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# Editorial – Volume 25, Issue 4

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To close out 2024, this issue of IRRODL offers eight research articles, a book note, two literature reviews, and a leadership note in open and distance learning, all of which contribute to the ongoing changes within this field of education. The IRRODL editors wish to thank our readers, reviewers, and authors for their continued support of the journal and wish that 2025 may provide further opportunities for learning from and with each other in the areas of open and distributed learning.

"Strengthening policies for education, innovation, and digitization through teacher training: Evaluating ProFuturo's open model in Ecuador" by the researchers **Hernández-Sellés** and **Massigoge-Galbis** provide findings from a 2020-2022 study. Through a collaboration between the Ecuadorian Ministry of Education and the ProFuturo program over 7200 primary and secondary school teachers received training to strengthen digital competency among teachers and their pupils. The research also explored the strengthening of mass ICT training for teachers within Ecuador.

**Bardakci** sought to understand quality assurance in open and distance education through an examination of published papers. "Unveiling scholarly insights: Quality assurance in open and distance education" provides the results of this recent study. The findings indicate that the scholarship continues to expand with instructional design implications for the micro and macro levels of open and distance education learning.

"Socio-demographical variables as predictors of academic self-directedness" has results from a South Africa study. **Botha** and **Potgieter** applied the Adult Learner Self-Directedness Scale to explore the influences of high school grades, English language proficiency, library access, number of courses taken, and financial commitments as part of the complexities of student success, especially for women, Black Africans, and younger students.

**Rohmani**, **Zulkarnaen**, and **Winar Cahyo** researched a web application for nursing students and their online learning of nursing documentation. This study occurred in Indonesia with the results from beta testing shared in "Web-based nursing care documentation for students to support online learning."

**He, Ding, Liu, Wu, Liu, Guo,** and **Wang** report their results in "Teaching reform and practice based on four dimensions and one penetration for sensing and detection technology." This blended learning research involved industry-university collaboration to bring sensing and detection technology to Chinese engineering students learning online. Through this pedagogical innovation, the researchers addressed the disconnect between conventional sensor teaching and practical application during the COVID-19 pandemic.

"Navigating challenges in remote speaking tasks: Unveiling technical and non-technical problems faced by students" was a study completed in Indonesia. **Tauchid**, **Barata**, **Wafa**, and **Wijayanti** found that both

technical and non-technical considerations are required to support students learning English through speaking tasks.

The Community of Inquiry, student engagement, and transactional distance form the basis of **Gökoğlu**, **Karaoğlan Yılmaz**, and **Yılmaz**'s Turkish research. Through regression analysis this quantitative study analyzed results indicate that instructional interventions related to transactional distance and the Community of Inquiry have a greater effect on students' behavioral and emotional engagement than on cognitive engagement.

**Castellanos-Reyes, Camargo Salamanca**, and **Wiley** contribute to open education research with their article, "The impact of OER's continuous improvement cycles on students' performance: A longitudinal analysis of the RISE framework." Through the application of learning analytics and the RISE framework, the researchers found that continuous improvement cycles of targeted OER substantially contributed to student achievement. The authors suggest the importance of user-friendly learning analytics as part of instructional design and continuous improvement cycles for OER.

A book review by **Mandal** offers insight into the edited volume, *Academic Quality and Integrity in the New Higher Education Digital Environment: A Global Perspective.* With the implications of GenAI still unfolding, this book comes at an important time and offers insights for academics, education administrators, and those involved with higher education policy development.

This issue offers two literature reviews. The first, authored by **Akkan** and **Eminoglu Kucuktepe** provide their results of a systematic review that compares distance education practices during the COVID-19 lockdown in four OECD countries. As each country varied in their distance education maturity the response to this pandemic varied with the comparison results given in "Distance education practices during the COVID-19 lockdown: Comparison of Belgium, Japan, Spain, and Türkiye." The second literature review comes from **Chiappe, Díaz,** and **Ramirez-Montoya.** Their literature analysis showed the conditions needed for successful OER development and implementation, the importance of open attributes for digital literacy skill development and the positive orientation of students toward open educational materials and practices. Read the full results in "Fostering 4.0 digital literacy skills through attributes of openness: A review."

The final contribution to this issue is from **Flinn** and **Openo** with their paper "Are we asking too much of OER? A conversation on OER from OE Global 2023." As part of IRRODL's Notes From Leadership in Open and Distance Learning section, these two authors offer their insights and the social intelligence garnered as part of a facilitated conference presentation with respect to OER as disruptor in contrast to achieving OER goals.





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# Strengthening Policies for Education, Innovation, and Digitization Through Teacher Training: Evaluating ProFuturo's Open Model in Ecuador

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# Abstract

Teacher training and a commitment to innovation in teaching are determining factors in the success of technology adoption processes. This article presents a study on the opportunities produced through the collaboration of the Ecuadorian Ministry of Education and the ProFuturo program, which arose during the COVID-19 pandemic. This collaboration resulted in the improvement of digital competency among teachers and pupils and in transference to educational practise. It also strengthened the existing limited capabilities for developing mass training programs for teachers in the country. The research was conducted through an online survey, with a cross-sectional, quantitative, and non-experimental focus from two data sources. A total of 3,565 teachers answered the digital survey for teachers trained using the Open Model in Ecuador between 2020 and 2022. On the other hand, 7,257 teachers answered the ProFuturo Digital Skills Self-Assessment of of Teachers (https://competencyassessment.profuturo.education/?lang=en). The results show an improvement in the competency of teachers following their participation in the program and confirm that they considered digital transformation in the classroom to be of great utility. Teacher training remains a cornerstone of high-quality education and research as this contribution proves a positive impact on learning experiences, where there was a significant transference, driven by an improvement in digital skills applied to the teaching process.

*Keywords*: digital competence, education policies, institutional strengthening, teaching innovation, teaching role

# Introduction

Globally, educational institutions undertake continuous commitment to training and supporting their teaching staff, in a context conditioned by digital adoption in all spheres of activity, both work-related and personal. This shift entails continuous innovation in all processes connected to teaching and learning. Among other changes, adoption of technology in educational institutions has resulted in profound transformation, not only for managing educational projects, planning, implementation, and assessment, but also for instruction, thereby facilitating the acquisition of skills assigned to the different stages of the curriculum, as well as those needed in a social context determined precisely by digital transformation (Falode, 2019; Falode & Mohammed, 2023; Sangrà et al., 2023).

