	328	comUS (42) Palau (9) India (7) orgUS (6) coIndia (5) netUS (5) infoUS (2) netIndia (2)	1,985	12	21	22	10	10	9
Swayam	3,370	acIndia (4) comUS (24) India (15) orgUS (12)	216,443	26	34	21	12	5	0.6

MOOC platform	No. of Websites pointing to platform	Distribution of Websites by country (%)	No. of links pointing to platform	Age of links (%)					
				2021	2020	2019	2018	2017	2016
		eduIndia (10) coIndia (2) orgIndia (2)							
ThaiMOOC	217	comUS (26) acThailand (12) Palau (12) India (1) coIndia (7) orgUS (6) govThailand (5) netUS (4) netIndia (2)	3,378	17	37	25	8	13	0.1
Udacity	30,096	comUS (52) orgUS (12) netUS (5) Germany (2) eduUS (1)	450,815	14	19	13	15	15	5
Udemy	124,260	comUS (59) orgUS (7) netUS (4) Brazil (2) Germany (2) UK (2) Italy (1)	2,508,417	18	24	21	14	14	4
XuetangX *			?						
Xue Yin Online	48	India (35) coIndia (29) comUS (19) netIndia (10) eduChina (2) eduMacao (2)	58	16	22	62	0	0	0
Zhihuishu			?						

Note. A question mark means that data were not available. * Indicates there were connection problems in reviewing the platform.

It is apparent from Table 5 that although similar numbers of Websites pointed to Coursera (110,000) and Udemy (124,000), the number of hyperlinks pointing to them differed greatly. A huge number of hyperlinks pointed to Udemy (2.5 million), followed by edX (1 million), Coursera (807,000), FutureLearn (544,000), and Udacity (451,000). Over 100,000 links pointed to each of the following regional platforms: Fun-MOOC (187,000), MiriadaX (154,000), and Swayam (216,000).

The evolution of a platform's visibility became apparent through examining the number of links to a platform over the years. For example, among the 2.5 million links pointing to Udemy, 4% were created in 2016, 14% in 2017, 14% in 2018, 21% in 2019, 24% in 2020, and 18% in 2021 (see Table 5). It is interesting to note that during 2021, Coursera and Prometheus managed to double the number of links pointing to them. Also, during 2020 to 2021, eWant, iCourse163, and Swayam substantially increased the numbers of links pointing to them. One reason for this increase was the rising demand for online learning during the COVID-19 pandemic (Perifanou et al., 2022; Asare et al., 2021; Lee et al., 2022). It is possible that these platforms exploited the increased demand for online learning and attracted the attention of many Websites. They may also have invested in large marketing campaigns to promote their Websites. On the other hand, Edraak, EMMA, Fisdom, Gacco, and Iversity did not gain links during the 2020 to 2021 period. It seems that these platforms did not take advantage of the growing demand for online learning, and lost the chance to increase their visibility during the pandemic period.

Visitor Engagement

Visitors to Federica stayed for the longest time (Table 6); the average visit duration at Federica was more than 21 minutes. Note that all MOOCs on Federica were free of charge. Also, visitors stayed more than 10 minutes at Coursera (11:51), eWant (10:07), iCourse163 (11:50), ThaiMOOC (13:58), Udacity (12:10), Udemy (11:06), and XuetangX (12:01). On the other hand, visitors stayed the shortest time at Canvas Network (1:36). On average, a visitor remained at a platform for eight minutes.

Table 6

MOOC Platforms: Visitor Engagement and Technical Characteristics

MOOC platform	Avg. visit duration (min:sec)	Avg no. of pages per visit	Bounce rate (%)	Speed	Mobile-friendly?	Access Errors	Contrast Errors	Access Alerts
Canvas Network	01:36	2.83	56	11	Yes	1	5	3
CNMOOC	?	?	?	?	?	?	?	?
Coursera	11:51	8.61	32	26	Yes	?	?	?
Edraak	09:25	7.25	40	15	Yes	32	1	38
EduOpen	?	?	?	26	Yes	56	48	15
edX	09:12	6.83	37	25	Yes	?	?	?
EMMA	?	?	?	59	Yes	71	118	90
eWant *	10:07	12.29	36	17	Yes	29	16	82
Federica Web Learning	21:17	14.22	23	21	Yes	30	3	15
Fisdom	?	?	?	62	No	17	36	95
Fun-MOOC	06:49	6.77	40	35	Yes	2	1	5
FutureLearn	06:02	6.24	52	30	Yes	0	0	42
Gacco	05:54	6.24	38	40	Yes	1	9	13
JMOOC	?	?	?	45	Yes	73	128	87
iCourse163	11:50	8.5	24	23	Yes	5	7	4
IndonesiaX	?	?	?	5	Yes	?	?	?

MOOC platform	Avg. visit duration (min:sec)	Avg no. of pages per visit	Bounce rate (%)	Speed	Mobile-friendly?	Access Errors	Contrast Errors	Access Alerts
Iversity	02:01	3.27	52	43	Yes	37	19	26
Kadenze	03:19	9.65	49	19	Yes	26	6	86
K-MOOC	05:44	8.08	39	31	No	?	?	?
MexicoX *	09:16	6.21	36	37	Yes	27	39	142
MiriadaX	04:57	5.45	51	16	Yes	5	6	28
Open Education Taiwan	?	?	?	25	Yes	72	75	46
Openedu.ru	06:25	6.05	45	40	Yes	46	11	29
OpenHPI	08:49	5.95	36	39	Yes	11	25	77
Open Learning Japan	?	?	?	61	Yes	106	30	120
Open Universities Australia	03:01	4.59	43	29	Yes	0	0	9
Prometheus	06:37	5.17	50	26	Yes	45	69	154
Rwaq (Riwaq or Rewaq)	05:56	5.98	51	21	Yes	49	28	38
Swayam	03:07	2.69	45	69	Yes	0	0	14
ThaiMOOC	13:58	13.57	30	29	Yes	49	5	51
Udacity	12:10	8.11	32	42	Yes	9	0	12
Udemy	11:06	6.71	35	34	Yes	2	4	4
XuetangX *	12:01	7.35	30	5	Yes	?	?	?
Xue Yin Online	06:06	8.77	21	45	?	?	?	?
Zhihuishu	09:43	6.96	25	97	Yes	62	56	125

Note. A question mark means that data were not available. * Indicates there were connection problems in reviewing the platform.

Table 6 indicates that, the greatest average number of pages per visit was to Federica (14.22), ThaiMOOC (13.57), and eWant (12.29). By comparison, the least average number of pages per visit was to Canvas Network (2.83), Iversity (3.27), and Swayam (2.69). Overall, the average number of pages per visit was 7.2.

Federica, iCourse163, ThaiMOOC, XuetangX, Xue Yin Online, and Zhihuishu achieved a bounce rate less than or equal to 30%. It is notable that most of these platforms were Chinese. One possible explanation is that these platforms have designed their Websites in such a way that visitors stayed longer and visited many pages. Another explanation may be related to visitors' personal, cultural, or other characteristics. In contrast, almost half of the visitors to Canvas Network, FutureLearn, Iversity, MiriadaX, and Rwaq left the platform after viewing just one page.

Platforms' Technical Characteristics

A platform speed score of 90 or above was considered good. A score between 50 to 90 meant that the platform needed improvement, and a score below 50 was considered poor. As shown in Table 6, almost all platforms (with the exception of Zhihuishu) needed to increase their speed. Zhihuishu showed almost perfect speed, while EMMA, Federica, Open Learning Japan, and Swayam achieved a moderate speed. The rest of the platforms performed extremely poorly, and they urgently need to increase their speed.

Most platforms were mobile-friendly with the exception of Fisdom and K-MOOC. For these two platforms, the Google mobile-friendly tool indicated that the text was too small to read and clickable items were very close to each other. Platforms showed mixed results regarding their accessibility. Some platforms had very few accessibility and contrast errors while other platforms performed poorly. In particular, Canvas Network, Fun-MOOC, FutureLearn, Gacco, Open Universities Australia, Swayam, and Udemy show few accessibility and contrast errors or none at all. On the other hand, many accessibility and contrast errors were detected in EdOpen, EMMA, JMOOC, Open Education Taiwan, Openedu.ru, Open learning Japan, Prometheus, Rwaq, ThaiMOOC, and Zhihuishu.

Conclusions, Limitations, and Future Research

This study analyzed 35 MOOC platforms from around the world. It employed both manual and automatic evaluation methods. Each platform was thoroughly explored and several metrics were recorded. This information was also combined with data from MOOC platforms' directories. Five Web analytics tools used to automatically measure various metrics of the platforms; in total, 21 metrics were recorded. The findings revealed that some platforms had developed many partnerships with universities, companies, and others, and were offering thousands of MOOCs on a variety of subjects. Although most MOOCs were in English or in the local language where the platform resided, efforts had been made to offer MOOCs in various languages. On the other hand, some platforms had only a few partners and offered a scant number of MOOCs in a limited range of subjects and languages. These platforms should be encouraged to increase their number of (a) partners, (b) MOOCs offered, (c) MOOC subjects, and (d) MOOC languages.

Some platforms had millions of registered users while others a few thousand. Major global platforms (e.g., Coursera, edX, Udacity, Udemy) had an international appeal and attracted visitors from all over the world. On the other hand, regional platforms mainly attracted users from countries where the language spoken was the same as that in the platform's host country. Expanding a platform to offer many MOOCs in various subject and languages would help attract partners and learners from all over the world. Also, offering MOOCs free of charge would help a platform to attract learners. Platforms should make efforts to increase their visibility, brand name recognition, and popularity worldwide. Collaboration with other educational institutes, organizations, and companies would serve to increase their ranking, as well as the number of Websites and hyperlinks pointing to them. Platforms should develop marketing campaigns on search engines, Websites, and social media.

Some platforms succeeded in engaging users for long periods while others failed to have users stay after they viewed the platform's first page. On average, a visitor stayed on a platform for 8 minutes and visited 7.2 pages per visit. By offering an easy-to-use interface and structure, efficient search engine and filters, as well as free educational material and other interesting resources, a platform would attract visitors to stay longer time and visit more pages per visit. Finally, almost no platforms had adequate speed. Even so, most platforms provided mobile-friendly pages. Some platforms presented few accessibility and contrast errors while others had many accessibility issues. Overall, it is important that platforms improve their speed and accessibility while remaining mobile-friendly.

One of the limitations of this study was that the measurements given by the Web analytics tools were not always accurate. Their measurements can even change after some time period. Even so, these measurements could be used as a current picture of the MOOC platforms landscape. Also, they can be used by a platform's administrators to compare their platform to others. The results of this study may serve to motivate administrators to enhance their platforms by taking appropriate actions. Administrators may also be inspired by the tactics of successful platforms such as Coursera and Udemy. Future research could use other evaluation methods and criteria, such as usability and openness (Economides & Perifanou, 2018a; 2018b), to measure the quality of platforms as well as analyze platforms' business and revenue models. Finally, future research may investigate methods to increase a platform's number of MOOCs, partners, registered users, Websites and links pointing to it, degree of user engagement, and accessibility.

Declaration of Conflict of Interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

This publication has been partially supported by Erasmus+ project OPENLang Network 2018- 1-ELO1-KA203-047967. This publication reflects the views only of the authors. The European Commission support for the production of this publication does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 23, Number 3

September – 2022

Open Textbook Author Journeys: Internal Conversations and Cycles of Time

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Abstract

One of the challenges experienced in South African higher education (HE) is a lack of access to affordable, appropriate textbooks and other teaching materials that can be legally shared on online forums and the Internet. There are also increasing calls to address transformation and social justice globally and in South African HE through curriculum transformation. This article draws on the research of the Digital Open Textbooks for Development initiative at the University of Cape Town (UCT). It presents the journeys of four open textbook authors at UCT in relation to the social injustices they witness in their classrooms. It also makes use of Margaret Archer's social realist approach to explore dynamics related to open textbook authors' agency and ultimate concerns, as well as how their internal conversations shape their practices and approaches to open textbooks. Open textbooks are framed as a set of practices that play out in varying cycles of time and hold promise in terms of addressing the need for greater access and inclusivity in HE.

Keywords: agency, open textbooks, social justice, social realism

Introduction

Calls for action to address inequities in South African higher education (HE) continue to intensify in the wake of COVID-19 shutdowns and severe economic recession—all of which threaten to exacerbate the education divide and other inequalities as large numbers of university students and lecturers struggle to afford access to the connectivity, devices, and educational tools required to participate in new ways of online teaching and learning (Black et al., 2020; Czerniewicz et al., 2020; Soudien, 2020).

The Department of Higher Education and Training's *Access to and Use of Learning Materials: Survey Report 2020* (DHET, 2020) shows that a large number of South African university students (26%) are not buying any textbooks, with only 10% buying five or more. This is despite most (87%) of their modules having a strong reliance on textbooks as a means to deliver course content (DHET, 2020). The primary reason cited by students for not purchasing textbooks is that they are too expensive. In addition to overall cost, there was also a value-for-money factor: a number of students surveyed felt that if they were not going to be using the entire textbook, it was not worth purchasing (DHET, 2020).

A DHET study on the *Social Impact of the COVID-19 Pandemic on Youth in the Post School Education and Training (PSET) Sector in South Africa* (2021) indicates that more than 40% of students were unable to buy their own food during COVID-19 lockdowns, and almost a third of students who had access to online resources had no suitable place to study during lockdowns.

The potential learning losses experienced from not having access to the curriculum through textbooks and other learning materials combined with the challenges of remote learning in the COVID-19 context are exacerbated in South Africa by high data costs when accessing resources on the Internet and sporadic power outages, which amplify economic injustice and unequal access to education.

In addition to concerns around value and affordability, there are also increasing calls to address transformation and social justice in South African HE through curriculum transformation to address "local and current needs of staff whilst, simultaneously, [being] aligned to and resolving the economic and socio-political challenges facing universities and its learners" (Mendy & Madiope, 2020, p. 2). South African university students are therefore also choosing to forego purchasing textbooks because they are deemed unfit for the local context (Cox et al., 2020).

Research at the University of Cape Town (UCT) suggests that increasing numbers of lecturers are taking steps to explore alternative content creation approaches that address limitations around relevance, format, and genre associated with traditional textbooks (Cox et al., 2020). The discontent experienced by many lecturers at UCT is in line with Jhangiani et al.'s (2016, p. 193) assertion that "traditional textbooks are, at best, pedagogically impoverished, context-neutral content in an age where Internet connectivity affords access to rich multimedia and dynamic, contextualized knowledge."

The injustices relating to access and representation described here are germane to many countries around the world to varying degrees. The South African UCT context provides a useful focus of study in that it simultaneously presents a broad range of challenges and demonstrates some of the innovative solutions being explored in the context of a resource-constrained developing country.

Open Textbooks for Social Justice

Open textbooks and other forms of open educational resources (OER) published under Creative Commons licences allow academics and students to legally reuse and work with content in new ways without copyright limitations, provided that the original work's author is attributed and a range of licensing conditions are adhered to (Baker & Hood, 2011; Morris-Babb & Henderson, 2012; Moxley, 2013).

Open textbooks are freely available digital collections of scaffolded teaching and learning content published under open licences on platforms and in formats that provide affordances for content delivery on a range of devices, the integration of multimedia, and the incorporation of content from varying sources through collaborative authorship models.

Like traditional textbooks, open textbooks are written by academics and disciplinary experts and are subject to a range of quality assurance methods. They are typically digital, although they can include versions that can be printed on demand and distributed to students who are constrained in terms of Internet connectivity and digital access (Bethel, 2020; Frydenberg & Matkin, 2007; Jhangiani et al., 2016).

In South African HE, the potential of open textbooks is increasingly being recognised, as evidenced in the Open Textbooks in South African Higher Education initiative, in which managers, government bodies, and knowledge-production sector partners are collaboratively exploring open textbooks as a means to address curriculum transformation and social (in)justice in the classroom (Digital Open Textbooks for Development, 2021).

This article responds to the insights of Haveman (2016), who recognises that "openness in education is not a movement for the emancipation of resources, but of people and practice" (p. 7), and Pitt et al. (2020), who call for a "deeper understanding of both the student and educator experience" (p. 12). There is also a strong awareness that the characteristic of something being open does not equate to equality and democratisation of knowledge and that "true democratization and globalization of knowledge cannot exist without a critical examination of the systems that contribute to the production of scholarship" (Inefuku, 2017, para. 8). Cronin (2020) calls for this kind of critique of openness, moving beyond simply considering access to also considering awareness of the Global North–centric hegemony.

The research presented here will explore openness on an individual level, where educators' open practices play out in a complex, continually negotiated manner (Cronin, 2017). Using a social realist approach (Archer, 2003, 2005, 2007), we will demonstrate how the agency of these authors is intertwined with their practices and social justice motivations. However, we see that even in cases where there is an intention of justice, effective pathways are only enabled by the agents themselves when they are able to find ways around constraints. Those who do not manage to complete the work are burdened into inactivity by the challenges of academic life.

The study presented originates in the research of the Digital Open Textbooks for Development (DOT4D) project, which investigates the current ecosystem of open textbook publishing and provides implementation support in open textbook publishing activity at UCT. It has a social justice agenda in that it interrogates economic maldistribution, cultural misrecognition, and political misrepresentation in the context of open textbook provision using critical theorist Nancy Fraser's (2005) social justice framework.

This article presents the stories of four open textbook authors to examine the various approaches adopted at UCT to address injustice in the classroom. It also explores the dynamics related to these authors' agency and ultimate concerns. In line with this approach, this article addresses the following research question:

What are the drivers and social justice imperatives that inspire academics at UCT to adopt innovative approaches to producing open textbooks, and how do these relate to these academics' ultimate concerns?

The findings are of particular interest to academics navigating the complexities of open textbook production in that they provide insight into the personal strategies associated with undertaking this work and into dynamics relating to certain authors' inability to complete their content development processes. An understanding of these complex dynamics will also aid institutional managers and policy-makers engaging with this new area of work.

Theoretical Framework

Debates focused on social justice currently dominate much of the critical questioning of the inequalities present in HE (Hölscher & Bozalek, 2020). The open education movement has also been critiqued for not foregrounding social justice in all of its work (Lambert, 2018). These are macrolevel debates. In this article, the focus is not on the broader aspects of social justice but rather on the consideration of micro, individual agency–level contributions towards redressing injustice.

The overarching imperative of the DOT4D initiative is to produce evidence for the ability of open textbooks to address social injustice in South African HE. Within this context, the work of Nancy Fraser, a political philosopher, is used to identify the dimensions of injustice and to critically examine the role of open textbooks (Cox et al., 2020). Fraser's (2005) trivalent lens is used to identify inequality, specifically as relates to economic (maldistribution of resources), cultural (misrecognition of culture and identities), and political (misrepresentation or exclusion of voice) injustice. In this article, Fraser is used to frame the drivers or reasons given by the authors to create open textbooks.

In addition to Fraser's work, these case studies reveal the importance of the agency of the lecturers creating this content. Margaret Archer's social realist approach is used to try and surface why some of the lecturers in this cohort are able to get further along in their open textbook development processes than others, as well as the challenges that exist for open textbook authors in general. Archer is a sociologist, and her theory (2003) seeks to explain the relationship between structure, culture, and agency. She argues that the power of agency is key to understanding this relationship. She theorises how agents (the open textbook creators in this instance) have ways of anticipating challenges and acting strategically.

These constraints are considered and acted upon as "agents identify their own interests, and they must design projects they deem appropriate to attaining their ends" (Archer, 2003, p. 9). Archer (2007, p. 42) refers to these interests as being the "ultimate concerns" of individuals, "goods that they care most about." Individuals reflect on their actions through what Archer calls an "internal conversation." These internal conversations result in courses of action—the principle being that agents deliberate constraints and enablements in their contexts and choose specific stances based on these internal conversations. There are four different modes of internal conversation: communicative reflexive, autonomous reflexive, meta-reflexive, and fractured reflexive (Archer, 2003).

Communicative reflexives require others to give them advice or back up their actions. They are "family orientated," seek like-minded people, and typically prefer to stay in the same hometown and/or job (Archer, 2003, p. 168). Communicatives tend to evade constraints and enablements, choosing to maintain situations. They struggle when they move away from friends and family whom they trust. They are not particularly ambitious.

Autonomous reflexives make their own decisions and do not require deliberation with others to act; they are, in this sense, self-contained. They are task oriented and are strategic in their approach to constraints and enablements. Archer (2003, p. 254) refers to them as "agents of change." They are strategic in their approach to constraints and enablements. Autonomous reflexives are mostly individualist, self-disciplined, and self-motivated (Archer, 2007). They do not require approval from others for their work. They are ambitious and conceptualise clear projects in life.

Meta-reflexives reflect on reflecting. Their internal conversations are focused on the self, and they tend to be subversive towards constraints and enablements, choosing to be critical of society and change their projects throughout their lives. They are self-critical and strive for self-knowledge and finding value in their actions.

Fractured reflexives are unable to take action. This fracture can be temporary and the result of life events, such as divorce, family death, or moving to a different country. Fractured reflexives are passive agents who tend to live in the moment and make their way through life in an ad hoc basis (Archer, 2012, p. 279).

Archer's work (2003, 2007) has previously been used to understand the contribution and non-contribution of OER at UCT (Cox, 2016). Cox (2016) has found that applying Archer's concept of ultimate concerns combined with an understanding of the academic's internal conversation helped to explain why lecturers undertook OER production. Her study found that it was mostly autonomous reflexives who were contributing OER at UCT. They were driven by an awareness of a Global South need for accessible, localised content, and their contribution aligned with these concerns. They were ambitious, task-driven individuals who were happy to share imperfect (even incomplete) materials as they were confident that the materials would be used. Meta-reflexives, by contrast, felt that sharing OER was a great concept, but they were focused on the students in their physical classrooms and were reluctant to have their materials publicly available for scrutiny (Cox 2016).

Methodology

This study used a case study approach (Merriam, 2009) to conduct a comprehensive examination of four open textbook authors at UCT. The case studies aimed to capture the details of open textbook production and provided a detailed narrative description of the experiences of academics who are open education practitioners and have experience with producing open textbooks at UCT. In this context, open education practitioners are identified as academics who produce OER and adopt open pedagogical approaches towards content sharing, providing feedback, innovating in teaching and learning, using open licences, giving credit, and focusing on students' needs relating to access and supportive learning.

Case Study Selection and Respondent Profile

This study made use of a purposeful sampling technique (Robinson, 2014) in selecting case study participants; that is, specific academics within the institution who were involved or had been involved in the production of open textbooks were invited to participate. This selection process took into consideration gender and race profile, evidence of transformation within the resource (in terms of decolonisation, localisation, multilingualism, and curriculum transformation), the inclusion of multiple voices (particularly the student voice in collaboration), and the technological innovations presented. Of the four participants interviewed, three were female and one was male. One participant was a head tutor and three were senior lecturers. The selected participants were from different disciplines, and all adopted different approaches to textbook production.

Data Gathering and Data Analysis

After obtaining ethical clearance, the case studies were developed through survey and interview processes. The study also used open textbook grant proposals and reports from the DOT4D grants programme, in addition to the field notes of the DOT4D publishing and implementation manager, as data sources.

Each of the case study participants completed a background, technology fluency, and personal reflection survey (Masuku et al., 2021), which included questions on demographics and use of technology. This survey also included the Internal Conversation Indicator (ICONI), a tool developed by Archer (2007, 2016) designed to identify a person's dominant mode of reflexivity (see Appendix). Archer's ICONI methodology has been critiqued for not taking social context into account (Caetano, 2014), and additional questions have been added to the questionnaire (Golob & Makarovic, 2019). These recent works recognise the value of Archer's contribution, and in this study, ICONI is used together with other forms of data in order to build holistic cases, thereby including participants' motivation and other contextual aspects.

Following the survey, the interview process comprised two sets of interviews with four open textbook authors at UCT. The first of these interviews was focused on surfacing key details on historical legacy, disciplinary norms, content development approaches, and motivations. The second interview was focused on gathering points of clarification and reflections around curriculum transformation and decolonisation. The field notes comprised notes from publishing conversations between the DOT4D publishing and implementation manager and project grantees; transcripts of the conversations that took place in two key DOT4D advocacy and community building events at UCT in the course of 2018; and minutes of conversations with senior representatives of UCT libraries. As Phillipi and Lauderdale (2018) point out, field notes are an essential component of rigorous qualitative research and are recommended as a means of documenting contextual information.

The grant proposals, submitted by UCT academics at the start of the grants programme in January 2019, shared the aspirations and envisioned plans of the grantees for their open textbook initiatives. The grant reports, submitted at the end of the grants programme in February 2020, provided a reflection of the grantees' processes and the results of their initiatives at the end of the grant period, surfacing the successes and challenges encountered.

Multiple data sources provided rich, nuanced data, which were used in constructing the narratives and findings presented here. These data sources were analysed collectively by the DOT4D principal investigator and researcher, and the results of their analysis were cross-verified to ensure rigour in the analysis process.

Participants were invited to review drafts of their case studies in order to provide feedback and clarification. This consultation with authors served as a valuable data verification process as well as a reflexive opportunity for authors to examine their practice.

Findings

This section presents the findings of this study in relation to drivers and social justice imperatives. We also examine the internal conversations authors have in terms of their agency and ultimate concerns to gain a sense of the reflexive conversations that authors have with themselves regarding motivations and ultimate concerns.

The stories presented provide insights into the motivations and processes of the following four open textbook authors:

- Abimbola Windapo (associate professor, Department of Construction Economics and Management),
- Stella Papanicoalou (senior lecturer, School of Architecture, Planning and Geomatics),
- Dr Claire Blackman (lecturer, Department of Mathematics and Applied Mathematics), and
- Kensleyrao "Kensley" Apajee (head tutor, Department of Mechanical Engineering).

Of the four cases discussed here, one (Abimbola) completed a full textbook publishing process, resulting in the release of a finalised textbook. This publishing process was, however, disappointing for the author in that she unwittingly signed a copyright transfer agreement, and the work released does not authentically qualify as an open textbook because of the absence of an open licence on the published work. Stella released first a mini textbook(let) (which functioned more as a guide than a complete textbook) and had further ambitions to extend the content development process. Her approach was iterative and entailed working with students over a period of several years in order to obtain the content required for a comprehensive textbook. Claire was forced to put her open textbook development process into incubation due to time and other professional constraints, including the impact of the COVID-19 pandemic. Kensley had made significant progress in the conceptualisation and design of his textbook and produced a number of chapters, but his process was derailed by personal circumstances.

The varying approaches presented are not judged or rated in terms of overall efficacy or preferable approach but are instead intended as narratives demonstrating the realities academics at UCT face in trying to undertake this work.

Drivers and Social Justice Imperatives

The UCT academics engaged in this study identified a number of drivers that inspired them to undertake their open textbook development processes. These drivers had a strong social justice dimension in that they addressed issues of access and representation.

The drivers or factors motivating academics to produce open textbooks can be framed using Fraser's (2005) trivalent lens. To obtain a DOT4D grant, the grantees were required to indicate how they considered curriculum transformation and student inclusion as part of their open textbook development process. Their drivers were therefore quite explicitly mentioned. However, the authors had their own personal motivations and emphasised and explored different aspects of social justice.

Economic injustice (maldistribution of resources) is addressed in the nature of the open textbook being freely available. Affordable access was mentioned by three of the four case study participants as a starting point and primary motivating factor for producing this work.

In terms of cost as a barrier to access, Jhangiani et al. (2016, pp. 186–187) express how the system of production for conventional textbooks sustains its profits at the expense of students and "is a logical result of the current education labour system and the growing tendency to see the education sector as an unmined source (students as consumers) rather than a source of a public good (learners as productive citizens)." Studies supporting these claims have not only revealed OER's ability to reduce the price barriers to HE (Hodgkinson-Williams & Arinto, 2017) but have also explored how the provision of OER has specific impact on historically underserved and low-income students (Jenkins et al., 2020), which is particularly relevant in the South African context. The examination of this impact (of OER) through a social justice lens confirms that advocating for the affordability of textbooks is a redistributive justice issue. The creation of OER such as open textbooks is an avenue for realising a more socially just HE experience (Jenkins et al., 2020).

The cultural dimension (misrecognition of culture and identities) is manifest in the authors' ambition to transform curriculum. The four academics in this study were exploring different ways to shift away from the dominance of knowledge from the Global North. They aimed to include in current curricula ideas and perspectives that are more locally relevant and better suited to contexts and experiences within the Global South while balancing the value of contributions from the Global North. Leibowitz (2017) describes this as "cognitive justice." She explains that:

> this does not mean that all forms of knowledge are equal, but that the equality of the knowers forms the basis of dialogue between knowledges, and that what is required for democracy is a dialogue amongst knowers and their knowledges. (p. 101)

Political injustice (misrepresentation or exclusion of voice) is addressed by authors who are motivated to change the way they teach and include students as co-creators of teaching and learning content. This pedagogical change driver has the potential to redress both cultural injustice, through local authors (specifically students) collaborating to create local content, and political injustice, through the inclusion of voices which have previously been excluded.

Also noted as a social justice imperative among academics producing open textbooks is the aspiration to shift and reshape pedagogy. Freire's (2000) writings in *Pedagogy of the Oppressed* speak to the challenges of pedagogical practices and propose a pedagogy that shifts the dynamics between teacher, student, and society. With open textbooks, academics are given an opportunity to reimagine the pedagogical approach in ways that encourage learners' participation in the cocreation of knowledge, as well as other empowering shifts in the teacher–student relationship. Jhangiani and DeRosa (2017) highlight the significance of pedagogical change in their discussion on open pedagogy and express the ways in which students and teachers could "open" education and transform pedagogy, particularly through the use of OER. As Bliss et al. (2013) argue, the creation of resources such as open textbooks by academics allows for all participants (students and teachers) to contribute to the knowledge commons and not only consume from it.

Abimbola was motivated by a number of social justice imperatives. She was concerned about the cost of textbooks and wanted to increase the accessibility of teaching materials. Her focus was different than that of the other case study participants: her primary concern was the imperative to make other researchers, practitioners, and government stakeholders aware of the research being done at UCT in her field. Abimbola began sharing teaching resources in 2010.

Stella wanted to make content that was relevant to her students; she stated that "buildings in the Global South should be made more visible and accessible to students." Her work is positioned as a response to the dominance of European and North American examples in the literature, which often leads students to believe that buildings located elsewhere and theorised by scholars from the Global North have more relevance than buildings closer to home. In addition to this, she focused on empowering students, providing them with a platform to cocreate content. In so doing, she incorporated the content development process for her textbook as part of the classroom experience. She described this approach as "an attempt at decolonising the curriculum and rethinking pedagogical approach to create a more student-centred approach to teaching."

Kensley started his open textbox development process because he felt the current textbook was too expensive (it cost around 2,000 South African rand (ZAR) or $135 US) and not adequate for teaching the drawing course in the South African context. He indicated that in addition to the prescribed work using imperial rather than metric measurements, as is convention in South Africa, many other conventions used locally also differed from those presented in the textbooks from the Global North. Moreover, students not only had to learn this new discipline in a rapid and condensed manner in one semester, but they had to do so in English, which for many was a second or third language. Kensley aimed to address economic and cultural injustices; the open textbook development process empowered him as a student author.

Claire had three primary motivations for wanting to undertake her textbook development process: (a) cost savings (the current textbook costs around ZAR700 or $50 US); (b) a need to tailor the content to her students' context (as opposed to being from a Global North perspective); and (c) pedagogical innovation, in that she wanted to empower students to be able to think critically.

Internal Conversations: Agency and Ultimate Concerns

This section presents an analysis of the four open textbook authors' responses to the ICONI questionnaire (Archer, 2016), which identified authors' internal conversations, as well as findings from the first round of interviews, which probed ultimate concerns and responses to constraints and enablements.

According to Archer's categorisation, three of the case study participants were meta-reflexives and one was an autonomous reflexive (Table 1). The numerical indicator used in Table 1 categorises the case study participants on a scale of 1 to 7, in which 1 is low and 7 is high. A participant's highest score indicates their mode of reflexivity. Scores of 4 are midway and scores under 4 are considered underdeveloped in the participant.

At first, this categorisation seemed to contradict the findings of Cox (2016), where contributors of OER were mostly autonomous reflexives. The ICONI survey was administered early in the DOT4D research process; at the end of the process, three of the four case study participants did not complete what they set out to do. This inability to complete the task can be explored using Archer's social realism and her modes of reflexivity and agents' ultimate concerns.

Table 1

Case Study Participants' Ranking from ICONI Questionnaire

Mode of internal conversation	Abimbola	Stella	Kensley	Claire
Communicative reflexive	1.00	1.60	3.00	1.60
Autonomous reflexive	**6.00**	6.00	5.00	5.60
Meta-reflexive	4.00	**7.00**	**6.30**	**6.60**
Fractured reflexive	1.25	1.00	2.25	2.00

Note: Bold text indicates the dominant mode of internal conversation.

Abimbola had a dominant score of 6 for autonomous reflexive, and she scored a 4 for meta-reflexive. Archer (2012) considers this a midway score. Her meta-reflexive nature is evidenced when she describes her ultimate concerns ("I think it's just to make a difference in people's lives … just to be able to contribute to society"), but her remarks about her concerns are typically autonomous reflexive. She stated,

> I see it as if time is running out. One has to quickly make use of the available time you have to make all these contributions to change our society, especially Africa … I'm always looking for these opportunities.

Abimbola acknowledged that time is a barrier, but she strategically overcame this by employing student assistance:

> I build on the capacity I have, like the students … you have to be able to give other people the opportunity. You have to coordinate what others are doing … I have a team of students … I have to acknowledge them.

Stella has a dominant meta-reflexive score of 7, the maximum one can score. She also has an autonomous reflexive score of 6. She reflects deeply on her process and acknowledges her own growth, discussing how she has learned to "go with the process" and not wait for everything to be finalised. This is a typical meta-reflexive comment, as academics with this characteristic tend to be self-critical to the point that it prevents them from sharing their teaching materials online (Archer, 2003).

Stella's immediate response to the question "What are your ultimate concerns and reasons for getting out of bed?" was "I'm often not motivated … I like connecting with people. I see if I can make something happen or facilitate something to happen." When asked how she overcomes barriers, she stated, "Sometimes those barriers help form what you want to do, and so that's how I take it," and then intriguingly she said, "I'm not good at doing the finished product."

Kensley scored 6.3 for meta-reflexive, 5 for autonomous reflexive, and 3 for communicative reflexive. The 3 score is below 4 and thus is not a dominant mode of reflexivity, but it is the highest score in the communicative reflexive group, and Kensley's back-and-forth conversation with the interviewer revealed this. He enjoyed conversation. His ultimate concern at the time of the interview was teaching: "I just love teaching. It's just so enriching … and … I like to talk about life. That's why we are living." He discussed his concern that some engineers don't think outside of the box, something that bothered him. He stated that "some researchers, some engineers, they're just stuck in a straight line in their minds." This had resulted in him sometimes being resentful and not putting in as much effort as he might otherwise.

Claire scored 6.6 for meta-reflexive and 5.6 for autonomous reflexive. Her ultimate concern was "watching people, students in particular, grow. Both academically but also emotionally … and supporting that process." She emphasised the importance of her students, stating:

> I work hard to create an environment where students feel comfortable to ask questions and get things wrong. I do mindful meditation at the start of every class with my students so that they can learn to calm themselves.

She discussed why teaching is so important to her: "I feel universities are no longer like the sole providers of content, so if we actually want to keep being useful we need to change the focus of how we teach." She also acknowledged hindrances and constraints in her context: "I'm a white person from a privileged background … so there is an entire context of which I have no experience." Claire emphasised that "time is a problem … time and energy" and then conceded that she was "working on it" but was realising that she "can't do everything. And some days I'm just like, okay, today I'm just teaching."

The various scenarios presented here indicate a complex interrelationship between drivers and social justice imperatives and internal conversations.

Discussion

The open textbook authors profiled here were motivated and had a strong sense of agency. This agency helps to explain why they were able to engage as open practitioners despite their personal and professional constraints, as well as why some projects moved further along the production process towards publication than others in the cycle of time under examination. The findings reveal differences in drivers and ultimate concerns, as well as in authorship and content development approaches.

The UCT academics engaged in this study were motivated by a range of drivers or imperatives, including the need for affordable access, curriculum transformation and decolonisation, pedagogical innovation, and student empowerment.

Abimbola's work was based on her motivation to make a difference in people's lives and to contribute to changing society. Her ultimate concern was focused beyond the classroom. This links to her autonomous reflexivity. She would make a plan to get things done. She completed her OER with student help and was typically autonomous in her delegation of work and in overcoming time as a constraint.

Stella learned valuable lessons in her open textbook journey, but her careful, self-critical approach slowed down the completion of her process. In a typically meta-reflexive manner, she was constrained by her need for excellent quality. She reflected that she should have started sooner and not waited for all the material required before initiating the process because it is in the process that the clarity emerges. Several iterations are required before the idea settles. She believed that the lesson was to "dive in and give it time and be flexible to make changes along the way that will improve the end product but always to hold the original intention in focus."

At the time of undertaking his open textbook initiative, Kensley was still a student and tutor, and his understanding of what students need for success was therefore especially nuanced. He discussed how he was grappling with making language accessible. Kensley did not complete his chapters, juggling the commitments of the many roles he was playing as part of his department's teaching staff and as an emerging open textbook creator, all while managing his life as a student studying abroad. He deliberated and struggled to reconcile all aspects of his life. Typical for a meta-reflexive, he was looking for a kind of self-transcendence.