Thus, teacher training is one of the determining factors for technology adoption processes that meet the needs of learners and the society of a region as a whole. In fact, a large part of the scientific literature has focused specifically on identifying a framework that would facilitate training designs that encourage staff innovation and modernization. In this respect, studies, including those by Martin et al. (2021) and Muñoz-Carril et al. (2013), have emphasized the variety of roles a teacher must perform in technology-mediated education, given that, in addition to acting as an expert in their field, they must also carry out roles such as these:

- **technologist**: expert in the technological environments and digital media involved in the teaching process
- **researcher**: commits to continuing education over the course of their lives, understands trends that develop in response to societal challenges, and frequently bridges generation gaps
- **manager/administrator**: organizes all media and resources, groups students together, and plans or structures processes
- **mentor/facilitator**: attends to students' personal and social-emotional needs, in addition to those of a purely academic nature
- **instructional designer**: chooses the methods, techniques, and activities best suited to the specific needs of students and aligns them with learning objectives
- **assessor**: coordinates the processes of continuous, formative, and summative assessment of students, in addition to evaluating the process to improve its quality

Based on this analysis, training teachers to manage the integration of technology in educational contexts involves careful planning in order to provide training in areas as diverse as management, research, methodology, individualized attention, and technology (Maile Cutri & Mena, 2020). This complexity is reflected in benchmark initiatives, such as one by UNESCO which recognizes that training and evaluating teachers is a cornerstone of high-quality education and a means of achieving the educational objectives of the 2030 Agenda (UNESCO, 2020). The EDUCAUSE Horizon 2020, 2021, and 2022 reports, which predict trends and priorities for educational contexts, emphasized the need to provide high quality online education, hybrid teaching models, and teacher training to enable interventions in both modalities (Brown et al., 2020; Pelletier et al., 2021; Pelletier et al., 2022).

Furthermore, in order to provide a reference framework to channel and reinforce national, regional, and local efforts to develop the digital competence of educators, the European Commission, in line with other areas of competence, have designed the European Framework for the Digital Competence of Educators, thereby promoting innovation in education (Redecker, 2017). In the same vein, UNESCO's 2023 Global Education Monitoring Report on technology in education analyzes the suitability, scalability, and sustainability of the use of technology in education throughout the world.

All digital training initiatives run since the start of the 21st century became even more meaningful in the face of the regrettable global crisis caused by the COVID-19 pandemic, which affected 1.6 billion students in more than 190 countries. The pandemic gave rise to a global, forced, and accelerated redesign of the 20th-century school structure, in addition to the digitization of education. The challenges varied by country, depending primarily on their degree of digitalization. For example, the Zoomification of teaching (Tullett et al., 2022) in more developed countries was able to support 80%–85% of students, compared to coverage of less than 50% experienced in countries with fewer resources, according to data from UNESCO. This was due to the lack of computers or Internet in homes and schools, which sadly demonstrates the social injustice caused by a digital divide that has not been globally addressed (Dreesen et al., 2020; García Aretio, 2021).

In the context of the pandemic, it became clear that there was a pressing need to train teaching staff; while in many cases, platforms and digital media managed to provide an emergency solution to continue schooling, in each and every context, the urgent need to train teachers became evident, both in order to fulfill the technologist role mentioned previously and to develop the variety of teaching roles needed in virtual environments (Martin et al., 2021; Prieto et al., 2018).

In this sense, as a consequence of the pandemic, some countries were forced to accelerate the digitization of educational processes, adopting training in a virtual mode in order to continue the schooling of their students and adding a range of technologies, such as digital OER content, instant messaging, and video conferencing tools, in the service of educational processes, while they simultaneously attempted, with varying levels of success, to address the increasing issues arising from the educator remaining the articulator of these experiences (Scarlat et al., 2022). On the other hand, in many contexts, the conditions for connectivity, technological equipment, planning, or necessary teacher training programs (García Aretio, 2021) were non-existent. Some countries adopted accelerated digitization programs, betting on high investments in technology adoption without taking into account the lessons learned and widely published in studies, which have concluded that in order to ensure learning, it is necessary to employ educational strategies that incorporate training plans which interrelate the relevant curriculum framework, pedagogical lines, and the technology available (González-Sanmamed et al., 2020; Hernández-Sellés, et al. 2019; Hodges et al., 2020). In this respect, it is important to note that these digital acceleration processes have not been limited to emergency contexts; there have also been policies to adopt these decisions without previous experience or studies which, as we have noted, can now serve as guides to successful processes. Therefore, in spite of the abundance of literature and previous experience in different contexts, when there are ongoing educational digital processes on a macro national level, there are still evident challenges in adopting policies that promote quality of education.

In the case of Ecuador, the emergency forced practically all educational activities to cease, as these were predominantly in-person and the country did not have the required infrastructure to continue in virtual formats. In August 2020, Ecuador subscribed to the Inter-institutional Cooperation Framework

Agreement between the Ministry of Education and Fundación Telefónica Ecuador for three years, to establish a cooperation framework for implementing projects and processes focused on strengthening the digital skills and abilities of the educational community. As part of this framework agreement, the ProFuturo program ran seven online training sessions, provided 198 courses, and certified 200,000 teachers who completed training between 2020 and 2022.

ProFuturo is a digital education program promoted by Fundación Telefónica and the Fundación "la Caixa" in line with objective 4 of the 2030 Agenda for the United Nations Sustainable Development Goals (SDG4): quality education. It focuses on reducing the education gap and promoting high quality education. With a presence in 45 countries in Latin America, the Caribbean, Africa, and Asia, the program has trained over 1.4 million teachers and benefited 28 million children in these four regions.

At the same time, Fundación Telefónica Ecuador has developed initiatives through the ProFuturo program that serve as a basis for building a global learning community in Ecuador. The three most pertinent are: (a) the digital environment run through a private Facebook group named Comunidad de aprendizaje—Docentes ProFuturo [Learning Community—ProFuturo Teachers] which had over 19,000 members in 2023, with an average of 13 publications and a reach of over 6,000 teachers each week, and an average of 3,000 interactions each year; aimed at improving interaction among teachers and sharing learning guides and micro-content about the use of technology and digital education (the source and data are public in Facebook; analysis were provided to authors by Fundación Telefónica Ecuador); (b) the Festival de Ideas Educativas "Ideas de 10" [Festival of Educational Ideas] which has taken place on three occasions; and (c) the teaching community built around the Project Based Learning pilot training project developed in 2022.