Claire had thoughtfully planned out how she would continue her work as an open practitioner through the development of an open textbook, including her work on helping students write proofs and helping them to learn how to think mathematically. Her aim was to focus on "making the language of mathematics more accessible." As a meta-reflexive, Claire was focused on her students. She was value oriented and struggled to align her ultimate concerns. Claire is an example of an author with the best intentions that simply could not find the time, due to competing requirements, to write her textbook. This was unexpected in that at the beginning of her open textbook development process, she had already generated content and was comfortable with the publishing platform she intended using to develop content. She was excited to get started but could not subvert the lack of time, and her classroom-focused project was of higher concern than producing an open textbook.

The drivers for creating open textbooks and associated social justice imperatives, the ultimate concerns, and the reflexivity and the agency of these four case studies are intermeshed aspects that help to explain the success or lack of success of these initiatives.

In addition to this set of intermeshed factors, it is important to consider the institutional backdrop against which these authors undertook their work and to contextualise their efforts with regards to the degree of institutional support and recognition they received. All the authors in this study relied to various degrees on institutional support to undertake their open textbook development processes and raised concerns about the sustainability of the work going forward without adequate resourcing.

Conclusion

The social realism theoretical approach has enabled a deeper understanding of open textbook creation at UCT and the cycles of time over which this activity plays out. There is no formal requirement or mandate for these academics to create open textbooks; instead, they are driven to make this contribution by the fact that their practices align with their internal conversations and ultimate concerns, which in the case of the four authors examined here are all social justice focused.

Lessons learned highlight the complexities of conceptualising and creating open textbooks over cycles of time. Open textbook authors face many challenges. In some cases, their plans have to be scaled down, while in other cases, their plans are completely derailed. Some academics may be open practitioners, but the constraints in their contexts prevent them from completing their journeys.

As we have seen in this study, open textbooks have the potential to address social injustice in South African HE. This potential can only be realised, however, if there is broader institutional and inter-institutional support for open textbook production and use. The Open Textbooks in South African Higher Education initiative has recognised this need and aims to maximise efficiencies through collaboration and support in order to address the sustainability of open textbook production across the South African HE sector.

While an enabling environment is key, the level of success in completing a textbook development process and the efficacy of the resource produced relies most significantly on the social injustice dynamics in the classroom and the internal conversations academics have as they grapple with these factors in their teaching.

The research presented here provides a theoretical explanation for the completion or lack of completion of four open textbook initiatives. It could be valuable for prospective open textbook authors to complete the ICONI questionnaire so they can anticipate possible constraints. Researchers studying open textbook creation and adaptation could test this theory on a larger sample. Future DOT4D research will include the articulation of models of open textbook production using Fraser's social justice theory to better understand inclusivity and student co-creation in authorship, quality assurance, and publishing processes.

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Appendix

Internal Conversation Indicator (ICONI) questionnaire

This questionnaire was developed by Margaret Archer (2016). It is a tool used to gain a sense of your internal conversation regarding your teaching practice and personal motivation.

1. Some of us are aware that we are having a conversation with ourselves, silently in our heads. We might just call this "thinking things over." Is this the case for you?

Yes

No

2. On the whole …

(1 = strongly disagree; 7 = strongly agree)

2.1. I daydream about winning the lottery.

1	2	3	4	5	6	7

2.2. I think about work a great deal, even when I am away from it.

1	2	3	4	5	6	7

2.3. I dwell long and hard on moral questions.

1	2	3	4	5	6	7

2.4. I blot difficulties out of my mind, rather than trying to think them through.

1	2	3	4	5	6	7

2.5. My only reason for wanting to work is to be able to pay for the things that matter to me.

1	2	3	4	5	6	7

2.6. Being decisive does not come easily to me.

1	2	3	4	5	6	7

2.7. I try to live up to an ideal, even if it costs me a lot to do so.

1	2	3	4	5	6	7

2.8. When I consider my problems, I get overwhelmed with emotion.

1	2	3	4	5	6	7

2.9. So long as I know those I care about are OK, nothing else really matters to me at all.

1	2	3	4	5	6	7

2.10. I just dither, because nothing I do can really make a difference to how things turn out.

1	2	3	4	5	6	7

2.11. I'm dissatisfied with myself and my way of life—both could be better than they are.

1	2	3	4	5	6	7

2.12. I know that I should play an active role in reducing social injustice.

1	2	3	4	5	6	7

2.13. I feel helpless and powerless to deal with my problems, however hard I try and sort them out.

1	2	3	4	5	6	7

3. In general, what are the three most important areas of your life now—those that you care about deeply? (List the most important first, e.g., interpersonal relations with family and friends; work, career and performance achievements; financial success; socio-ethical preoccupations; spirituality.)

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 23, Number 3

September – 2022

Doing Open Science in a Research-Based Seminar: Students' Positioning Towards Openness in Higher Education

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Abstract

This study investigates undergraduate students' attitudes towards and experiences with open education practices (OEP) in a research-based linguistics seminar. Data was collected through written assignments in which two groups of students in subsequent terms were surveyed on their willingness to publish (a) academic posters in open access (OA); (b) teaching concepts as open educational resources (OER); and (c) personal reflections on the research process in OA. Through qualitative data analysis, we examine students' apprehensions and motivations to publish their artifacts. We find that key motivators are a sense of belonging, personal reward, and an active contribution to a culture of collaboration, whereas apprehensions are grounded in concerns about the quality of their work, uncertainties about licensing, and fear of vulnerability through visibility. We show that open science practices and OEP can be combined synergistically in process-oriented, research-based, and collaborative seminar concepts, and we formulate recommendations for lecturers on how to successfully address OEP in the classroom.

Keywords: Open science, open education, open education practices, open educational resources, research-based teaching, collaboration, higher education, students' attitudes

Introduction

Open science (OS) unites highly diverse practices that range from (a) sharing resources (e.g., code, data, research materials, methods); (b) publishing in alternative formats, such as uploading preprints (i.e., manuscripts that have not yet been subjected to a peer-review evaluation) to an open repository or to one's personal website; to (c) sharing research questions and methodologies (Allen & Mehler, 2019, p. 2). Within this broad field, open education encompasses the free exchange of knowledge and ideas through "resources, tools and practices" (Cronin, 2017, p. 2) in educational contexts. The label *open* refers to four interrelated areas: (a) open admission to formal education; (b) free access to educational resources, online in particular; (c) open educational resources (OER); and (d) open educational practices (OEP) (Cronin, 2017, p. 3).

In this paper, we focus on OER and OEP. OER are considered a step beyond simply free access to educational resources, as *open* broadens its semantic scope from gratis (free of cost) to libre (enabling legal reuse (Winn, 2012, as cited in Cronin, 2017). Open then includes rights, access, use, transparency, and participation (Pomerantz & Peek, 2016), but also, crucially, an attitude (Lalonde, 2012). The term OER, first coined in 2002, points to resources conceived in such a way as to enable reuse through open licenses such as Creative Commons licenses and/or open platforms belonging to the public domain OER Commons (Wiley et al., 2014, p. 782). OER can then not only be accessed openly, but also modified, reused, and/or repurposed in other contexts following the five Rs of openness: retain, reuse, revise, remix, and redistribute (Weller, 2018; Wiley, 2014; Wiley et al., 2014).

OEP "shift the focus from resources to practices, with learners and teachers sharing the processes of knowledge creation" (Cronin, 2017, p. 3). OEP, as "practices which support the (re)use and production of OER through institutional policies, promote innovative pedagogical models, and respect and empower learners as co-producers on their lifelong learning paths" (Ehlers, 2011, p. 4). OEP thus encompass not only the final product, but also the process of (collaboratively) producing educational resources. Importantly, OEP do not revolve around the educators only, but show the potential for integrated practices where all participants experience openness together. The seminar discussed here not only invites students to take part in research projects and develop educational resources, but also fosters critical thinking by integrating a personal reflection on the challenges and potentials of OS. We thus describe the seminar's conception and learning goals as embracing the principles of OEP.

Reflecting on the creation and dissemination of posters in OA as well as OER together with students who had little to no prior experience with openness in education, this case study of a university seminar in the humanities shows how OEP could be implemented in higher education. On the basis of qualitative findings on how students training to become teachers evaluate their experiences with OEP, we suggest directions for teaching openness in education. Since the assignments involved publishing a scientific poster and/or personal reflections in OA as well as the creation of OER, we refer to the students' positioning as their evaluation of OS.

By recentering the students' experiences, this paper proposes to advance the reflection on openness in education on two grounds. First, it shows how open education can be implemented in higher education with limited institutional support and funds, and shows that it indeed works at a small-scale level. Second, it also shows how open education is perceived by students enrolled in a program to become teachers. We contribute to the growing body of literature on attitudes towards OS (Abele-Brehm et al., 2019) and open education (Anderson et al., 2017) with a focus on students' experiences (Axe et al., 2020; Cooney, 2016; Werth & Williams, 2021). With this first account of students' perception of open education in the humanities in Germany, we hope to show practicable ways to discuss and reflect OER and OEP in higher education.

The paper is structured as follows: We first offer an overview of the literature on OEP by presenting the common barriers to open education, highlighting why and how we implemented open education principles in the seminar *Grammar in the Digital Age* that took place at the University of Leipzig, Germany, in 2020–2021. We then explain how we collected and coded the qualitative data on the students' positioning towards OS. In the core section of this paper, we discuss the students' positioning towards OS. Specifically, we show that depending on the material, the participants present various degrees of engagement with OS. Students are rather open to the idea of publishing academic posters in OA because posters demonstrate high scientific standards, although students do not view themselves as researchers. A central argument for the publication of educational materials is the desire to be part of an ongoing conversation with (prospective) teachers. Personal reflections on the learning process during the course are met with more cautiousness: Less than half of the students find it valuable to publish personal reflections in OA. We then review possible limitations of the study. Finally, we make four concrete recommendations for lecturers on how to address OEP in the classroom.

Engaging with OEP in a Research-Based Seminar

While OEP certainly have great potential to improve teaching and learning in the future, their adoptions in educational institutions have been relatively slow due to a range of systemic and personal barriers (Mishra, 2017, p. 375). We review prior research on OEP in higher education and potential barriers, then we outline the structure of the seminar *Grammar in the Digital Age*.

Chances and Challenges of OEP in Teaching and Learning

Within the paradigm of openness, open education addresses barriers to learning by engaging with OS practices in the classroom and through the development and use of OER (Deimann, 2018). OEP encompass "collaborative practices that include the creation, use, and reuse of OER, as well as pedagogical practices employing participatory technologies and social networks for interaction, peer-learning, knowledge creation, and empowerment of learners" (Cronin, 2017, p. 4; see also Bellinger & Mayrberger, 2019).

In higher education, lecturers can make syllabi and teaching materials available for other teachers. These materials can subsequently be adapted to other teaching contexts, and teachers can improve them according to their experiences with the students. In this way, innovative and/or experimental teaching concepts can be made accessible for other teachers, and didactic considerations can be communicated easily, creating opportunities for exchange, community building, and visibility beyond their own workplace (Zimmermann 2018).

For students, OEP may contribute to fostering a collaborative learning culture, increasing learning engagement, and developing a sense of self (Axe et al., 2020). At the same time, the specific impact of OER on learning experiences and outcomes has yet to be investigated in depth. Smith and Seward (2017) suggest that "a static piece of digital content does not do anything on its own; it has to be part of a process of use for an outcome to emerge." In order to make an impact, the implementation of OEP requires educators to shift their focus from the mere accessibility of materials to a broader view about integration of OER in the teaching-learning process (Ehlers & Conole, 2010). Wiley and Hilton (2018) developed a framework to develop and assess OER-enabled pedagogy and stipulated a set of criteria for the successful implementation of OEP into the classroom: (a) Students create new artifacts or revise existing OER; (b) the new artifact has value beyond supporting its creator's learning; (c) students are invited to share their new artifacts publicly; and (d) students are invited to openly license their work. In our project, we implement key aspects of such a pedagogy into a research-based seminar that integrates the process of use of OER into the scientific process of student-led research projects. We aim to establish an understanding of OEP as being part of OS, and attempt to lay the groundwork for transparent and accountable research practices in higher education (also see Steinhardt, 2020).

Attitudes Towards Open Education

Despite growing interest, OEP remain a niche phenomenon in (German) higher education, and the prospects for teaching innovation and workload reduction remain uncharted (Langfelder, 2018, p. 1). Early studies suggested that faculty members (at Californian schools) had reservations about using OER due to perceived lack of content quality, time pressures, high workload, and loss of compensation for authors (Harley et al., 2010; Lee et al., 2008), whereas more recent studies reveal increasingly positive attitudes towards OER (Allen & Seaman, 2014; Seaman & Seaman, 2017). However, many educators only have a vague understanding of what OER are. In addition to a lack of awareness and experience with OER, the successful and impactful adoption of OEP has been shown to require a more general culture of sharing that provides individual practitioners with opportunities for pedagogical innovation and collaboration (Carey et al., 2015; Karunanayaka et al., 2015).

In order to address the "combination of factors including fear, resistance, and lack of training" (Cooney, 2016, p. 3), the discourse around OER and OEP has predominantly been centered around faculty and educators. As a consequence, students' attitudes towards and experiences with OER have only been researched to a very limited extent (Axe et al., 2020; Hilton et al., 2020). Students have been shown to have, for the most part, a positive attitude towards using OER; likely motivators for student engagement with OER encompass assessment requirements, learner awareness and involvement, engagement with communities of practice, and lecturers' attitudes (Issa et al., 2020; Jurado & Pettersson, 2020).

The Seminar: Grammar in the Digital Age

Grammar in the Digital Age is a research-based seminar dealing with digital writing practices from a linguistic perspective taught by Naomi Truan. The goal of the project was for participants to examine their own language use through the collection, annotation, and analysis of their written digital interactions during the seminar (i.e., forums, chats, collaborative documents) and beyond the seminar (e.g., private messages, see Truan & Dressel 2021). The seminar has been conducted twice, in two subsequent semesters and with two groups of students. The participants were all teachers-in-training between their third and fifth year of study. In Germany, prospective teachers enroll in special programs including pedagogy, didactics, and two disciplines. In this case, one of the disciplines the students will teach at the end of their studies is German.

By producing, collecting, and analyzing their own data, students not only experienced the empirical research process first hand, but were also able to "actively immerse themselves in research activities" (Haaker & Morgan-Brett, 2017, p. 1). In this sense, they gained awareness of fundamental principles of OS: They (a) collaborated with other students in group projects; (b) shared their data, research process, and results with other seminar participants; and ultimately (c) could choose to make their findings publicly available. The participants learned how to appropriately deal with personal data and were sensitized to the advantages and challenges of sharing data and research findings with their peers. The participants signed a data privacy statement at the beginning of the semester that covered the use of their data online (e.g., use of learning platforms), as well as the data collected for the seminar (participants analyzed their own digital interactions) and the data on attitudes towards OS that are at the core of this paper.

Importantly, the seminar did not revolve around OS, nor was OS its ultimate goal. Rather, OS practices were implemented in addition to other practices such as collaborative data gathering, annotation, and analysis. OS was thus conceived of as a possible (and desired) effect of research-based teaching and made explicit only at moment of the assignments.

As can be seen in Table 1, the assignments differed slightly from semester to semester to accommodate the students' needs. Both groups completed Block 1 and 2, and were thus offered the possibility to publish an academic poster in OA. Due to COVID-19 restrictions, one of the groups could not work extensively on the production of teaching materials. Group 1 was thus invited to reflect on the learning process instead, which we summarized as personal reflections based on how the assignment had been interpreted by the participants. Group 2 produced teaching materials that they could decide to publish as OER.

Table 1

Structure of the Grammar in the Digital Age Seminar, Including OEP and Data on Students' Experiences of OS

Seminar component	Activities and learning goals	OEP	Data on students' attitudes
Block 1 (4 weeks) Theoretical framework: Writing in the digital age	Collaborative Etherpads (reading research literature) Collaborative text annotation with Perusall	Use of OER learning materials Collaboration on various platforms	/

Block 2 (6 weeks) Critical examination of one's own digital writing practices: Collecting and analyzing data	Research project in groups: Collect and categorize linguistic data Formulate research questions and hypotheses Present research process and findings as a poster	Collaborative development of an academic poster Possibility to publish an academic poster in OA	**Assignment 1** Willingness to publish poster in OA (group 1, n = 23; group 2, n = 37)
Assignment on OS (in two parts)	Critical reflection on whether the participants opt for: 1) the publication of their academic poster in OA 2) the publication of their personal reflections in OA or their teaching concept as an OER		
Block 3 (4 weeks) Transfer to professional practice: Developing a teaching concept	Teaching materials integrating the research findings of the poster, either in groups or alone	Possibility to publish a teaching concept as an OER	**Assignment 2** Willingness to publish personal reflections in OA (group 1, n = 23) Willingness to publish teaching concept as OER (group 2, n = 31)

Collecting and Coding Qualitative Data on Students' Positioning Towards OS

Our qualitative analysis relies on elicited written data based on open questions, thus allowing us to capture with nuance the multiplicity of the participants' experiences. The individual reflection on OS was integrated into the seminar as two asynchronous assignments. We first outline the assignments, then describe the coding scheme we developed within the framework of grounded theory.

Collecting Qualitative Data

The students were asked to submit two statements of approximately 300 words, in which they brought forward their views on the opportunities and challenges of OS. They were provided a handout on OER in German, which detailed the core ideas and values of OER as well as examples of existing platforms. (The handout is available as an OER under a license CC BY 4.0.) The handout encouraged students to critically reflect on their needs as future teachers by asking about their motives for (not) making their own materials and preliminary results open. We furthermore indicated that our own materials would be published as OER and that the students opting to publish their materials would be part of a bigger project. The assignment was phrased as an invitation to critically reflect on the benefits and challenges of OS with only limited background or explanation on how OS works in general.

Coding Qualitative Data

Our data collection and analysis are informed by the guiding principles of grounded theory practice. The objective of this methodology is to inductively build theory through a process of constructing analytic codes, concepts, and categories from data itself, rather than deducing theory from preconceived hypotheses (Charmaz, 2006, p. 5).

For the present study, grounded theory allows us to investigate how students perceived themselves and their work throughout the research process. Its inductive approach to theory building enables us to focus on the participants' individual and subjective experiences, while grasping patterns that emerge from the collectivity of subjectivities. Having only limited experience with OEP at the beginning of this project, this methodology also allowed us to develop an independent analysis and to formulate our own theoretical considerations before familiarizing ourselves with prior research.

The data was collected throughout the semesters. We inductively developed analytic categories that encompass a number of interrelated codes. We used the term *category* to denote a classification of concepts (Corbin & Strauss, 1990). Our six categories are audience, connection, quality, visibility, responsibility, and vulnerability.

Table 2

Qualitative Data Analysis: Categories and Associated Codes

Category	Category description	Associated codes
Audience	Arguments with regard to the target group(s) or imagined audience(s) of the participants' artifacts. Who will use the artifact and how? How does the target audience influence the design of the artifact?	within academia peers/university students teachers high-school students/children everyone (related: equal opportunities)
Connection	Perspectives on OEP fostering the mutual exchange of ideas, mostly within academia, and mostly during the research process, prior to publication. What are the chances and challenges of collaboratively producing and publishing an artifact?	collaboration academic dialogue/comparison accountability/transparency usefulness/utility multilingualism
Quality	Concerns about (perceived) scientific norms and requirements for publishing in OA. Is the research product scientifically sound and comprehensible? Who can provide supervision and/or feedback to ensure the quality of the artifact?	scientific standards references comprehensibility process (higher) workload supervision/quality control/feedback

Visibility	Thoughts on (anticipated) positive and negative consequences of sharing one's work and becoming visible to an audience beyond the classroom	motivation/reward anonymity data protection
Responsibility	Concerns about properly licensing and maintaining artifact subsequent to their publication	maintenance misuse/licensing
Vulnerability	Participants' implicit and explicit expressions of anxieties and insecurities concerning the relevance worthiness of their research	relevance value/worth qualification (lack of) experience personal reflections uncertainty

Students' Positioning Towards OS

In this section, we present a qualitative analysis of the participants' responses to the two assignments on OS the students wrote for their active participation in the class. In the winter term 2020, 22 students out of 24 submitted the assignments, as did all 37 students in the summer term 2021. When offered the opportunity to publish their academic poster in OA, most students (50 out of 59) value the possibility and express strong arguments in favor of OS. Most of the students (27 out of 37) were willing to publish their teaching materials as OER, but making this decision before engaging in the actual process negatively impacts the students' confidence in the worth of their work. Finally, we find that the publication of work-in-progress with a personal component is subject to more restrictions and is less often considered necessary to be shared.

Publishing a Scientific Poster in OA: Willingness Overrides Doubts

A vast majority of the students chose to publish their poster in OA (18 out of 22 students in the winter term, and 32 out of 37 in the summer term). The main reasons for agreeing to publish encompass connection (i.e., contributing to the academic dialogue), accessibility (of knowledge, data, and materials), and the reward for hard work. In this section, we address the enthusiasm generated by the idea of making the posters available in OA, but also the participants' apprehensions in terms of visibility and exposure, thus leading to an increased feeling of vulnerability.

Arguments in Favor of OA Publication: Sense of Belonging and Personal Reward

For students in favor of OA, sharing data and preliminary results contributes to advancing research in their respective fields and fostered solidarity within research communities. The focus on research-in-progress allows students to participate in the research process, which, in turn, can foster a feeling of belonging and of community, as it "promotes the feeling for science—What's behind it all?" (student participant).

Importantly, publishing an academic poster in OA is viewed as being part of a bigger collaborative project, and related to the accessibility of research to practitioners. Making scientific results available brings linguistic research to the classroom and serves to scientifically underpin public discourse, democratize knowledge, and challenge unfounded claims about language change and anti-scientific attitudes. Availability does not equal accessibility; for research to enter the classroom or the public discourse in a meaningful way, it must be presented comprehensively and transparently. In order to be useful for teachers, the posters need to be readily usable or adaptable.

More than a quarter of the participants (17 out of 59) explicitly draw motivation, reward, and a sense of purpose from the opportunity to publish their work after having invested time and energy into the scientific posters. Sharing one's work retroactively gives participants a sense of visibility and of belonging. However, the novel online visibility brought by the publication of a poster in OA is also perceived as an argument against OA.

Arguments Against OA Publication: Resisting Visibility, Fearing Vulnerability

While most participants express enthusiasm for publishing their research, they also express their concerns and fears. The main reasons not to publish their work encompass apprehensions concerning uncontrollable (online) visibility (e.g., anonymity and data protection), and their feelings of vulnerability (e.g., the relevance and value of their work). The participants' uncertainties are fundamentally rooted in the realization that visibility entails accountability, thus opting for an anonymous publication.

In order to maintain control over their online persona, 6 out of 59 students express their willingness to publish their academic poster anonymously, arguing that the release in OA could have negative effects beyond the seminar and harm the participants' careers in state educational institutions, "as the Internet never forgets" (student participant). Others concede that anonymously published materials are unlikely to be reused. Being cautious about one's data privacy does not mean that the poster should be published anonymously: six students explicitly name transparency, authorship attribution, and accountability as key academic values.

In addition to future-oriented apprehensions, about a quarter (13 out of 59) of the participants grapple with the switch from their role as students during the seminar to their role as researchers. We describe these uncertainties under the umbrella term *vulnerability*. The need to publish a poster "free of errors in terms of content" (student participant) pertains to basic scientific standards and reflects the willingness to implement a round of revisions. Even so, it often becomes the locus of self-doubts regarding the relevance and worth of their work, as well as their status, as "transparency can highlight and amplify the vulnerabilities" (Pownall et al., 2021, p. 4). Concerns about the quality of materials are sometimes expressed in general terms: ensuring the quality of teaching, not spreading false information, and avoiding "pointlessly cluttering up" (student participant) the OER hub.

More frequently however, concerns about scientific standards are attached to personal qualification or the students' perceived status of their work as being "largely based on our own thoughts and elaborations, which are not necessarily correct" (student participant). The two most frequently cited arguments about the possible inaccuracy of the poster pertain to the lack of scientific literature and the small size of the corpus.

While at first glance, this line of reasoning seems to apply to usual academic standards, it actually shows more profound concerns about the quantity of information students assess as adequate in order for their work to be considered sufficiently scientific.

Students who voted against publishing the poster use the non-representativeness of the corpus as an argument against the publication of the preliminary results in OA even when it is "understood only as a stage of development—an open beta if you will—that preceded our term papers" (student participant). Importantly, being aware of the small size of the dataset does not necessarily mean that the analysis does not deserve to be published:

> I think it is important that the findings are well-founded or, if not, that this is indicated (as in our case). Smaller datasets are of course not as valid as large-scale studies and their findings should be considered in a differentiated way. (student participant)

For students in favor of publishing their poster in OA, the limited scope of their research project is not seen as a disadvantage, but as an integral part of the research project. Limitations of the poster are not seen as compromising its scientific quality if they are recognized and made transparent.

Publishing Teaching Materials as OER: Between Collaboration and Resistance

Similar to the enthusiasm towards publishing the poster in OA, most students (27 out of 37) chose to publish their teaching materials as OER. The main argument pertains to a culture of collaboration among peers. Collaboration is part of the code category *connection* (i.e., the desire to contribute to academic work and to be part of a community of practice). While 17 out of 59 students express concerns regarding the small size of their dataset or the lack of references in their poster—even when agreeing to its publication in OA—they are more confident in their role as prospective teachers. As most arguments in favor of publishing teaching materials overlap with those presented above, we focus in this section on two new aspects. The first is the collaboration component, and the second is the difficulty of taking a stance for or against publishing teaching materials as OER before the materials have been produced.

Arguments in Favor of OER Publication: Fostering a Culture of Collaboration

As for the academic posters, the desire to publish teaching materials as OER is motivated by a sense of belonging and personal reward. A new aspect is that of collaboration, both within academia and between academia and schools. As prospective teachers, participants acknowledge the value of OER for early-career educators who may gain inspiration. Moreover, OER can create a novel, low-threshold permeability between research and school practitioners. Established teachers can easily access "up-to-date subject knowledge, and modern teaching concepts that go beyond the curriculum, competency standards, and textbooks" (student participant). In this sense, OER offer a medium for inter-generational exchange and collaboration.

In addition to teachers, students are also thought to benefit from the publication of teaching materials as OER. One particularly interesting aspect is the integration of scientific methods and OS practices into the classroom. In their teaching concepts, participants often model their own experiences with the scientific method and develop immersive learning environments that should allow their students to conduct their own studies and to develop a critical understanding of their own language use. Aspects of collaboration thus permeate all levels of the production and use of the OER. Teaching materials are produced collaboratively within the seminar, designed to be used and further developed in collaboration with teachers, and foster collaboration among students.

Arguments Against OER Publication: Not Deciding Too Early

The specificity of the arguments against a publication is that they do not pertain to a refusal of OS principles altogether. Rather, the arguments against publishing OER are the result of uncertainty regarding the process, especially as students had to decide if they wanted to make their teaching materials as OER before they produced them. The argument pertains to two aspects. First, the need for supervision: students want feedback and quality control before publishing materials as OER. Second, 10 out of 37 are skeptical about the value of their work before it is complete. Importantly, looking for feedback and quality control does not only mean looking for external sources of validation. Rather, the students need to be satisfied with the result—independently from its assessment by the peers or the lecturer—in order to consider publishing it.

Publishing Personal Reflections in OA: A More Mixed Picture

Due to COVID-19 restrictions, participants during the winter term 2020–2021 did not develop teaching materials. Instead, they were offered the opportunity to reflect on the experience of their collaborative research project. Here, we offer insights on why more than half of the students (13 out of 22) voted against publishing their reflections in OA.

Arguments Against OA Publication: Personal Thoughts do not Deserve to be Shared

The main argument against publishing personal reflections in OA is apparent in this participant's statement: "These are 'only' my thoughts and feelings. This is nothing generalizable and therefore it is only limitedly suitable for further use." The importance of meeting scientific standards that are reproducible, intelligible, and distinct from personal opinions, thus appears central in the students' understanding of OS.

The assignment was conceived as a point of entry into the participants' learning process and aimed at keeping track of one's own positioning towards a certain topic at a given time. The decidedly personal nature of the assignment precisely renders its publication irrelevant for most participants. "What is helpful and useful to others?", one participant asks. This shows an acute awareness of the necessity to add value, although they recognize that they cannot determine alone what is useful to others. "Perhaps everyone should be able to decide for themselves what is helpful information for them and what is not", concludes another participant.

Such findings show the need for a discussion about who feels legitimate to engage in OS, as there is still a "limited discussion about . . . whose participation is valued" (Koyama & Page-Gould, 2020; cited by Pownall et al., 2021, p. 4). Participants unwilling to publish personal reflections establish a clear distinction between what counts as scientific and may thus deserve proper recognition through OA publishing, and what does not.

Arguments in Favor of OA Publication: Inspiring Others Through One's Journey

Among the 8 out of 22 participants who are in favor of publishing their reflections in OA, half highlight the relevance of thematizing their own learning journey to inspire others. Being aware of their own biases towards digital literacy, the students map out the potential of research-based teaching for experiencing a shift in perspective. The participants in favor of publishing their reflection in OA believe in the potential of the research process for making them change their opinion. They recognize the possibility for the data to tell another story than the one they would have suspected. Crucially, the openness regarding the outcome of the research process and their initial shortcomings are reflected in their willingness to transparently and critically share their reflections with others. In these cases, research is conceptualized as a process.

With their reflections, the participants pursue different aims than with the publication of the poster in OA, notably having an impact helping people "recognize themselves" in the testimonies of others, especially regarding bias towards digital practices. Often, the imagined audience is conceived widely; texts should be "accessible for a broader mass and also understandable" (student participant).

Such findings invite us to investigate the relationship between self-reflection and commitment to OS. To what extent do participants who describe a shift in how they perceive their own digital writing practices also are willing to make this process visible to others? Combining auto-ethnographic reflections with research-based explorations in teaching may open up new avenues regarding whether and how the willingness to map one's personal journey is linked with an openness towards OS practices.

Limitations

As this qualitative study is based on a small sample of students (59), it could be complemented by larger-scale studies concerning other disciplines. Moreover, the assignments differed from semester to semester; while all groups submitted reflections on OS regarding publishing a poster, one group produced teaching materials, and the other wrote personal reflections. As our investigation is based on an extensive cluster of the arguments brought forward by the participants (see Table 2), we were able to correlate types of materials participants are willing to publish in OA or as OER.

Finally, it would be interesting to link the findings with biographic and social variables such as the age, gender, or students' previous experience with OS. Collecting sensitive information within the context of a university seminar where the assignments are linked to the students' identities would not be in compliance with data protection policies.

Recommendations for Lecturers: How to Achieve OEP in the Classroom?

Based on the qualitative analysis of the students' positioning towards OS, we formulate four recommendations for lecturers who wish to implement OEP in higher education.

Make the Collaborative Research Process Central

Our experience with both groups shows that OEP encourage students to explore new ways of learning research by doing research. Based on their willingness to publish posters in OA, among the participants who consider research as a process, we hypothesize that integrating openness practices into the classroom relates to concepts of research-based learning. In contrast to other forms of research-oriented learning, research-based learning (*forschendes Lernen*) focuses on the research process itself (Huber, 2014). As a teaching concept, this means that the participants themselves actively go through the essential phases of this process—collecting data, developing research questions and hypotheses, and presenting the results (see Truan & Dressel, 2021). We argue that collaborative work simulates a community of researchers. When the students experience a sense of belonging, they are ready to move beyond the course in the form of an OA publication, as they become confident that through their research they potentially achieve "results that are interesting for third parties" (Huber, 2014, p. 25; our translation, 2022). We thus invite further teaching projects and academic contributions to explore the relationships between research-based teaching and the implementation of openness. Our findings indeed suggest that the focus on the research process—rather than the output—fosters willingness to engage with OS.

Let the Students Decide (After They Have Worked on a Topic)

One central lesson was the importance of timing; participants' insecurities and apprehensions came about when the prospect of publication was raised too early, as was the case for the teaching concepts. While this was a conscious choice in our seminar, these issues can be avoided or mitigated through an approach that scaffolds the production and publication of OER in a way that creates an early awareness of OEP in participants and guides them through the entire process.

Show the Students How They are Contributing to a Bigger Project

As our data suggests, students fundamentally appreciated the novel types of connection and participation that OEP can provide. They were most positive about contributing their artifacts when they had a clear sense of purpose and utility (i.e., when they knew who would benefit) and when they had a strong sense of belonging (i.e., when they could identify with the role they assumed in the production of the artifact). It is important to create spaces for critical discussions about target audiences and implications on the design and distribution of OER.

Build on the Students' Previous Experiences

Our data shows that previous experiences with research processes in making a decision are central to the participants' readiness to publish their work. Early and regular exposure to the principles of OS across the curriculum increases the students' willingness to engage in OS practices going forward. We thus recommend building groups where students familiar with OS principles can play the role of ambassadors and initiate a fruitful debate with peers.

Conclusion

This paper contributes to the under-researched field of students' attitudes towards and experiences with OEP. It outlines our research-based linguistics seminar *Grammar in the Digital Age* that introduced two groups of students to OS practices and OEP in a hands-on, process-oriented, and highly collaborative way. In order to gain insight into how students feel about publishing artifacts from the seminar, we collected data through written assignments and analyzed the results within the methodological framework of grounded theory. The data suggests that students are fundamentally in favor of the ideals and values of OS and have a positive attitude towards creating and using OER. Apprehensions to publish their own work were contingent on the nature of the artifacts in question. The prospect of publishing their teaching concepts as OER was met with overall approval whereas publishing academic posters in OA was met slightly more hesitantly and revealed insecurities about the quality of their research and their role of students versus so-called real researchers. Finally, the majority of participants disagreed with publishing their personal reflections on the research process, arguing that such artifacts are of little to no value for third parties.

Our findings suggest that while OEP have great potential to foster a culture of collaboration within and beyond academia, they also demonstrate the importance of guiding students carefully through the complex process of creating and publishing their work in OA or as OER.

Acknowledgments

We would like to thank Georg Fischer, Rima-Maria Rahal, Isabel Steinhardt, and Erzsébet Tóth-Czifra for valuable comments on earlier versions of this paper.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 23, Number 3

September – 2022

Examining Pre-Service Teachers' Perceptions About Virtual Classrooms in Online Learning

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Abstract

Using a descriptive research design, this study explored pre-service teachers' perceptions of synchronous virtual classrooms and Web camera use in online learning. The study sample consisted of 256 pre-service teachers from the education faculty of a university in Turkey, and data was collected using a survey. The results showed that most pre-service teachers did not want to open their own Web cameras, due to reasons such as unsuitable physical environment, unsuitable appearance, and distractions on the screen. In addition, they stated that instructors' gestures, facial expressions, and verbal-visual emphases were essential, and they wanted instructors to be visible on screen. They also suggested that student-centered practices and question-answer activities should be carried out to increase the effectiveness of virtual classrooms. In addition, sessions should not be scheduled in the early hours of the day, and should be of short duration.

Keywords: synchronous learning, virtual classroom, online learning, pre-service teacher, web camera

Introduction

Online learning (OL) resources differ according to the purposes they are used for and the technological opportunities available. In addition to asynchronous resources such as video lecture recordings, written content, and discussion forums, synchronous resources such as audio-video conferences and virtual classrooms (VCs) that allow instant interaction and information exchange are also used (Simonson & Schlosser, 2009). Students and teachers meet online for each learning session at a pre-determined time for instruction with synchronous resources (Fidalgo et al., 2020).

VCs are an important part of the array of synchronous resources. Theory regarding synchronous learning has focused on concepts related to interaction and distance. Teacher-student, student-student, and student-content interaction are among the factors and stakeholders of distance education emphasized by Moore (1989), and have an important role in positive learning outcomes in OL environments (Zimmerman, 2012). Moore (1993) discussed these three interaction types within his theory of transactional distance that focused on the perceived psychological and emotional distance between instructor and learner rather than physical distance. VCs have the potential to decrease levels of these non-physical distances while enhancing interaction.

VCs have been used very often throughout the world, especially during periods of emergency remote teaching. VCs are interactive OL environments where participants can attend meetings live (Falloon, 2012). VC applications allow for discussion and collaborative activities and have also improved self-disciplined students' learning outcomes (Ng & Peggy, 2020). Moreover, compared to traditional classrooms, students tended to prefer VCs that minimize barriers such as travel difficulties and costs (Morice et al., 2020). University administrators and instructors have also seen these applications as a tool to reach more students through online education (Zydney et al., 2019). VCs have the potential to bring aspects of face-to-face classroom environments to the digital learning environment. Therefore, student behavior and classroom management are critical issues for teachers in VCs, as in face-to-face education (Rufai et al., 2015). Lisciandrello (2020) suggested that the problems occurring in classroom management may be reduced when students are motivated to follow the teacher's directions closely and are engaged in cooperative tasks. Increasing motivation and cooperation in a virtual lesson has also facilitated classroom management in OL (Dyer et al., 2015). Moreover, thanks to their interactive features, VCs have provided conveniences in terms of student participation and communication (Gotsiridze, 2014).

This study investigated pre-service teachers' (PTs) opinions about VCs in detail. Specifically, it aimed to reveal the underlying reasons for their participation in VCs and their Web camera use. To make VCs more effective, teachers should learn new methods and techniques about digital applications that will motivate students (Kosturska, 2019). However, analyzing students' behavioral tendencies in virtual sessions is an important aspect of OL. There is a need for further research on what students think about the components used in VCs, what factors affect their use, and recommendations for their practical application.

With the increase of OL and virtual courses, particularly in the post-pandemic period (Lockee, 2021), such studies have become more critical. The results of the current research were intended to contribute to closing the gap between VCs and face-to-face classes and reducing the limitations in OL. It may also encourage reflection on the interrelation of critical educational variables such as student satisfaction, motivation, and performance. In addition, these results may help practitioners to increase the effectiveness of VCs and design of virtual learning environments in the future.

The purpose of this study was to examine pre-service teachers' perceptions on synchronous VCs and Web camera use in online learning. In light of this, our four research questions (RQs) were as follows:

RQ1: What are PTs' opinions about the effectiveness of various VC combinations made up of elements such as presentation, camera, and whiteboard?

RQ2: What factors direct PTs to attend VCs or not attend?

RQ3: What are PTs' opinions about Web camera use by instructors and PTs during VC sessions?

RQ4: What are PTs' suggestions for making VCs more effective?

Literature Review

Previous research has addressed various aspects of VCs, including (a) student opinions of their advantages and limitations (Faloon, 2012); (b) perceived stress among students taking courses in VCs (AlAteeq et al., 2020); (c) comparison of anxiety levels of these students with those in face-to-face classrooms (Moïse-Richard, 2021); and (d) comparison with video podcasts (Aghababaeian et al., 2019).

Web cameras and video conferencing applications have been widely used to increase interaction in OL. Thanks to Web cameras, communication in synchronous online lessons have been enriched by including the images of students and teachers (Codreanu & Celik, 2013). While this has helped simulate face-to-face classroom environments, it has also offered positive pedagogical effects (e.g., motivation, participation) associated with interactive learning (Jauregi et al., 2012).

However, a limited number of studies have investigated the trends of Web camera use in online courses. For instance, Kozar (2015) found that students turned on the camera for a few weeks at the beginning of the semester for social and emotional reasons, and then turned it off in the following weeks. Students noted privacy concerns and tediousness as their reasons for turning off the Web camera. Gherhes et al. (2021) also investigated the reasons why students turn their cameras on and off during online courses; the main reasons for students turning off their cameras were factors such as anxiety, shyness, and home privacy.

Rajab and Soheib (2021) showed that many students who study online in higher education are against using cameras for reasons such as privacy and anxiety. Moreover, other reasons for their opposition included poor Internet connections and concern for background visuals in their study environment (Castelli & Sarvary, 2021). Several other studies have focused on the effects of camera use on communication in VCs. According to O'Dowd (2006), cameras provided for the transmission of non-verbal messages and strengthened interaction. Aaltonen et al. (2009) stated that gestures and facial expressions were beneficial during online synchronous communication. Similarly, Giesbers et al. (2013) found that the use of video conferencing in lectures encouraged social interaction and feedback. They indicated that a video conferencing system had a positive effect on participation, motivation, and success.

Telles (2010) pointed out the important effects of cameras on communication and pedagogical elements. Other studies focused on the use of Web cameras in online language teaching (Hampel & Stickler, 2012; Jauregi et al., 2012) and their effects on interactive learning (Codreanu & Celik, 2013). However, despite the studies mentioned above, there is still a need to investigate students' opinions in detail and to make pedagogical inferences accordingly. It is important to reveal the impacts of VC technology, which has become an indispensable part of distance education, on the learning environment. Such inquiries will inform the innovative and more efficient pedagogical use of these technologies. In these aspects, this study differed from previous research.

Methodology

Design and Sample

We adopted a descriptive research design in this study, as it is the most appropriate method to describe an existing phenomenon or situation without analyzing the relationships between variables (Fraenkel & Wallen, 1993). A total of 256 (145 females, 111 males) PTs from the education faculty of a university located in the Black Sea Region in Turkey voluntarily participated in this study. Their ages ranged from 18 to 42 years (M = 20.03, SD = 1.02). Participants majored in mathematics (n = 50), teaching social sciences (n = 45), teaching Turkish (n = 43), primary education (n = 42), psychological counselling and guidance (n = 32), fine arts (n = 23), and teaching science (n = 21).

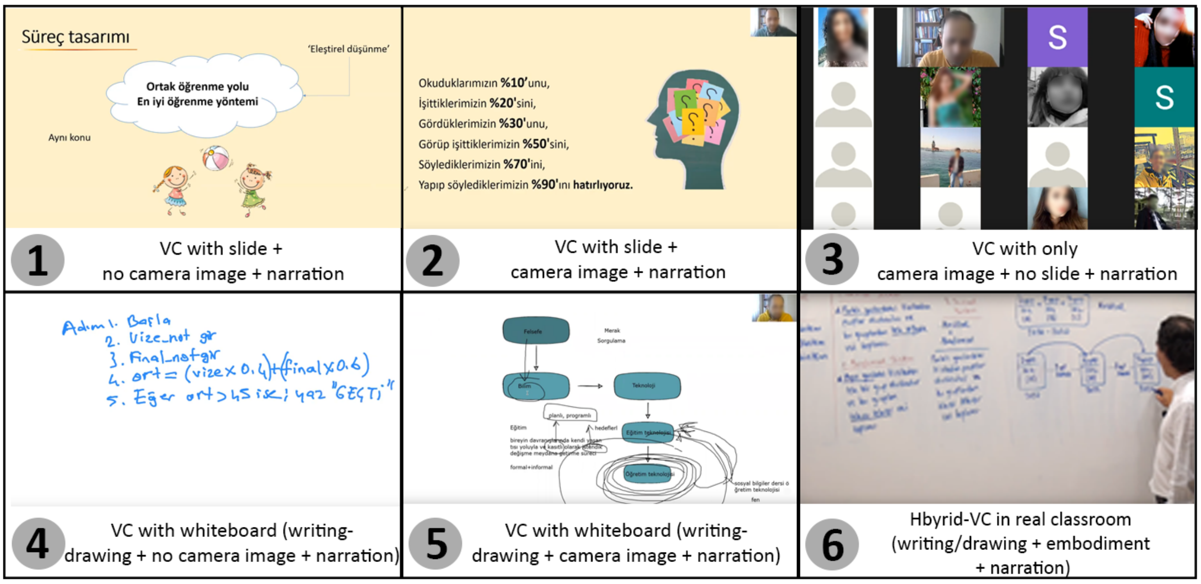
Procedure and Data Collection

This study was performed during the fall term of the 2020–2021 academic year. Because of the COVID-19 pandemic, the participants took their courses in an OL environment, through a learning management system (LMS) both synchronously and asynchronously. PTs connected to the VCs via the Zoom application. Data in this study were collected using a survey created in Microsoft Forms; the link to the survey was shared with PTs on the LMS and was active for three weeks.

The survey consisted of three sections. The first had several questions to gather demographic information such as PTs gender and area of study. The second section used a seven-point Likert scale to evaluate the effectiveness of the given VC combinations (see Figure 1). The scale ranges from 1 (*less effective*) to 7 (*more effective*). PTs rated six common VC combinations made up of the following synchronous elements: whiteboard, instructor's image, and content presentation. Figure 1 shows the screenshots of these combinations.

Figure 1

Screenshots of VCs: Combinations of Synchronous Elements



The third section of the survey presented nine open-ended questions and a closed-ended question to gather data on PTs' perceptions of VCs (see Appendix).

We examined the relevant literature to create the survey questions. Two academics reviewed the survey to ensure its validity and reliability. The survey questionnaire was finalized according to both the experts' opinions and feedback from a pilot implementation. The experts' opinions indicated that the questions were appropriate in terms of content, understandability, and usability. The pilot implementation was conducted with eight PTs to ensure the questions were clear and complete.

Data Analysis

The data obtained from the survey were reported with descriptive statistics such as frequency (*f*), mean (*M*), and standard deviation (*SD*) to determine the effectiveness of different combinations of VCs. The responses to the open-ended questions in the third part of the survey were analyzed using both descriptive analysis and content analysis. In the descriptive analysis, data are interpreted according to previously determined themes (Yildirim & Simsek, 2011). In the present study, both the research questions and the survey questions formed a framework for the descriptive analysis. Content analysis was used for a more in-depth analysis of the data summarized in the descriptive analysis.

The content analysis was carried out in two stages. First, codes and themes were identified by the researchers. PTs' perceptions were organized by converting them to pieces of code. Then, similar codes were combined into themes. In this second stage, the qualitative datasets obtained through the initial coding and sorting were analyzed by two experts who were not part of the main research team. Miles and Huberman's (1994) formula was used to compare codings and check the consensus; this value was found to be 92%. The frequencies (*f*) of the codes related to the repeated opinions in the study were presented in a tabular form. In addition, PTs' direct quotations were also included. To keep the identity of each participant confidential during the data editing, identifiers (e.g., PT-1, PT-2) were created for each individual.

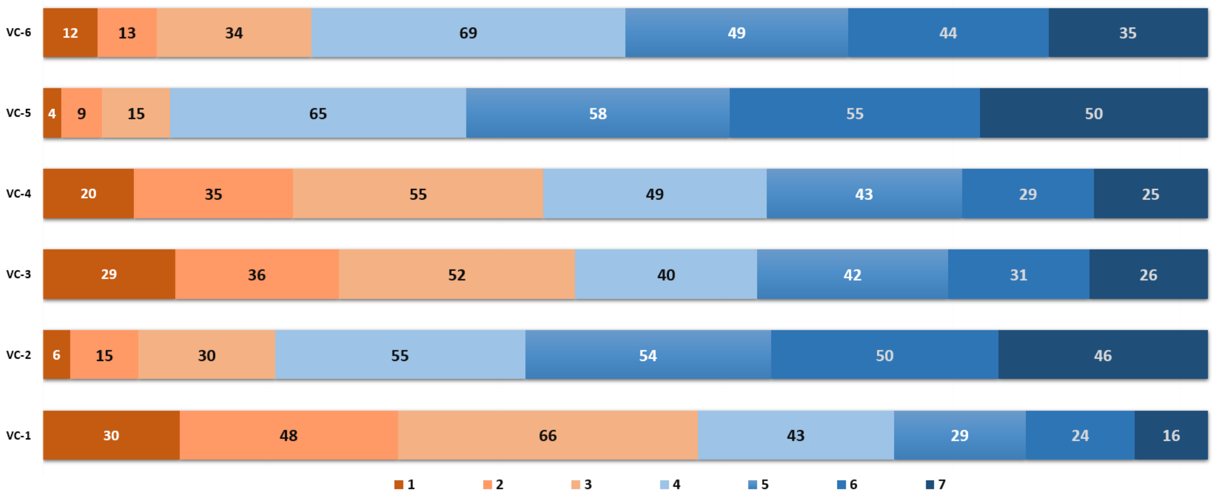
Findings

PTs' Opinions About the Effectiveness of Various VC Combinations

To address the first research question, PTs compared the effectiveness of six VC combinations made up of the elements of whiteboard, instructor's image, and content presentation. Figure 2 shows the frequency distribution of these comparisons of VCs.

Figure 2

Comparison of Various VC Combinations of Elements



As seen in Figure 2, PTs evaluated VC-5 ($M = 5.07$, $SD = 1.14$), VC-2 ($M = 4.84$, $SD = 1.20$), and VC-6 ($M = 4.57$, $SD = 1.24$) as more effective. They perceived the VC-1 ($M = 3.50$, $SD = 1.43$) as less effective. In particular, the elements such as whiteboard use for writing or drawing and the presence of the instructor's image were found more effective than the presentation of PowerPoint slides without an instructor's image or any other interaction on screen. VCs with the instructor's image, drawing/writing on the screen or a whiteboard, or visuals were perceived as more effective by PTs.

Factors That Direct PTs to Attend VCs or Not

In exploring the second research question, we identified two sub-themes, namely the reasons for attending VCs and the reasons for not attending VCs. Tables 1 and 2 show the specific codes for PTs' opinions and their frequency distributions.

Table 1

Reasons for Attending VCs and Frequency of Response

Code	*f*
To better learn and reinforce the subject matter	54
To ask the instructor about subjects of interest or needing clarification	52
To create an interactive classroom environment	32
To improve exam mark, grade, and to pass the class	30
To get immediate feedback	25
Compulsory attendance and roll call	22
To get information and tips about the exam	22
Instructor's qualifications	14
Attractiveness of the course and the pleasure it offers	13
A more effective learning environment than asynchronous content	12
To stay current and not fall behind in the course	11
To be informed about the announcements and anything new	9
Sense of responsibility	6
VC not recorded	3
Opportunity to make up for deficiencies	2
Complements the asynchronous educational content	2
Possibility of attending from anywhere	2
Professional development and its contribution to learning	1

As seen in Table 1, most PTs stated that they attended VCs mainly it helped them better reinforce the subject matter (f = 54), and instantly ask the instructor about subjects that were interesting or they didn't understand (f = 52). For example, PT-203 noted that "usually, when there is a point that I don't understand or I am confused about, I try to ask a question to learn the answer. In general, I try to attend the class whenever I find time." According to PT-91:

> I have a chance to pause and listen to the content with asynchronous video when I do not understand, but I do not have a chance to ask questions when I get stuck. There cannot be a better opportunity to ask questions about things I could not comprehend.

Some PTs emphasized that they attended VCs with anxiety about exams and grades, as attendance was compulsory. PT-45 expressed this concern, stating "frankly, I attend the VCs to get high marks in the exam and pass the course… In the course, the instructor can sometimes give information about the exam." PT-40 stated reasons for attending the VCs as "the fear of absenteeism, being responsible for the subjects in exams and homework, and passing the course." Some PTs also emphasized reasons such as the instructor's qualifications, the attractiveness of the course, ineffective asynchronous course content, and their sense of responsibility.

Table 2

Reasons for Not Attending VCs and Frequency of Response

Code	*f*
Instructor's lecture ineffective and boring	83
VCs scheduled in the early hours of the day	82
Technical problems	44
Lengthy course duration	16
Poor interaction and socialization	9
Having access to asynchronous recording	7
Boring course content	7
Disliking the course	5
Work responsibilities and illness	5
Efficient asynchronous content	2
Late starting the course	2
Personal study environment	2
Laziness	2
Waste of time	1
Learning better alone	1
Fear of turning on the Web camera	1

As seen in Table 2, the main reasons PTs did not attend VCs were instructors' ineffective and boring lectures and scheduling early in the day. As PT-16 explained, "the teacher's inability to explain the subject, being in the early hours of the morning and the dull tone of her voice makes me sleepy." PT-203 expressed that "I generally attend the VCs, but when it is early in the morning, especially during this pandemic period, I have to listen to the lesson without having breakfast, and I cannot get enough sleep." These findings suggest that the instructor's lecturing style and the lesson's start time had the greatest impact on students' reluctance to attend the VC. Factors such as technical problems (e.g., sound, image, Internet), VCs long duration, and poor interaction were among the other reasons emphasized. In support of this finding, PT-52 reported that:

> VCs in which the instructors are not in contact with the students are not effective. Some instructors' VCs take too long. Also, there are the same contents on LMS, they overspeak on a subject. It gets too boring and uninteresting.

For example, PT-100 drew attention to the ineffectiveness of the VC in which the teachers read and run the presentations, the students do not talk at all, and there are no opportunities for questions and answers. These findings also show that the factors originating from the instructor were critical in developing negative attitudes towards the course.

PTs' Opinions About Web Camera use by Instructors and PTs During VC Sessions

Related to our third research question, Table 3 depicts PTs' responses about whether the students' and teachers' cameras should be turned on or not.

Table 3

PTs' Responses: Should Students' and Teachers' Web Cameras Be Turned On or Not

Student		**Instructor**	
Code	*f*	Code	*f*
Should not be compulsory	119	Better if his/her camera is on	102
Should not turn on the camera	48	Should turn the camera on	68
Should turn camera on at his/her will	42	Not important	7
Better if the camera is on	40	Should turn it on at his/her will	4
Should turn on the camera	24	Should turn on the camera during activities	3
Should turn on the camera when possible	20		
Should turn on the camera during activities	10		
Only the respondent should turn it on	8		
Not important	7		

As shown in Table 3, most PTs emphasized that it should not be compulsory for students to turn on their cameras during VCs. There were 48 different opinions regarding the perspective that cameras should not be turned on at all. Some of the students who stated that it should not be compulsory emphasized that they should turn it on at their own will, while others stressed that students' cameras should be turned on at the time of an activity, when possible, or when they are allowed to speak. 24 PTs stated that their cameras should be turned on. A total of 170 different opinions were reported about instructors' camera, mainly indicating that "it is better if the camera is on" (f = 102) and "the camera should be turned on" (f = 68). PTs' opinions mostly emphasized that instructors should turn on their cameras during VCs. PTs noted that turning on the camera should not be compulsory for students. For example:

> Considering this period and the lessons with and without cameras on, I think teachers should turn on their cameras. While I was reluctant to attend the course in which opening the camera was obligatory, I willingly attended the course of our instructor who asked us to open it as long as we were available. (PT-105)

Although most PTs generally felt that it should not be compulsory to turn on the cameras during VCs, some PTs expressed their views on the effectiveness of turning on the cameras. Moreover, we identified two sub-themes, namely the reasons for the necessity of turning on the camera in VCs and the reasons for not turning on their cameras in VCs. The codes related to these sub-themes and the frequency distributions of PTs' opinions are presented in Tables 4 and 5.

Table 4

Reasons for the Necessity of Turning on Cameras

Code	*f*
Increase interaction and communication	39
Create more effective learning environment	21
Use gestures and facial expressions	17
Ensure concentration on the course	13
Ensure attentive listening	9
Make eye contact	8
Increase seriousness	7
Increase participation in the course	5
Create a warm atmosphere	3
Monitor students in the course	3
Maintain order and discipline	3
Ensure the course is not being boring and monotonous	3
Adapt to the course	2
Increase the liveliness of the course	2
Create motivating environment	1

As seen in Table 4, PTs emphasized turning on the cameras mainly to (a) increase interaction and communication, (b) create a more effective learning environment, (c) use gestures and facial expressions, and (d) ensure concentration on the course. PT-66 stated that "it will be better if cameras are on. It creates a more interactive and friendly atmosphere and helps students direct their attention to the course." Similarly, PT-142 noted that:

> In the VC, it is better if the cameras are turned on because it gives at least a sense of classroom environment close to the real one though not creating an environment just like in the classroom. Teachers and students interact better. The instructor can observe whether the students understand the subject from their facial expressions.

In addition, some PTs also suggested that turning on the cameras helped them listen to the instructor and establish eye contact, and increased their seriousness and participation in the course. Codes and frequencies for the sub-theme of reasons for not turning on their cameras in VCs are given in Table 5.

Table 5

Reasons for Not Turning on Their Cameras in VC

Code	*f*
Inappropriate physical environment	182
Inappropriate personal appearance	61
Distracting and tiring	54
Others do not turn on the camera	22
Privacy issues and invasion of private space	16
Feeling stress or tension	14
Shyness	14
Early class hours	12
Slow Internet	9
No reason	9
Not necessary	8
Privacy or security concerns	8
Not compulsory	7
Poor-quality camera	6
Not willing to be seen by others	3
Having no camera	3
Inability to express oneself comfortably	3
Desire to watch the lesson in a more comfortable position	3
Loneliness	3

In Table 5, the code inappropriate physical environment stood out. PT-31 illustrated the perceptions behind this code, stating that:

> I think it should not be compulsory to turn on the camera. Because we cannot always attend classes in a suitable environment at home. I agree that the instructor's camera opening increases participation in the course. For students, I think, this situation causes more stress.

PT-103 explained the reason for this situation in this way: "I don't have a room of my own, there are always people going in and out, so I don't open a live camera." The other remarkable codes in this group include (a) inappropriateness of personal appearance, (b) distracting and tiring, (c) others do not turn on cameras, (d) privacy issues and invasion of private space, (e) feeling stress and tension, (f) shyness, and (g) early class hours. As an example of student comments regarding these codes, PT-211 noted that "I don't want to show my current appearance and my home state to everyone. I feel more comfortable with the camera off. Otherwise, I get excited and stressed."

Based on the PTs' opinions, it can be inferred that they tended not to turn on their cameras, especially during VCs in the early morning hours. For instance, according to PT-98 "when morning class comes, I get out of bed and directly go to the VC in my pajamas and with no make-up. My clothes are not suitable to show myself." Some PTs had privacy and security concerns during VCs; PT-33 stated that "frankly, I do not trust the system in terms of privacy, there may be unwanted images and screenshots can be taken and shared." Some students suggested guidelines for turning on the camera. For example, PT-44 emphasized that only those speaking or presenting for an extended period of time should turn on the camera.

PTs' Suggestions for Making VCs More Effective

Regarding the fourth research question, PTs offered several suggestions for making VCs more effective. Table 6 shows the codes related to PTs' suggestions and their frequency distributions.

Table 6

PTs' Suggestions for making VCs More Effective

Code	*f*
Use student-centered activities	68
Provide question-and-answer activities	52
No early-hour classes	33
Short session duration	17
Instructors should take students' opinions	14
Use engaging visuals	8
Use applications that increase interaction	7
Use of whiteboard	6
Chat on different extracurricular topics	6
Create a sense of a real classroom	5
Cameras should be on	5
Talk about current issues	4
Provide tips, use of highlighting elements	3
Give extra points to those who attend VCs	3
Provide evaluation activities at the end of sessions	3
Increase instructor qualifications	2
Ask pre-reminding-organizer questions	1
Relaxing music	1
Use gestures and facial expressions	1

As seen in Table 6, most PTs stressed that student-centered activities should be carried out in VCs rather than just instructors' lecturing with presentations. They stated that the interaction should be increased by asking questions of students. "Student-teacher interaction should be ensured and students should be made more active by conducting question-answer activities" (PT-8). PT-30 suggested that "instructors can make the course enjoyable and more interesting with different methods and techniques instead of constantly reading from the presentation."

Some PTs stated that VCs in the early hours of the day should be brief. As PT-62 explained,

> While we have difficulty in focusing in the early hours even in face-to-face education, we have more problems in VCs early in the morning. I think it will be more efficient if the sessions are shortened and start a little later.

Clearly, both the start time and duration of the VC session were seen as related to its effectiveness, as well as the instructor's lecturing style, planning the learning-teaching environment, and focusing on student-centered activities.

Regarding the duration of VCs, participants responded to the following questions: How long do you think the VCs should last for a single session? After which minute do you start to get distracted? Based on our findings, the mean value for the VC duration was calculated as 27.5 minutes (N = 256, Min = 10, Max = 60, SD = 7.85). PTs were also asked: Considering the asynchronous content, at which time intervals do you think the VCs should be held? In all, 176 PTs reported that they should be held once a week, 33 PTs suggested once every two to three weeks, another 8 PTs said once a month, 31 PTs stated only before the exam, and 8 PTs felt VCs should never be held.

Discussion

This study indicated that PTs perceived virtual classrooms in which the instructor was visible via Web camera and supported by several highlighting elements (e.g., underlying important points, accentuation of voice, gestures, and facial expressions of instructor) to be more effective. VCs in which the instructor was not visible and the subject matter was presented only through narration were rated as less effective. The results showed that PTs did not want the cameras to be compulsory in VCs. Their primary reasons were that their physical environment and personal appearance were not suitable, the sessions were scheduled early in the morning, and cameras were a distracting factor. Similarly, Castelli and Sarvary (2021) showed that the most frequent reasons why students did not turn on their cameras were personal and environmental concerns. Costa (2020) also suggested that if students were ashamed of their home environment and did not have a private study room, the best policy would be not to ask them to turn on their cameras.

The results of this study showed that teachers, in particular, should turn on their cameras because gestures, facial expressions, emphases, and visual hints increase interaction. On the other hand, the act of students turning on their cameras can increase interaction depending on whether the class is crowded or the students could get the floor for speaking. However, when students are required to turn on the cameras, they may feel pressure and their desire to learn may be lowered. In the case of crowded classrooms, turning on the cameras in VCs may distract the students by watching each other from the camera images on the screen. These factors should not be overlooked when turning on the cameras in VCs and making communicative decisions. In particular, the COVID-19 pandemic and subsequent changes in teaching and learning have negatively affected students psychologically. When interpreting the findings in this study and similar studies, students' levels of anxiety and depression should be taken in account as these have increased since the COVID-19 outbreak (Huckins et al., 2020). An obligation to turn on their cameras may also worsen students' psychological state. Therefore, positive factors that will trigger camera use can be recommended by instructors before VC instruction begins.

On the other hand, as previously revealed by many studies, for VCs to reach the efficacy of face-to-face education, student-student and student-teacher interaction are critical factors (Gloria & Uttal, 2020). For instance, Kalman et al. (2020) pointed out that students who were previously engaged in collaborative work that increased interaction felt as if they were in a physical classroom when completing activities with the camera on. During VCs, collaborative learning can be used as well as methods such as project-based learning (Cortazar et al., 2021) and peer collaboration (Rapanta et al., 2020). Moreover, in order to increase the interaction, the suggestions of PTs in the use of virtual classrooms should be taken into consideration such as student-centered practices as well as question-and-answer activities. In this direction, Caton et al. (2020) emphasized the increase in students' questioning behavior had a positive effect on student participation in general.

In addition to these student-centered activities in the VCs, instructional materials such as videos can be used before the virtual classroom to support these student-centered activities. For instance, in their study with higher education students, Brockfeld et al. (2018) concluded that students found the videos at least as effective as VCs; they stated that supporting VCs with videos could increase their effectiveness. Islam et al. (2020) suggested that pre-recorded videos offered a more flexible learning opportunity. However, they also drew attention to the need for students to be motivated to watch such videos and the provision of time for students to watch them.

Finally, it should be noted that the concept of equal opportunity plays a key role in studies of online learning and VCs. Although the basic philosophy of distance education is to provide equality of opportunity, there must also be equal access to the technological infrastructure necessary for online learning environments to achieve this goal. In developing countries, there are gaps in access to technology and infrastructure facilities among different socio-economic classes (Venkatesh & Sykes 2013). Similarly, on a global scale, it can be said that this problem also exists between countries (Hill & Lawton, 2018). In addition, Internet connection problems make it difficult for some students to access online education (Todd, 2020). While some international organizations have provided tablets and computers, they have also opened their learning platforms and provided free digital educational resources (United Nations Educational, Scientific and Cultural Organization, 2020).

Limitations

This study had several limitations. First, respondents were participants in VCs with crowded classes at the higher education level. The perceived importance of the various elements in VCs with small class sizes and at different academic levels may vary. Keeping the cameras on in VCs for classes that are not crowded is an important factor that increases interaction. Second, the current study was not designed as an experiment, so did not allow for cause-and-effect inferences. Future studies could explore different communication elements in VC environments compared experimentally. Indeed, current research findings can pave the way for specific issues to be discussed in future experimental and causal-comparative studies. Third, since it was carried out in the emergency remote education process, the findings of this study may have differed from other distance education studies. Moreover, the sample for this research came from a university in Turkey. Hence, the results about turning on and not turning on the camera during VCs may vary in different countries. Geographic, religious, and cultural elements (e.g., Islamic religion) may have affected the results. Accordingly, similar research should be replicated with different samples in various regional contexts.

Conclusion and Recommendations

This study revealed the opinions of PTs about the effectiveness of various VC combinations, reasons for attending or not attending VCs, use of Web cameras, and suggestions for making VCs more effective. First, the results of this study showed that the elements such as whiteboard use for writing or drawing and the presence of the instructor's image were more effective than the presentation of PowerPoint slides without an instructor's image or any other interaction on screen. Second, PTs emphasized their reasons for participating in VCs, such as reinforcing the subject of the lesson, asking questions of the instructor, and increasing interaction. Many PTs stated that they did not want to attend the VCs because of the instructor's professional inadequacy and the earliness of the lesson hour. Third, we also asked questions about the use of the Web camera itself, an important element of VCs. Most PTs stated that instructors' Web cameras should be turned on during the Zoom session. As well, most PTs said that they did not want their Web cameras on for reasons such as unsuitable physical environment, unsuitable appearance, and distractions on the screen. It should be noted that these views were related to crowded online classes. It is clear that turning on the cameras in online classrooms with a small number of students increases interaction. Last, PTs offered several suggestions on how to make VCs more effective. They recommended student-centered activities (e.g., gamification, question-and-answer technique, online cooperative learning tools), effective instructional design, and short virtual sessions.

Based on our findings, in future studies, it would be interesting to perform this study on larger samples, in different fields and grade levels in higher education. We recommend that instructors should turn on their cameras in VCs, while the students who want to speak can turn on their cameras as they wish. Moreover, considering that the students attend the session from home or a dormitory, synchronous sessions should not be in the early hours of the day, and their durations should be short. We suggest that instructors use the interactive features of the applications (e.g., break-out room, emojis, polling, and video backgrounds) available in VCs.

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Appendix

Questions in the Third Part of the Survey

1. What are the factors direct you attending VCs (via Zoom)? Please explain.
2. What are the factors direct you not attending VCs (via Zoom)? Please explain.
3. What do you think about whether students should turn on their cameras or not in VCs? Please explain.
4. What do you think about the instructors turning on the camera or not in VC? Please explain.
5. What are your opinions about the effectiveness of turning on student and teacher cameras during VCs in distance education? Please explain.
6. What are the reasons for not turning on your camera in VCs? Please explain.
7. What are your suggestions for making VCs more effective? Please explain.
8. How long do you think the VCs should last for a single session? After which minute do you start to get distracted?
9. Considering the asynchronous content, at which time intervals do you think the VCs should be held?
   ( ) Once a week
   ( ) Once every two to three weeks
   ( ) Once a month
   ( ) Just before the exam
10. Which way do you mostly use to communicate with your instructor during the VCs? Please explain.

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 23, Number 3

September – 2022

Qualifying with Different Types of Quizzes in an Online EFL Course: Influences on Perceived Learning and Academic Achievement

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Abstract

This quasi-experimental study explored how different online exam types differentiate learners' academic achievement and perceived learning. The participants comprised 95 undergraduate students enrolled in an English course at a Turkish university in three groups, each taking a different type of quiz: with multiple-choice, open-ended, and mixed type questions. The results indicated that the academic achievement of the students in multiple-choice and open-ended groups increased and that quiz results improved the most for the multiple-choice group relative to the other groups. The study found a moderate level of significant relationship between cognitive and affective perceived learning and multiple-choice quiz scores. In addition, the study found a weak level of significant relationship between cognitive and affective perceived learning and mixed-design quiz scores, and between cognitive learning and the academic achievement scores of the mixed-design group. Semi-structured online interviews undertaken to further explain the quantitative data displayed positive influences of the different types of quizzes in terms of study behaviors and satisfaction. The findings of this study are expected to shed light for practitioners aiming to use different online assessment types.

Keywords: quiz types, online learning, EFL course, perceived learning

Introduction

In recent years, technological and pedagogical improvements have made online learning more attractive, and a great number of students prefer to study English as a Foreign Language (EFL) in courses delivered online. Moreover, methods used in computer-assisted language learning have proven to be effective in delivering EFL courses (Ebadi & Rahimi, 2018; Yang, 2017) and in facilitating teachers to monitor learner progress through online formative assessments (Alharbi & Meccawy, 2020).

Recent studies highlight the benefits of online assessment tools, such as improving student motivation, enhancing active learning, and deterring cheating as long as the questions are not too easy (Rinaldi et al., 2017; Schneider et al., 2018). The use of online exams in different forms of online assessment tools, such as fill-in-the blanks, multiple-choice, true-false, cloze test, word-order, match the columns, and table-verbs, has led to the discovery of a new world of teaching effectiveness and learning approaches (Yadollahi & Rahimi, 2011). Some scholars have highlighted the advantages of various online formative assessment tools such as Google Forms, Blackboard, Plickers, Socrative, and Kahoot! (Alharbi & Meccawy, 2020; Fageeh, 2015; Jazil et al., 2020). These are perceived as positive tools that enhance achievement in different ways, offering to improve learners' responses (Elbasyouny, 2021). For example, Fageeh (2015) reported that online testing via Blackboard provides opportunities for multiple practices, influencing achievement, automated scoring and instant feedback. Another study found that students perceived their learning as effective via an online grammar assessment included in Google Forms, a supportive tool that provides immediate feedback after completing the exam (Jazil et al., 2020). The perceived usefulness of online testing can also enhance students' performance. In fact, a high correlation has been reported between students' performance, perceived learning, and satisfaction with online learning (Gray & DiLoreto, 2016). Thus, applying different assessment approaches may result in different learning outcomes such as academic achievements or perceived learning.

Assessment tools in online learning

Online assessment tools can be used for formative assessments (quizzes) or summative assessments (exams). A series of studies have been carried out to examine the learning outcomes of various types of online assessments. Sek et al. (2012) find that the most preferred assessment format was multiple-choice questions, followed by true/false questions and single choice questions. Kılıç and Çetin (2018) report the most preferred exam type to be multiple-choice tests because students consider they could succeed better. In contrast, Ogange et al. (2018) document that students perceive the various types of formative online assessments as nonsignificant. Accordingly, understanding the effects of different quiz types on students' perceived performance and success has important implications for instructors' decisions regarding online assessment.

The research to date has tended to focus on the effect of online exams on students' performance, motivation, study style, and exam anxiety (Pan et al., 2019; Vayre & Vonthron, 2019) rather than on their perceived learning which allows students to evaluate themselves.

Perceived Learning in Online Learning

Perceived learning is an indicator of the effectiveness of online learning environments (Barbera et al., 2013) and is considered as an evaluation of learning experience (Caspi & Blau, 2011). Researchers define perceived learning in cognitive and socio-emotional dimensions. While the cognitive dimension is the sense of achieving new knowledge, the socio-emotional dimension includes the students' degree of involvement, experiences, and feelings in the learning process (Caspi & Blau, 2011).

Previous studies have reported that perceived learning has a significant and positive relationship with online course flexibility and student-student interaction (Marks et al., 2005); student-instructor interaction (Kang & Im, 2013); cognitive presence, social presence, and teaching presence (Arbaugh, 2008; Rockinson-Szapkiw et al., 2016); and learning content and course design (Barbera et al., 2013). Additionally, Paechter et al. (2010) report that students' expectations regarding subject knowledge have predictive power for their perceived learning in online learning settings. Furthermore, Artino (2008) reports a significant correlation between perceived learning and satisfaction in online learning settings.

Perceived learning is also considered to be a significant predictor of students' course grades in online learning settings (Rockinson-Szapkiw et al., 2016). Having different learning approaches gives students options to study with various tools in different time periods with varying goals and expectations about their learning. In line with this expectation, they engage actively in online quizzes by paying more attention to the classes (Dobbins & Denton, 2017). In this sense, previous studies have addressed positive perceptions about online quizzes in terms of learning outcomes, technology acceptance, and perceived usefulness (Raes & Depaepe, 2020). Accordingly, different types of online exams can be thought to differentiate the perceived learning levels, and the relationship between online quizzes and students' perceived learning is considered to be a variable worth examining. Within this framework, this study aims to reveal the relationship between perceived learning and the academic achievement of students studying using different types of online exams in an online EFL course.

Aim of the Study

One prominent area that uses online assessment is EFL classes. These are commonly required courses in the first year of all universities in Turkey, targeting basic skills such as reading, writing, speaking, listening, and grammar and vocabulary. Given the importance of the use of quizzes in online EFL classes, this study aims to determine how online exam types differentiate learners' perceived learning and academic achievement. As the nature of the topics is appropriate for the preparation of different kinds of tests for the same outcomes, we focused on an EFL course. The motivation for the study was the idea that an online EFL course supported by different quiz types would differentiate students' academic achievements and perceived learning. Focusing on the relationship between academic achievement and perceived learning, this research seeks answers to the following research questions:

1. Is there a significant difference between the academic achievement (quizzes, EFL test) scores of the students who study with different quiz types?

2. Is there a significant difference between the perceived learning scores of the students who study with different quiz types?

3. What is the relationship between students' academic achievement (with regard to question types in quizzes, EFL test) and their perceived learning scores?

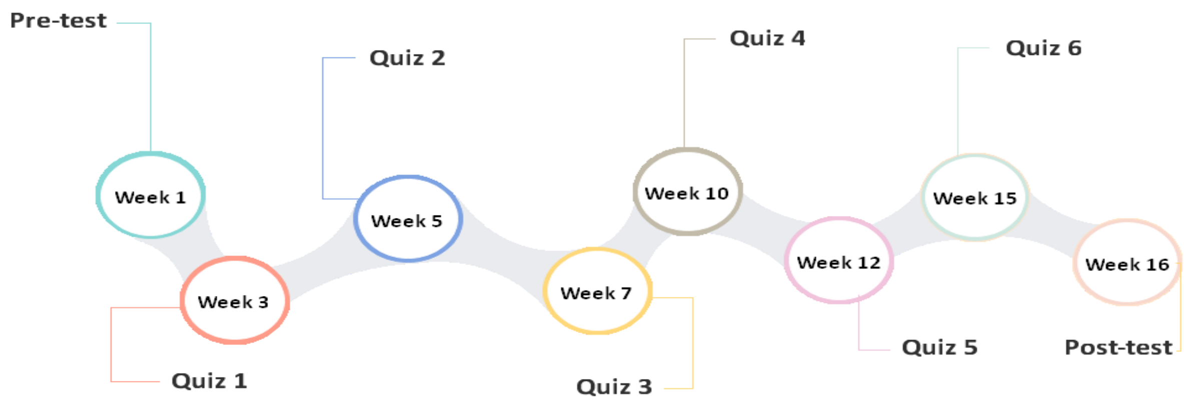
Method

This quasi-experimental study with three randomized study groups, using a pre- and post-test design, was carried out in a university-level EFL course in Turkey. The same instructor taught the same instructional package to all groups during the fall semester of the 2020–2021 academic year. An academic achievement test including all the targeted teaching modules was applied as a pre-test.