ProFuturo works to improve the conditions of educational systems in vulnerable areas. To this end, they have created three models of intervention:

- **comprehensive model**: based on teacher development (training and support), a digital solution (that includes technological equipment and a Learning Management System that works online and offline); high quality digital educational resources; and a monitoring and evaluation system
- **refugee model**: complements the previous model, by including psychosocial support, safe spaces for learning, and food aid and/or health care
- **massive open model**: provides virtual or in-person training for teachers.

The massive open model focuses on innovative educational training for teachers, based on leadership, communication, and planning in the classroom. It provides online courses in innovation and Information and Communication Technology (ICT), pedagogical and teaching skills, and digital competence. The model is accessible to all countries and offered to teachers through the use of free educational resources.

In this study, we analyzed the collaboration between the public education system in Ecuador and the ProFuturo program during the years of the pandemic, starting from August 2020 and continuing over the course of three years, from two perspectives: first, as a model for collaborative interventions during emergencies, and second, as a means of demonstrating the impact of this type of collaboration on teacher training, improving digital competence, and transference to educational practice.

# Methodology

# Objectives

We analyzed ProFuturo's intervention in Ecuador during the pandemic years, starting in August 2020 and spanning three years. Our analysis focused on the perception of the teaching staff who participated in ProFuturo's open model, with particular attention to:

- the utility of the digital training provided by ProFuturo's open model for improving teacher learning
- the improvement in competence associated with the training received
- transference of the training to the classroom environment, resulting in innovative methodological practise.

# **Study Design**

We designed an ex post facto study based on an online survey method, with a cross-sectional, quantitative, and non-experimental focus (Hai-Jew, 2020). A non-probabilistic, accidental, or convenience sampling technique was used (McMillan & Schumacher, 2006) to count the informants according to their availability or accessibility. Further on, descriptive analyses were carried out. We present partial results of the data obtained from two sources:

- The digital survey for teachers trained using the open model in Ecuador between 2020 and 2022 and, in particular, the questions related to the teacher training offered and its level of transference. In respect to instrument design, the questionnaire was reviewed by seven specialist judges in digital education and teacher training processes and three research methodology specialists. A pilot study with teachers from several different countries was also carried out.
- The test Autoevaluación de Competencias Digitales para Profesoras y Profesores [Self-Assessment of Digital Skills of Teachers], which was self-assessed by teachers in the country, enabled ex-post measurement of the impact of the ProFuturo training on the level of teacher competence, comparing teachers who had previously received ProFuturo training with those who had not. It was based on the teacher self-assessment survey designed by the Centro de Inovação para a Educação Brasileira (CIEB) [Brazilian Centre for Educational Innovation] which is used in the region, particularly in Brazil, as a reliable tool for measuring competence. This is a free online tool with two main objectives: (a) to encourage teachers to reflect on their own knowledge and the use of digital technology; and (b) to provide information for education networks, regarding the aggregate profile of digital competence among teachers, in order to develop more effective teacher training. It includes 23 questions which evaluate 12 skills, distributed across three areas.

The instruments measured:

• the level of utility perceived by teachers in improving learning for their students and the frequency of modification of educational activities after participating in the courses, all arranged by hours of training, gender, age, educational stage, and school funding,

- the level of transference to educational practise,
- the level of improvement in competency associated with the training received, and
- the percentage of improvement by number of training hours, according to the following variables: gender, age, studies undertaken, and specialty.

# **Description of the Intervention Context**

Fundación Telefónica has been working in Ecuador since 2008 to promote and develop educational competence through responsible use of ICT in educational processes, including both teachers and the student body. Through the ProFuturo program, it has worked in 24 provinces and 1,133 schools in the country, training more than 85,000 teachers and benefiting more than two million children since 2017. In April 2020, training courses were launched through the Fundación Telefónica website and the educational resource and planning portal on the Ministry of Education website. The courses were designed to develop digital skills, educational methodologies, educational strategies, gamification, mathematics, leadership, and digital citizenship, with lengths ranging from 5 to 40 hours each. Table 1 includes a summary of examination sessions, courses, hours of training, registrants, passing grades and certified teachers, to portray the training scope. In that year, 30% of the courses related to pedagogy and pedagogical methodologies, 26% to digital skills for teachers, and 13% to digital citizenship.

## Table 1

Examination	Duration	Courses	Hours of	Registrants	Passing g	grades	Teachers
session		п	training	n -		0/	certified
			ก		n	%	n
2020_1st	March-September	23	537	146,376	129,764	88.65	129,754
2021_1st	Dec 2020–May 2021	38	813	391,464	207,863	52.08	59,733
2021_2nd	May–July	7	233	23,567	11,594	49.20	8,164
2021_3rd	July-December	47	861	339,005	106,876	31.53	15,107
2021_5th	October-December	40	993	21,800	12,927	59.30	777
2022_1st	April–December	32	651	197,275	45,084	22.85	4,519
2022_2nd	September– December	11	212	121,724	49,307	40.05	8,081
Total		198	4,300	1,241,211	563,415		218,054

Summary of Examination Sessions 2020–2022

*Note*. This information has been provided by Fundación Telefónica Ecuador. The Ministry of Ecuador offered certificates only if a certain hour of study and full itineraries were fulfilled, that is what explains the discrepancy between the number of teachers who received a passing grade and the number of certifications.

In 2021, ProFuturo launched four sessions that were published in the Fundación Telefónica website and its social networks, as well as in the MeCapacito section of the Ministry of Education website. This resulted in a total of 776,230 registrations with a pass rate of 43.74%. A total of 133 courses were developed, divided across 13 skills, 21 itineraries, and six levels. The courses were built around the areas of (a) digital competence for teachers, where 33.29% of the students completed the courses, (b)

pedagogy and pedagogical methodologies, where 18.28% of teachers completed the training, and (c) digital citizenship, where 14.36% of teachers received training that year.

For 2022, the program was designed to align with the digital education agenda, defining the training as a means of strengthening digital competence among teachers.

A total of 43 courses was provided, distributed across four areas, three skills, four itineraries, and six levels. Courses related to digital competence for teachers continued to be the most frequently offered (37.21%) and the most in-demand (45% of registrants). However, courses related to social-emotional and communication skills had the highest passing grade rate per registrant (with 37.25% and 32.52% respectively).

During 2020, training was divided into the areas of competence shown in Table 2.