The students were introduced to the question types of the quizzes they would have following every module: Group A—multiple-choice questions; Group B—mixed-design questions (fill-in-the blanks, true-false, matching); and Group C—open-ended questions. The study lasted for 16 weeks with a total of 18 online quizzes, 6 for each group. The academic achievement test was applied as a post-test followed by an online interview with volunteering students. The perceived learning scale was used to determine the perceived learning scores. Figure 1 shows the procedure followed during the study.

Figure 1

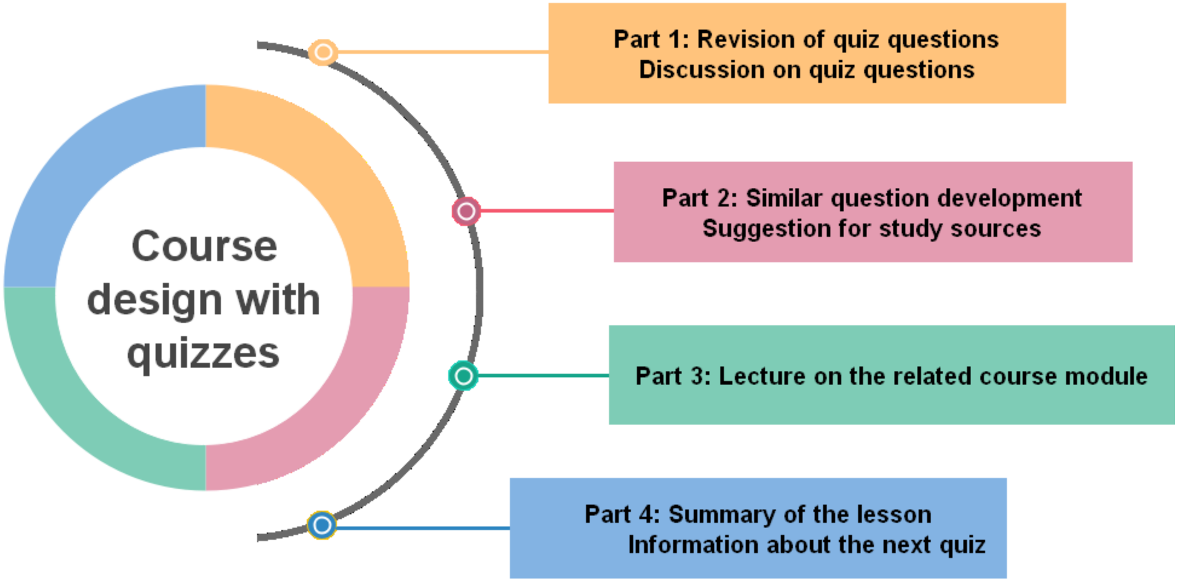
Study Procedure



Other than the established methodology of Presentation, Practice, and Production in teaching EFL, the online course design was outlined to fit with the quizzes. Each group had one synchronous lesson of at least 90 minutes on Adobe Connect Web Conferencing System every week. The quizzes were conducted as out-of-class activities at the end of each module and reviewed at the beginning of the following lesson, as shown in Figure 2.

Figure 2

Course Design with Quizzes



In part 1 of the course design, the quiz questions were answered, and students discussed the questions, contextual clues, and correct answers. In part 2, the students formed quiz-type sample questions and shared them with each other to get familiar with the quiz question type(s). Sample materials were presented to students to study for the next quiz, shaping their learning approach fitting with the question type. In part 3, the course topic was delivered via an appropriate teaching strategy by providing examples according to the type of the quiz questions. In part 4, a question-answer session was followed by a summary of the lesson and information about the next quiz (duration, number of questions, etc.).

Data Collection Tools

The quantitative data were gathered using the perceived learning scale, academic achievement test, and online quizzes.

Perceived Learning Scale

The original Cognitive, Affective and Psychomotor (CAP) Perceived Learning Scale designed by Rovai et al. (2009) for both face-to-face and online learning includes a total of 9 items, 3 items for each of the cognitive learning, affective learning, and psychomotor learning subscales. Since this study did not include psychomotor skills as learning goals, we were only concerned with cognitive and affective learning, each represented by 1 item. The item, or question, related to cognitive perceived learning was the following: "When you evaluate on a scale of 0 to 9, how much do you think you learned in this course? (0: meaning I think I learned nothing; 9: meaning I think I learned a lot)" as adapted by Çelik (2020) from Richmond et al. (1987) with a correlation coefficient of .806. Adapting this item with the help of four field experts, we tested the affective perceived learning with the item, "When you evaluate on a scale of 0 to 9, how much do you think your attitude towards the course changed? (0:meaning I think my attitude didn't change at all; 9: meaning I think my attitude changed a lot)." The Pearson correlation to assess the test retest reliability of the affective perceived learning was found $r(74) = .802$. The two ten-point Likert items ranging from 0 to 9 had an internal consistency reliability of Cronbach's alpha of .933.

Academic Achievement Test

We assessed the effectiveness of the interventions on students' academic achievement scores using a standardized academic achievement test of 20 mixed-type questions, each worth 5 points, in four parts selected from the course book end-of-term tests that serve as the framework for the course. The *Smart Choice* course book (Wilson & Healy, 2016) by Oxford University Press, which is widely used in various K-12 and tertiary level schools, includes tests containing questions targeting the outcomes of the foreign language curriculum and is also the main instrument of various online EFL studies (Jakob & Afdaliah, 2019; Wongpornprateep & Boonmoh, 2019). The instructor and one field expert reviewed the test items in terms of content validity. Google Forms was used to implement the tests.

Online Quizzes

The online quizzes developed by the researchers, one of whom was also the course instructor, covered the relevant module of that week. While the content of the questions was the same, the form of the questions in the quizzes differed for each group. Figure 3 outlines the forms of questions in the quizzes.

Figure 3

Some Examples of the Same Questions of Different Question Types

Groups	Exam Types	
Open-Ended Exam Group	Where are the children now? (Garden) Short answer text	What is his job?  Short answer text
Mixed Exam Group	The children .... in the garden now. Short answer text	 A: What is his job? B:He is an artist — True / False
Multiple Choice Exam Group	The children .... in the garden now. am is are isn't	What is his job?  artist soldier server architect

Each quiz included 20 questions, targeting the same vocabulary and grammatical content with different question types. In all groups, some questions also included visuals for clarification and guidance. All the quiz questions were similar to the question contents of the academic achievement test. Two field experts checked whether each question in the quizzes aimed at the same objectives.

Interviews

Online interviews were carried out with a total of 18 volunteering students after the post-test based on their perceived learning scores—2 low, 2 medium, and 2 high scores (6 students from each quiz group)—to further explain the data from the scales. The participants were asked questions about the effects of the quizzes on their learning, study behavior, attitude towards the lesson, academic achievement, and the factors they perceive contributing to their learning.

Participants

Ninety-five freshman students (F = 64, M = 31, mean age = 19) enrolled in the English 1 course participated in this study. None of the participants completed preparatory English class as this is not required for the vocational school students. However, they all had the same A1 level of basic English classes. The participants were from the departments of Banking and Insurance, Finance, Public Relations, and Accounting, and they were randomly assigned to one of three groups: open-ended (n = 32), multiple-choice (n = 33), and mixed-design (n = 30).

Data Analysis

An analysis of variance (ANOVA) with the Tukey HSD post-hoc test and Kruskal-Wallis H test were used to determine significant differences among the students' scores in pre-tests, post-tests, and quizzes. Split Plot ANOVA was used to show the change in academic achievement in the pre-tests and post-tests. A *t*-test was used to put forth the difference in pre-tests and post-tests within groups.

The data obtained from the interviews were analyzed descriptively and students' opinions were presented referring to the perceived learning scores of the groups. For example, when quoting from the open-ended quiz group, students with perceived learning total score of <9 were considered as "low," between 9 and 15 as "medium," and >15 as "high"; and these were coded as OEL-1, OEM-1, and OEH-1, respectively.

Results

The quantitative data were presented with regard to the research questions, and the interview data were used to explain the factors in the intervention process.

Academic Achievement Scores of the Groups

Is there a significant difference in the pre-test results of the students in different quiz types?

The normal distribution of the data for the pre-test was confirmed with the homogeneity of the variance test. Levene's test showed that the variances for quiz types were equal, $F(2,92) = 0.163$; $p = 0.850$; $p>0.05$. Since the data showed the normality assumptions, we performed a one-way ANOVA test to compare the pre-test scores of the groups, as shown in Table 1.

Table 1

One-way ANOVA Results of the Groups for Pre-test

	Sum of squares	df	Mean square	F	Sig.
Between groups	2330.705	2	1165.353	2.874	.062
Within groups	37299.295	92	405.427		
Total	39630.000	94			

Note. $^*p < .05$.

Table 1 indicates that there was not a statistically significant difference between pre-test results of the groups as determined by one-way ANOVA ($F(2,92) = 2.874$; $p = .062$; $p > 0.05$).

Is there a significant difference in the post-test results of the students in different quiz types?

The normal distribution of the data for the post-test was confirmed by the homogeneity of the variance test. Levene's test showed that the variances for post-test were not equal, $F(2,92) = 3.281$; $p = 0.042$; $p < 0.05$. Therefore, a non-parametric test, the Kruskal-Wallis H test, was carried out and the difference between the posttest scores of the groups is shown in Table 2.

Table 2

Kruskal-Wallis H Test Results of the Groups for Post-test

Test statistics	
	Post-test
Chi-Square	2.755
df	2
Asymp. Sig.	.252

Note. * $p < .05$.

Table 2 indicates that there was not a statistically significant difference between groups as $\chi^2(2) = 2.755$, $p = 0.252$, $p > 0.05$. However, the change in the academic achievement scores is shown in Figure 4.

Figure 4

Change of Pre-tests and Post-tests for Academic Achievement

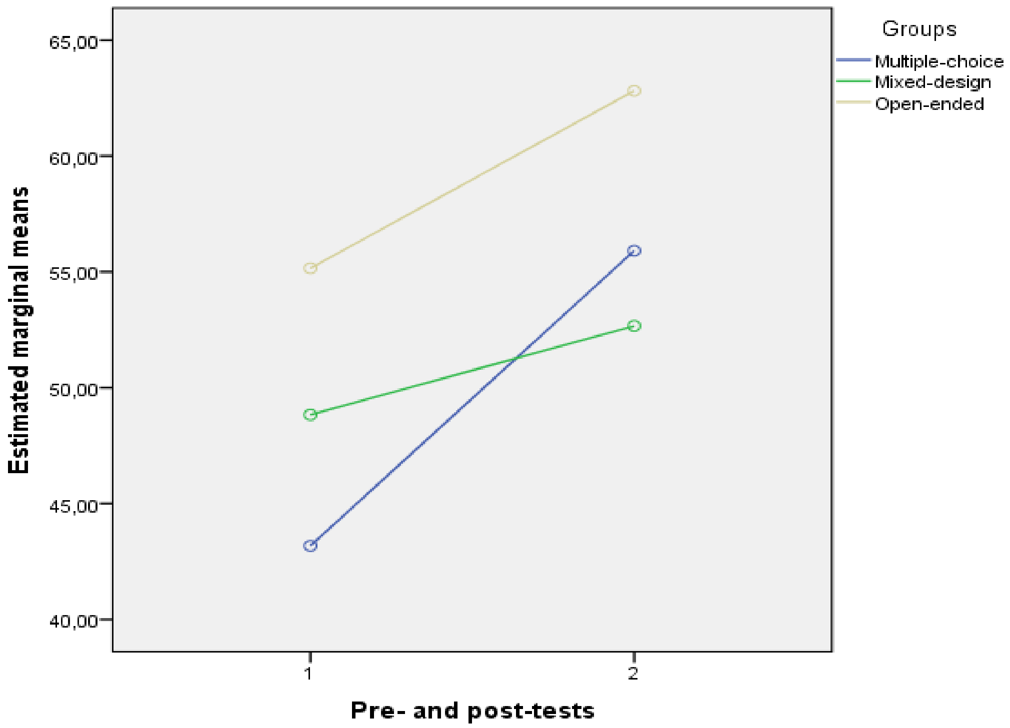


Figure 4 reveals that the post-test scores increased significantly from $\bar{x}$ = 43.18 to $\bar{x}$ = 55.90 in multiple-choice groups; from $\bar{x}$ = 48.83 to $\bar{x}$ =52.66 in mixed-design groups; and from $\bar{x}$ = 55.15 to $\bar{x}$ = 62.81 in open-ended groups. The change was higher in the multiple-choice group compared to the others, surpassing the average post-test score of the mixed-design group, which had a higher academic achievement score in the pre-test.

Is there a significant difference in the quiz scores of the students in different quiz types?

The homogeneity of the variance test showed that the data were normally distributed and Levene's test showed that the variances for quiz mean scores were equal, $F(2,92) = 1.301$; $p = 0.277$; $p>0.05$. The difference of the groups in the quiz mean scores is shown in Table 3.

Table 3

ANOVA results of the groups for average quiz scores

	Sum of Squares	df	Mean Square	F	Sig.	Tukey HSD
Between Groups	9746.200	2	4873.100	21.906	.000	A-B,A-C,B-C
Within Groups	20465.484	92	222.451			
Total	30211.684	94				

Note. A—multiple-choice quiz group; B—mixed-design quiz group; C—open-ended questions group * p < .05.

A statistically significant difference was found between groups as ($F(2,92) = 21.906$; $p = .000$; $p<0.05$). Post hoc Tukey HSD test results revealed a significant difference between multiple-choice ($\bar{x}$ = 64.81; SD = 13.42) and mixed-design groups ($\bar{x}$ = 54.90; SD = 14.85) in favor of multiple-choice and between multiple-choice and open-ended ($\bar{x}$ = 40.43; SD = 16.35) groups in favor of multiple-choice groups. In addition, there was a significant difference between mixed-design and open-ended groups in favor of the mixed-design quiz group.

Is there a significant difference in the academic achievement scores of the students within groups?

The differences in the academic achievement scores of the multiple-choice, mixed-design and open-ended groups were all confirmed with the paired samples t-test as shown in Table 4, Table 5 and Table 6, respectively.

Table 4

Paired Samples T-Test of the Multiple-choice Group for Academic Achievement

Paired samples test									
		Paired differences					t	df	Sig. (2-tailed)
		Mean	Std. deviation	Std. error mean	95% confidence interval of the difference				
					Lower	Upper			
Pair 1	pre-test – post-test	-12.72727	20.99445	3.65467	-20.17158	-5.28296	-3.482	32	.001

Note. * p < .05.

Table 4 shows that the difference in the academic achievements of the multiple-choice quiz group between pre-test ($\bar{x}$ = 43.18; SD = 18.86) and post-test ($\bar{x}$ = 55.90; SD = 24.98) was significant $t(32) = -3.482$; p =.001; p<0.05.

Table 5

Paired Samples t-Test of the Mixed-design Group for Academic Achievement

Paired samples test									
		Paired differences					t	df	Sig. (2-tailed)
		Mean	Std. deviation	Std. error mean	95% confidence interval of the difference				
					Lower	Upper			
Pair 1	pre-test – post-test	-3.83333	20.66495	3.77289	-11.54975	3.88309	-1.016	29	.318

Note. * $p < .05$.

The difference in academic achievements of the mixed-design group between pre-test ($\bar{x}$ = 48.83; SD = 20.32) and post-test ($\bar{x}$ = 52.66 SD = 22.42) was not significant $t(29) = -1.016$; p = .318; p>0.05.

Table 6

Paired Samples t-Test of the Open-Ended Group for Academic Achievement

Paired Samples Test									
		Paired differences					t	df	Sig. (2-tailed)
		Mean	Std. deviation	Std. error mean	95% confidence interval of the difference				
					Lower	Upper			
Pair 1	pre-test - post-test	-7.65625	17.17953	3.03694	-13.85013	-1.46237	-2.521	31	.017

Note. * $p < .05$.

The difference in academic achievements of the open-ended group between pre-test ($\bar{x}$ = 55. 15; SD = 21. 19) and post-test ($\bar{x}$ = 62.81; SD = 16.74) was significant $t(31) = -2.521$; p = .017; p<0.05.

Perceived Learning Scores of the Groups

Is there a significant difference in the perceived learning scores of the students in different quiz types?

We examined the perceived learning scores of the groups under affective learning and cognitive learning dimensions. We confirmed the normal distribution of the data for affective learning and cognitive learning using the homogeneity of variance test. Levene's test showed that the variances for affective learning, F(2,92) = 6.210; p = 0.003; p<0.05, and for cognitive learning were not equal, F(2,92) = 5.345; p= 0.006; p<0.05. Table 7 shows the Kruskal-Wallis H test results showing the difference between the affective and cognitive perceived learning scores of the groups.

Table 7

Kruskal-Wallis H Test Results of the Groups for Affective and Cognitive Learning Scores

Test statistics		
	Affective	Cognitive
Chi-Square	2.906	5.406
df	2	2
Asymp. Sig.	.234	.067

Note. * $p < .05$.

The descriptive results revealed the mean scores of:

- affective perceived learning (multiple-choice: $\bar{x}$ = 6.15, SD = 2.18; mixed-design: $\bar{x}$ = 5.36, SD = 2.89; open-ended: $\bar{x}$ = 6.71, SD = 1.72);
- cognitive perceived learning (multiple-choice: $\bar{x}$ = 6.30, SD = 2.48; mixed-design: $\bar{x}$ = 5.33, SD = 2.80; open-ended: $\bar{x}$ = 7.0, SD = 1.60); and
- total perceived learning (multiple-choice: $\bar{x}$ = 12.45, SD = 4.58; mixed-design: $\bar{x}$ = 10.83, SD = 5.31; open-ended: $\bar{x}$ = 13.71, SD = 3.03).

Table 7 shows that there was not a statistically significant difference in affective perceived learning results between groups, $\chi^2(2) = 2.906$, p = .234, p>0.05, and in cognitive perceived learning results between groups as determined by the Kruskal-Wallis H test, $\chi^2(2) = 5.406$, p = .067, p>0.05.

Relationships between Academic Achievement and Perceived Learning Scores of the Groups

Is there a significant relationship between students' learning performance and their perceived learning scores?

We used a Pearson correlation coefficient to determine the relationship between affective learning, cognitive learning, averages of quiz scores, and academic achievement scores of multiple-choice, mixed-design, and open-ended quiz groups, as shown in Table 8, Table 9 and Table 10, respectively.

Table 8

Multiple-choice Quiz Group Correlations between Affective Learning, Cognitive Learning, Quiz Averages, and Post-test as Academic Achievement Scores

Correlations					
		Affective learning	Cognitive learning	Quiz averages	Post-test
Affective learning	Pearson correlation	1	.933**	.449**	.336
	Sig. (2-tailed)		.000	.009	.056
	N	33	33	33	33
Cognitive learning	Pearson correlation	.933**	1	.418*	.263
	Sig. (2-tailed)	.000		.015	.140
	N	33	33	33	33
Quiz averages	Pearson correlation	.449**	.418*	1	.741**
	Sig. (2-tailed)	.009	.015		.000
	N	33	33	33	33
Post-test	Pearson correlation	.336	.263	.741**	1
	Sig. (2-tailed)	.056	.140	.000	
	N	33	33	33	33

Note. * $p < .05$. ** $p < .01$.

The results revealed a very strong positive correlation between perceived affective learning and cognitive learning, a moderate positive correlation between perceived affective learning and average quiz scores, and a weak positive correlation between affective learning and academic achievement scores. In addition, there was a moderate positive correlation between perceived cognitive learning and the average quiz scores, a weak positive correlation between cognitive learning and academic achievement, but a strong positive correlation between average quiz scores and academic achievement, which means increases in quiz averages were correlated with increases in academic achievement.

Students' perspectives about the process also provided clues to explain the positive effect of quizzes on their perceived learning. In this regard, students with high perceived learning scores stated that quizzes had a positive effect on their learning, while students with low perceived learning scores stated that quizzes had no effect on their learning. For example, MCH-5 stated, "The exams are very efficient as they are loaded right after finishing the subject and I understand the subjects better," while MCL-1 stated, "The quizzes are not very effective on my learning as they are easy to answer and I know I will pass the test very easily."

Table 9

Mixed-design Group Correlations between Affective Learning, Cognitive Learning, Quiz Means, and Posttest as Academic Achievement Scores

Correlations					
		Affective learning	Cognitive learning	Quiz averages	Post-test
Affective learning	Pearson correlation	1	.901**	.393*	.343
	Sig. (2-tailed)		.000	.032	.064
	N	30	30	30	30
Cognitive learning	Pearson correlation	.901**	1	.393*	.385*
	Sig. (2-tailed)	.000		.031	.036
	N	30	30	30	30
Quiz averages	Pearson correlation	.393*	.393*	1	.756**
	Sig. (2-tailed)	.032	.031		.000
	N	30	30	30	30
Post-test	Pearson correlation	.343	.385*	.756**	1
	Sig. (2-tailed)	.064	.036	.000	
	N	30	30	30	30

Note. $^*p < .05$ $^{**}p < .01$

We found a very strong positive correlation between affective learning and cognitive learning, and a weak positive correlation between affective learning and average quiz scores. In addition, we found a weak positive correlation between affective learning and academic achievement scores, and a weak positive correlation between cognitive learning and average quiz scores. We found a weak positive correlation between cognitive learning and academic achievement and a strong positive correlation between quiz averages and academic achievement, which means increases in quiz means were correlated with increases in academic achievement at a high level.

Students' perspectives showing the factors explaining the effect of the interventions to the research variables were generally in line with the quantitative data. While students with low perceived learning scores stated that the quizzes were not impressive on their learning, students with medium and high perceived learning scores expressed the positive effects of quizzes. In this sense, MIXL-1 stated, "Quizzes are good work but not beneficial for my learning," while MIXM-4 stated, "Quizzes allow me to repeat the topics I have learned," and MIXH-6 stated, "The exams help me improve what I learned in the lesson." Overall, students reported that quizzes had positive effects on their learning.

Table 10

Open-Ended Group Correlations between Affective Learning, Cognitive Learning, Average Quiz Scores, and Post-test as Academic Achievement Scores

Correlations		Affective learning	Cognitive learning	Quiz averages	Post-test
Affective learning	Pearson correlation	1	.663**	.147	.101
	Sig. (2-tailed)		.000	.421	.583
	N	32	32	32	32
Cognitive learning	Pearson correlation	.663**	1	.259	.252
	Sig. (2-tailed)	.000		.152	.165
	N	32	32	32	32
Quiz averages	Pearson correlation	.147	.259	1	.521**
	Sig. (2-tailed)	.421	.152		.002
	N	32	32	32	32
Post-test	Pearson correlation	.101	.252	.521**	1
	Sig. (2-tailed)	.583	.165	.002	
	N	32	32	32	32

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

We found a strong positive correlation between affective learning and cognitive learning, but a very weak positive correlation between affective learning and average quiz scores and between affective learning and academic achievement scores and a weak positive relationship between cognitive learning and quiz scores and between cognitive learning and academic achievement scores. However, we found a moderate positive correlation between average quiz and academic achievement scores, which indicates that increases in quiz average scores were correlated with increases in academic achievement at a moderate level.

The perspectives of the open-ended quiz group 'students explain the relationship between perceived learning scores and academic achievement, though at a low level. Unlike the other two test groups, all of the volunteering interview students in this group stated the positive effects of quizzes on their perceived learning. For example, OEL-2 stated, "I studied for quizzes, and they helped me learn by making it easier to learn," and, similarly, OEM-4 claimed, "I think quizzes were difficult for me but having to study affected my learning." OEH-5 stated, "Quizzes certainly have an effect on my learning. I realized that I understood and improved my English skills more with them," and OEH-6 stated, "I think I improved what I learned in the lessons better with quizzes."

The overall interviews revealed that the students with high perceived learning scores in all groups reported that quizzes helped them learn by providing opportunities to review and practice the topics they learned. Students with low perceived learning scores in multiple-choice and mixed groups generally stated that quizzes had no effect on their learning.

Discussion

Various studies have reported the positive effects of using several assessments instead of a single final exam, such as improved student learning and retention (Rezaei, 2015), student engagement, and feedback opportunities (Holmes, 2015). Day et al. (2018) indicate that assessment leads to more effective study behavior promoting student academic achievement, but that the type of continuous assessment does not influence academic achievement; that is, students' performances do not differ depending on whether assessment is through a written assignment, a partial exam, or homework assignments. However, Brown and Wang (2013) claim that the types of exams used for assessment lead students to use different learning approaches in the process of preparing for the exam. Different from the former study and similar to the latter, our study found that students' quiz scores improved more in the multiple-choice group, mixed-design group, and open-ended group. The fact that the correct option in multiple-choice exams is among the choices, which act as clues, makes it easier for students to recall the correct answer, but the answers in open-ended exams are required to be written in students' own sentences. The mixed-design group includes both types of questions, which may result in the great discrepancy between the quiz mean scores.

The average quiz scores of the mixed-design group were lower than the multiple-choice group but higher than the open-ended group. However, the open-ended quiz group was the most successful in the post achievement test with all question types. The comparison of the descriptive results of the pre- and post-test academic achievement verifies the role of the question types. Given that students in multiple-choice and the mixed-design groups, to some extent, choose among predetermined options or statements, they may have felt all the questions would be uncomplicated. This resulted in superficial studying or none, as they assumed they would pass the quiz or the exam readily. In contrast, the open-ended quiz group was overwhelmed with questions, with limited or no hints other than contextual clues or pictures. This required students to use all their academic knowledge, learning strategies, and skills. However, students may use an in-depth learning approach to understand the subject when asked questions requiring answers based on interpretation. Because test items leading to remembrance or guesswork require less mental effort, the academic achievement scores of the students in this study may have fallen behind the open-ended group, who studied with deeper learning strategies. Notwithstanding the seeming disadvantage in the quizzes, the open-ended group acquired higher perceived learning and achievement scores and expressed absolute ideas on the benefits of this kind of quiz type. Confronted with challenging questions, the open-ended group might have been compelled to study for sentence structures or different expressions and to consider that the only option to pass the quiz or the exam was to study hard, leading to higher learning.

Regarding the perceived learning, this study did not find any statistically significant differences between groups in total perceived learning scores. However, the open-ended group had the highest total perceived learning scores, which may be explained by the fact that the open-ended group used deeper learning strategies to study. The mixed-design group fell behind the multiple-choice group, despite facing fill-in-the-blanks type questions as well as true/false and match-type questions. This might be the result of their feeling they did superficial learning with the less accustomed type of matching questions.

In-depth analysis of the multiple-choice group revealed a moderate level of relationship between affective learning scores and average quiz scores, and between cognitive learning scores and average quiz scores. There was a weak level of relationship between affective learning scores and academic achievement scores, and between cognitive learning scores and academic achievement scores. This variation may be the result of students' perceiving higher learning in quizzes with options facilitating ease-of-decision but their low performance in the academic achievement test with open-ended, short answer, fill-in-the-blanks as well as multiple-choice questions, which they are more familiar with.

Previous studies have reported higher cognitive perceived learning in online courses as a result of increased student satisfaction (Baturay, 2011) and higher achievement (Rockinson-Szapkiw et al., 2016). Consistent with the literature, the students in the multiple-choice quiz group achieved higher scores in the quizzes and referred to the positive impacts of quizzes, implying their satisfaction with their higher scores, which might have led them to believe they acquired higher learning. The differences between multiple-choice and mixed-design groups can be explained by the fact that the true/false questions that the mixed-design group faced required less thinking and had simpler, easy-to-guess matching questions. The students frequently face multiple-choice tests or open-ended questions in their academic lives, but they seldom face the mixed-design exams, which may have adversely affected their learning approach and academic achievement.

Finally, the analysis of the open-ended group showed a very weak positive relationship between affective learning scores and average quiz scores, and between affective learning scores and academic achievement scores. There was a weak relationship between cognitive learning scores and average quiz scores, and between cognitive learning scores and academic achievement scores. The discrepancy from the other two groups is obviously a result of the students' feeling they have learnt more while studying for questions that provide no hints but have made more mistakes in answering the questions without any options or clues within the given limited time. As is seen in previous studies, enhancing interactions that influence learners' perceived learning and satisfaction relates strongly to learner-content interaction (Alqurashi, 2019; Baber, 2020; Baturay, 2011; Lin et al., 2017). In this framework, all the students interviewed in this group confirmed the positive role of the open-ended type of questions in guiding them to use deeper learning and studying strategies while interacting more with the content of the quizzes.

Overall, the types of the questions given to different groups might have changed the study behaviors. Thus, students' study behaviors may have influenced the expectations and satisfactions that were indirectly related to the perceived learning. In addition, the observed increase in the academic achievement of the open-ended group could be attributed to their study behavior.

Some researchers argue that the determinants of perceived learning and satisfaction outcomes of students in online learning are course structure, instructor knowledge, and facilitation of learning process by feedback (Baber, 2020; Cole et al., 2021). Others report the variables that principally influence student satisfaction and perceived learning in online courses to be the course design, interaction, and the learning content (Barbera et al., 2013; Cui, 2021). In accordance with the previous studies, the course structure in our study enabled the instructor to give feedback on the quizzes and learning processes by answering the quiz questions and allowing students to create similar questions in the first lesson following the related quiz. This allowed higher interaction, which may have positively affected students' perceived learning.

Conclusion

This study set out the relationships between different quiz types, academic achievement, and perceived learning. The participants were most successful in the multiple-choice type of questions and least successful in the open-ended questions. Conversely, those who were exposed to open-ended quizzes were most successful in the achievement test, revealing the effect of this type of question in improving study behaviors and deepening learning strategies for mixed-design exams. The students in the open-ended quiz group displayed the highest affective and cognitive learning scores, implying the impact of dealing with questions that require deeper learning strategies. Finally, the current study confirmed the positive relationship between the overall perceived learning scores and academic achievement scores, that is, the higher the perceived learning score, the higher the academic achievement score. The question types in this study shaped students' study behaviors and also affected their expectations and satisfactions.

Limitations and Implications

This study is not exempt from limitations. The sample size in the groups was small and the instructional package was specific to the English course. A larger sample size and content would enhance the sensitivity analysis. The study was carried out through the most frequently used online quiz types. Further studies could examine the types of quizzes created with other assessment types. We hope the results of the study are helpful to online instructors who desire to make more effective use of various types of quizzes in online EFL courses.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 23, Number 3

September – 2022

Latent Profiles of Online Self-Regulated Learning: Relationships with Predicted and Final Course Grades

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Abstract

This study used a combined person- and variable-centered approach to identify self-regulated online learning latent profiles and examine their relationships with the predicted and earned course grades. College students (N=177) at a Southeastern U.S. university responded to the Online Self-Regulated Learning Questionnaire. Exploratory structural equation modeling revealed four self-regulation factors: goal setting, environment management, peer help-seeking, and task strategies. Latent profile analysis yielded four latent profiles: Below Average Self-Regulation (BASR), Average Self-Regulation (ASR), Above Average Self-Regulation (AASR), and Low Peer Help-Seeking (LPHS). Compared with the AASR group, when students anticipated obtaining a higher course grade, they were less likely to engage in peer help-seeking and task strategies and more likely to adopt the LPHS self-regulation profile. Relating to LPHS, membership to all other groups predicted significantly lower course grades. AASR and LPHS predicted their performance most accurately, with non-significant differences between the predicted and the final course grades.

Keywords: online self-regulated learning, latent profile analysis, person-centered approach, variable-centered approach, higher education

Introduction

With advances in technology, as well as the COVID-19 pandemic, online learning has become an essential component of the learning opportunities available to most students (Aristovnik et al., 2020; Kaplan, 2017) and will likely become mainstream by 2025 (Palvia et al., 2018. Online learning, defined as learning taking place on the Internet (Moore et al., 2011) implies learners' physical separation from their instructors and the institution. It requires students to engage more actively in regulating their learning as they decide where, when, and how to study (Gerjets et al., 2008; Wang et al., 2013). Therefore, students' self-regulating abilities are essential for their academic performance when taking online courses (Ally, 2004; Barnard et al., 2009; Sitzmann et al., 2009; Winters et al., 2008; Zimmerman, 2008).

Self-regulated learning (SRL) is essential in all learning environments, whether face-to-face, blended, or online (Greene, 2018; Zimmerman, 2008); it allows for the achievement of learning goals and serves as a valuable educational outcome in and of itself (Chen, 2012; Greene, 2018). However, students encounter more difficulties in online classes than in other environments when they do not employ effective SRL techniques (Azevedo, 2005). Understanding how individual students develop and deploy self-regulation strategies is essential in order to promote online SRL (OSRL) and provide differentiated support according to students' characteristics and needs (Guo & Reinecke, 2014; Hood et al., 2015; Kocdar et al., 2018; Schwam et al., 2021; Wong et al., 2019; Yeh et al., 2010; Zhang et al., 2015; Zheng, 2016;). Although research has acknowledged differences in students' SRL skills and strategies (Greene & Azevedo, 2007), there has been a lack of clarity on how to account for these differences (Barnard-Brak et al., 2010). The current study addressed this gap by classifying OSRL characteristics based on how individual students endorsed and employed self-regulated learning strategies in an online course. Identifying profiles based on attributes of SRL among online students, and determining how such profiles relate to academic performance, was intended to advance SRL theory and offer guidance to support OSRL through a more nuanced personal approach.

Most research studies on SRL have followed a variable-centered approach, examining relationships among variables and summarizing trends for an entire sample without investigating how such relationships may vary across subgroups (Howard & Hoffman, 2017). In contrast, person-oriented approaches have examined each person, identifying subgroups of individuals with similar profiles (Bergman & Anderson, 2010). Such profiles reflect individual differences in motivation, strategy use, communication, and relation to others (Hampson & Colman, 1995; Woolfolk et al., 2006). Identifying OSRL profiles helps reveal distinct OSRL strategies and provided valuable information for promoting self-regulatory strategies based on individual student needs (Woolfolk, 2001). Combining the variable-centered and the person-centered methods allows researchers to investigate generalities across entire samples as well as the profiles of distinct subgroups (Marsh et al., 2009; Raufelder et al., 2013). In the current study, we used the combined approach to:

1. Identify the OSRL factors underlying the data.
2. Distinguish OSRL latent profiles.
3. Estimate the relationship between predicted grades and OSRL latent profiles.

4. Estimate the relationship between OSRL latent profiles and final grades.

Theoretical Perspective

The term self-regulation has been used to refer to self-generated thoughts, feelings, and actions that learners activate and maintain to attain personal goals (Zimmerman, 1998; Zimmerman & Kitsantas, 2014). Self-regulated learners often displayed specific motivational beliefs or attitudes, cognitive strategies, and metacognitive abilities. They engaged in a cyclical process of planning, performing, evaluating, and reflecting, functioned as active agents in their learning (Schunk & Zimmerman, 2008; Winne, 1997; 2018), and obtained improved academic performance (Greene, 2018; Pintrich, 2004; Pintrich & DeGroot, 1990). Research has shown that SRL processes enabled learning in online environments (Azevedo & Hadwin, 2005; Lehmann et al., 2014; Winters et al., 2008). SRL strategies have led to increased academic achievement in online learning (e.g., Broadbent & Poon, 2015; Cuesta, 2010). "Individuals who are self-regulated in their learning appear to achieve more positive academic outcomes than individuals who do not exhibit self-regulated learning behaviors" (Barnard-Brak et al., 2010, p. 61).

Over the past four decades, SRL has been examined from various theoretical perspectives (Boekaerts, 1996, 1999; Boekaerts & Corno, 2005; Efklides, 2011; Paris & Paris, 2001; Pintrich & Zusho, 2002; Schunk & Greene, 2018; Zimmerman & Schunk, 1989). A common feature of these theoretical perspectives their description of SRL as an active cyclical process of three phases: (a) a preparatory phase of task analysis and goal setting; (b) a performance phase of strategy use and monitoring; and (c) an appraisal phrase of reflection on and evaluation of learning outcomes (Panadero, 2017; Peel, 2019; Puustinen & Pulkkinen, 2001). This broader view has highlighted SRL as a multi-dimensional process, driven by goal-directed learning of individual learners and mediated by contextual influences. By adopting this view, researchers have made continuous efforts to identify the personal and environmental factors that may influence SRL (Greene, 2018; Peel, 2019; Winne, 2018).

Understanding how students developed and deployed an optimal combination of the SRL knowledge and skills for enhanced learning and achievement has gained attention in the recent research on OSRL. This research has often focused on identifying motivation factors (Puzziferro, 2008; Wang et al., 2013) and the most effective strategies to help students learn and achieve academic goals (Cleary & Callan, 2018; Greene, 2018; Hirt et al., 2021; Lynch & Dembo, 2004; Reimann & Bannert, 2018; Schunk & Greene, 2018). Such studies have been criticized for using predominantly self-reported measures of student satisfaction, feelings, or perceived value of the educational experience (Deimann & Bastiaens, 2010; Wang et al., 2013) and for their lack of accurate determinants of the effectiveness of SRL (Broadbent & Fuller-Tysiewicz, 2018; Reimann & Bannert, 2018; Schunk & Greene, 2018; Zimmerman, 1989, 1990). These authors did not compare survey results with academic performance as measured by the course grade; further, they did not investigate the impact of the students' prediction of their course grades on self-regulation strategies. The current study addressed this limitation by examining the relationships between predicted course grades (will), the selection and use of self-regulatory techniques (skill), and earned course grades (outcome).

Most researchers have used variable-centered approaches to examine SRL. Such methods focused on associations between variables and predictors' contributions to a response variable (Lausen & Hoff, 2006); they did not help explain how individuals selectively used combinations of self-regulatory techniques and how the selected strategies integrated into self-regulation profiles (Schwinger et al., 2012). Variable-centered approaches have relied upon "the assumption that relationships observed at this group level are representative of the whole sample; an assumption that will be false in cases where distinct subgroups exist" (Broadbent & Fuller-Tysiewicz, 2018, p. 1437).

Studies that used variable-centered approaches neglected individual differences and the existence of distinct subgroups. Such studies did not explain how individual students selected and implemented motivational and learning strategies, and how specific regulation profiles were formulated based on each learner's individualized strategy use (Broadbent & Fuller-Tysiewicz, 2018; Schwinger et al., 2012). In contrast, person-centered approaches to SRL adopted an idiographic perspective (Molenaar, 2004; Molenaar & Campbell, 2009). This perspective viewed individuals as organized entities who functioned and developed distinctively from other individuals (Bergman & Magnusson, 1997; Bergman et al., 2003). Person-centered approaches defined SRL as a dynamic, multi-dimensional process influenced by student characteristics, abilities, and personal experiences. Characterizing SRL as a multi-dimensional and individualized process provided a unique perspective and examined how "learners personally activate and sustain cognitions, affects, and behaviors that are systematically oriented toward the attainment of personal goals" (Zimmerman & Schunk, 2011, p. 1).

Variable-centered and person-centered approaches operated on disparate but complementary assumptions; therefore, a combinational method has emerged. The combined method offered the potential to minimize weaknesses and maximize each method's advantages (Bámaca-Colbert & Gayles, 2010; Raufelder et al., 2013) and provided an alternative way to explore individual differences in educational research. Building on different cases, Bergman (1998) and von Eye (2010) proposed the following sequence of combined analyses: (a) start with variable-centered procedures to identify operating factors (Feyerabend, 1975; von Eye & Bogat, 2006); (b) use exploratory, person-centered analyses to distinguish possibly existing subpopulations (von Eye & Bogat, 2006); (c) use confirmatory person-centered analyses of data from independent samples to test theoretical assumptions; and finally, (d) use variable-centered methods to link theories and results from the various research approaches (Feyerabend, 1975; Molenaar & Campbell, 2009).

Current Study

Following the recommended sequence (Bergman, 1998; von Eye, 2010), the current study used a combined variable-centered and person-centered approach and focused on the link between individualized use of SRL strategies and academic achievement (e.g., Schwinger et al., 2009, 2012; Wang et al., 2013). First, we employed the variable-centered method to operationalize the construct of SRL and its latent dimensions. We used survey variables to identify OSRL factors and estimate OSRL factor scores. Second, we used the person-centered approach to analyze and compare online learning self-regulation patterns and identify latent profiles. As Bergman and Magnusson (1997) suggested, variables included in the analyses were considered "only as components of the pattern under analysis and interpreted in relation to all the other variables considered simultaneously; the relevant aspect is the profile of scores" (p. 293). Third, we used the variable-centered procedures to investigate the relationship between self-regulation profiles and academic performance.

The course grade served as an outcome variable for evaluating the overall effectiveness of online learning (Lim et al., 2006). Previous studies did not include critical predictors of academic performance. Such predictors include help-seeking, metacognition, effort regulation, elaboration, time management, and critical thinking (Schwinger et al., 2009, 2012). Examining the relatedness of profiles of SRL to student predicted and actual course grades addressed this limitation.

Including a broader range of OSRL techniques allowed us to determine whether high-performing students used all SRL strategies more than did other students or whether they employed only the most effective ones (Broadbent & Fuller-Tysiewicz, 2018; Hirt et al., 2021). The person-centered approach enabled us to (a) identify several distinct self-regulation profiles with unique characteristics, (b) determine whether the academic performance anticipated at the beginning of the course impacted the self-regulation profile employed by online learners, and (c) determine which of the identified profiles predicted increased academic performance. Establishing SRL profiles helped us better understand how motivations and strategies interacted in OSRL. Specifically, we investigated four hypotheses:

Hypothesis 1

Distinct latent factors of online learning self-regulation underlie the data (Barnard et al., 2009). We examined a broad range of motivational and SRL skills to identify the OSRL strategies most frequently employed by the students in our sample.

Hypothesis 2

Distinct latent profiles of self-regulation exist based on participants' endorsement of OSRL factors (Barnard et al., 2008). The OSRL profiles help educators facilitate the use and proficiency of the most effective self-regulation techniques (Bruso & Stefaniak, 2016; Panadero, 2017).

Hypothesis 3

Depending on the expected course grade, students adopt specific OSRL strategies as described by the online learning self-regulation latent profiles (Barnard et al., 2008). Including student-predicted course grades is a novel approach to explore how OSRL profiles differ based on the expected level of performance.

Hypothesis 4

Students' final course grades vary across OSRL latent profiles. This hypothesis assumes that academic outcomes are significantly related to OSRL strategies (Greene, 2018). Unlike previous research, our study employed more complex modeling techniques that estimated the impact of variables measuring expected academic performance on the classification process. Based on previous research, our goal was to identify strategies of self-regulation and describe how such strategies may vary due to context, procedural factors, and individual differences. Based on previous research, our goal was to identify self-regulation strategies and describe how such strategies may vary due to context, procedural factors, and individual differences (Hampson & Colman, 1995; Händel et al., 2020; Schwam et al., 2021).

Method

Participants

Participants in the study (N = 177) were students enrolled in fully online graduate-level education courses at a southeastern US university. Most participants were females (n = 161, 91%,) and only 9% (n = 16) identified as males. Participants identified themselves as White (n = 133, 75.1%), African American (n = 33, 18.6%), Hispanic (n = 6, 3.4%), or as other ethnicities (n = 5, 2.9%).

Data Sources

Data for the study consisted of (a) demographic information, (b) predicted course grade, (c) final course grade, and (d) responses to an online learning self-regulation questionnaire. At the beginning of the semester, we collected demographic information and asked participants to predict their overall grade at the end of the course as a percent correct estimate (e.g., 84%). The course syllabus described the class letter grade scale as: A = 90%, B = 80%, C = 70%, and F = 69% or below. The final course grade was the sum of student performance scores on (a) six end-of-unit tests developed by the instructor based on the textbook (Alexander, 2016); (b) two theory-to-practice assignments; and (c) two online discussions.

The Online Self-Regulated Learning Questionnaire (OSLQ; Barnard et al., 2009) was adapted to examine student OSRL. The OSLQ was designed to measure students' ability to self-regulate their learning in online and traditional face-to-face learning environments. Our modified OSLQ included 24 items that measured 6 dimensions of self-regulation: (a) goal setting; (b) environment structuring; (c) task strategies; (d) time management; (e) help-seeking; and (f) self-evaluation on a Likert scale, ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Higher scores showed increased OSRL. According to Nunnally (1978), Cronbach α coefficient of .70 or better is acceptable when used in social science research such as this study. The values for Cronbach α ranged from .786 to .899 in the current study, indicating high levels of internal consistency.

Data Analysis

Data analyses consisted of (a) descriptive analysis, (b) exploratory factor analysis, (c) latent profile analysis with a covariate and a distal outcome, and (d) examining demographic and achievement variables by latent profile. We calculated item means and standard deviations to examine the distribution of survey responses. Then, we used exploratory factor analysis (EFA) within the exploratory structural equation modeling (ESEM) framework to identify the latent variables underlying the data (Marsh et al., 2014). The ESEM approach was beneficial because it allowed the estimation and rotation of common factors and yielded a realistic representation of the data by calculating cross-loadings and assessing model fit (Marsh et al., 2014; Morin & Maiano, 2011; Morin et al., 2013). ESEM was employed to overcome the limitations of confirmatory procedures. With confirmatory approaches, the strict requirement of zero cross-loadings may lead to distorted factors, overestimated factor correlations, and distorted structural coefficients (Asparouhov & Muthén, 2009). Especially in the early stages of theory development, items are rarely pure indicators of the corresponding constructs. Cross-loadings other than zero could inflate the associations between the factors and misspecified cross-loading items. Simulation studies have shown that researchers should estimate even small cross-loadings such as .100; otherwise, parameters could be inflated or biased (Asparouhov et al., 2015).

We used Mplus 8.2 statistical software as well as the mean- and variance-adjusted weighted least squares (WLSMV) estimation procedure with Geomin rotation. The WLSMV method does not rely on the assumption of multivariate normality and provides more accurate results with smaller samples and ordinal data than do other estimation procedures (Finney & DiStefano, 2006). The indices used to assess model fit were the (a) $\chi2$ statistic and its p-value; (b) $\chi2/df$ index; (c) root mean square error of approximation index (RMSEA) and its 95% confidence interval (CI); (d) comparative fit index (CFI); (e) Tucker-Lewis index (TLI); and (f) weighted root mean residual (WRMR). We sequentially removed cross-loading items until the model reached a simple structure. After obtaining an optimal solution, researchers computed scores for individual factors. These coefficients estimate the location of every person on the identified factors (DiStefano et al., 2009).

We then conducted latent profile analysis (LPA) to estimate a latent categorical variable (C) using a set of continuous observed indicators (Collins & Lanza, 2009). The LPA model specified the individual factor scores as observed indicators of the latent categorical variable of online learning self-regulation. The LPA model included the predicted course grade as a covariate of C and the final course grade as C's distal outcome. To estimate this model, we followed Asparouhov and Muthén's (2014) three-step approach. It corrects for classification error by (a) estimating the LPA model first, (b) creating a nominal most likely profile variable N, and (c) estimating the mixture model with covariates and a distal outcome where N is an indicator of C with measurement error at the misclassification rate estimated at step one.

Models with two (model 2), three (model 3), four (model 4), and five (model 5) latent profiles were estimated. We selected the optimal model based on the interpretability of the latent profiles and statistical measures. The statistical criteria consisted of goodness of fit indices and estimates of classification precision. The indices used to assess model fit were the Bayesian Information Criteria (BIC) and the Akaike Information Criteria (AIC). Models with lower AIC and BIC values are more parsimonious and better fit the data (DiStefano, 2012; Muthén, 2004; Vermunt & Magidson, 2002).

The classification precision measures were (a) the average latent profile probabilities for the most likely profile membership, (b) classification probabilities for the most likely latent profile membership, and (c) entropy. Average latent profile probabilities and classification probabilities for most likely profile membership represent the proportions of correctly classified cases in each latent profile. Entropy is an overall index of classification certainty and shows whether the estimated profiles have distinct characteristics. Entropy coefficients range from 0 to 1, and values closer to 1 show that a model has superior classification precision (Akaike, 1977; Ramaswamy et al., 1993; Vermunt & Magdison, 2002).

Finally, latent profiles were further described by comparing factor scores, demographic information, student GPA, course grades, and predicted grades across groups. We compared continuous variables across groups using the Kruskal-Wallis H test. Similarly, we compared the distribution of categorical variables across profiles using the $\chi2$ test. Using the Wilcoxon Signed Ranks Test, we examined differences between predicted grades and final course grades within each group.

Results

The survey item with the highest mean rating was from the environment structuring scale (Barnard et al., 2009); the item stated "I know where I can study most efficiently for online courses." The item with the lowest mean rating was from the help-seeking scale (Barnard et al., 2009) and stated "I am persistent in getting help from the instructor through e-mail." Table 1 reports the means and standards deviation of all survey items.

Table 1

Descriptive Statistics and Model Parameter Estimates

Factors	Cronbach's alpha	Survey item	*M* (*SD*)	Loading	Two-tailed *p*-value
F1: Goal setting	.826	I set goals to help me manage my studying time for my online courses.	5.20 (1.418)	0.886	0.000
		I set short-term (daily or weekly) goals as well as long-term goals (monthly or for the semester).	5.19 (1.590)	0.885	0.000
		I keep a high standard for my learning in my online courses.	5.59 (1.268)	0.478	0.000
		I try to schedule the same time every day or every week to study for my online courses, and I observe the schedule.	4.86 (1.691)	0.441	0.000
F2: Environment management	.899				
		I find a comfortable way to study.	5.62 (1.369)	0.922	0.000
		I choose the location where I want to study to avoid too much distraction.	5.58 (1.334)	0.914	0.000
		I know where I can study most efficiently for online courses.	5.66 (1.292)	0.727	0.000
		I choose a time with few distractions for studying for my online courses.	5.40 (1.419)	0.678	0.000
F3: Peer help-seeking	.893				
		I communicate with my classmates to find out how I am doing in my online classes.	4.51 (1.837)	0.998	0.000
		I share my problems with my classmates online, so we know what we are struggling with and how to solve our problems.	4.59 (1.817)	0.865	0.000
		I communicate with my classmates to find out what I am learning that is different from what they are learning.	4.37 (1.820)	0.86	0.000

Factors	Cronbach's alpha	Survey item	*M* (*SD*)	Loading	Two-tailed *p*-value
		I find someone knowledgeable in course content so that I can consult with him or her when I need help.	4.33 (1.817)	0.685	0.000
		If needed, I try to meet my classmates face-to-face.	4.54 (1.974)	0.574	0.000
F4: Task strategies	.786				
		I summarize my learning in online courses to examine my understanding of what I learned.	4.77 (1.476)	0.757	0.000
		I work extra problems in my online courses in addition to the assigned ones to master the course content.	3.75 (1.824)	0.702	0.000
		I prepare my questions before joining the chat room and discussion.	4.47 (1.758)	0.674	0.000
		I ask myself a lot of questions about the course material when studying for an online course.	4.67 (1.468)	0.623	0.000
		I am persistent in getting help from the instructor through email.	3.60 (1.800)	0.464	0.000
		I read aloud instructional materials posted online to fight against distractions.	4.56 (1.846)	0.37	0.000
F2 – F1				0.538	0.000
F3 – F1				0.221	0.001
F3 – F2				0.228	0.000
F4 – F1				0.620	0.000
F4 – F2				0.402	0.000
F4 – F3				0.441	0.000

Exploratory factor analysis (EFA) yielded a four-factor solution. We obtained a simple structure after sequentially removing five cross-loading items. Goodness of fit indices showed that the final solution had an overall good fit to the data ($\chi2_{(101)}$ = 211.255, $\chi2/df$ = 2.091, RMSEA = 0.079, CI = [0.064 - 0.093]; CFI = 0.983; TLI = 0.971). Table 1 lists the items included in each factor and their factor loading estimates, and *p* values. The first factor, F1, included four items referring to setting learning goals and study time. Cronbach's α index of internal consistency for this factor was .826. The second factor, F2, included four items referring to choosing a suitable environment for studying. F2 had an internal consistency of .899. The third factor, F3, included five items referring to communicating with peers for self-evaluation and help-seeking. This factor had an internal consistency of .893. Finally, the fourth factor, F4, included six items referring to task strategies and had an internal consistency of .786. As indicated in Table 1, all relationships among factors were statistically significant. The strongest relationships were F1 - F4 and F1 - F2 (Table 1). Table 2 presents the factor covariances and correlations.

Table 2

Factor Covariances and Correlations

Factor	F1	F2	F3	F4
		Covariance		
F1	0.921			
F2	0.559	0.891		
F3	0.233	0.232	0.919	
F4	0.666	0.419	0.434	0.901
		Correlation		
F2	0.618**			
F3	0.254**	0.257**		
F4	0.731**	0.468**	0.477**	

Note. ** Significant at $\alpha = 0.01$ (2-tailed). F1: goal setting; F2: environment management; F3: peer help-seeking; F4: task strategies.

We estimated LPA models with two (Model 2), three (Model 3), four (Model 4), and five (Model 5) latent profiles. Although Model 5 had a better fit to the data (Table 3), it included a group of only four individuals, which may indicate an overfitted model (DiStefano, 2012; Nylund et al., 2007). Typically, groups that include less than 5% of the sample are considered too small (Nasserinejad et al., 2017).

Table 3

Goodness of Fit and Classification Precision by Model

Index	Model 2	Model 3	Model 4	Model 5
Entropy	.864	.816	.841	.855
AIC	1817.507	1750.905	1724.390	1703.768
BIC	1861.973	1814.428	1806.969	1805.405
Sample-adjusted BIC	1817.638	1751.092	1724.632	1704.067

Note. AIC: Akaike Information Criterion; BIC: Bayesian Information Criterion.

Model 4 included larger groups, had the most informative solution, and had a good fit to the data. This model was, therefore, selected as the optimal model. Model 4 had an adequate classification precision, with an entropy of 84.1%. As illustrated in Figure 1, the largest group (n = 92) had factor scores close to average on all factor scores and was labeled average self-regulation (ASR). The second largest group (n = 32) had scores that were significantly below the average on all factors and was labeled below average self-regulation (BASR). The third group (n = 30) had scores significantly above average on all factors, and we labeled it above average self-regulation (AASR). The fourth latent profile (n = 23) had scores higher than average on F1 and F2, lower than average on F3, and close to average on F4. We named this group low peer help-seeking (LPHS). Average latent profile probabilities and classification probabilities for most likely latent profile membership ranged between 75.7% and 95.5% (Table 4).

Figure 1

Mean Factor Scores by Latent Profile

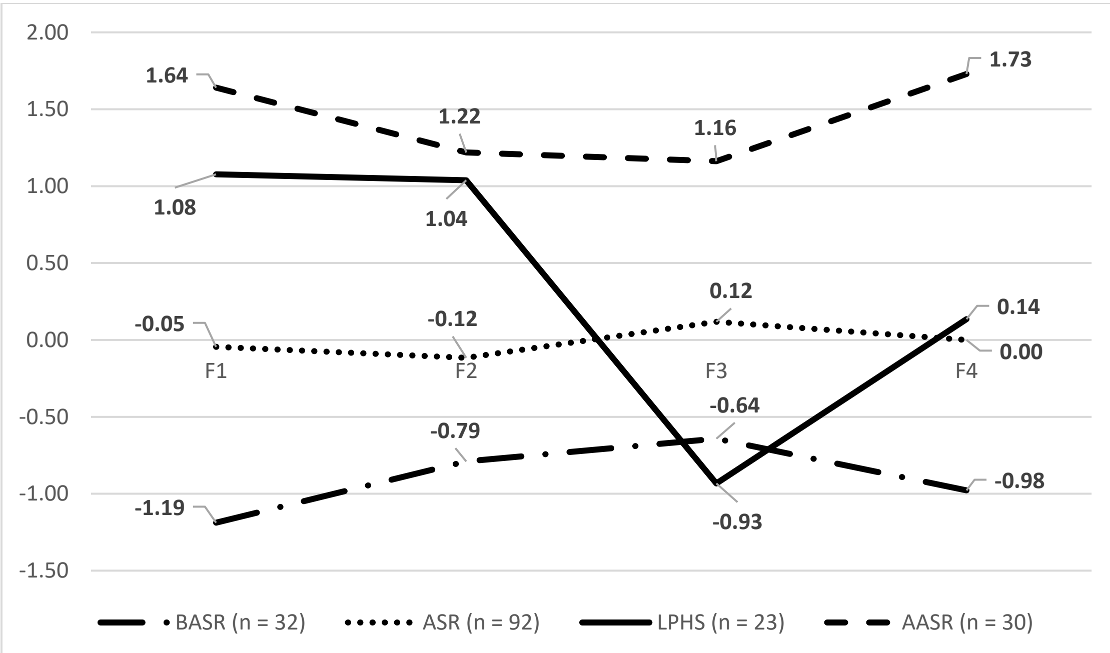


Table 4

Model 4: Average Latent Profile Probabilities and Classification Probabilities

Latent Profile Probability	BASR	ASR	LPHS	AASR
BASR: Average latent profile	.909	.091	.000	.000
BASR: Classification	.830	.170	.000	.000
ASR: Average latent profile	.053	.917	.024	.006
ASR: Classification	.027	.955	.012	.006
LPHS: Average latent profile	.000	.101	.878	.021
LPHS: Classification	.000	.178	.757	.064
AASR: Average latent profile	.000	.033	.049	.919
AASR: Classification	.000	.035	.014	.951

Note. Below average self-regulation (BASR), average self-regulation (ASR), above average self-regulation (AASR), low peer help-seeking (LPHS).

Table 5 reports the latent profile mean factor scores and two-tailed *p*-values. The Kruskal-Wallis test showed that scores on the four factors differed significantly across latent profiles (Table 6).

Table 5

Mean Factor Scores by Latent Profile

Profile	Factor	Estimate	Two-tailed *p* value
BASR (*n* = 32)			
	F1	-1.188	0.000
	F2	-0.790	0.000
	F3	-0.642	0.000
	F4	-0.978	0.000
ASR (*n* = 92)			
	F1	-0.045	0.693
	F2	-0.116	0.286
	F3	0.118	0.318
	F4	0.000	0.999
LPHS (*n* = 23)			
	F1	1.077	0.000
	F2	1.038	0.000
	F3	-0.933	0.007
	F4	0.135	0.695
AASR (*n* = 30)			
	F1	1.640	0.000
	F2	1.219	0.000
	F3	1.162	0.000
	F4	1.729	0.000

Note. Below average self-regulation (BASR), average self-regulation (ASR), above average self-regulation (AASR), low peer help-seeking (LPHS).

Table 6

Tests Factor Score Variation Across Latent Profiles

Statistic	F1	F2	F3	F4
Kruskal-Wallis *H*	123.542	78.267	60.300	89.833
df	3	3	3	3
p value	<.001	<.001	<.001	<.001

Note. F1: goal setting; F2: environment management; F3: peer help-seeking; F4: task strategies.

Table 7 reports, for each group, demographic distribution, average GPA, predicted grade, final course grade, and the difference between the expected and the final course grade. Results from significance tests showed that ethnicity ($\chi^2_{(12)} = 6.492$, $p = .889$), gender ($\chi^2_{(3)} = 1.402$, $p = .705$), age ($H_{(3)} = 5.874$, $p = .118$), GPA ($H_{(3)} = 5.614$, $p = .132$) , final course grade ($H_{(3)} = 7.500$, $p = .058$) , and the difference between the predicted and the final course grade ($H_{(3)} = .431$, $p = .934$) did not differ significantly across latent profiles. Only the predicted course grade ($H_{(3)} = 10.886$, $p = .012$) recorded statistically significant differences across groups, with higher values for the LPHS group, followed by AASR, ASR, and BASR.

Table 7

Demographics and Student Achievement by Latent Profile

Variable	BASR n = 32 18%	ASR n = 92 52%	LPHS n = 23 13%	AASR n = 30 17%	Total N = 177 100%
Ethnicity					
White	75%	77%	66%	63%	73%
African American	22%	14%	30%	37%	21%
Hispanic	0%	5%	4%	0%	3%
Native American	0%	1%	0%	0%	1%
Other	3%	3%	0%	0%	2%
Gender					
Male	9%	12%	0%	7%	9%
Female	91%	88%	100%	93%	91%
Age					
M	24	25	30	23	25
(SD)	(6)	(8)	(11)	(6)	(8)
Kruskal-Wallis Test					
Mean rank	93.67	85.92	118.69	79.50	
GPA					
M	3.49	3.49	3.62	3.35	3.49
(SD)	(.41)	(.36)	(.49)	(.40)	(.39)
Kruskal-Wallis Test					
Mean rank	91.17	88.87	113.27	70.5	
Predicted grade					
M	86.52	88.12	91.85	88.56	88.12
(SD)	(5.01)	(5.62)	(3.24)	(5.13)	(5.42)
Kruskal-Wallis Test					
Mean rank	71.50	89.22	126.04	91.70	
Course grade					
M	89.44	90.32	94.47	90.43	90.48
(SD)	(6.11)	(6.33)	(3.88)	(7.73)	(6.39)
Kruskal-Wallis Test					
Mean rank	79.10	86.63	123.85	90.60	

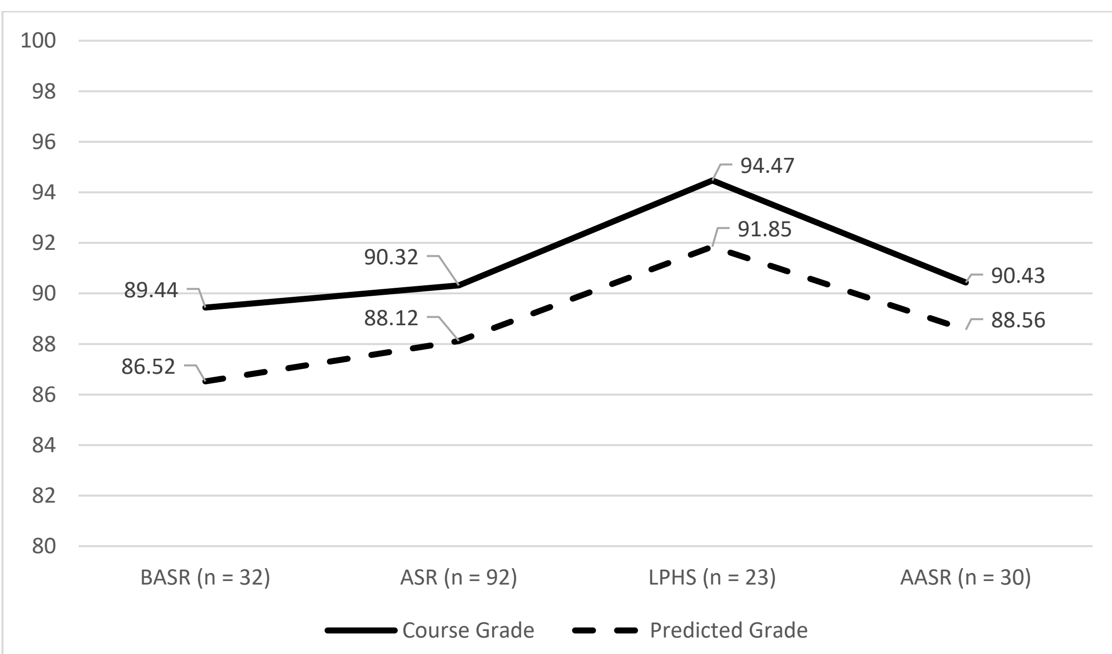
Variable	BASR n = 32 18%	ASR n = 92 52%	LPHS n = 23 13%	AASR n = 30 17%	Total N = 177 100%
Predicted grade - Course grade					
M	-2.92	-2.20	-2.62	-1.87	-2.32
(SD)	(5.48)	(6.16)	(4.72)	(8.31)	(6.19)
Kruskal-Wallis Test					
Mean rank	71.50	89.22	126.04	91.70	
Wilcoxon Signed Ranks Test					
Z	-2.704	-3.848	-1.853	-1.456	
P	.007**	.000**	.064	.145	

Note. *Statistically significant at α = .05. ** Statistically significant at α=.01. Below average self-regulation (BASR), average self-regulation (ASR), above average self-regulation (AASR), low peer help-seeking (LPHS).

The final course grade followed the same pattern (Figure 2), but differences across groups were not statistically significant. The LPHS profile had the highest average GPA, the highest final grade, and the highest predicted course grade. All groups underestimated their course grade by approximately two points. The Wilcoxon Signed Ranks test yielded differences statistically different from zero between the predicted course grades and final course grades for the ASR and the BASR latent profiles. These differences were not statistically significant for the LPHS and AASR latent profiles. Overall, the difference between the predicted grade and final course grade did not vary significantly across the four latent profiles (Table 7).

Figure 2

Average Course Grade and Predicted Grade by Latent Profile



Compared to AASR, the predicted grade had a significant relationship with the LPHS group, but not with the other latent profiles (Table 8). In other words, in the AASR group, individuals with higher predicted grades were 20.7% more likely to be members of the LPHS group. Compared to the LPHS group, membership in any other latent profile was a significant predictor of a lower final course grade. Conversely, members of the LPHS latent profile were more likely to have higher final grades than those of the BASR and the ASR latent profiles (Table 8).

Table 8

Relationships between Latent Profiles, Predicted Grade, and the Course Grade

Relationship	Estimate	*SE*	Estimate/*SE*	Two-tailed *p*-value	Odds ratio
Reference: AASR					
Predicted grade -> BASR	-0.059	0.064	-0.923	0.356	0.945
Predicted grade -> ASR	0.007	0.059	0.122	0.903	1.007
Predicted grade -> LPHS	0.188	0.079	2.373	0.018*	1.207
Reference: AASR					
BASR -> Final grade	-0.016	0.055	-0.286	0.775	
ASR -> Final grade	0.004	0.051	0.086	0.932	
LPHS -> Final grade	0.198	0.102	1.952	0.051	
Reference: BASR					
ASR -> Final grade	0.020	0.033	0.610	0.542	
LPHS -> Final grade	0.214	0.087	2.462	0.014*	
AASR -> Final grade	0.016	0.055	0.286	0.775	
Reference: ARS					
BASR -> Final grade	-0.020	0.033	-0.610	0.542	
LPHS -> Final grade	0.194	0.086	2.256	0.024*	
AASR -> Final grade	-0.004	0.051	-0.086	0.932	
Reference: LPHS					
BASR -> Final grade	-0.214	0.087	-2.462	0.014*	
ASR -> Final grade	-0.194	0.086	-2.256	0.024*	
AASR -> Final grade	-0.201	0.102	-1.970	0.049*	

Note: * Statistically significant at $\alpha = .05$. Below average self-regulation (BASR), average self-regulation (ASR), above average self-regulation (AASR), low peer help-seeking (LPHS).

Discussion

The current study combined person-centered and variable-centered perspectives (Bergman & Magnusson, 1997; Marsh et al., 2009; von Eye, 2010) and expanded the existing research on OSRL (e.g., Abar & Locken, 2010; Barnard-Brak et al., 2010; Broadbent & Poon, 2015; Cuesta, 2010; Schwinger et al., 2009, 2012). Our results helped clarify the complexity of self-regulation of learning in the online environment: particularly, on what constitutes OSRL, how individual differences permeate through profiles of OSRL, and how the OSRL latent profiles are related to academic performance in the online learning environment.

Factors of Online Learning Self-Regulation

Our first objective was to ascertain the factors of OSRL. Exploratory factor analytic procedures within the ESEM framework yielded four OSRL factors: (a) goal-setting (F1); (b) environment management (F2); (c) peer help-seeking (F3); and (d) task strategies (F4). Items included in these four factors had high internal consistency levels, and the factor structure had a very good model fit. This evidence supported the four-factor solution as the optimal factor structure for our sample. Results were very similar to some of the factors of online self-regulated learning identified by Barnard et al. (2009): goal setting, environment structuring, task strategies, and help-seeking.

Nevertheless, our factor structure did not include two of the factors identified by Barnard et al. namely time management and self-evaluation. Items from these scales were either removed because of cross-loadings or loaded under a different factor. For example, two items from the original self-evaluation scale loaded under the task strategies factor (F4), whereas the other two loaded under the peer help-seeking factor (F3). The help-seeking factor was redefined as peer help-seeking (F3). This factor referred only to communicating with peers for self-evaluation and information on class progress and did not include seeking help from the instructor.

Similarly, the environment structuring factor became environment management. This factor referred primarily to selecting or manipulating the environment rather than making changes. All factor correlations and covariances were statistically significant. The most robust relationship was between goal-setting (F1) and task strategies (F4), followed by goal setting (F1) and environment management (F2). In contrast, the weakest relationships were between peer help-seeking (F3) and environment management (F2), and between peer help-seeking (F3) and goal setting (F1). However, the factor structure identified in this study varied from previous studies using the same instrument (Barnard et al., 2009). Further research should focus on examining the dimensions of OSRL with samples that are larger and reflect demographic distributions that are representative of the population. Such studies would provide evidence of external validity for the OSRL factor structure.

Latent Profiles of Online Self-Regulated Learning

The second objective was to identify latent profiles of OSRL. Results from LPA showed that students in our sample employed four types of self-regulation, as described by the BASR, ASR, LPHS, and AARS latent profiles. The BASR, ASR, and AASR latent profiles differed mainly quantitatively in the overall level of self-regulation. Nevertheless, the LPHS latent profile described a pattern of high levels of goal setting and environment management, average levels of task strategies, and reduced peer help-seeking levels. This model had good classification precision and was a good fit to the data. Scores on the four factors showed significant variations across latent profiles. These results constitute evidence that the four groups represent distinct profiles of online learning self-regulation.

The study conducted by Barnard-Brak et al. (2010) identified five profiles of online self-regulated learning identified as (a) super self-regulators, (b) competent self-regulators, (c) forethought-endorsing self-regulators, (d) “performance-reflection self-regulators, and (e) non- or minimal self-regulators. Although the current study used the same data collection instrument, we found a four-profile model optimal for our sample. These four latent profiles were comparable to four of the groups identified by Barnard-Brak et al. The AASR, ASR, and BASR latent profiles identified in the current study described overall online learning self-regulation levels. These groups had profiles similar to the super self-regulators, competent self-regulators, and non- or minimal self-regulators. The LPHS latent profile corresponds to the forethought-endorsing self-regulators. Individuals assigned to this group more highly endorse goal setting and environment structuring as self-regulated learning skills while endorsing task strategies, time management, help-seeking, and self-evaluation to much lesser extents (Barnard-Brak et al., 2010). We did not identify a group of performance-reflection self-regulators in our sample. A critical difference between the two studies was that items measuring time management and self-evaluation did not load under distinct factors and were not, consequently, used as separate observed indicators for LPA. These survey items loaded under the task strategies factor (F4) and the peer help-seeking factor (F3).

While very informative and directly applicable to online learning, the OSRL latent profiles that we identified in the current study are sample-specific and based on a relatively small group of students. Future studies could continue examining OSRL using cross-sectional designs to determine whether the OSRL latent profiles differ across age groups, educational levels, subject areas, or geographical locations. Replicating the study with larger samples and samples with a more balanced demographic distribution would support the external validity of the OSRL latent profile model. Further, repeating the current study in other subject areas and learning environments would show the extent to which the learning context influences how students approach their learning (Severiens et al., 2001; Wong et al., 2019).

In addition to a cross-sectional design, future research should also investigate OSRL longitudinally, as OSRL entails a dynamic personal process that continually evolves with students’ development of existing behaviors and strategies based on prior success and emerging challenges (Abar & Loken, 2010; Greene, 2018; Severiens et al., 2001; Winne, 1995, 1996, 1997, 2018). Such studies would clarify whether increases in students’ OSRL are associated with gains in academic achievement over time (Barnard et al., 2009). Further, longitudinal studies using latent transition analysis may help determine whether students’ OSRL latent profiles change across time.

Predicted Grades and OSRL Latent Profiles

Our third objective focused on the relationship between the predicted course grades and the adoption of specific latent profiles of online learning self-regulation. Predicted course grades showed significant differences across groups, with the highest values for the LPHS latent profile, followed by the AASR, ASR, and BASR latent profiles. Results from LPA showed that, in reference to AASR, a higher predicted grade was a significant predictor of adopting the LPHS self-regulation strategy. In other words, compared with the AASR group, when students anticipated obtaining a higher course grade, they were less likely to engage in peer help-seeking and task strategies and, therefore, were more likely to adopt the LPHS self-regulation profile. This finding partially confirmed the initial hypothesis that the predicted course grade is a significant predictor of adopting a specific type of online learning self-regulation as described by the online learning self-regulation latent profiles (Barnard-Brak et al., 2010; Stan, 2012; Wang et al., 2013). Our study also examined the differences between students’ predicted course grades and their final course grades. All students underestimated their final course grades; however, the two groups with higher levels of OSRL (AASR and LPHS) had better prediction accuracy. These were the only groups with non-significant differences between the predicted grade and the final course grade.

Examining the relationship between expected outcomes and OSRL latent profiles is a unique contribution of our study. As far as we know, this has not been investigated previously. Therefore, further research is needed to determine whether the current results are sample-specific or replicate with other samples. Also, future research should investigate whether the relationship between predicted grades and OSRL strategies varies across age groups and subject areas. Additional covariates, representing human factors or individual differences, could be included in the latent profile model to examine how they predict OSRL latent profile memberships. Such covariates may be self-efficacy, goal orientations, educational level, prior academic performance, and so on.

OSRL Latent Profiles and Final Grades

Our fourth objective was to examine the relationship between latent profiles of online learning self-regulation and student academic performance by including the final course grade as a distal outcome of the self-regulation latent categorical variable. Descriptive statistics showed that groups with higher self-regulation levels had slightly higher final course grades, but variations across groups did not reach statistical significance. Specifically, the LPHS group had the highest course grades, followed by the AASR, ASR, and BASR groups. LPA results showed that, compared to the LPHS latent profile, membership in any of the other latent profiles predicted a lower final course grade. However, some relationships between latent profile memberships and final course grades did not vary significantly across all latent profiles.

These findings partially support the hypothesis that academic outcomes differ across self-regulation latent profiles (Broadbent & Poon, 2015; Greene, 2018; Wang et al., 2013). Further, our study did not replicate the significant differences in student GPA across online learning self-regulation latent profiles recorded by Barnard-Brak et al. (2010). Therefore, further research is needed to determine whether OSRL latent profiles are course-specific and how they relate to students' GPAs. Investigating the predictive power of the OSRL latent profiles on course grades across age groups and subject areas would contribute to a better understanding of how individualized OSRL impacts outcomes of online learning.

The current study expanded the research on establishing profiles of online SRL from undergraduate students (e.g., Barnard et al., 2009; Barnard-Brak, et al., 2010; Broadbent & Fuller-Tyszkiewicz, 2018; Broadbent & Poon, 2015) to graduate students. These findings can help online instructors design interventions and instructional techniques that support those strategies of self-regulation that have a positive impact on student achievement and thus avoid the practices that are not productive (Bruso & Stefaniak, 2016; Greene, 2018; Panadero, 2017; Wang et al., 2013; Winne & Nesbit, 2010). This information is critical in the online learning environment, which may require increased levels of self-regulation to achieve academic success (Barnard et al., 2009). For instance, (a) providing increased opportunities for interaction, (b) including a self-monitoring system, (c) supporting self-efficacy beliefs and optimistic attributions, (d) creating opportunities for cognitive apprenticeship such as coaching, and (e) providing feedback have been shown to help self-regulation when using technology-enhanced learning environments (Abar & Loken, 2010; Steffens, 2006; Wong et al., 2019).