# Table 2

Teaching competence	Courses n	Proportio n of all courses %	Registrants n	Passing grades n	Passing grade per session %	Passing grade per registrant %
Pedagogy	7	30.43	42,732	38,134	29.39	89.24
Digital skills for teachers	6	26.09	57,353	50,749	39.11	88.49
Digital citizenship	3	13.04	8,147	7,652	5.90	93.92
Communication skills	2	8.70	13,084	11,146	8.59	85.19
Direction and management skills	2	8.70	7,384	6,306	4.86	85.40
Collaboration skills	1	4.35	5,210	4,428	3.41	84.99
Mathematical competence	1	4.35	6,534	5,727	4.41	87.65
Social-emotional skills	1	4.35	5,932	5,622	4.33	94.77
Total	23	100.00	146,376	129,764	100.00	

ProFuturo Open Model Courses by Area of Competence, 2020

Note. Based on data from ProFuturo.

Some of this content was offered over 3 consecutive years. See Table 3.

# Table 3

ProFuturo Open Model Courses That Ran Consecutively 2020–2022

Course name and code	ourse name and code Examination session <i>n</i>			IS
	2020	2021	2022	Total
Project-Based Learning	1	4	2	7
Action Against Cyberbullying	1	3	2	6
Cooperative Learning	1	3	2	6

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Digital Skills for Teachers I D	1	3	2	6
Digital Skills for Teachers II	1	3	2	6
Digital Skills for Teachers III	1	3	2	6
Affective Communication in the Classroom	1	4	1	6
Skills for a Life of Peace	1	3	2	6
Learning Difficulties	1	3	2	6
School Bullying: Prevention, Detection, and Action	1	2	1	4
Dyslexia in the Classroom	1	2	1	4

Education in Ecuador is regulated by four types of models according to the type of funding: public (managed by public administration), fiscomisional (which receives funding from both public and private sources), municipal (public management with part of the education specific to the municipality that governs it), and private. The distribution of students, during the research, by type of establishment is shown in Table 4.

# Table 4

Distribution of Students in Ecuador by Funding and Establishment Type 2019–2022

Type of funding	Students							
-	2019-2	2020	2020-	-2021	2021-2022			
-	n	%	n	%	n	%		
Public	3,219,939	73.06	3,297,505	76.42	3,324,405	77.15		
Fiscomisional	286,382	6.50	269,742	6.25	259,054	6.01		
Municipal	35,191	0.80	34,173	0.79	33,652	0.78		
Private	865,518	19.64	713,357	16.53	692,028	16.06		
Total	4,407,030	100.00	4,314,777	100.00	4,309,139	100.00		

Note. Based on data from ProFuturo.

The school age population in 2021–2022 was more than 4,300,000. The majority of students received a public education (approximately 77%), followed by private (16%), fiscomisional (6%), and municipal (less than 1%).

During the study period, approximately 70% of the educational institutions in the country were public or state schools, followed by 20% which were private schools. Fiscomisional schools (equivalent to state-subsidized) represented 4% of all institutions, and only 0.7% of schools were municipally-funded. See Table 5.

# Table 5

Type of funding	Educational institutions						
	2019-	-2020	2020-	-2021	2021-2022		
	п	%	п	%	п	%	
Public	12,385	75.41	12,383	76.40	12,367	76.84	
Fiscomisional	669	4.07	652	4.02	645	4.01	
Municipal	113	0.69	109	0.67	108	0.67	
Private	3,256	19.83	3,065	18.91	2,975	18.48	
Total	16,423	100.00	16,209	100.00	16,095	100.00	

Distribution of Educational Institutions in Ecuador by Type of Financing 2019–2022

Note. Based on data from ProFuturo.

Reflecting this distribution, the majority of teachers during the study period received public funding (more than 70%), followed by private funding (more than 20%), with the remaining number divided between fiscomisional (6%) and municipal (less than 1%). See Table 6.

# Table 6

Distribution of Teachers in Ecuador by Institution Type 2019–2022

Type of funding	Teachers							
-	2019-	·2020	2020-2021		2021-2022			
-	п	%	п	%	п	%		
Public	152,149	69.16	148,156	71.62	144,625	71.04		
Fiscomisional	14,009	6.37	13,365	6.46	13,074	6.42		
Municipal	1,812	0.82	1,803	0.87	1,816	0.89		
Private	52,025	23.65	43,551	21.05	44,080	21.65		
Total	219,995	100.00	206,875	100.00	203,595	100.00		

Note. Based on data from ProFuturo.

# **Learning Communities**

# Participants and Procedure

From the digital survey for teachers trained using the open model in Ecuador between 2020 and 2022, we obtained 3,565 responses, which constitutes 4.42% of teachers who completed at least one course. In terms of statistical representation, this resulted in a sampling error of  $\pm$  1.6%, a confidence level of 95%, and a worst-case scenario for sampling variability of: p = q = 0.5 (Hai-Jew, 2020).

The sample was analyzed according to several characteristics: number of training hours completed, gender, age, educational stage, and school funding. See tables 7, 8, and 9.

# Gender

As regards ProFuturo's Self-Assessment of Digital Skills of Teachers, we analyzed the results of 7,257 teachers who used the self-assessment tool, of which 3,162 had completed at least one ProFuturo course before completing the test.

# Results

First, we present the results obtained from the digital survey of teachers who were trained as part of the open model in Ecuador between 2020 and 2022. Disaggregated data are presented in tables 7, 8, and 9, which demonstrate the respondents' views on (a) the usefulness of technological resources in improving learning for their students, (b) how often they made changes to educational activities after participating in the courses, and (c) the frequency and type of transference of their new skills to their educational practices.

# Table 7

Level of Utility Perceived by Teachers in Improving Student Learning by Hours of Training, Gender, Age, Educational Stage, and School Funding

Demograp	ohic characteristic	Usefulness of technology for improving student learning					
		Very useful	Quite useful	Not very	Not at all		
		%	%	useful	useful		
				%	%		
Hours of	< 50	73.03	25.84	1.12	0.00		
completed	50-100	67.71	31.25	1.04	0.00		
	100-150	72.33	27.04	0.63	0.00		
	150-250	70.43	28.40	0.78	0.39		
	> 250	71.53	27.01	0.73	0.73		
Gender	Male	74.10	25.00	0.20	0.70		
	Female	69.30	29.40	1.20	0.10		
Age	< 30	78.26	19.54	2.20	0.00		
	30-39	72.85	26.32	0.60	0.23		
	40-49	69.77	28.97	0.50	0.76		
	> 50	69.70	29.00	1.30	0.00		
Educational	Early education	74.65	23.90	1.40	0.05		
stage	EGB (Grade 1–6)	72.30	26.40	1.30	0.00		
	EGB (Grade 7–10)	71.04	28.20	0.40	0.36		
	High school	69.79	29.40	0.40	0.41		
	Higher education	69.62	26.60	2.50	1.28		
Funding	Public	69.70	29.10	0.80	0.40		
	Fiscomisional	74.80	24.30	0.90	0.00		

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	Private	84.40	13.33	2.20	0.07
	Municipal	80.00	20.00	0.00	0.00
Average		71.00	27.80	0.80	0.30

Upon analyzing the teachers' perceived utility of both technology and digital resources in the classroom for improving student learning, no significant differences were observed between hours of training, gender, age, and educational stage. However, there was a favourable difference between private schools, with 84.4% of teachers awarding the highest value compared to teachers from public schools, who did this to a lesser extent, with 69.7%.