Conclusion

The current study aimed to better understand how individual students used self-regulation strategies in the online learning environment. Using both variable-centered and person-centered approaches, we ascertained four dimensions of OSRL, identified four latent profiles of OSRL strategies employed by the students, and examined how the OSRL latent profiles relate to the predicted and the final course grades. Our results showed that the latent self-regulation variable did not necessarily have a continuous distribution. Students employed the various dimensions of self-regulation to a different extent based on their predicted performance in the course. The majority of high-performing students used all self-regulating strategies at the highest level (AARS). Nevertheless, a smaller group of high-performing students (LHPS) sought less help from their peers than the other groups and employed fewer task strategies than did the AASR group. Our results also showed that high-performing students predicted their course grades with more accuracy than did low-performing groups.

Together with other emerging studies (Abar & Loken, 2010; Barnard-Brak et al., 2010; Broadbent & Poon, 2015; Broadbent & Fuller-Tyszkiewicz, 2018; Hirt et al., 2021; Schwinger et al., 2009, 2012), the current research demonstrated the advantages of using a combined person-centered and variable-centered approach in the research of SRL in the online environment. Our results showed that viewing SRL as a multi-dimensional construct, and particularly as a discrete latent variable, could help us better understand the self-regulation of online learning. Addressing individual difference factors in the study of OSRL would enable us to account for the wide range of personal and contextual factors (Schwam et al., 2021; Wong et al., 2019). More importantly, such studies will shed light on developing online learning environments with adaptive support to optimize learning for individual students.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 23, Number 3

September – 2022

Unleashing Adult Learners' Numeracy Agency Through Self-Determined Online Professional Development

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Abstract

Opportunities for self-determined online professional development (OPD) are emerging, but their potential for increasing adult learners' agency is not yet fully realised. Faced with the problem of successfully designing a self-determined comprehensive evidence-based online numeracy resource for educators who are often time poor and do not engage with online learning unless they are intrinsically motivated, we engaged in design research to conceptualise the *Birth to Level 10 Numeracy Guide* for educators and families. The *Birth to Level 10 Numeracy Guide* fosters educators' and adult learners' numeracy capability across numeracy focus areas from birth to level 10 (16-year-olds). This extensive OPD resource incorporates consistent design elements, double-looped learning, nonlinear learning, self-reflection, and metacognition activities to foster educators' pedagogical content knowledge (PCK) through experiential learning. With a section dedicated to families, the resource provides suggestions and advice to parents and carers on everyday, authentic activities to develop children and young people's numeracy understandings at home and in the local community. As education systems continue to grapple with the disruption brought about by the COVID-19 pandemic, the *Birth to Level 10 Numeracy Guide* is a timely, freely accessed, viable, and scalable option for providing low-cost OPD.

Keywords: online professional development (OPD), numeracy, self-determined learning, experiential learning, heutagogy, families, design research

Introduction

The global COVID-19 pandemic has forced citizens into lockdown. In-person instruction closed across educational institutions at all levels, affecting 1.6 billion students and 63 million primary and secondary teachers (United Nations, 2020). These unprecedented closures, to halt the spread of the deadly virus, resulted in a rapid shift to distance education and online learning in those countries equipped to undertake the transition. The full-scale and long-term impact of the COVID-19 pandemic is yet unknown, though indications by the United Nations Secretary-General (2020) suggest the devastating economic impact of the virus may result in approximately 24 million students never returning to school. Simulations by the World Bank Group (Azevedo et al., 2020) paint a dire picture of the potential impact on learners; the general level of basic education will fall globally resulting in a loss in income for current students across their lifetime. Further, the "care economy" inside households has been greatly impacted by the closure of schools, with parents/carers, particularly women, taking on an increased and more time-consuming role of facilitating the education of children and young people within households (Power, 2020, p. 67). The challenge to balance employee demands and their children's learning is the most commonly reported struggle of families whose children have made the shift to online learning during the pandemic (Garbe et al., 2020).

Paramount to the rapid and compulsory shift to online learning is the need for effective numeracy OPD for educators and families. This need is because many educators struggle or are anxious to teach mathematics (Gresham, 2018). For families experiencing lockdown, an online resource to assist them in supporting and scaffolding their children's numeracy learning at home is needed due to common myths about the difficulty of teaching and learning mathematics (Dowling, 2002). For both educators and families, an online self-determined numeracy resource that aims to build their confidence in dynamic approaches to developing children's numeracy is timely. Descriptions of how self-determined learning or heutagogical learning models can be applied as well as the technologies that can be used to create self-determined learning environments are emerging from the literature (Blaschke, 2019; Bojanek et al., 2021; Gillaspy & Vasilica, 2021), yet examples of these learning environments remain elusive. This paper provides an example of a self-determined OPD resource for adult learners that was developed using design research and that provides an overview and understanding of numeracy development from birth to level 10 (0 to 16 years old). The resource challenges and explores educators' and parents'/carers' assumptions and preconceptions about learning, teaching, and assessing mathematics as a result of the disruption to formal education due to the COVID-19 pandemic and shift to online learning.

The use of self-determined professional development for numeracy educators and families (i.e., adult learners) is an emerging field (Agonács & Matos, 2019), but when incorporated into OPD, the affordances of online platforms offer adult learners increased opportunities to engage in self-determined numeracy learning activities (Blaschke, 2013). High-quality self-determined OPD is critical for educators (Reimers et al., 2020) to assist them in improving their pedagogical content knowledge (PCK) in mathematics (Barnett, 1991; Lee et al., 2018). Yet examples of these kinds of freely available online resources remain rare and represent a gap in the research literature. Specifically, those that include heutagogical approaches to teaching and learning where adult learners are autonomous and self-determined are mostly absent. Equally rare are online numeracy resources for parents, carers, and families. Additionally, self-determined learning environments provide new opportunities to empower parents/carers to be active participants in their child's numeracy development (Muir, 2012), particularly when the professional development resource provides systematically curated numeracy teaching resources to explore and discover the theory and practice of developing numeracy in learners.

Our purpose was to design a self-determined OPD resource based on the principles of heutagogy (Blaschke & Hase, 2016) that assisted educators and parents/carers in acquiring dynamic approaches to developing their students' and children's numeracy. This paper presents the *Birth to Level 10 Numeracy Guide* (referred to as the "numeracy guide" onwards) that provides OPD to numeracy educators and families. The numeracy guide offers a model for providing self-determined OPD globally to ameliorate the ongoing negative impact of the COVID-19 pandemic on education systems.

The numeracy guide provides high-quality, freely-accessible, and self-determined numeracy professional development to Australian teachers and families that meets their needs for flexible anytime, anywhere numeracy learning (Blaschke, 2012; Magidin de Kramer et al., 2012; Suppo & Mayton, 2014). Critical to the design of the numeracy guide was ensuring it supported a self-determined approach that improved educators' numeracy capabilities and PCK, while relevant to their professional learning needs (Blaschke, 2012; Dalgarno & Colgan, 2007; Magidin de Kramer et al., 2012), and to the needs of families supporting students' numeracy learning at home. Through its design elements, the numeracy guide assists educators and families to acquire new numeracy understandings and skills. There is a strong focus on reflective learning, that prompts adult learners to not only reflect on what they have learned, but how they have learned. A central focus on reflective practice assists adult learners, specifically educators, to determine what future learning they need to engage in: reflection-for-action or the process of being anticipatory and thinking ahead. This approach draws on experience in the present, to successfully overcome any challenges in teaching mathematics that will likely arise in the future (Thompson & Pascal, 2012).

Unlike many OPD resources for educators and families, the design of the numeracy guide places responsibility for learning with the learner, who is "the major agent in their own learning" (Hase & Kenyon, 2007, p. 112). Professional development for teachers typically takes the form of workshops which are attended in person and usually led by a "knowledgeable other" (Hauge, 2019). Such workshops are generally planned in advance, follow a set schedule, and provide few opportunities for teachers to be actively involved and participatory in their own learning process (Pedder & Opfer, 2011). Technology has opened up the online delivery of PD, enabling access to online professional learning courses, including massive open online courses (MOOCs) which often involve learner choice where participants can create their own programmes of study (Beaven et al., 2014). Recently, largely because of the COVID-19 pandemic, there has been an increase in online or virtual conferences. The numeracy guide offers a different experience from more directed forms of professional learning. Conceptualised and designed using heutagogical principles and self-determined learning approaches (Agonács & Matos, 2019; Blaschke & Hase, 2016), adult learners choose numeracy content and components that are most relevant to them. Adult learners are not restricted to educators' learning objectives or more traditional linear learning models. Rather, the numeracy guide has been designed to put adult learners at the centre and views them as self-motivated, autonomous, and capable of deciding what and how they will learn. In addition, the numeracy guide includes features that are characteristic of effective professional learning, including relevance, evidence-based, and potential to be sustained and ongoing.

Design Research to Develop Numeracy Online Professional Development (OPD) for Adults

We engaged in design research (Abutabenjeh & Jaradat, 2018; Cash, 2018; Collins et al., 2004; Reeves, 2006) based on the theoretical principles of heutagogy (Blaschke & Hase, 2016) to design an effective form of OPD that could easily be tested and refined in an online learning environment accessible at scale in the Australian state of Victoria. The numeracy guide design elements specifically:

- support adult learners' capability and confidence to develop numeracy and integrate the four proficiencies: understanding; fluency; problem-solving; and reasoning (Victorian Curriculum and Assessment Authority [VCAA], 2019) through a nonlinear, learner-determined design;

- encourage adult learners to engage in metacognition activities to acquire understanding of how they learn, preparing them to successfully plot a path of future learning to acquire more robust numeracy teaching knowledge, skills, and practices;

- foster the development of educators' PCK to assist them in making numeracy content accessible to their students (Shulman, 1986) through the presentation and reflection on numeracy teaching strategies and representations (Ball et al., 2008; Kleickmann et al., 2013; Park & Oliver, 2008).

- provide an overview of contemporary evidence-based research and practice in numeracy in an Australian context, with specific reference to the Victorian Early Years Learning and Development Framework (VEYLDF; VCAA, 2016) and the Victorian Curriculum F-10 (VCAA, 2019);

- provide a map to developing a whole-school approach to numeracy;

- support school leadership teams, teachers, early childhood practitioners, and system leaders in enacting a numeracy framework for improving student outcomes (FISO) improvement cycle;

- present high-quality numeracy teaching and learning through high impact teaching strategies (HITS; Department of Education and Training, 2017) in context and across three key developmental stages;

- foster adult learner-centred learning, rather than teacher-determined learning to strengthen educators' and families' numeracy teaching capabilities, as well as students' competencies;

- encourage double-loop learning through continual reflective practice on how new knowledge and understandings influence educators' numeracy teaching values and beliefs; and

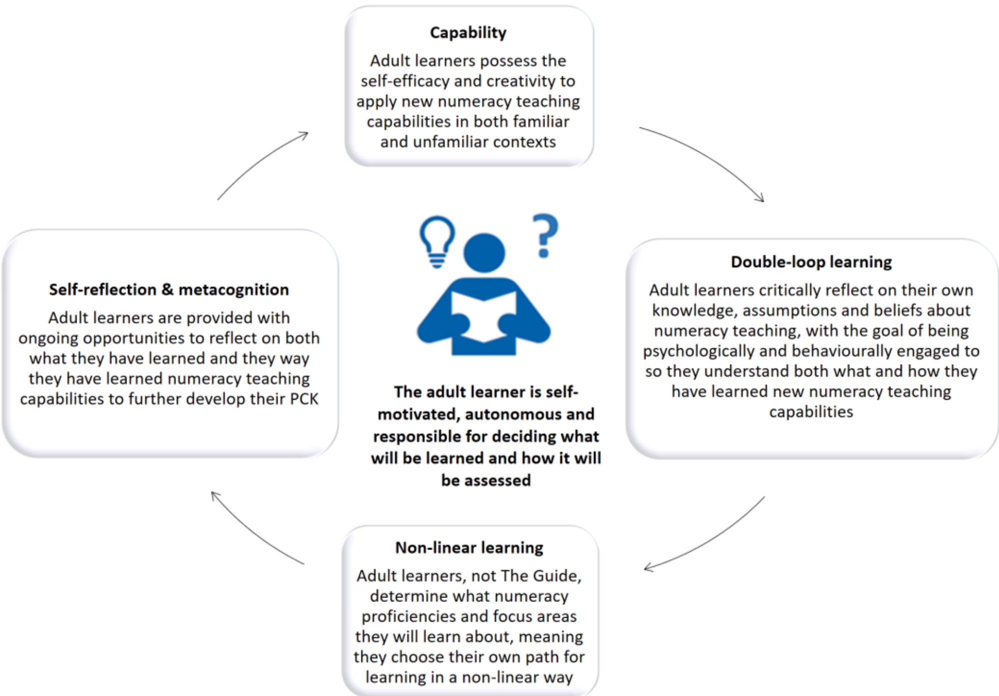
- assist families in developing and supporting positive attitudes towards mathematics and numeracy in the home environment.

Applying the Principles of Heutagogy to the Numeracy Guide

The project team incorporated elements of Blaschke and Hase's (2016) principles of heutagogy to conceptualise and design the components and content of the numeracy guide (Figure 1). This action was fundamental in ensuring the design of the guide placed adult learners at the centre of the learning process where they are agentic in deciding both what they will learn as well as how they will learn. The project team believed this stance would foster educators' PCK as they came to better understand how children and young people learn numeracy. The numeracy guide's learner-centred and learner-determined design develops adult learners' capability, self-reflection, and metacognition through double-loop and nonlinear learning that is content, individual, and situation specific (Van Driel & Berry, 2012). Our intention was to design not only OPD that fosters adults' responsibility for their learning (andragogy), but also an online environment for adults to acquire numeracy capabilities to further develop their PCK to apply to new and unfamiliar situations in their classrooms or at home (heutagogy).

Figure 1

The Numeracy Guide's Principles of Heutagogy



The decision to focus the numeracy guide from birth to level 10 was to ensure it was consistent with the structure of the Victorian Early Years Learning and Development Framework (VEYLDF; VCAA, 2016) which focuses on birth to eight-year-olds, and the Victorian Curriculum, which is focused on foundation (F) to level 10 (5- to 16-year-olds) (VCAA, 2019). The Victorian Curriculum is derived from the Australian Curriculum (Australian Curriculum Assessment and Reporting Authority [ACARA], 2018a) where explicit reference to numeracy is made frequently, for example, within the general capabilities (ACARA, 2018b) and elsewhere in the National Numeracy Learning Progressions (ACARA, 2018c). Aligning the numeracy guide with these key curriculum documents provided authenticity and reassurance to educators and families to support the numeracy guide's use. In what follows, we provide an overview of the numeracy guide and its six components.

The Birth to Level 10 Numeracy Guide Components

The numeracy guide presents dynamic approaches to developing student numeracy across three stages of learning: birth to level 2 (0- to 7-year-olds); levels 3 to 8 (8- to 14-year-olds); and levels 9 to 10 (15- to 16-year-olds). With six research and evidence-based components, the numeracy guide fosters knowledge, understanding, confidence, and capability in mathematics. This allows numeracy to be strengthened and incorporated across schools, by school leadership teams, teachers, early childhood practitioners, and system leaders. A stand-alone section has been specifically designed to assist families in fostering and supporting positive attitudes towards mathematics and numeracy in the home environment. Central to increasing adult learners' agency and numeracy teaching capabilities is the numeracy guide's constant invitation for users to engage in reflective practice. For both educators and families, reflective prompts are regularly incorporated within the guide to invite and support critical evaluation, reflection, and review of practice and understandings. An ethos embedded within the guide is a belief that at the heart of fostering children and young people's successful numeracy outcomes are reflective practitioners and supportive families who strive for continuous improvement (Muir et al., 2020). The numeracy guide comprises six key components: proficiencies; numeracy focus areas; high impact teaching strategies; resources; numeracy at home; and evidence base. An overview of each component follows.

Proficiencies

Components of the numeracy guide were influenced by a specification to align with numeracy elements of the Victorian Curriculum where feasible. These included the mathematical proficiency strands of the F-10 mathematics curriculum: understanding, fluency, problem solving, and reasoning (VCAA, 2019. While the numeracy guide differentiates between the teaching and learning of numeracy and mathematics, integrating the four proficiencies supports the aim of building educators' and families' capacities and confidence to teach curriculum content, plan for numeracy, and take risks and implement new teaching practices whether in the classroom or at home. The fundamental importance of the proficiencies in the learning of mathematics and numeracy was made explicit in the threading of the proficiencies throughout all aspects of the numeracy guide. A key consideration was again the notion of self-determined learning and the principles of heutagogy (Blaschke & Hase, 2016). While the numeracy guide was influenced by the Victorian Curriculum, much of the language and structure of the curriculum were reinterpreted and reorganised to make the language and positioning of numeracy more clearly distinguished from the mathematics curriculum and more easily accessible for the intended audiences.

Numeracy Focus Areas

Connections to the key curriculum, governmental initiatives, and numeracy research are evident in the development of the six numeracy focus areas of the guide: developing number sense; exploring patterns and relationships; using proportional reasoning; understanding and using geometric properties and spatial reasoning; understanding, estimating, and using measurement; and exploring chance and data. Figure 2 demonstrates the alignment between (a) these six numeracy focus areas, (b) the Victorian Numeracy Learning Progressions (VCAA, 2018), (c) the three core strands of the Victorian Curriculum (VCAA, 2016), i.e., number sense and algebra, measurement and geometry, and statistics and probability; and (d) the six interrelated elements of the Australian Curriculum numeracy capabilities (ACARA, 2018c). The wording of these foci was carefully chosen to be simple, accessible, and consistent with these key state and national curricula.

Figure 2

Numeracy Focus Areas and Their Alignment to Key State and National Curricula

Numeracy Focus Areas	Victorian Curriculum Numeracy Learning Progressions	Victorian Curriculum Frameworks: VEYLDF and VC F-10		Australian Curriculum Numeracy capability
Developing number sense Quantifying numbers, using additive and multiplicative strategies	Quantifying numbers Additive strategies Multiplicative strategies	VEYLDF Learning Outcomes	Number and Algebra	Estimating and calculating with whole numbers
Exploring patterns and relationships Using number patterns and thinking algebraically	Number patterns and algebraic thinking			Recognising and using patterns and relationships
Using proportional reasoning Operating and interpreting decimals, fractions, percentages, ratios and rates	Operating with decimals Operating with percentages Comparing units Interpreting fractions			Using proportional reasoning
	Understanding money*			
Understanding and using geometric properties and spatial reasoning	Understanding geometric properties Positioning and locating		Measurement and Geometry	Using spatial reasoning
Understanding, estimating, and using measurement	Understanding units of measurement			Using measurement
	Measuring time*			
Exploring chance and data	Interpreting and representing data Understanding chance		Statistics and probability	Interpreting statistical information

*These progressions have not been explicitly referenced in the revised Numeracy Focus Areas as they are subcategories of the listed big ideas.

Note: VEYLDF = Victorian Early Years Learning and Development Framework; VC F-10 = Victorian Curriculum, foundation to level 10.

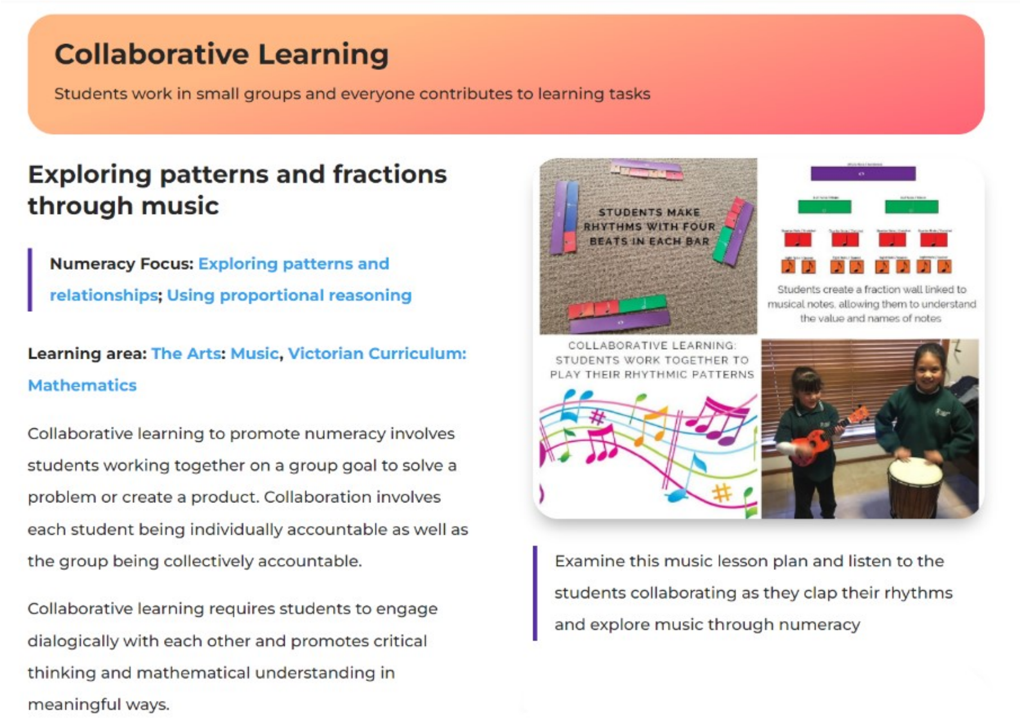
High Impact Teaching Strategies

The high impact teaching strategies (HITS; Department of Education and Training, 2017) are ten evidence-based, instructional practices that support and foster student learning. These effective teaching strategies emerged from the synthesis of tens of thousands of studies, and the top-ranking strategies were: setting goals, structured lessons, explicit teaching, worked examples, collaborative learning, multiple exposures, questioning, feedback, metacognition strategies, and differentiated teaching. The numeracy guide provides evidenced-based HITS for teachers, professional learning communities, and school leaders that focus specifically on numeracy.

The numeracy exemplars of the HITS illustrate instructional practices that increase students' numeracy learning across the three developmental stages of birth to level 2, levels 3 to 8, and levels 9 to 10, connecting to the numeracy focus area and cross-curriculum content. Figure 3 illustrates an exemplar of collaborative learning in a music lesson to foster numeracy.

Figure 3

The High Impact Teaching Strategy of Collaborative Learning Illustrating Numeracy Within a Music Lesson



The numeracy-focused HITS likely have the strongest impact on learners when embedded into an ongoing institutional improvement cycle. A key feature of the exemplars is that they interweave numeracy with all curriculum content areas to support educators' capacity and confidence in teaching numeracy. For example, exemplars model numeracy within music, history, and physical education to name a few. The numeracy HITS demonstrate and reinforce that numeracy is located and taught beyond the mathematics classroom.

Resources

Resources for teaching mathematics and numeracy, such as mathematical worksheets, drill and practice games, lesson plans, wall charts, blackline masters, and digital manipulatives are plentiful on the Internet. The difficulty for many educators and families is searching through these abundant, often teacher-centred, didactic resources to locate useful, educationally-rich, and effective materials which focus on better numeracy outcomes for children and young people. The numeracy guide provides over 100 carefully reviewed, critiqued, and curated Australian and international student-centred resources which surface numeracy across the curriculum and support planning, teaching, and assessment in mathematics. An inbuilt search engine filters the resources by the three developmental stages, four proficiencies (understanding, fluency, problem-solving, and reasoning) or numeracy focus area. Additionally, resources for families are available to develop children and young peoples' positive attitudes towards numeracy and for families to discover and share numeracy activities at home and notice mathematics in their community. The inclusion criteria for the resources were that they were educationally sound, promoted positive attitudes to mathematics, and were engaging, motivating, intrinsically interesting, easily accessible, free, and supportive of a hands-on approach to the teaching of mathematics and numeracy. The resources include open-ended problems that promote intrigue in students' lived environments to explore mathematical opportunities, digital manipulatives and games that build and promote transference of mathematical conceptual understanding, songs, photographs, reflections, etc.

Numeracy at Home

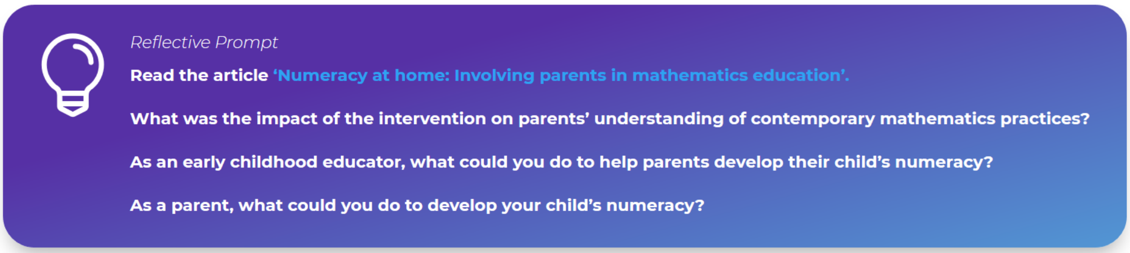
The numeracy at home component was designed to assist families in developing and supporting positive attitudes towards mathematics and numeracy in the home environment. It provides examples of everyday contexts which can be used to capitalise on numeracy teaching opportunities. This component contains videos which provide insights into numeracy at home experiences across a range of age groups. Sub-components include: busting some common mathematical myths; how to help build a child's numeracy; helping with homework; and fun numeracy activities to share with your child. Activities are grouped to cater to the three developmental stages. A random generator provides access to a range of resources and activities to be undertaken at home, such as, "Make predictions by estimating and measuring who can jump the furthest, or stand on one foot the longest, or how many buttons might fill a jar."

Evidence Base

The evidence base component provides an overview of contemporary research and numeracy practice in Australia and internationally. The sub-components include: defining numeracy; numeracy in the twenty-first century; numeracy and the proficiencies; developing a capacity to teach numeracy; numeracy in the early years; and at home with numeracy. Each sub-component includes reference to contemporary research and recommended evidence-based practices. For example, elements of the model for teaching numeracy in the 21st century are described (Goos et al., 2012), together with critical numeracy (Watson, 2009), numeracy across the curriculum, numeracy reform (Westwood, 2011), and the importance of play (MacDonald, 2018). Professional learning is addressed through readings and reflective prompts as shown in the example in Figure 4.

Figure 4

Reflective Prompt From the Evidence Base Component



In summary, there were six components of the numeracy guide, the inclusion of which were determined by their suitability and rigour in fostering continuous improvement in numeracy. The numeracy guide's presentation in the online environment supported learning through effective design features which are critical for engaging the user in experiential learning. The experiential learning feature of the numeracy guide is described below.

Experiential Learning as a Key Design Feature of the Numeracy Guide

The numeracy guide was not only designed to develop users' competencies and capabilities, which are key components of self-determined learning (Blaschke, 2012) and PCK (Van Driel & Berry, 2012), but to foster experiential learning (Kolb, 1976; Kolb, 1984; Kolb & Kolb, 2005) in the delivery of OPD for teachers and families. When OPD is designed to foster experiential learning, the pedagogical approach is adult learner centred, active, and focused on adults' direct experience with numeracy teaching and children and young people's numeracy learning. As such, the numeracy guide intentionally emphasises the participation of adult learners in the construction and strengthening of their experiences to enable and extend PCK, understanding, confidence, and capability in numeracy and mathematics. This in turn assists adult learners in demonstrating autonomy and empowerment (Moon, 2004) to incorporate successful numeracy teaching and learning practices across educational settings and at home.

The numeracy guide's nonlinear design and its central focus on self-directed learning, problem-based learning, and reflective practice better places adult learners to acquire numeracy knowledge and numeracy teaching capabilities they believe they need and that emerge from their concrete experience. Improved numeracy teaching capabilities and curriculum planning expertise as part of teachers' OPD is most often achieved and demonstrated through ongoing reflection (Avalos, 1998; Girvan et al., 2016). Because the experiences and situational contexts of adult learners, specifically numeracy educators and families, is central to the design of the numeracy guide, it differs significantly from other forms of standalone OPD that tend to be more didactic and instructor driven. This design feature allows adult learners to create personalised learning pathways and acquire numeracy PCK through engaging in the metacognitive work of reflection (Agonács & Matos, 2017). The numeracy guide does not provide a "discipline-constrained transmission of knowledge" (Andresen et al., 2000, p. 225). Instead, the design assists adult learners to overcome the conflict between their concrete experience and the abstracted theories of how to teach numeracy and support planning for numeracy teaching that integrates the four VCAA proficiencies: understanding, fluency, problem-solving, and reasoning (2019). This is because the design of the guide does not present the teaching of numeracy as fixed and immutable; rather, an adult's numeracy teaching capabilities are formed and reformed and continuously modified through experience (Kolb, 1984) within their classrooms or at home. The numeracy guide has a central focus on continuous reflective practice through the metacognitive work of reflection incorporating double-loop learning (Argyris, 2002), which encourages teachers and adult learners to try new numeracy teaching and learning practices. The goal is to demystify negative attitudes towards the teaching and learning of mathematics, as users strive for continuous self-improvement by reflecting on what they have learned and how.

The numeracy guide's intentional design to position teachers and families as active participants in their learning with a focus on lived experience where adult learners are encouraged to think, act, and reflect is central to experiential learning. This is because the guide fosters a process of change in adult learners as they draw on their numeracy teaching and learning experiences from the past as a foundation to transform their teaching practice in the present through targeted, relevant, and evidence-based OPD. This experiential learning approach embedded within the numeracy guide is motivating for adult learners as it encourages them to test and experiment with new numeracy teaching approaches on their own terms, with the goal of making permanent changes to their professional practice (Camburn & Han, 2015). Designed to draw on both educators' and families' experiences when confronted with a common numeracy teaching concern, the numeracy guide's problem-based learning activities seek to challenge and explore adult learners' assumptions and preconceptions about learning, teaching, and assessing mathematics and numeracy. With a foundation in experiential learning, the guide works to foster adult learners' application of their learning in authentic ways as they connect their numeracy teaching capabilities to the lived experiences of their classrooms and homes, and then reflect on the process.

Discussion

Teachers face challenges accessing high-quality professional development opportunities online (Powell & Bodur, 2019) because many approaches remain entrenched in face-to-face approaches that resist the implementation of new strategies and theories (i.e., heutagogy) emerging from educational research (vanOostveen et al., 2019). After the global disruption to education as a result of COVID-19, teachers navigating the curriculum and identifying key elements and resources that may be appropriate for their students is difficult for many numeracy teachers and educators, even with their professional experience. Families are unlikely to access the curriculum directly themselves, but if they did, they would likely find the formal language and structure confusing (Bhamani et al., 2020). This, combined with the abundance of resources that are not explicitly focusing on numeracy and numeracy teaching across the home and community, can be overwhelming for parents and carers (Ferri et al., 2020). The design research that underpins the development of the numeracy guide creates an interactive and experiential online learning environment that brings together key aspects of numeracy under one umbrella, in a model purposefully designed to cater to a diverse audience of numeracy educators, teachers, and families with different levels of experience and needs. Careful consideration has been given to the language used within the guide, with deliberate attention to everyday language and building connections to the more formalised language of numeracy and mathematics. The numeracy guide provides an invaluable and easily accessible online resource for educators and families and is particularly helpful for those tasked with facilitating numeracy development at home. At the same time, a strong evidence base is apparent and provides a detailed overview of contemporary research and numeracy practice in Australian and international literature for those interested in pursuing further research or in developing a deeper understanding of current thinking in the field.

With the incorporation of more than 100 carefully chosen multimodal resources to support teachers with their planning, teaching, and assessment in mathematics and to infuse numeracy across the curriculum and at home, the guide is a dynamic and timely resource in the face of the global COVID-19 pandemic. The OPD resources include text, web links, graphics, videos, animations, and audio, with dynamic links both within the guide and externally to Australian and international sites. Everyday examples are identified, especially in the Australian context, to make the numeracy guide relevant for its audience and better attuned to the lives of the young people for whom the activities are intended.

The principles of heutagogy applied to the design mean that users can independently interact with the OPD site, for example to brush up on topics, teaching strategies, proficiencies, HITS, or numeracy focus areas. As Muir et al. (2020) concluded:

The focus on reflection and self-determined learning throughout the Numeracy Guide adds to its value and makes it more than a curated website of resources and activities. We view it as a form of professional learning that can be utilised in a variety of ways:

- by individual educators through using the self-directed prompts;
- by literacy leaders, coaches and facilitators to conduct numeracy targeted professional learning sessions; and
- by teaching teams to facilitate peer learning circles. (p. 30)

With face-to-face professional development for teachers and families no longer an option across many educational jurisdictions globally, the numeracy guide's focus on self-determined learning with invitations to engage in active learning grounded in adult learners' experiences, offers a new conceptualisation for the provision of OPD. It is rooted in experiential learning and heutagogy as a pedagogical approach to design high-quality OPD for educators and families to improve numeracy outcomes for all learners (Reimers et al., 2020).

Conclusion

The *Birth to Level 10 Numeracy Guide* is an example of design research (McKenney & Reeves, 2018) to produce a high-quality and freely-accessible OPD that embeds self-determined and experiential learning (Beard & Wilson, 2018) approaches to foster educators' numeracy teaching capabilities because it places them at the centre of the learning process. Furthermore, it represents a viable model for the design of OPD and other educational products because it presents a design outcome, procedure, and solution facilitated by research conducted by the project and by analysing current research to determine gaps. The numeracy guide's focus on educators' acquisition of evidence-based numeracy knowledge and skills that assists them to understand how children and young people learn specific numeracy content is an example of OPD that targets individual needs (Ertmer at al., 2005). The numeracy guide's nonlinear heutagogical design, where educators are agentic in deciding both what and how they will learn, is novel. This approach is opportune given the disruption to global education as a result of the COVID-19 pandemic. As education systems grapple with new waves of the virus, the guide provides them with a resource to learn about, implement, and reflect on dynamic approaches to developing students' numeracy learning from birth to level 10. The limitations to the guide itself are that families may lack the technological hardware and Internet access required. Further, 26% of families in Victoria, Australia speak a language other than English at home and the guide is currently available only in English. Due to the dramatic shift to online learning for teachers and students, supported at home by families, fatigue with learning and teaching in the online environment may limit adult learners' desire to engage with OPD and online resources, despite the educational value of the guide.

The guide is an intervention into the provision of OPD for adults at scale because it represents a practical solution to improving the numeracy learning of children and young people. It breaks from presenter-driven OPD, inviting educators to engage in double-loop learning activities to solve problems they experience in their practice. Through multiple invitations to reflect on problem-solving numeracy teaching challenges, the guide's reflective prompts invite educators to consider how their participation in OPD questions and tests their personal values and assumptions of learning how to teach numeracy in their specific context. With a focus on double-loop learning that enhances educators' understandings of how to learn through the practice of reflection-on-action, educators are positioned to successfully extend their PCK.

We are living in times characterised by volatility, uncertainty, complexity, and ambiguity (VUCA), with unprecedented educational challenges presented by the COVID-19 pandemic. The guide responds to these challenges, presenting a viable option for families as they take on an increased and more time-consuming role of facilitating the numeracy education of children and young people at home due to school closures and hybrid scheduling where students spend less time at school. Providing numeracy OPD for families that is self-determined, evidence-based, and comprehensive is empowering. Often parents and caregivers possess negative self-beliefs about their mathematical capabilities and inadvertently communicate that it is okay to "not be good at mathematics" to children and young people. The guide works to bust this mindset and other common mathematics myths and misconceptions by demonstrating how to promote positive attitudes towards mathematics.

The numeracy guide is an innovative model for how OPD can cater to diverse adult learners with wide ranging numeracy learning needs. Financial and personnel limitations impact the breadth, depth, and availability of similar experiential models of teacher professional development. However, the design research employed to develop the numeracy guide, including consistent design elements, double-looped learning, nonlinear learning, self-reflection, and metacognition activities to foster educators' pedagogical content knowledge through experiential learning, can be used in conceptualising OPD for any educational content area regardless of context. Critically, the guide represents a low-cost, high-quality alternative to face-to-face professional development that can be leveraged at scale as it provides a roadmap to build the capacity of individual educators, as well as a whole school approach to numeracy that includes families and the home environment.

Acknowledgement

The authors wish to acknowledge the contributions of the many members of the team in the development of the *Birth to Level 10 Numeracy Guide*, but especially our dear late colleague Associate Professor Judy Mousely, Deakin University, whose support, experience and knowledge were invaluable in its success.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 23, Number 3

September – 2022

Evaluation of Higher-Order Skills Development in an Asynchronous Online Poster Session for Final Year Science Undergraduates

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Abstract

Preparing a scientific poster and presenting it at a conference supports the development of a range of skills in undergraduates that are relevant to further study and the workplace. This investigation focused on an asynchronous online poster session in a final year undergraduate science module at a UK university to assess evidence of higher-order skills development and determine student perceptions of the benefits and challenges of participating in the session.

The study analysed 100 randomly selected posters from the 2020 session for evidence of scientific understanding, application, and critical evaluation, together with the feedback received on them. While 73% of the posters demonstrated understanding and 70% application, a lower proportion (42%) demonstrated critical evaluation skills. Seventy-eight percent of posters were considered to have received feedback from peers that gave an effective or partially effective evaluation of scientific content.

Focus group discussions involving nine students led to the identification of themes relating to constraints, academic challenges, skills and experience, and personal development. Students recognized the value of the conference for skills development and the experience it gave of "real" science, while acknowledging the challenges involved in producing posters, giving feedback to peers, and managing their time.