In the overall assessment, we found that "very useful" and "quite useful" were the two most frequent responses, adding up to 98.8% of the assessments, and 71% of teachers considered the use of technology and resources to be "very useful," representing a significant proportion of the teachers surveyed.

# Table 8

Frequency of Modification of Educational Activities After Participating in the Courses by Number of Training Hours, Gender, Age, Educational Stage, and School Funding

Demographic characteristic		Frequency of modification in educational activities						
		Very often %	Somewhat often %	Not very often %	Never %			
Hours of	< 50	20.5	53.0	23.8	2.74			
training completed	50-100	30.8	47.2	21.5	0.48			
	100–150	22.0	57.3	20.1	0.56			
	150-250	17.9	56.3	24.0	1.87			
	> 250	28.9	53.1	17.2	0.77			
Gender	Male	28.6	50.50	19.1	1.75			
	Female	22.4	55.10	21.6	0.85			
Age	< 30	21.7	47.80	26.1	4.37			
	30-39	23.2	54.60	21.1	1.08			
	40-49	27.0	50.40	21.1	1.46			
	< 50	23.9	55.90	19.5	0.75			
Educational	Early education	27.4	45.2	24.7	2.74			
stage	EGB (Grade 1–6)	24.3	53.5	21.5	0.62			
	EGB (Grade 7–10)	21.3	57.7	20.6	0.37			
	High school	26.9	52.6	19.6	0.84			
	Higher education	21.0	50.6	21.0	7.41			
Funding	Public	23.80	53.50	21.50	1.20			
	Fiscomisional	33.90	50.80	15.30	0.00			
	Private	24.40	60.00	13.30	2.30			

#### Strengthening Policies for Education, Innovation, and Digitization Through Teacher Training: Evaluating ProFuturo's Open Model in Ecuador Hernández-Sellés and Massigoge-Galbis

	Municipal	18.20	48.50	27.30	6.00
Average		24.70	53.40	20.70	1.20

With regards to transference resulting from the training, upon analyzing the frequency of modification of educational activities after completing the courses, we saw statistically significant differences in some categories.

First, we noted the relationship between the number of training hours completed and the frequency with which teachers attested to having changed their pedagogical activities. On the one hand, those who completed between 50 and 100 hours of training and those who completed over 250 hours most often reported modifying their means of working with their class (30.8% and 28.9% respectively). On the other hand, only 17.9% of teachers who completed between 150 and 250 hours of training stated that they often changed their educational activities.

Second, when we analyzed the results by gender, 28.6% of male teachers "very often" changed their means of working after training, compared to 22.4% of female teachers, the majority of which (55.1%) stated having done this "somewhat often."

There were no significant differences by age or educational stage.

In the overall assessment, the most frequent responses were "very often" and "somewhat often," which represented a combined total of 78.1% of all teachers.

Table 9 shows the level of transference to educational practices. The most often used practice, according to 86.2% of teachers, was "collaborative methodology and group learning." "Research activities" came in second place. In general, the degree of transference by activity type was high, except for activities where students create and produce digital resources, which had a transference level of only 61.3%.

# Table 9

Level of Transference to Educational Practise as Reported by Participants

Level of transference to educational practise	Frequency %
Research activities	83.50
Collaborative methodology or group learning	86.20
Project-based learning methodology	80.50
Activities using existing digital resources and online content	81.60
Activities using self-made digital resources	78.80
Activities where students create and produce digital resources	61.30

In Table 10, we present our analysis of the teacher self-assessment tool in 2020, 2021, and 2022.

We analyzed the impact of the ProFuturo training on the level of teacher competence, through a nonexperimental comparison of the results obtained from teachers without ProFuturo training and those who had received more than 150 hours of training before using the tool.

# Table 10

Demographic characteristic		Score	
	> 150 hours	Without	Improvement
	of training	training	%
Gender			
Male	37.03	34.60	7.03
Female	35.11	33.18	5.80
Age			
< 30	36.34	36.22	0.35
30-40	38.51	35.73	7.78
40-50	35.67	33.24	7.32
> 50	33.01	29.94	10.26
Education level			
Postgraduate university studies	37.43	35.84	4.44
University graduate (undergraduate degree)	35.55	33.44	6.30
Technical training graduate	32.16	32.72	-1.71
Compulsory education and high school graduate	35.11	31.46	11.58
Discipline			
Arts	35.83	33.65	6.47
Sciences	36.05	33.57	7.37
Citizenship	36.65	33.85	8.25
Physical education	35.20	34.09	3.25
Tutor	32.46	31.13	4.27
Languages	35.36	33.44	5.75
Mathematics	39.89	35.57	12.13
Technology/IT	37.62	35.91	4.77

Teacher Self-Reported Competence With and Without Training Disaggregated by Sex, Age, Education Level, and Discipline

Male teachers demonstrated greater improvement than female teachers after training. When comparing males who were untrained with those who had 150 or more training hours, there was an improvement of 7.03%.

In terms of age, individuals over the age of 50 appeared to benefit most from the training, exhibiting a score increase of 10.26%. Notably, the group under 30 saw practically no improvement (0.35%).

When analyzing improvement in terms of the level of previous education attained by teachers, the compulsory education and high school graduate group showed the greatest level of improvement

(11.58%). The technical training graduate group were also noteworthy here, showing, not surprisingly, no improvement (-1.71%).

In terms of discipline, the greatest improvements were for those teaching mathematics (12.13%), citizenship (8.25%), and sciences (7.37%).

# **Conclusions and Implications**

In analyzing the utility perceived by teachers regarding the use of technology and digital resources in the classroom for improving student learning, we found that up to 98.8% of the assessments indicated the usefulness of the model implemented by ProFuturo in Ecuador, which uses technology as a tool for improving quality in education. From this, we can infer that teachers are aware of the utility of digital transformation in the classroom as a means of improving the learning experience. This demonstrates the necessity for training in order to facilitate digital transition through the competence required. On the other hand, it is important to remember that perceived utility and satisfaction are key factors in explaining users' intentions to remain in technology-mediated studies (Tiyar & Khoshsima, 2015; Yu, 2022; Zhou, 2017).