The asynchronous online poster session enabled students to develop higher-order cognitive and communication skills that are valued by employers. This format provides a pragmatic and easy to implement alternative to synchronous online conferences, which is relevant to the shift toward online learning in higher education, due to the COVID-19 pandemic and increase in distance learning and international students.

Keywords: online poster session, asynchronous, student perceptions, higher-order skills

Introduction

Participation in academic conferences provides an opportunity for undergraduate students to expand their knowledge while developing skills in networking and communication, both of which are increasingly valued by employers (Kneale et al., 2016). Poster sessions in conferences enable students to present their work and receive feedback but can feel less intimidating than oral presentations. Hence, they may be particularly suitable for novice presenters (Halligan, 2008). Preparing and presenting a poster enables "situated learning" to take place (Lave & Wenger, 1991), providing a safe environment for the novice, supported by collaboration with peers and more experienced members of the academic community (Kneale et al., 2016).

The process of preparing a poster and presenting it at a conference supports the development of creative, scientific, and communication skills (Holt et al., 2020). Through communicating their research to others, students can apply their knowledge and demonstrate a deeper understanding of the subject (Spronken-Smith et al., 2013). The ability to review, synthesise, and clearly articulate ideas can be considered an essential skill to help graduates transition into careers and be successful life-long learners (Jewell et al., 2020). Giving and receiving feedback engages students actively, which enhances their learning (Liu & Carless, 2007) and can develop critical evaluation and reflection skills (Little, 2020). Careful thought is needed to construct explanations when giving feedback, which helps consolidate the giver's own knowledge and understanding (Van Popta et al., 2017). Both preparing a poster and giving and receiving feedback can therefore support deeper learning, with a greater focus on understanding and constructing meaning (Mathieson, 2014). Previous studies report that students value poster sessions (Kinikin & Hench, 2012; Kneale et al., 2016; Mabrouk, 2009), recognising their benefits, including developing science communication skills and interacting with others at the poster session (Holt et al., 2020).

Bloom's taxonomy (Bloom, 1956) provides a hierarchical framework to assess skills development in producing posters and giving feedback on them. Students need to know and understand concepts to be able to apply that knowledge, for example in considering the wider implications of research findings and critically evaluating study methodologies. Thus, application and evaluation can be considered higher-order skills than knowledge and understanding (Zheng et al. 2008). While some studies have evaluated student academic performance in posters (e.g., Gosselin & Golick, 2020), few have focused on student posters in terms of higher-order cognitive skills, such as critical evaluation and the application of knowledge. These higher-order skills will be the focus of this study, together with the understanding and explanation of the ideas and concepts that underpins them (Zheng et al., 2008).

Student poster sessions can take place online and have increasingly done so because of the COVID-19 pandemic, which necessitated a rapid shift to "virtual" delivery of higher education (HE) tuition throughout the world. This shift has accelerated the removal of boundaries between traditional and online education, which were already becoming blurred prior to the pandemic (Lockee, 2021). While the online format has some advantages, such as lower costs (Freeze et al., 2020; Holt et al., 2020) and increased accessibility and equity (Saribipour et al., 2021), the lack of in-person interaction can make it more difficult to discuss the research outlined in posters. This lack of interaction can be particularly challenging for distance learners, who can already feel somewhat isolated (Gillett-Swan, 2017). Despite the challenges of delivering online learning, it is likely that it will continue to be offered throughout the HE sector as a delivery mode (Lockee, 2021).

Several online poster sessions that have taken place since the start of the pandemic have been wholly or partly synchronous. For example, Freeze et al. (2020) report on a student poster session involving a combination of pre-recorded video presentations on YouTube and a live session using Zoom breakout rooms, while Holt et al. (2020) describe a synchronous poster session hosted on Mozilla Hubs involving a virtual poster hall, with students using avatars to stand by their posters and interact with viewers. Synchronous online sessions provide a degree of social presence and can give a sense of community (Holt et al., 2020), but there can be issues with connectivity and Internet speed (Basaran & Yalman, 2020; Freeze et al., 2020).

Online poster sessions can also take place in an asynchronous format. Although they may feel less personal and interactive and lack the immediate feedback that can reduce miscommunication (Wang & Wang, 2021), asynchronous platforms can be more convenient for distance learning (Kear et al., 2012). They give students from different time zones or with other commitments an opportunity to participate that might not be possible with synchronous sessions. Furthermore, the flexibility of asynchronous platforms can make for a more comfortable learning environment for students with disabilities (Terras et al., 2015) and give more time and space for participation (Wang & Wang, 2021).

The Open University (OU) is one of the largest universities in Europe, with over 150,000 students (Open University, 2021). It is an established and respected provider of online HE, which it delivers through a combination of synchronous and asynchronous platforms. OU students have an average age of 27 when commencing their degrees and are often employed in full or part-time work or have family and caring responsibilities. They study at a flexible intensity, ranging from 8 to 36 hours per week depending on the number of modules studied. Here, we focus on an asynchronous online student poster session that is a core component of a third-year multidisciplinary science module. Through analysis of poster content and student perceptions of the poster session we will address the following questions:

- How can an asynchronous online poster session help develop science students' understanding, application, and critical evaluation skills?
- What do students consider to be the key benefits and challenges of participating in the asynchronous online poster session and how does this relate to the skills evidenced in their posters?

These questions will be relevant in terms of planning and improving online activities for distance-learning students. They are also more widely relevant as HE institutions expand their online tuition in response both to the COVID-19 pandemic and to increasing numbers of international and distance-learning students, for whom participation in face-to-face activities is not always feasible.

The Online Student Poster Session

The OU runs an online student poster session as part of the third-year undergraduate multidisciplinary "Evaluating Contemporary Science" module, which has up to 250 students in each cohort. The module is recommended to be studied for 8 to 10 hours per week, with three study weeks allocated for researching and preparing the poster and accompanying materials. Each student prepares a poster on a subject of their choosing within one of five topics (antibiotic resistance, diesel vehicles, nuclear legacy, moons and asteroids, and rare earth elements), through which they compare the scientific approaches and research findings in two recent primary research papers of their choice. They also produce a four-minute audio commentary of the poster, key words, and an image that is used to promote their poster.

A series of live online tutorials are offered prior to the poster session on each of the topics, which are recorded so that students can review them as required. These provide instruction on how to search for relevant literature and emphasise the science aspect, which complements the written guidance the students are given on what to include in their posters. Students are instructed to produce their poster in portrait mode and in a font size that is legible, but they are otherwise encouraged to develop their own style and format.

The poster and accompanying material are uploaded onto OpenStudio. This is an online platform where artefacts (e.g., posters and images) are shared and students can add feedback comments, together with more immediate feedback in the form of icons such as "smile" and "favourite." In this way, OpenStudio supports a form of social learning (Jones et al., 2017).

The poster session takes place over a two-week period. During this time, students select at least two other posters through browsing titles and thumbnail images or through a keyword search, and they provide feedback as comments in OpenStudio. They are given a set of structured questions and are encouraged to use the CORBS (clear, owned, regular, balanced, specific) approach when giving feedback (Hawkins & Shohet, 2012).

The student poster and feedback given on other posters contribute to approximately 10 percent of the assessment score for the module. Following the poster session, students develop the research carried out for their poster over an eight-week period, leading to the production of a briefing document and research proposal that forms a major component of their final examined assessment.

Methodology

The research used a mixed-methods approach involving two phases. In the first phase, we analysed student poster content for evidence of scientific understanding, application, and critical evaluation. In the second phase we considered student perceptions of the benefits and challenges of participating in the poster session through synchronous online focus group discussions. Ethical approval for both phases of the research was gained from the OU's Human Research and Ethics Committee prior to commencement.

Analysis of Poster Content and Feedback

We randomly selected 100 posters from the 198 that were uploaded by the 2020 student cohort. This was considered a sufficiently large sample size to capture the variation in the posters while being pragmatic to analyse within the time and resources available for the study. Following anonymisation, they were assessed using eight criteria (Table 1) covering scientific understanding (understanding), application (application), and critical evaluation (evaluation). Each criterion was assigned a score on a Likert scale from 1 (very poor / no attempt) to 5 (excellent). For example, for "use of language," a score of 3 indicated it was satisfactory in meeting the criteria of being clear, concise, and having appropriate use of terminology. "Use of language" that scored 4 (good) and 5 (excellent) also recognised which terms needed to be explained to students from outside their discipline in a manner appropriate to a generally scientifically educated audience.

Table 1

Summary of Criteria Used to Assess Poster Content

Criterion
Understanding • Use of language • Use and amendment of figures
Application • Interpretation of results • Drawing of conclusions • Suggestions for further research • Contextualisation
Evaluation • Evaluation of individual studies • Comparative evaluation of both studies

The criteria were grouped into overarching criteria for understanding, application, and evaluation, and the individual criterion scores totalled for each of the three overarching groups. These overarching criteria are hierarchical and reflect elements of Bloom's taxonomy (Bloom, 1956), with understanding (Bloom's "comprehension") underpinning application, above which sits evaluation.

Scientific understanding can be demonstrated through the students' use of language; if they conveyed the key points from the studies in concise and non-technical language, this indicated that they understood them. The presentation of data from the studies can also indicate understanding, with students who successfully produced their own figures and/or annotated figures to indicate key points considered to show a greater understanding than those who simply copied figures from the original papers.

In terms of Bloom's taxonomy, interpretation has been treated as part of both "understanding" or "application" in previous studies (Stanny, 2016), but we considered it a measure of "application" for the purpose of this study. Students' application of knowledge and understanding was evaluated through how they interpreted the research findings from the two papers they compared and drew conclusions from them. They were also required to suggest future research based on their interpretation of the research findings and apply their understanding to contextualise the research. They can demonstrate evaluation skills both through evaluating each study, for example in terms of their limitations, and comparing the two studies.

We assessed the feedback received on each poster in terms of (i) whether the feedback focused on appearance or scientific content (assigned to one of three categories: appearance, content, or equally) and (ii) whether the feedback was considered to give an effective evaluation of the poster's scientific content. This was also assigned to one of three categories: yes (constructive criticism and engagement with points made in the poster), partially (some attempt to give feedback on scientific content) or no (lack of feedback on scientific content).

Each of the study authors assessed approximately half the posters, with a standardisation exercise undertaken prior to analysis to ensure consistency. This involved both study authors, together with a third, independent researcher, analysing the same 10 posters and comparing criteria scores and assessment of the feedback. This showed there were minimal differences between the researchers in their assessment of the posters.

Student Perceptions

Student participants were recruited by contacting all those studying the module in 2020, of whom nine volunteered for the focus group discussions. Two one-hour discussions took place via an online platform (Adobe Connect), with four students in one group and five in the other. The discussions were held after the final module assignment was submitted but before the results were released, to avoid this influencing student views in the discussions.

The focus groups were facilitated by two student volunteers. The volunteers were experienced in using the Adobe Connect platform so they could assist with any technical problems, but they were not part of the student cohort for the module. Prompts for discussion related to:

- how students prepared for the poster session
- how students experienced the poster session
- what students thought they gained from the poster session

Thematic analysis was undertaken on the transcripts from the discussion recordings, which were coded using NVivo software. This helped identify groupings within the initial codes and led to the identification of key themes and subthemes (Braun & Clarke, 2006).

Findings

Poster Content and Feedback

Table 2 shows the percentage of posters gaining each score for the three overarching criteria (understanding, application, evaluation). Posters generally scored highly in terms of the understanding and application criteria, with 73 percent and 70 percent of the posters scoring in the 3 to 5 range (i.e., considered satisfactory, good, or excellent) and both criteria having a mean Likert score of 3.1. Scores for the evaluation criteria were somewhat lower, with 42% of posters scoring in the 3 to 5 range and with a mean Likert score of 2.3.

Table 2

Percentage of Scores Awarded and Mean Likert Score for the Overarching Criteria

Overarching criterion	Score					
	1	2	3	4	5	Mean score
Understanding	4%	23%	42%	20%	11%	3.1
Application	5%	25%	37%	25%	8%	3.1
Evaluation	33%	26%	27%	13%	2%	2.3

Note. A score of 1 = very poor/no attempt; 2 = poor; 3 = satisfactory; 4 = good; 5 = excellent.

Nearly three-quarters of posters received feedback that focused mainly on scientific content (19%) or had an equal focus on content and appearance (53%). Over three-quarters of posters were considered to provide an effective evaluation of scientific content (53%) or at least partially so (25%).

Student Perceptions

Four main themes emerged from the student focus group discussions: constraints, academic challenges, skills and experience, and personal development. These themes and the underlying subthemes (Table 3) are discussed below, illustrated by anonymised quotations from focus group participants.

Table 3

Themes and Subthemes Identified from Focus Group Discussions

Constraints • Time pressure • Assessment
Academic challenges • Researching and preparing poster • Selecting posters and giving feedback
Skills and experience • Appreciation of value of feedback • Skills development • Experience of "real" science
Personal development • Interest and enjoyment • Building confidence • Social learning

Constraints

Several participants experienced time pressures, particularly those who were studying other modules with competing deadlines or had other commitments that limited the time they could devote to preparing their poster and participating in the poster session. To add to these pressures, the 2020 poster session took place between March 21 and April 3, which coincided with the start of the first COVID-19 lockdown in the United Kingdom. The run up to the March 20 deadline for uploading posters to

OpenStudio involved a period of considerable uncertainty, with schools and workplaces shutting in the week preceding the lockdown.

Some participants felt somewhat constrained by the fact that their poster and the feedback they gave on others was assessed. For example, one participant noted that "you were being graded based on how you presented what was said" and that "you were pandering to what you felt was required some of the time as well."

Academic Challenges

The participants had some experience searching for suitable papers from previous study, including earlier on in the module, but some found it challenging to choose suitable papers to base their poster on. The large number of potentially suitable papers available in the literature made it difficult for students to know when to stop searching and finalise their choice of papers. Another challenge was synthesising and comparing the two papers and communicating the findings to a wider audience within the limited space available. One participant noted that "a lot of it was down to how much detail to include … you don't want to give too much but you don't want to give too little – so it's getting the balance right."

Choosing posters to give feedback on was sometimes challenging, as there were numerous posters to choose from. The participants wanted to choose posters for which they could provide constructive feedback. One commented that they "wanted one I could actually provide feedback for" and not one which they looked at and thought "I don't really know what to say about this."

Giving feedback on posters that were weaker overall was particularly challenging as the participants were aware how much work had gone into each poster and did not want to cause offence. As one participant put it "it was a good exercise in how to be tactful – knowing how to tell somebody that they can improve an aspect not in a way to cause offence but that could actually help them."

It was considered more challenging to give feedback on a poster's scientific content than its appearance. However, the importance of giving feedback on content was recognised, with one participant noting that "you've got to try and concentrate on the actual science – obviously the display is part of the process but it's looking at the science – that's the main focus."

Skills and Experience

The participants appreciated the value of giving and receiving feedback and recognised where this fitted into their studies and how this could help improve their work. One participant observed that "it's difficult when people are giving you constructive criticism, but you've just got to take it on board and actually give it some reflection … and try to move forward and incorporate that into your future work."

They also recognised the role of the conference in developing skills, including those needed for further study, dissertations, and work-related projects. According to one participant, "You are learning or improving the [skills] you've already got—things like evaluating, making sure work is concise, making sure you are doing it to the right audiences—lots and lots of skills to get your teeth into."

The participants appreciated the role of conference poster sessions and the feedback process in real science. As one participant noted, "It's how they learn as well, doing a poster, because they are getting feedback from other scientists, which helps to build and develop whatever you are talking about at conferences and that's how they learn and progress."

Linked to this was a more general feeling that they were experiencing how real science operates, for example that "people really do just talk to each other and that's how they develop their ideas."

Personal Development

Recurring themes throughout the discussions were those of interest and enjoyment, with one participant stating that they "enjoyed the creative side" of making a poster as well, while others commented on the interesting science that was presented and how they enjoyed the opportunity to broaden their knowledge. As one participant put it, "It was really interesting to learn about other subjects ... I never expected to be reading a poster about volcanoes and satellites, for instance."

While the poster session was challenging and took some participants out of their comfort zones, it also helped build confidence. One participant noted that they "gained confidence, otherwise I wouldn't be contributing to this focus group now, so I think it is certainly going to help me in the future."

The participants also appreciated the social aspect of the session through interacting with fellow students with similar interests and learning from them:

> One of the nicest things for me was actually getting to see other students' work because you never normally get to see something another student [has produced] and I think it's quite beneficial to see how other students approach things.

Some participants mentioned that they would have liked to have had the opportunity to discuss each other's posters in real time: that is, for there to have been a synchronous element to the poster session. However, another noted that "because everybody has different timetables, I don't know how it would have been possible to bring everybody together." Furthermore, the asynchronous format meant that students could take their time to look at the posters, which remained accessible in the weeks after the poster session had finished. One participant stated that "you do what you need to do at the time and then you can go back at your leisure which is really nice to have a look through them all."

Discussion

Analysis of the poster content showed that nearly three-quarters (73%) of students demonstrated their understanding through use of language and use and/or adaptation of figures. A slightly lower proportion (70%) demonstrated their application skills through interpreting results, drawing conclusions, proposing further research and contextualising the research. A lower proportion (42%) critically evaluated the studies they investigated, which was also evidenced in the focus group discussions, where the academic challenges in producing posters was highlighted. Understanding provides the foundation for the application of higher-order cognitive skills such as application and evaluation, with a solid understanding of the material needed to apply these skills (Zheng et al., 2008). It is therefore not surprising that evaluation—the highest-order skill out of those assessed according to Bloom's taxonomy—was the least well demonstrated skill, and that the converse was the case with understanding. However, the abilities to apply knowledge and understanding, evaluate information, and think critically are needed for the workplace (Gasper & Gardner, 2013), so development of these skills is particularly important for students.

From the focus group discussions, it was clear that students recognised the role of the poster session in developing key skills such as communication and critical evaluation, which is supported by the wider literature on student conferences (Kneale et al., 2016; Little, 2020; Walkington et al., 2017). They also recognised the relevance of these skills to their future study and work, which also emerged as a key theme in another study investigating the value of student poster presentations (Kneale et al., 2016). The students appreciated the insight the poster session gave them into real science, for example, by experiencing the types of discussion that take place at conferences. This can act as a motivator through enabling them to see themselves as part of an academic community (Little, 2020).

Several academic challenges were mentioned in the focus group discussions, such as choosing suitable papers to base the poster on and communicating findings in the limited space afforded by the poster format. The limited space and time available might have contributed to the poorer performance overall in terms of evaluation, which may have been considered less of a priority by students when having to cover several elements in their posters. The investigation focused on a final year module, where a higher level of learner autonomy and discipline knowledge was expected. Students were therefore provided with less comprehensive guidance than they would be at an earlier stage of study, but we nevertheless recommend this is consolidated and made more prominent for future poster sessions. Some focus group participants commented on the difficulties in selecting posters to give feedback on. Students might not necessarily select the highest quality posters to comment on, instead being drawn to “middling” posters where there is more of an opportunity to give constructive, critical feedback (Lotz et al., 2018).

Over three-quarters of the posters received feedback that was considered to make at least some attempt to effectively evaluate their scientific content. In addition, the majority of posters received feedback that either focused on scientific content, or had an equal focus on content and appearance. However, nearly 30 percent received feedback that focused on the poster’s appearance rather than its content, which could be considered an “easier” option to give. Possible reasons for this were not explored in the current study but could be the result of a reluctance to give critical feedback (McMahon, 2010) and risk causing offence, as noted in the focus group discussions. Students might be more comfortable giving critical feedback on poster appearance, such as font size or layout, than on the scientific content when they are aware how much effort went into researching and creating it. Given the challenges students faced producing their posters and their weaker performance in terms of evaluation, it is unsurprising that they found it difficult to give feedback on the scientific content of other posters, whose contents they were not familiar with and might not have felt qualified to judge. Furthermore, some students might have adopted a “surface” approach (Mathieson, 2014) to giving feedback through finding something to say to “tick a box” rather than engaging more deeply with the poster content. Workloads and their perception can influence student approaches to learning, with heavy workloads associated with the adoption of a surface approach (Scully & Kerr, 2014). Some focus group participants commented on the time pressures they were under, and it is possible that students with less time available might have engaged less deeply with poster content when giving feedback.

The focus group participants appreciated the value of receiving critical feedback in terms of improving their future work. The benefits of receiving feedback are widely recognised, both in terms of improving students’ research work (Van Popta et al., 2017) and preparing them for developing academic careers: for example, through exposure to the peer review process (Kneale et al., 2016). However, the benefits of giving feedback are less widely recognised, despite contributing to improved understanding (Van Popta et al., 2017) and improving students' self-assessment skills when evaluating their own work in the future (Yucel et al., 2014).

The student posters and the feedback students gave were assessed as part of the module. This was considered a constraint by some focus group participants in that they did not feel they could take any risks in producing their posters, and the feedback format they were expected to use was rather formal. This contrasts with optional, non-assessed student conferences, described by Little (2020) as a "risk-free space, away from the determinants and pressures of summative assessments," which enable research to be reported in an interesting and engaging manner (Walkington et al., 2017). A non-assessed poster session may also give space for students to undertake more challenging conversations with each other, which could support the development of critical thinking skills (Little, 2020). However, such non-assessed activities might involve lower levels of participation, particularly from students experiencing time pressures.

The poster session provided a confidence boost for some participants, which could help reduce anxiety with any future presentations, both in their studies and employment (Little, 2020) and improve their sense of self-worth. Producing a poster and participating in a conference can be an enjoyable experience and give students a feeling of ownership and achievement (Kinikin & Hench, 2012). It can also enable students to gain ideas and inspiration (Kneale et al., 2016), as shown in the focus group discussions where one student described a "lightbulb moment" as to how real science operates. Indeed, some researchers have described student experience of a research conference as being "transformative," both in the short and longer term (Little, 2020; Walkington et al., 2017).

The poster session used an asynchronous format. Although there were a few reported issues with the OpenStudio interface, such as the need to download the audio commentary before listening, the session ran smoothly, with the asynchronous format less reliant on Internet connectivity than a synchronous format (Holt et al., 2020). An asynchronous poster session may lack the informal and spontaneous conversations that may take place in real time, with immediate feedback including from social cues such as facial expressions (Walkington et al., 2017). However, there is some evidence for text-based non-verbal communication through electronic cues such as the frequency and tone of postings and use of emoticons, which could have a positive influence on student engagement (Al Tawil, 2019). Such peer interaction was commented on positively in the focus groups and can help combat feelings of isolation among students (Al Tawil, 2019), particularly those studying at a distance. Asynchronous poster sessions can therefore provide a pragmatic and flexible alternative to synchronous online sessions, which is relevant not just in times of pandemics, but more widely with the increase in distance learning and international students in HE.

The study had some limitations. Firstly, the audio commentaries that students submitted to accompany their posters were not analysed due to time constraints. This may have influenced the findings regarding evidence for skills development, as it is possible the audio might have provided additional evidence, such as for critical evaluation. Analysing the audio commentaries would be a worthwhile follow up to gain a further insight, while recognising that oral communication is a key employability skill. Secondly, although the sample size was large, representing just over half the posters from the 2020 student cohort, it represented a snapshot from a single, perhaps somewhat atypical, year as the conference coincided with the start of the COVID-19 pandemic and first UK lockdown. This meant that students were experiencing considerable stress and uncertainty, both when producing and uploading their posters and during the two-week poster session, which might have compromised their efforts. A longitudinal study following the same approach, but in a more "normal" year would be a worthwhile follow up to this investigation. Thirdly, the number of focus group participants was low, and students volunteered to participate in them. The focus group participants might therefore not have been representative of the wider student population for the module and are likely to have been those that are more actively engaged to start with.

Conclusions

The HE landscape is rapidly changing, with online tuition and learning no longer an exception. This study demonstrated that an asynchronous online format could provide an effective, pragmatic, and flexible alternative to synchronous online poster sessions. The study showed that an asynchronous poster session enabled students to develop and demonstrate a range of higher-order skills relating to understanding, application, and critical evaluation. Students recognised the role of the poster session in developing these skills while being aware of the challenges involved in producing the poster and giving feedback. They appreciated the insight it gave them into real science, together with the personal benefits they gained in the form of enjoyment and increased confidence. Such confidence, together with the skills developed, will be of key importance as they complete their degrees and enter the future workplace.

Acknowledgements

This work was funded by the OU's eSTEeM scholarship program, and we are grateful to the eSTEeM team for their support throughout the project. We would also like to thank Simon Collinson, Karen Kear, the associate lecturers on the "Evaluating Contemporary Science" module, the student focus group participants, and Cath Brown and Charlotte Hancox for facilitating the focus groups.

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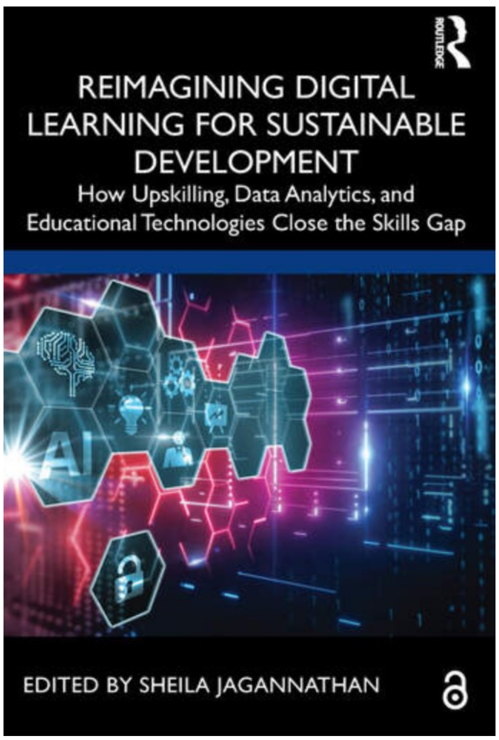
Athabasca University

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 23, Number 3

September – 2022

Book Review: Reimagining Digital Learning for Sustainable Development: How Upskilling, Data Analytics, and Educational Technologies Close the Skill Gap



Editor: Sheila Jagannathan (Routledge, 2021, 379 pages). ISBN: 978-0-367-5-54018-0.

Reviewed by: Professor Santosh Panda, *Director, Staff Training & Research Institute of Distance Education, Indira Gandhi National Open University, New Delhi 110068, India.* Correspondence: spanda.ignou@gmail.com

The intent and content of this book are clearly reflected in the book title—and this straightforward style is appreciated. I have seen some of the recently published books related to education and development, information and communication technologies (ICT) for development, digitalization and development, and other related themes. This is the first book to cover a broad spectrum of the area of digital education for sustainable development, effectively and systematically collating the areas of education and learning, digitalization, and sustainable development. Some books have gone into critical discourses (I would say critical romanticization) on these areas of contemporary concern, but this book judiciously combines theories and practices within the most urgent practical concern of sustainable development. The editor, Dr. Sheila Jagannathan, is a well-known global practitioner, staff developer, and policy influencer in this area which is of significant concern among national governments and global multinational organizations, as well as teachers, trainers, and other practitioners. Dr. Jagannathan has brought together experts in the field to reflect and focus on their themes, combining theories and translating discourse into practical applications and further reflections. The 27-chapter book has been organized into 8 themes—learning in the 21st century, innovative pedagogies, new models for deeper learning, cases of digital and blended learning, open resources, smart technologies and tools, data analytics and credentials, partnerships. The book is enhanced by the editor's thought-provoking conclusion.

In the first section, Theme 1 deals appropriately with 21st century learning through four chapters, the first two written by Dr. Jagannathan. In the first chapter, she highlights the deeper concerns of global learning poverty and the need for strengthening learning and learning skills as well as reskilling and upskilling vis-a-vis the United Nations' fourth sustainable development goal. This warrants massive institutional and individual capacity building, as well as involvement of other stakeholders noting that "leveraging technology is the only solution possible to provide high-quality learning (skilling) at a massive scale" (p. 13). In the second chapter, Jagannathan argues for the necessity of more educational technology innovation and digital learning. The unprecedented phenomenon of COVID-19 has demonstrated the need to go beyond Zoom and Google approaches to that of collaborative, engaging, and reflective learning. The author appropriately argues for blended learning, active learning, connected learning, and virtual facilitation of learning, which can facilitate the reduction of skill gaps while building appropriate skills and competencies to deal with the changing nature of work, jobs, and careers.

In the third chapter, Dede and McGivney analyze lifelong learning for jobs that, while yet to come, are clearly present at the border of centre stage. The authors plead for going beyond educational silos to more lifelong learning beyond formal educational training as well as the training provided by the employers. Some of the examples of technology-enabled learning opportunities and sites should be handy for readers.

The last chapter in this section by Ryan Watkins describes various types of diverse decisions that leaders, academics, staff, and other stakeholders make regarding impacts, outcomes, and outputs so that effective digital transformation of learning can occur. The author provides an implementation pathway comprising: (a) assess and analyze-design; (b) develop-implement; (c) improve-manage; and (d) support. The provision of short example cases and guidelines stress the need to change mindsets and make forward-looking choices.

In the second section, four chapters, written by specialized scholars in the field, focus on innovative pedagogies. Jagannathan takes the lead by appropriately collating a conversational dialogue on pedagogy for the digital age with Tony Bates, who argues that teaching methods do not depend on delivery modes and technology deployed, though each media and technology has its own language. Appropriate media selection could be guided by the SECTIONS model (revised from ACTIONS): students, ease of use, costs, teaching functions, interaction, organizational issues, networking, and security/privacy. Bates posits that effective and judicious blended learning could be qualitatively more enriching than a single or supplementary mode of delivery. In the next chapter, Som and Sharishna present the case for effective pedagogic interventions to develop practitioners' skills, based on cases from the South Pacific. These authors argue for and describe three pedagogic choreographies related to models of learning and teaching, approaches for assessing learning outcomes, and institutional accreditation and certification. They stress scenario- and problem-based learning, to which project-based learning may be added.

In the seventh chapter, Ehlers focuses on the issue of quality, discusses various quality standards in digital learning, and argues that there should be congruence between quality standards and "requirements of learning in new digital culture" (p. 82). Technology provides for immense learning opportunities and processes. Readers should consider some of the good practices outlined in the chapter—self-evaluation, e-portfolios, peer reflection, peer assistance—and the suggestion that economics of quality assurance should not neglect the requirements of quality standards. In the last chapter in this section, Peter Evans critically reflects on capacity building in complex digital education, with due consideration to the digital environment itself, digital equity, digital credentialing, and use of artificial intelligence for capacity building, using the case of *Manifesto for Teaching Online* developed by the University of Edinburgh.

The third section, with three chapters, deals with various contemporary models for deeper learning, focusing specifically on massive open online courses (MOOCs), game machines, and immersive virtual reality. Lee Rubenstein discusses how MOOCs, as well as new credentials like MicroBachelors® and alternative credentials, address new demands for micro-learning and flexible new learning requirements of students, workforces, and managers. Blended learning has emerged as the preferred and most effective strategy for corporations, as well as government and non-government sectors to address the SDGs through MOOCs. In the next chapter, John Traxler discusses an emerging area of game mechanics for digital learning. Based on a critical analysis of mobile learning, e-moderating, curation, heutagogy, and learner-generated content, Traxler discusses game mechanics. This strategy, in which a community of learners can engage in collaborative and reflective learning in digital learning spaces, also aligns technologies and pedagogies with the experiences and expectations of community members. The last chapter in this section by Anders Gronstedt is focused on immersive learning—games, simulations, and virtual reality. The author applies developments in cognitive science to virtual reality, through the example case of *Novartis VR Simulatio*n conducted in the Novartis VR lab. Gronstedt argues that the future of virtual learning is through augmented reality and artificial intelligence; "VR can take one to any place; AR can bring anything to the learner" (p. 143).

The fourth section presents five studies of cases and good practice of digital and blended learning. Laura Ruiz Perez analyses the case of Tecnologico de Monterrey from Mexico, which offers blended and peer-to-peer approaches to education in Mexico and Latin America through various innovations and entrepreneurship, as well as flexible educational solutions. This case exposes us to excellent practices in online ecosystems and communities of practice. Ansari Ahmed, in the next chapter, presents the Malaysian experience of national partnerships and alliances for successful e-learning. The best example is the Asia e University (AeU), based on experiences gained from the Universiti Sains Malaysia and the Open University of Malaysia, and partnered with other countries and institutions to offer programs and courses in over 80 countries. In Chapter 14, Edgar Gonzales, Stella Porto, and Xemia Coton present the case of the Inter-American Institute for Economic and Social Development (established by the Inter-American Development Bank) for enhancing capacity and employability through e-learning. The e-learning ecosystem comprises (a) governments and international agencies; (b) schools, colleges, ICT providers, and NGOs; (c) networks and industries; and (d) learners. Their pedagogies and e-learning innovations considered operational relevance, appropriate modes of learning, personalization, and socialization. The authors suggest that appropriate policy formulations and involvement of various stakeholders are necessary for effective implementation of an e-learning ecosystem.

In the next case study on China, authors Huang, Wang, Lu, Gao, Li, and Tlili discuss two national educational technology initiatives that use a holistic approach to digital learning for capacity building (cloud-based courses by China Construction Bank University) and AI and gamification to promote digital learning in Internet companies (Net Dragon University). The authors reflect on innovative pedagogical methods, integrating of digital learning formats, leveraging digital learning, and using a new set of metrics to measure the impact of digital learning. They suggest the need for continuous engagement with online learning strategies regarding online safety, online bullying and fraud, and dealing with constantly changing Web-based technologies. The last national case study addresses the federal Ministry of Skill Development and Entrepreneurship's National Skill Development Corporation (NSDC) under the Skill India Mission. Manish Kumar presents the strategies adopted by the NSDC in skilling and upskilling workforce students and trainers in a variety of areas based on 10 levels—from schooling, through higher education, to the level of research degrees. Various partnerships are explained, including funding and non-funding partnerships, innovative partnerships, corporate green channel partnerships, and skill loan financing. Implementation through various sector skills councils, and with the help of qualification packs and national occupational standards, has significantly contributed to training millions of people in various sector skills relating to national, regional, as well as industry and business occupational needs. The author underlines technological interventions for lifelong skilling management, and cost-efficiency in technology-enabled skill development investment.

The next section on the future of content development contains only one chapter on OER policy and capacity building for sustainable development. Sanjaya Mishra critically analyses the identification of OER, the use of OER for teaching and learning, and presents guidelines for OER policy development and capacity building. Two small case studies on effective implementation of OER policy and practice, namely *ICT in Education Policy and Strategy*, and *Understanding Open Educational Resources*, both by the Commonwealth of Learning are discussed. Mishra suggests five important ideas to take forward for further reflection and consideration. A second chapter in this section, dealing with integrating OER with technology-enabled learning as well as open pedagogy and open educational practices, will enhance readers' understanding and reflection on the effective use of OER for sustainable development.

Section six of the book, with four chapters, is devoted to smart technologies and tools. Martin Dougiamas, the founder of MOODLE, provides a detailed explanation of Moodle and its effective use, along with the Moodle Educator certification and the future of open education relating to OER, open education technology, and open recognition. A key concern is that of transferring recognized skills (credentials) across organizations and institutions, including the issue of open badges. Dougiamas is "excited for the future and to be a part of helping it to happen" (p. 231). In the next chapter, Balaji and Carr analyze the power of artificial intelligence, blockchain, and 5G in leveraging education, upskilling, and lifelong learning. They point out that though machine learning and deep learning are generally considered within AI, today we see the application of artificial narrow intelligence, with artificial general intelligence in the near future. The technology practices during the COVID-19 pandemic have induced us to consider more AI, blockchain, and 5G "to increase flexibility in learning and cross-border recognition of achievements, and to create personalized learning experiences for all learners" (p. 242).

In chapter 20, David Guralnick describes real world experiences of artificial intelligence vis-a-vis virtual reality, augmented reality, holograms, Internet of things, blockchain, 5G, and neurohead sets. Guralnick's explanations in relation to underlying pedagogies of active learning, learning by doing, situated learning, constructivism and constructionism, and user-centred design are very useful. Irrespective of delivery mode, whether face-to-face, distance, online, or blended, the important consideration is that of learning experiences. The author suggests we consider learning by doing and critical thinking in any learning design with technology. Experiences work better when they are personalized, interactive and immersive, framed by micro-learning, and skill based. In the last chapter in this section, Abtar Singh and others present a framework of using smart mobile learning for training trainers. Their SCALED framework comprises stakeholders, competencies, affordances, learners, evaluation, and design intentions. The authors exemplify the application of the framework through a few case studies of programs; these should be helpful to trainers across the educational spectrum.

The seventh section with three chapters focuses on learning measurement, evaluation, and credentialing in the contexts of digital learning, learning analytics, and open digital credentials and badges. In Chapter 22, Guerra-Lopez focuses on the impact of digital learning. The indicators for the five-stage framework cover (a) stakeholders and purpose, (b) evaluation design, (c) evaluation deliverables, (d) dissemination, and (e) continual improvement. Regarding learning analytics, Gary Natriello, in Chapter 23, discusses the use of learning analytics for accelerating change in educational systems and operations. Data assumes importance in this process including data related to learning, learners, programs, instruction, social interactions, resources, and engagement. Two related issues assume considerable importance—capacity building and ethical issues—which system leaders need to address in order for learning analytics embedded in programs, instructor and learner involvement, and learning analytics to become part of educational practice. Hickey and Buchem, in the final chapter of this section, focus on open digital credentials and badges to advance sustainable educational ecosystems. They discuss the limitations of traditional credentials and the functions of open digital badges including finding, capturing, recognizing, motivating, and endorsing learning. In respect to making and recognizing learning, the authors suggest we "think big, start small, work fast" (p. 305).