With regards to the transference promoted by the training, we found that teachers with more training hours made the most changes, and when asked specifically about the level of transference for specific educational practices, the degree of transference was generally high, with values above 78.8%, except for activities in which students create and produce digital resources, which had a transference level of 61.3%. These levels of transference to the classroom attest to teachers' conviction in the utility of these practices, both for improving the digital abilities of students and for improving curriculum skills. In this respect, there are numerous studies regarding the need to invest in training at the same time as making the technological investments required to address educational digitization plans. These studies invite us to learn from the challenges and uncertainties raised by emergency contexts, such as the COVID-19 pandemic and similar scenarios (García Aretio, 2021).

With regards to the level of improvement in competence associated with the training received, the results of the self-assessment tool show significant differences in the level of digital competence in teachers who completed over 150 hours of training compared to those who did not participate in the training process, demonstrating the benefits of the program and the pivotal role of teacher training for change and innovation in digital transformation contexts which, in this case, resulted from an emergency context, and for strengthening national policies and systems for teacher training.

A key approach for digital transformation is having experienced partners to structure plans and providing them with the necessary infrastructure to train students. However, teachers must also be trained to successfully handle the virtualization stage of lessons, and this should be presented not only as an emergency solution, but also as a means of improving skills in the short and medium term, given that such globalizing transformations will involve changes which apply also to the macro or institutional level, resulting in national and transnational reform of policies (Van Dijck et al., 2018).

In the case analyzed, ProFuturo's intervention in Ecuador brought the necessary experience and infrastructure to address a serious issue in the country, which was faced with the weakness of existing structures for providing training through digital channels on a massive scale in an emergency context,

in much the same way as most other places in the world in this period. The teacher training proposal incorporated digital training, without disregarding innovation or methodology. Our results suggest that in addition to mitigating the risks inherent in the pandemic, this strategy served to improve competence and transference to the classroom.

Given that the strength of technologies, content, and training systems in a country cannot be rapidly improved, a good means of addressing unanticipated need is through collaboration with specialized organizations, not only as a means of responding to the emergent situation, but also to begin the process of institutional learning through collaboration, with the goal of strengthening and training the system, and thereby leaving the country with necessary capacity and autonomy to manage themselves. In an ideal world, governments and educational institutions would learn from this experience and employ pre-crisis planning which leads to the transformation of the educational process (Burns, 2020).

These processes entail profound structural changes for countries and regions. Such changes are not simple to articulate, since they require the design of complex strategies involving many actors within a system, including ministries of education, public and private institutions, parents, school directors, teachers, and students. In this sense, it is important to remember that unless those responsible for developing educational policies take advantage of the potential benefits of research, development, and innovation, and make the necessary efforts to correctly deploy these projects, the global education gap will continue to grow.

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# Unveiling Scholarly Insights: Quality Assurance in Open and Distance Education

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# Abstract

Open and distance education (ODE) has continuously evolved, significantly influencing educational, daily, and professional spheres, thereby prompting interest in its sustainability and quality. This study explored global scientific perspectives on quality assurance in ODE using the science mapping method. Search terms centred on open education, distance education, and quality assurance; data was gathered from 4,224 scientific texts in the Web of Science Core Collection. Analyses were conducted using VOSviewer software. Co-authorship analyses explored scientific collaboration structures at the country level. Globally shared concepts of interest to the scientific community were addressed using co-occurrence analyses. A detailed examination of co-occurrence outputs led to classification related to general and emerging key concepts. Results depicted a widespread global interest in quality assurance in ODE, fostering connections based on new cultural similarities. The concept of quality assurance in ODE continues to be enriched and developed, gravitating towards focused learning and instruction, establishing strong ties with various components of regular education as well as human elements. However, the prevailing view of quality assurance has yet to encompass this diversity. Rather than consider the nature and current potential of ODE, it has maintained an externalized and technical perspective.

*Keywords:* open and distance education, quality assurance, science mapping, scientific collaborations, scholarly perspectives

# Unveiling Scholarly Insights: Quality Assurance in Open and Distance Education

Since the 2020s, open and distance education (ODE) has transcended its role as merely an alternative or enrichment; it now stands as a unique and accessible form of education, seamlessly integrated into educational systems. In practice, our perception of ODE still focuses on adapting face-to-face processes to digital materials or online learning environments. However, ODE, as a unique form, necessitates methods and approaches tailored to its inherent characteristics. The scenario is not vastly different regarding quality assurance. Traditional education processes, where relationships, roles, and responsibility structures have evolved over centuries, still encompasses mechanisms for monitoring and enhancing teaching processes. But when it comes to ODE, who, on a global scale, are the mature actors concerned enough about its quality? What concepts shape our scholarly understanding of ODE? Addressing these pivotal questions served as a promising starting point for establishing robust quality assurance mechanisms within ODE processes and, potentially, integrating quality assurance seamlessly into the design processes of these learning environments.

# **Quality Assurance in ODE**

Quality assurance in education can be simply defined as the process of ensuring that the provided educational service fulfils objectives at an acceptable level. The actual quality of education, on the other hand, is a complex and multi-dimensional issue. It includes not only domain-specific learning outcomes but also information age skills (e.g., 21st-century skills), measurable cognitive competencies, as well as emotional and social competencies, along with various environmental, societal, and ethical sensitivities. In this context, the quality of education encompasses (a) the inputs of the educational service (e.g., students, instructors, environment, resources, materials); (b) the components of the instructional process, including teaching-learning activities, student engagement, and effectiveness; as well as (c) short- and long-term outcomes and impacts (Chapman & Adams, 2002; Mireku & Bervell, 2023; UNESCO, 2021). In the context of ODE, even though the goals and outcomes are similar to face-to-face instruction, distinctive components need to be emphasized. These include unique (a) environmental features, (b) materials and resources, (c) instructional methods and techniques, and (d) components such as learning facilitation competencies and student expectations.

While discussions on the quality of ODE can be traced back to the early 1990s, these early studies were primarily focused on how the quality of distance education, often preferred by a student profile with generally lower standards compared to face-to-face instruction, could be equivalent to traditional education in terms of learning environment, teaching method, instructional effectiveness, and participation (Kohl & Miller, 1994; McLendon & Cronk, 1995; Stella & Gnanam, 2004). In the 2000s, various education authorities and quality assurance agencies began to publish quality criteria. For example, in 2000, in order to ensure quality in Internet-based distance education processes, the Institute for Higher Education Policy of the USA (IHEP) outlined various criteria under the headings of (a) institutional support, (b) course development, (c) teaching/learning, (d) course structure, (e) student support, (f) faculty support, and (g) evaluation and assessment (IHEP, 2000). In 2002, the Quality Assurance Agency for Higher Education (QAA) in the United Kingdom, grouped the standards for distance higher education processes under the following six headings: (a) system design; (b) program design, approval, and review; (c) managing program

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delivery; (d) student development and support; (e) student communication and representation; and (f) student assessment (Stella & Gnanam, 2004). It is evident that quality processes in ODE have been associated with components such as (a) complying with traditional education standards; (b) fulfilling the objectives of educational services; (c) meeting customer expectations; (d) ensuring continuous improvement, and (e) meeting national, regional, and international standards and requirements (Jung & Latchem, 2007, 2012; Stella & Gnanam, 2004).

Since the 2010s, online learning resources and opportunities have increased, and in parallel with increasing demand for lifelong learning across the globe, ODE has evolved from being an alternative to regular education to becoming a complementary and enriching component. This shift has turned the quality of ODE and, consequently, the assurance of quality, into a multidimensional issue involving stakeholders with different expectations, such as governments, universities, employers, employees, and graduates (Latchem, 2016). The pandemic period has clearly demonstrated the crucial role of distance education not only in higher education and lifelong learning processes but also at the basic education level, highlighting the importance of its quality and quality assurance. Today, for each level of education, ODE has become essential to enriching our learning experiences and helping us personalize learning processes according to our expectations and preferences. QAA has classified learning experiences for current and future learners based on the degree of enrichment with digital resources and opportunities as follows (QAA, 2020).

- 1. Passive digital engagement/experience: There are no or very limited opportunities for distance or online learning. The learning environment is designed according to the requirements of face-to-face learning. Students do not interact with digital learning opportunities or tools unless necessary.
- 2. Supportive digital engagement/experience: Online or distance learning activities are used to support face-to-face instruction, and, as an option, students can benefit from these activities to support their learning processes.
- 3. Augmented digital engagement/experience: The learning environment is designed to include digital learning opportunities and engagement situations. Students are required to participate in distance/online learning activities but can choose their level of engagement depending on the subject and type of activity.
- 4. Interactive digital engagement/experience: Distance or online learning components are integrated into the design processes as a fundamental means of interaction for students with the program and with each other. Students are obliged to actively engage in these activities, and they have limited options to choose their level of engagement. The program may include some face-to-face learning activities, but participation is not mandatory.
- 5. Immersive digital engagement/experience: Digital learning and teaching activities are the only way for students to interact with the program and with each other. All students must participate in distance or online learning-teaching activities, and there is no alternative.

This classification illustrates that the current learning experience can be enhanced across different levels through ODE processes. Depending on the nature of this enhancement, engagement, and interaction

become crucial components for ensuring the quality of learning and teaching activities. As highlighted by Schindler et al. (2015) and Zuhairi et al. (2020), this scenario encompasses various affective and sociocultural elements within ODE services and their associated quality assurance processes. Ossiannilsson et al. (2015) outlined the essential components for designing such a versatile and inclusive quality assurance system in ODE as follows:

- Multifaceted takes into account comprehensive measurements to adopt a holistic perspective.
- Dynamic refers to flexible enough to adapt to changes in technology and society.
- Mainstreamed means becoming a natural part of the daily work of employees throughout the institution.
- Representative as in aims to balance the perspectives and demands of all stakeholders in ODE processes (e.g., students, teachers, industry, government, society).
- Multifunctional to maintain a certain quality standard while also building a culture of quality within the institution and providing a roadmap for future improvements.

Today, quality assurance has become an integral and essential facet within the realm of ODE. Educational institutions, alongside numerous organizations at both national and international levels, have been actively formulating standards and models for quality assurance, encompassing diverse and multi-dimensional perspectives (Jung, 2023; Turkish Higher Education Quality Council, 2020; The Quality Assurance Authority of Mauritius, 2021; United Nations Educational, Scientific and Cultural Organization [UNESCO], 2020; Asia-Pacific Quality Network [APQN], 2021; European Commission, 2018). While this is the case in practice, the scientific community's response to this phenomenon has been intriguing. How has the ODE literature addressed quality assurance? What global collaborative structures have emerged? What concepts have constituted the discourse on quality assurance in ODE? How have these discussions evolved in recent years? Framed by these questions, this study aimed to examine the scientific approach to quality assurance in open and distance education.

# Method

This study employed science mapping, also known as bibliographic mapping, as a key research approach. The focus was to uncover the nature of, orientations to, and relationships within the relevant disciplines through mathematical and statistical analyses of scientific texts. This approach alloweds for a detailed examination and visualization of relationships based on authors, institutions, countries, keywords, and citations, using bibliographic data from sources such as scientific databases (Bardakcı et al., 2019; Cobo et al., 2011; Morris & VanDer Veer Martens, 2008; Pritchard, 1969; Small, 1973).

The data was extracted from the Web of Science (WOS-Core Collection) database on October 9, 2023. The search focussed on the topic field, and encompassed title, abstract, and keyword information. An approach similar to snowball sampling was employed to determine search terms. Initially, a search was conducted

using the terms distance education, open education, and quality assurance; subsequently, the terms were expanded through both the related concepts suggested by the database and a review of relevant literature. In this process, it has been observed that the concept of ODE has been extensively studied in connection with terms such as distance learning, open learning, open education, and open university. Therefore, all these variations were reflected in the search terms. Additionally, it was noted that quality assurance has been examined in relation to many diverse concepts. Consequently, simply using the term quality on its own was thought to represent this diversity without limiting it. Thus, the formulated search string was as follows:

- "distance education" and quality - or - "open education" and quality - or - "open and distance education" and quality - or - "distance learning" and quality - or - "open and distance learning" and quality - or - "open universities" and quality -

# **Data Collection**

The search yielded access to 4,224 scholarly texts. Bibliographic data related to these texts were exported from the database using the full record and cited references content type and then recorded. Table 1 provides general information about the accessed texts, and Figure 1 illustrates the distribution of texts over time.