The final section, with two chapters, is devoted to partnerships and support pathways. In Chapter 25, Shafika Isaacs analyses the lessons learned from partnerships in educational technology for sustainable development. Eight levels of partnerships, with corresponding features and examples, are discussed, followed by challenges and required competencies. Isaacs provides useful guidelines for forming learning partnerships. In Chapter 26, the editor gives a detailed account of accelerating digital learning for achieving SDGs as evidenced by learning practitioners in the field. Jagannathan emphasizes innovations by youth and fostering a culture of innovative mindsets (evidenced at the time of COVID-19) to further advance partnerships and learning outcomes.

In the last chapter, Jagannathan presents a workable roadmap based on the critical discussions undertaken in the preceding 26 chapters. She notes that "if you have reached this last chapter, then you must be serious about your intent to transform traditional 'brick-and-mortar' learning organizations to digital and blended ecosystems to join the global movement of digitization to stay relevant in the 21st century" (p. 337). The seven indicators or steps on the roadmap to transformation as theory of change are very useful. Her recap of the eight important themes provides the basis for a conclusive discussion: (a) 21st century learning skills, (b) innovative pedagogies, (c) deeper learning models, (d) good practices of digital and blended learning, (e) open resources, (f) smart technologies and tools, (g) data analytics, and (h) partnerships. Analysis of the seven conditions for success should be useful to education and training policy-makers and practitioners at all levels, namely (a) equity and inclusion, (b) multi-stakeholder partnerships, (c) learning providers, (d) curating digital learning assets, (e) evidence-based data and decision-making, (f) frequent communication of change, and (g) futurist thinking. Very useful as well are Jagannathan's critically reflected suggestions for the future.

To conclude, this book represents the latest ideas, research, practices, innovations, and future projections in this multidisciplinary field of digital learning for sustainable development. I was looking forward to a chapter providing a critical review of research in this area as well as suggestions for future research. However, even in the absence of such a review, each chapter covers an important area of digital learning, and the thematic organization of the chapters is sound, logical, orderly, reflective, and readable. I highly recommend this book to policy-makers, specialists in international agencies, leaders, practitioners, researchers, as well as to critics of digital learning for development.

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Volume 23, Number 3

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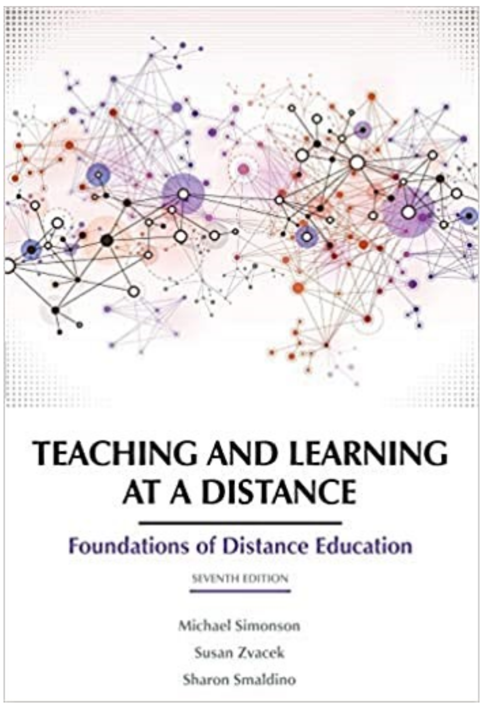
Book Review: Teaching and Learning at a Distance: Foundations of Distance Education (7th ed.)



Authors: Michael Simonson, Susan M. Zvacek, and Sharon Smaldino (Information Age Publishing, 2019, 368 pages)
ISBN: 978-1-64113-626-6

Reviewed by: Mohsen Keshavarz[1a,1b] and Zohrehsadat Mirmoghtadaie[2]

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First published in 1999 and edited and published seven times over the past 23 years, *Teaching and Learning at a Distance* has clearly been popular in the field of distance education. It was written primarily for distance education courses for learners to better understand of key issues and concepts in this area. The text includes 12 chapters divided into three main sections: Foundations (Chapters 1–4), Teaching and Learning at a Distance (Chapters 5–9), and Managing and Evaluating Distance Education (Chapters 10–12).

To review the book, we first use a descriptive approach to describe essential information about the specifications, content, and structure of the book; we then present the goals of each chapter. The key features are described in the conclusion section with an analytical and critical perspective.

The first chapter of *Teaching and Learning at a Distance* explains the concept of distance education and explains its impact on education systems. This chapter presents the historical roots of distance education.

A highlight is the reference to Richard Clark's views and theory in the field of media and education, emphasizing that media are "mere vehicles that deliver instruction but do not influence student achievement" (p.69).

The main purpose of Chapter 2 is to review the definitions, history, and theories of distance education and explain its historical roots since Isaac Pitman.

In the third chapter, the authors present research on distance education. Research on various aspects of distance education is pointed out to be currently based on theory and methodologically appropriate. Its positive effect on the performance of distance education is also discussed.

Chapter 4 refers to the technologies used in distance education. This chapter provides information on a broad range of technologies including audio, video, the Internet, Web 2.0, and massive open online courses.

From Chapter 5 onward, the book focuses more on instructional design and teaching and learning aspects of distance education. The purpose of this chapter is to provide a process for designing instruction at distance environments.

Chapter 6 provides guidance and advice for the instructors teaching at a distance education environment and identifies role and responsibilities of educators in online teaching. The authors argue that teaching methods should be chosen based on characteristics of the instructor, students, the course content, and the transfer system. Also, in designing instruction for a group of online students, the teacher needs to consider and address student issues.

The main focus of Chapter 7 is on distance learners. Its purpose is to describe the distance learner's characteristics and responsibilities. Learners in distance education are of different ages and have different educational backgrounds. Instructors should pay special attention to learners' differences based on their age, general ability, prior knowledge and learning styles.

Chapter 8 presents information about the effective use of learner support in distance education. It explains principles used to design the typical distance education course, covering course logistics, course policies, instructional activities, assessment information, and additional information. The authors provide a model and guide for designing e-books as interactive study guides (ISGs). An ISG can be used in any online classroom and is an essential tool for distance educators, helping them to provide better learning support.

The main topic of Chapter 9 is assessment in distance education. The authors present measurement as an essential tool for measuring student learning and discuss evaluation methods that are suitable for identifying learners' strengths and weaknesses and giving them feedback.

Chapter 10 discusses the implications of laws relevant to the creation, use, and protection of intellectual property for teaching in distance education environments. The key concept of this chapter is intellectual property. This chapter also presents the latest in the open education movement.

Chapter 11 discusses the functions and professional concerns of an administrator of distance education programs, and its main focus is on the concepts of management and leadership in distance education systems. The authors emphasize that the role of distance education manager is very important and plays a pivotal role in the success of an organization's programs.

Finally, Chapter 12 presents approaches for evaluating distance education courses, programs, and systems and focuses on approaches to evaluation for the purpose of improving distance education and determining the worth of distance education activities. The authors argue that e-learning evaluation should provide leaders the evidence they need to support or to refute training decisions. Kirkpatrick's four levels of evaluation and the AEIOU approach to evaluation (accountability, effectiveness, impact, organizational contexts, and unanticipated consequences) are discussed.

A highlight of *Teaching and Learning at a Distance* is that it is appropriate as a recommended text in a distance learning class. It covers a wide range of topics such as instructional design, student characteristics, student assessment, program evaluation, and copyright in the field of distance education. Each chapter includes a summary and self-assessment questions. The book has academic references, which give students a foundation in theory and research in distance education.

The objectives of the chapters as forming a conceptual framework provide regular and structured information to the book's audience. In explaining the concepts, the authors use clear practical examples with new information in the field of distance education, and this feature distinguishes the new edition from previous editions. Structurally, new visual images have been added to this edition, and the sources in each chapter have been updated. A prominent feature of this edition is the use of educational scenarios. Question-and-answer sections address and explain topics. The concept of educational design in online education is especially emphasized.

A salient feature of *Teaching and Learning at a Distance* when compared with similar books in this field is the authors' special attention to the history of distance education up to the present; few books have so beautifully stated the historical trends of distance education. This book attempts to properly explain the relevant theories in the field of e-learning and different perspectives. The principles and guidelines of the book are considered as a kind of instruction. Policy makers in the field of distance education can use them to plan and implement virtual learning environments. The text also highlights the duties and responsibilities of policy makers, educators, and students in the field of distance education.

Teaching and Learning at a Distance gives examples of different types of educational design models and distance learning systems. These models help readers gain a conceptual picture of the topics covered. Credible research and extensive statistics and information in the field of distance education are presented. By viewing this research and the results and statistics, readers can better understand the concepts of distance education and can rethink new research in this field based on previous research.

Finally, a weakness of the book is that it does not focus much on details of new educational technologies. It is mostly based on theory and examples in the field of distance education to provide practical guidelines and instructions in the field of instructional designing in distance education systems.

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Volume 23, Number 3

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Report Review: ICDE OERAC: Open Science, Open Educational Resources, and Open Innovation

Ossiannilsson, E., Martins Gomes de Gusmão, C., Leonor Ulloa-Cazarez, R., & Obiageli Agbu, J.-F. (2022). ICDE OERAC: Open Science, Open Educational Resources, and Open Innovation. *International Council for Open and Distance Education*. ISBN: 978-82-93172-50-5. https://www.icde.org/knowledge-hub/open-innovation-framework-oerac-2022

Reviewed by: Melissa Ashman

Introduction

In the digital age, resources and information are increasingly available in formats other than published books, such as white papers and grey literature. This evolving landscape—particularly in open education where more traditional publication routes are often circumvented—has created opportunities for reviews of emergent resources in alternative formats. Therefore, this review seeks to describe a recently published report by the International Council for Open and Distance Education (ICDE).

Origins of the Report

In October 2021, the ICDE Open Educational Resource Advocacy Committee (ICDE OERAC) brought together 13 participants from different countries to engage in a workshop as part of the ICDE Virtual

Global Conference Week. The purpose of this workshop was to create a framework for open innovation that could be published and disseminated globally to those in higher education, including scholars, researchers, and institutions. The report authors are deeply and broadly experienced scholars, practitioners, and leaders in open education initiatives worldwide, and, interestingly, they applied an open science approach to this project.

Participants in the workshop were presented a small survey, and 11 of them provided responses to a series of open-ended questions. The survey questions were designed to help the authors explore “how open science can support the design, implementation, and validation of formal, non-formal, and informal learning environments in innovative ways (e.g., using the term open innovation)” (Ossiannilsson et al., 2022, p. 11).

The survey results revealed that 6 of the 11 participants had no experience in open science. Nine of the participants worked in formal learning environments. The verbatim responses to the open-ended questions were included in the report, and the authors used these responses to develop a framework for open innovation. Additionally, the authors provided recommendations on next steps to support open innovation that can be taken by educational institutions, research institutions, and governments.

Open Science and Open Innovation

The authors began the report with a concise description of the history of the evolving relationships among open education, OER, open access, and open science. They explained that in 2019, UNESCO unanimously adopted the recommendation on OER in order to support the achievement of several Sustainable Development Goals (SDGs), and that over time, the concept of open education has expanded beyond open access and OER to include open research, open pedagogy, and more (Ossiannilsson et al., 2022). In particular, Ossiannilsson et al. (2022) stated that open science has emerged as an approach to research and development that encourages open access to infrastructure and data, uses collaborative processes at all stages, and advocates for policy with a goal of eliminating barriers. At the time of the workshop, the UNESCO recommendation on open science was under discussion, but it was officially adopted between the conclusion of the workshop in October 2021 and publication of the report in March 2022.

In the discussion section of the report, the authors provided a comprehensive explanation of the importance of having a framework for open innovation to support open science. They defined open innovation as “a management model for innovation that encourages collaboration with people and organizations outside the organization” (Ossiannilsson et al., 2022, p. 15). However, in the words of the authors, using an open innovation approach requires “a true cultural break with the silo mentality of business and the secrecy traditionally associated with corporate R&D culture” (Ossiannilsson et al., 2022, p. 15). Open innovation requires embracing collaborations across and between departments, institutions, organizations, and beyond (Ossiannilsson et al., 2022). Up to this point, how precisely this could be done or what aspects of openness would be required was not clear. Therefore, the framework developed by the authors could help provide some guidance and direction for further discussions.

The Framework

The framework was developed based on the responses the authors received from participants during the workshop. The framework has been built on the features and attributes of open access, OER, and open science (Ossiannilsson et al., 2022). It mentioned open culture, open access, open infrastructure, open software, open frameworks, open education, open practices, open principles, open ideas, and common definitions. Interestingly, the framework also included a component called open X, representing future—currently unknown—initiatives that might have a role in the framework. The history of open education has been one of evolution, growth, and refinement, so pre-emptively making space in the framework to acknowledge and account for future open initiatives was both pragmatic and strategic.

It appears part of the sixth question asked of participants, as listed on page 14, was unintentionally combined with the first participant response. The resulting question wording is "What are the possible barriers to supporting Open Science and a possible framework Lack of skills and opportunities to open up their research and educational artifacts" (Ossiannilsson et al., 2022, p. 14). Upon clarification in correspondence with the editor of the report (Dr. Ossiannilsson), the question should read "What are the possible barriers to supporting Open Science and a possible framework?" The report editor stated this will be corrected in the published report.

This report could be further improved by providing more commentary on the framework itself. The authors do not provide much discussion on the relationships among the components in the framework and how they fit together, though I do acknowledge the framework is intended to be a starting point for conversation. However, some of the design decisions in the visual representation of the framework left me with questions. For example, some of the components had a solid thick border, some had a solid thin border, and others had a dotted border. It was unclear to me why these different components were presented differently and what implications this might have for the use of the framework itself, the relationships among the components, or the importance of each component. However, upon follow-up, the report editor confirmed that the thicknesses of the borders were intended to represent the strength of connections among, and importance of, the framework components.

The authors have provided several thoughtful and detailed recommendations for how, where, and why discussions about open innovation and the framework should go next. These recommendations provide concrete, tangible action items that individuals, institutions, and organizations can begin working towards. These recommendations were organized into two lists; the second list is targeted specifically to colleagues and institutions. It is less clear to whom the first list of recommendations is targeted, but on follow-up, the report editor clarified that the first list provides general recommendations. Overall, the recommendations make clear that there are many avenues and opportunities for further discussions, and several starting points for people and organizations across disciplines and at different levels are available.

In my opinion, the strength of this report is its discussion of the complexities inherent within open innovation and the systemic barriers to it. Another strength of this report is in highlighting the urgency and importance of these issues globally. The emergence of the COVID-19 pandemic necessitated innovations in education, business, research, and more—innovations that could continue to have positive impacts in a post-pandemic world (Ossiannilsson et al., 2022). Therefore, it is important to consider how these developments and innovations could be leveraged and transformed into long-term, sustainable practices. As well, the application of an open science and open innovation approach to discussing issues of and future directions for open science and open innovation was an excellent example of openness in practice. For these reasons, this report would be of broad interest to all who are interested in open education.

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Volume 23, Number 3

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Bridging the Gap: Micro-credentials for Development

UNESCO Chairs Policy Brief Form - Under the III World Higher Education Conference (WHEC 2021) Type: Collective X

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Abstract

This paper describes current trends and issues in implementing micro-credentials. The Covid19 epidemic, combined with the increasing cost of higher education; employer concerns about graduate skills and competencies; increasing inequities in access; and student frustrations about lack of job opportunities have all been a catalyst for universities, colleges, independent credentialing agencies, and leaders of national qualification frameworks to rethink the broader credentials continuum in terms of open education and micro-credentials. Students desire more options at lower costs to combine their education and training for jobs. Employers want entry-level employees with better skills and capacity to learn. As a result, major colleges and universities are now actively engaged in granting and/or recognising micro-credentials. Standardising qualifications based on time competencies is an essential requirement for credit transfer among institutions. Micro-credentials are important in ensuring the acceptance and stackability of credentials from different institutions, while providing employers with a secure and unalterable permanent digital record of applicants' abilities to perform skills of high value in the workplace. The OERu (Open Educational Resources universitas) provides an example of how one international consortium is supporting SDG4: Education for All by implementing micro-credentials allowing for maximum transferability among institutions in different countries. The lesson for strategic leaders is simplicity. Micro-credentials should be well Integrated into current institutional programs, rendered easy-to-use with clear validation metrics, providing a value-added benefit for all stakeholders. A list of recommendations to institutions, governments, UNESCO and Non-Governmental Organizations (NGOs) is provided.

Keywords: OER, Open Educational Resources, policy, micro-credentials

Introduction

In recent years, there is growing interest from governments, higher education institutions (HEIs), international governmental agencies and the corporate sector in the affordances of micro-credentials. In response to the COVID-19 pandemic, these organisations in both the public and private sector are having to confront new economic and workforce imperatives for the future (Carnevale, Fasules, & Campbell, 2020). Moreover, the high cost of higher education, employer concerns about graduate skills and competencies, and student frustrations about lack of job opportunities have all been a catalyst for universities, colleges, independent credentialing agencies, and leaders of national qualification frameworks to rethink the broader credentials continuum in terms of micro-credentials (Bates, 2020; International Council for Open and Distance Education (ICDE), (2019; Matkin, et al., 2020; Oliver, 2019; Selvaratnam & Sankey, 2020). The years of the pandemic have increased already existing inequity in higher education. Micro-credentials are a possible solution to ameliorate these inequities but should not rely on becoming an "outgrowth of the neoliberal learning economy", where education is viewed as a profitable commodity (Ralston, 2020, p. 2).

A recent report from the World Economic Forum (2021) has highlighted the need for an international scalable credit recognition system based on "nano-credentials". These trends have increased the interest of institutions in micro-credentials, which are becoming popular as one means of expanding the ability of learners, especially those in disadvantaged populations, to have their earned skills and competencies formally recognised.

A major function of any HEI is to assess and credentialise learning by conferring qualifications and degrees. As organizations, HEIs are well equipped and experienced to assess the quality of learning for formal academic credit. Digital media are transforming the ways people create, share and learn from educational content available on the world wide web. A significant problem, especially for disadvantaged learners, is that those who access digital learning content on the Web and acquire knowledge and skills either formally or informally cannot readily receive appropriate formal recognition for their efforts.

Approaches and models for institutional or national assessment and accreditation vary considerably around the world (Commonwealth of Learning (COL), 2019). In addition, the unique requirements of student assessment in digital learning contexts must be considered. The rapidly growing availability of online learning content could provide many opportunities for access to Open Educational Resources (OER) and/or informal learning (Committee on Culture and Education, 2014; Palvia, Aeron et al., 2018).

Massive Open Online Courses (MOOCs), which use the open web and social media to offer courses to large student cohorts comprise both for-credit and non-credit learners in the same course, and frequently register hundreds and even thousands of participants. Presently, more than four billion people have reasonable access to the Internet. More than 50%, or two billion people, do so only using mobile devices (Clement, 2020; International Telecommunications Union (ITC), 2021). Many are using their devices for learning (Mbabazi, Ali, Geoffrey & Lawrence, 2018)

Despite the rhetoric about MOOCs serving the developing world, these 'alternative' digital courses are hardly impacting socio-economically disadvantaged communities, and there are increasing disparities amongst those traditionally excluded from higher education (Manda & Dhaou, 2019;

Tchamyou, 2020). Digital tools and ICTs may be expanding the traditional inequities amongst underserved disadvantaged populations in the developing world (Hülsmann, 2016; Ichou, 2018; Lambert, 2020). This is, in fact, a social justice issue that micro-credentials could address by supporting the wider acceptance of non-formal credentials granted for completing online courses. Social justice calls for the equal participation of all in society (Fraser 2005). Micro-credentials have the potential to redress economic maldistribution through cost savings; cultural misrecognition through recognising various forms of knowledge valued in a variety of cultures; and political misrepresentation by allowing students more power in deciding how and when they want to learn.

However, while the provision of MOOCs and other forms of open digital learning on the Internet is expanding, there is a lag in corresponding systems for assessment and credentialisation of this growing international type of non-formal networked learning. Consequently, the alignment of accreditation practice with technology-precipitated changes in higher education course delivery needs to be addressed (Mardis, Ma, Jones et al., 2018).

Even before the COVID-19 emergency, employers were increasing their demands for more highly skilled and qualified workers; and students were demanding more job opportunities, advancements, and mobility in their career paths (ICDE, 2019; Matkin et. al., 2020). For example, in Europe over 40% of all employers have reported they have been unable to hire the skilled workers they need (European MOOC Consortium, 2020; Fong, Janzow & Peck, 2016; O'Grady, 2019). Traditional credentialing institutions are not addressing the needs of these employers or their job applicants. The demand for relevant skills and competencies validation is driving the demand for different forms of accreditation.

As previously mentioned, **micro-credentials** otherwise known as Alternative Digital Credentials (ADCs) have emerged as providing different ways of addressing this demand. Micro-credentials are ADCs that are based on shorter, learning interventions that focus on assessing and validating specific competency-based skills (ICDE, 2019; Selvaratnam & Sankey, 2020; Zanville & Ton-Quinlivan, 2020). At the most basic level, micro-credentials are attestations that verify, validate, and confirmj that specific skills and/or competencies have been achieved. They may or may not be digital. They differ from traditional degrees and certificates in that they are generally offered for accomplishments achieved in shorter or more flexible timespans. Several authors and institutions have developed more concise definitions of micro-credentials (Commonwealth of Learning, 2019; DeakinCo. 2017; Fong, Janzow & Peck, 2016; SUNY Trustees, 2020.)

These different definitions of micro-credentials all note that micro-credentials are generally for shorter courses than traditional ones; these micro-courses can be taken either in a traditional class environment and/or online; and may or may not be certified by an authorized agency, association or HEI. A key requirement for broader adoption of micro-credentials is that learning outcomes should be assessed against transparent standards (European Commission, Directorate-General for Education et al., 2020). Micro-credentials may be stacked towards larger units of competence and are frequently targeted at just-in-time skills and focused competency-areas. They are verified by a trusted authority and are issued more commonly as a digital badge rather than a formal transcript (Commonwealth of Learning, 2019). Micro-credentials come in a variety of forms including, but not limited to digital badges, certificates, micro-masters, and nanodegrees (ICDE, 2019, Kurzweil, 2020).

The concept of micro-credentials is not new. Universities, community colleges, corporations, government agencies and independent providers have been offering variations of micro-credentials for many years, generally for non-credit certificate programs. The differentiator today is that more and more employers are placing a premium on skills and competencies and have a growing interest in the assessment and validation of competency-based skills rather than just attestations of knowledge. There is a new emphasis, not just on what you know, but also on what you can demonstrate you can do with that knowledge at specific levels of competency and skill grades.

Students desire more options at lower costs to combine their education and training for jobs. Employers want entry-level employees with better skills and capacity to learn, which in turn gives a company a competitive advantage in the marketplace. Education and training providers want to expand recruitment avenues to contribute to the modern workforce and remain competitive. In the past, qualifications for employment were generally defined by a combination of education, experience and competencies. However, until recently the weighting of these tended to be disproportionately focused on formal education and experience (Carnevale et al., 2020). Special or unique competencies have been relevant but less important. Today, conversely, the world of work and specialisations has ushered in new and changing demands, where both job applicants and those working must continually learn and master new skills and competencies.

Indeed, this realignment in the world of work results in the increased importance of post degree-certified skills and competencies. This does not necessarily portend the obsolescence or demise of traditional credentials. However, it does mean that employee qualifications will become more relevant and diverse, where this composite mix could become a competitive differentiator for candidates seeking expanded employment mobility and advancement.

The shift to a service-knowledge economy has been a catalyst for employers and other stakeholders to reframe their preferred qualifications mix. In sum, potential employees need up-to-date skills, and the existing employees need continual on-the-job training. Both must show demonstrated competencies and skills that have been vetted, assessed and validated. Similarly, student graduates and candidates need to skill-up to give them optimum competitive advantage in seeking career employment opportunities, mobility and advancement.

Institutional Response

Reputable HEIs are now actively engaged in granting and/or recognising micro-credentials. The adoption of micro-credentials is emergent, with only one in five institutions reporting that micro-credentials are non-existent at their institutions and roughly half of institutions have a micro-credential policy in place. In addition, according to a Holon IQ (2021) survey of 320, higher education leaders, micro-credentials were seen as being integrated within degree programs. Public-private partnerships such as *Coursera, Futurelearn*, *Udacity*, and *edX* are HEI consortia that now grant micro-credentials to learners who successfully complete their courses and/or programmes. In addition, many independent training organisations and certifying agencies have redirected their operations, using micro-credentials to address this rapidly growing market (Australian Government, 2019, 2020; COL, 2019; FutureLearn, 2020; ICDE 2019; Matkin et al., 2020).

Many HEIs work within their government's national qualifications frameworks or try to conform to industry-wide competency-based standards. Australia, New Zealand and Europe are notable examples of having robust qualification frameworks that can, and are being adapted for a burgeoning micro-credential marketplace (Australian Government, 2019, 2020; European Union, 2018; Kato, Galan-Muros, & Weko, 2020); New Zealand Qualifications Authority, 2019).

In the past, many HEIs have addressed informal competency training, particularly through their extension or continuing education offices. However, much of what was being offered by continuing education units were non-credit certifications of attendance or participation (e.g., like some open badges today); attendance at professional conferences or one-day seminars, etc. These learning experiences were not formally assessed, in most cases, for new knowledge learned or for competencies mastered.

Assessment and validation processes are becoming more refined and designed with greater rigour and standards. In addition, there is a trend for micro-credentials to be issued by different providers, whether they are academic institutions, professional/trade organizations or employers. These micro-credentials can be mixed and combined to become part of learners' portfolios attesting to their skills, knowledge and competencies. They may or may not be stackable towards higher qualifications and credentials or integrated into formal certificate and/or degree credit programmes (ICDE, 2019; Kato et al., 2020).

Key Characteristics of Micro-credentials for Academic Credit

Micro-credentials address time as a key factor in supporting accessible education. Time is a traditional variable nearly universally associated with the awarding of academic credit. Time in the classroom, time online, time in the field doing research. Time has traditionally been a key measure of learning effort for formal qualifications. To the benefit of learners, competency-based assessment proponents have challenged this assertion and argued that if the competencies in a targeted skill domain could be validated and assessed to a minimum performance level, then the time factor in acquiring those skills becomes less important. Indeed, whether credit or non-credit, the time factor may be discarded with micro-credentials, particularly when assessments become linked to specific competencies and ultimately to skill levels.

HEIs have historically not focused extensively on establishing polices and processes for non-credit or non-formal educational activities to be converted to academic credit. While some HEIs have robust practices for Recognition of Prior Learning, to recognise learning acquired outside of the classroom for formal credit, the labour intensive process of assessing portfolios is expensive and hard to scale (McGreal, Conrad, Murphy, Witthaus & Mackintosh, 2014). The time requirement for assessing non-formal learning is important. The duration and effort required by the learner must be in keeping with the amount of credit earned. In addition, the level and rigour of academic work (a valid quality issue) and must be commensurate with university credit requirements in order to be accepted and/or stackable (Lakin & Underwood, 2017; Teach Online, 2020).

Affordances of Micro-credentials

As a rationale for implementing and accepting micro-credentials, institutions refer to their importance as a means of upgrading their students' skills and competencies for employability. Micro-credentials should enable an HEI to remain competitive, adaptive and current in the marketplace, because they can provide employers with a secure and unalterable permanent digital record of applicants' abilities to perform skills of high value in the workplace. Students will have control of their micro-credentials and be capable of distributing them digitally, unlike with traditional transcripts that are controlled by the institution (Matkin, et al., 2020). The International Council for Open and Distance Education argues that institutions must use them to respond to technological change and the growing need for continual, rapid skills training (ICDE,2019).

The world economy is digital and online; society is digital and online; so, it is not surprising that students and employers are demanding the ability to validate and document skills and competencies digitally online. The present HEI paper-based transcript systems do not meet this need. Micro-credentials can address this need flexibly in a scalable system, by personalising credentials, providing recognition to employees, and by validating skills as they are acquired (DeakinCo, 2017). Other affordances of micro-credentials include the ability to respond quickly to training needs with faster stakeholder outcomes; lower cost in credential distribution; and the ability of learners to build skills portfolios. (Teachonline, 2020).

For the learner, the most important affordance of micro-credentials is the possibility of having their skills and competencies recognised. Other benefits, include having fast access to learning on demand at lower cost and with more choices, especially regarding skills in demand in the marketplace. For institutions, micro-credentials can be a new source of revenue from new markets, while decreasing costs. This, combined with stronger links with employers and professional bodies can lead to a better understanding of the needs of the marketplace. Employers, relying on micro-credentials can ensure that their hiring practices are more competency-based, and so enable their ability to adjust to new technologies and business processes as they become available. For governments, micro-credentials will empower citizens to quickly adjust to changes in the economy through rapid training and allow citizens to be more mobile through the acceptance of transfer credits among institutions nationally and even internationally.

Barriers to Micro-credentials

There are many potential barriers beyond the usual resistance of institutions to change. A recent international survey of university and industry leaders cite lack of agreed standards, quality assurance and trust as the greatest barriers to micro-credential adoption (Holon IQ, 2021). The lack of senior leadership, who are willing to position micro-credentials in a strategic context, is also seen to be a serious obstacle. This results in few resources (fiscal or human) being allocated. When there is no integration of micro-credentials into the institutional framework, it is seen as an add-on, and the costing is not clear. The lack of incentives for faculty and staff has also been noted (Cirlan & Loukkola, 2020; COL, 2019; ICDE, 2019; Kato et al., 2020; Matkin et al., 2020; & Pickard, 2018).

Another major barrier related to awarding academic credit concerns micro-credential validation and acceptance for transfer credits among institutions both within a country and internationally. Many HEIs even lack the authority to accept transfer credit at the institutional level, as the oversight and authority reside with each academic unit and its faculty members. Faculty can often refuse transfer credits to their programmes even from other departments within the same institution. This can be a significant impediment to micro-credential acceptance in institutions (McGreal & Olcott Jr., 2021)

Case Study: A Working Model for Transnational Micro-credentialing

This case study summarises the implementation of a transnational micro-credentialing system developed by the OER universitas (OERu). OERu is an international network of over 40 partner institutions across five continents, including 17 in developing countries, who collaborate to assemble freely accessible, high quality, accredited online courses from OER. Learners study for free and can request assessment-only services for micro-credit with pathways to formal academic credit towards university qualifications.

Drawing on five scenarios for reusing open courses, combined with alternate mechanisms for assessment, credit transfer, and credentialing (Conrad, Mackintosh, McGreal, Murphy & Witthaus, 2013), the OERu partner network opted to develop an international system for course credit articulation based on the Transnational Qualifications Framework for the Virtual University for Small States of the Commonwealth (Commonwealth of Learning, 2015). The framework defines standard levels of learning and corresponding learning effort for post-secondary qualifications to facilitate articulation within provincial and national accreditation and qualification systems.

The OERu partners first proposed developing micro-courses at their 2013 International Meeting (OER Foundation, 2013). Their aim was to develop an international system for credit transfer, accommodating small course components to facilitate network reuse of micro-courses, while still accommodating traditional university credit structures, with open pathways to formal qualifications.

This micro-credential system is based on the concept of notional learning hours, referring to the length of time a student would typically take to achieve a stated learning outcome. This could include contact time with an instructor, time spent studying, completing assignments or specified tasks, and time spent in assessment. Ten notional hours equal one credit.

The OERu standardised on 40 notional learning hours for each micro-course, to ensure sufficient learning for meaningful assessment, and to accommodate international differences in the size of degree courses. Consequently, three OERu micro-courses is equivalent to a standard three-credit course in North America, while four micro-courses is equivalent to a standard undergraduate course in Australia and New Zealand, and five micro-courses equates to a module of 200 notional learning hours in the United Kingdom.

This framework approach has facilitated reuse of OERu micro-courses at different institutions and enabled a system of transnational micro-credit transfer that is recognised by credentialing authorities. For example, the OERu's Learning in a Digital Age (LiDA103) series of micro-courses was recognised for assessment through Otago Polytechnic's micro-credentialing system, and the four combined micro-courses were approved for credit transfer at first-year undergraduate level towards qualifications at OERu partner universities in New Zealand, the USA, Canada, and the United Kingdom. The four LiDA micro-courses were submitted to the New Zealand Qualifications Authority, which evaluated them and assessed them to be equivalent to 16 credits (160 notional learning hours) at Level 5 on the New Zealand Qualifications Framework.

Western Pacific University in Papua-New Guinea, an OERu partner institution, has introduced LiDA as a required foundation course for all its students. Learners gain access to the micro-courses directly from the OERu site and will be assessed by the University. In another example, North-West University in South Africa remixed sections from the OERu's Introduction to Entrepreneurship series of micro-courses to offer a customised micro-course for inclusion in their Introduction to Business Management (BMAN111) course. Students were required to work through this micro-course hosted by OERu and complete a series of quizzes which contributed towards their continuous assessment mark for the course (TELIT-SA, 2021).

As an open education initiative, the OERu does not require learners to register an account to gain access to learning materials. During 2020, 208,234 learners, primarily from developing countries engaged with OERu micro-course materials. Of these, 14,492 (7.2%) opted to register on the respective micro-course sites to receive automated course instructions via email. Completion rates are defined as registered learners who complete all the learning pathways within a micro-course and range from 10% through to over 90% in cases where course completion was a requirement for formal academic credit, as in the North-West University example cited above (OER Foundation, 2021; TELIT-SA, 2021)

The OERu administers an optional New Participant Survey (n=2,255) which provides some insight into motivations of learners who register for micro-courses. Half of the learners are female, and one-third of OERu learners are unemployed. Intended levels of participation are typically low with 12% reporting that active participation is unlikely and 32% indicating that activity will be limited to a few contributions before commencing the courses. Four out of five OERu learners are post-secondary graduates. One in five learners are taking OERu courses as a formal study requirement at their respective institutions, with 44% and 20% reporting that they are taking OERu courses for professional or personal development respectively. Of particular interest is that 39% of respondents confirm that they are taking OERu micro-courses to gain formal academic credit towards a recognised qualification. The data indicates growing interest in micro-credentials with 46% of registered learners reporting that they intend to pursue an OERu micro-credential with an additional 33% responding that they are considering a micro-credential as a possibility.

In conclusion, free micro-courses that are open and online, enable professional development and opportunities for learners to study topics of interest, while providing peer-learning support for those studying for formal credit. The micro-course format facilitates reuse in different institutional contexts. Given the growing interest of learners in gaining micro-credentials, the OERu case study demonstrates a functioning model for transnational transfer of micro-course credit towards formal qualifications.

Summary

This paper describes current trends and issues in implementing micro-credentials. The portrait is complex and encapsulates many concurrent activities that are often difficult to map and monitor. The range of work on micro-credentials across the globe is impressive, the ideals are high and the potential impacts towards workforce and economic development are exciting. Employers and students are still confused and unfamiliar with the range of options that are evolving with micro-credentials. There is today more awareness as the growing demand for shorter focused credentials leading to employment continues. This in turn can empower both employers and learners and augment their competitive capacity. There are multiple players ranging from governments, qualification agencies, and HEIs to accrediting associations, independent training providers, and global consortia grappling with policy, marketing, and planning about micro-credentials. The lesson for educational leaders is simplicity. Integrate with current institutional programs, make micro-credentials easy to use with clear validation metrics, and make online-open-micro-credentials a value-added benefit for all stakeholders.

Institutional Recommendations

Effective implementation of micro-credentials requires that institutions: build trust in the quality of the credential for learners and employers, ensure that implementation adds value to existing practice and achieves sustainable resourcing (Oliver, 2019). Institutions embarking on micro-credentials should:

1. Adopt a pilot implementation approach to evaluate, refine and scale a sustainable solution, adopting existing open online courses published as OER to lower risk, minimise cost but maximise impact.

2. Develop and maintain supportive policies clarifying standards for credit-bearing micro-credentials aligned with qualifications integrated within existing degree structures.

3. Provide opportunities for augmenting course delivery, while ensuring quality, to serve new and emerging markets to address the changing needs of learners and employers.

4. Provide adequate resourcing for sustainability through new revenue or existing resource allocation, thus mainstreaming implementation within the institution.

5. Implement and stay the course! Most change initiatives fail because the leaders and team members lack the patience to go the distance.

Recommendations for Governments

The evolving nature of work combined with the challenges for higher and vocational education in a post-COVID world requires more flexible options for certifying learning, incorporating micro-credentials. However, a systems-wide approach is needed to align and integrate credit bearing micro-credentials within national qualification systems to facilitate interoperable certification systems combined with a digital system for registering and keeping record of learning achievement for assessed learning.

1. Regional accreditation agencies and/or national qualification authorities should integrate micro-credentials within their respective certification systems incorporating

levels of learning and metrics for expressing the value of learning achievement; for example, notional learning hours, in consultation with international counterparts to promote transnational interoperability of micro-credentials within qualification frameworks. This will build trust and facilitate agreed standards and quality assurance for learners and prospective employers.

2. Review national funding models to ensure that the financing of post-secondary systems does not discriminate against micro-credentials for public funding.

3. Develop national digital systems that can be self-managed by learners to record credit earned for assessed learning inclusive of micro-credentials in support of a lifelong learning record. Technologies like the Blockchain may support such systems for reliable recording of information.

Recommendation for UNESCO and NGOs

1. Work with the micro-credential community to create policy guidelines for governments, HEIs and other stakeholders promoting learner mobility using micro-credentials.

2. Develop an international database of micro-credentials initiatives and monitor the acceptance and use of micro-credentials in different regions.

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