# Table 1

Data Overview

Data alassification	Dotails
	Details
Search period	1973 to 2023
Types of texts	article (2,685), proceedings paper (1,425), review article (112),
	book chapter (75), early access (45), editorial material (36), book review (11),
	data paper (3), meeting abstract (3), book, reprint, software review (7)
Main WOS categories	education-educational research (52.27%), education-scientific disciplines
	(9%), computer science-information systems (8.74%), computer science-
	interdisciplinary applications (7.73%), electrical-electronic engineering (6.1%),
	computer science-theory methods (4.6%), computer science-artificial
	intelligence (3.8%), telecommunications (3.2%), social sciences-
	interdisciplinary (2.8%), management (2.77%), health care sciences services
	(2.63%)

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## Figure 1





# **Data Analysis**

Data was analyzed using the WOSviewer 1.6.18 software tool (van Eck & Waltman, 2022). WOSviewer is commonly used in science mapping studies to reveal relationship structures within bibliographic datasets. The analyses generate visual maps illustrating term weights, relationships, and temporal changes. Additionally, the tool can generate comprehensive outputs for each term on the maps, including occurrence frequency, average publication year, and total link strength (Bardakcı et al., 2019). In this study, insights were drawn from both the maps and output.

Co-authorship analysis, drawing insights from author information within the texts included in the dataset, provided a comprehensive examination of scientific collaborations at the individual, institutional, or country levels. This analytical approach unveiled both the publication influence related to the subject under investigation and the collaborative relationships embedded within the dataset. On the other hand, co-occurrence analysis, using keywords within the texts included in the dataset, systematically revealed (a) patterns of concepts, (b) the most frequently used terms within these patterns, (c) relationships of coexistence among them, and (d) temporal changes (Callon et al., 1983; van Eck & Waltman, 2022). In this study, co-authorship analyses were employed to derive insights about the countries where authors' institutions were located, whereas co-occurrence analyses examined author keywords within the texts.

In both co-authorship and co-occurrence analyses, the full counting method was employed. Each term in the analysis process (i.e., each author country, and keyword) was considered equal and assigned a value of 1. The values were not normalized by parameters such as the number of authors (van Eck & Waltman, 2022). Thus, the maps were generated based on the frequency of occurrence of each term across different texts, without being influenced by parameters such as the number of authors in the respective texts.

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In bibliographic mapping studies, a highly critical stage involves establishing selection criteria, or cut-off points, for generating maps. If the cut-off point is not accurately determined, the resulting maps can become extremely complex, and unintelligible, with terms overlapping and, in some cases, significant terms getting lost. Understanding and interpreting the generated maps can be challenging. In this study, the focus at this stage was on two fundamental criteria: ensuring clarity and preserving as much detail as possible. Various cut-off points were tested to access the most comprehensive and intelligible maps. The cut-off points and the selected term numbers for the concepts to be included in the maps are provided in Table 2.

# Table 2

Analysis	Counting method	Unit of analysis	Results	Cut-off points for the map	Selected terms for the map
Co-authorship	Full counting	Country	142	Minimum number	142
				of documents for a	
				country = 1	
Co- occurrence	Full counting	Author keyword	8,758	Minimum number	175
				of occurrences of a	
				keyword = 10	

Analyses and Characteristics

All countries with authors identified were incorporated into the co-authorship map. For the co-occurrence map, only keywords present in at least 10 different texts were considered. Notably, upon evaluating the relationship weights of these terms within the co-occurrence map, it was found that they contributed to roughly 55% of the total weight, signifying a substantial level of representation.

This study had a notable limitation related to the selection of the data source, since it was conducted on scientific texts searched in the WOS. Obviously, in the field of quality assurance in ODE, texts can be found in different databases. However, working with multiple databases in this kind of study can complicate data management and create issues such as including the same text multiple times. To avoid this problem, researchers chose to work with a single database. By selecting the WOS database, the aim was to include more qualitative, reliable, and high-impact texts in the review. With access to over 4,000 scientific texts, the selection had high representational power. A similar limitation was related to the search terms chosen. The researchers made choices with similar considerations to accessing scientific texts closest to the main research focus of the study.

# Results

Before presenting the co-authorship and co-occurrence maps, providing brief information about their structures helps clarify the results. In such maps, there are two main components: nodes and relationships.

A node represents a term on the map, while a relationship indicates the link between two nodes. Each node is characterized by two main parameters—occurrence indicates how frequently a term appears in different texts, and link strength expresses the intensity of connections with different terms. Consequently, nodes form clusters based on their co-existence frequencies, with each cluster represented in different colours on the map. Proximity to the centre of a cluster implies stronger connections within that cluster, while distance suggests connections with nodes from other clusters. The temporal spreads of the nodes can be tracked through the Overlay Visualization feature provided by VOSviewer, as well as through detailed outputs generated alongside the maps, which include information on the average publication year.

# **Collaboration Structures**

Upon a comprehensive examination of co-authorship patterns, it became evident that contributions to the field of quality assurance in ODE have originated from various regions worldwide. North America, Asia, and Europe emerged as prominent contributors, with Oceania, the Middle East, and South America following suit. The contribution from African countries, however, was relatively modest. Figure 2 illustrates the co-authorship map.

When examining the co-authorship map on a country basis, a more global landscape is observed rather than a regional concentration. The top 10 countries with the highest publications were the United States (USA), China, Brazil, Russia, the United Kingdom (UK), Spain, Ukraine, Canada, Turkey, and Australia. The strongest collaborations occurred between (a) the USA and the UK, (b) the USA and China, (c) Brazil and Portugal, (d) Spain and Ecuador, and (e) among Australia with the USA, China, and Thailand. Analysing the temporal spread of co-authorship relationships revealed a well-established research history for the USA, the UK, Canada, China, Japan, and Australia. However, since 2021, there has been evidence of expansion into Central Europe, and the Middle East, followed by the Arab countries, South America, and Africa. This expansion may have been influenced, in part, by the global experience during the pandemic.

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# Figure 2

Co-Authorship Map



Examining the map revealed six clusters, also described as co-occurrence patterns. The most significant of these patterns was led by the USA and China. Besides Canada, Oceania extended to countries such as Lebanon and Pakistan. The second largest pattern centred around the UK, Turkey, and South Africa, with collaborations extending from Europe to Africa and South America. The third pattern, mainly centred around Spain and Brazil, encompassed countries where Spanish and Portuguese are predominantly spoken, while also including countries like Italy, France, Romania, and Cyprus. Predominantly centred around Russia, the fourth pattern included Turkic Republics, Baltic countries, as well as Sweden, the Netherlands, and Iran. The fifth pattern, centred around Ukraine, encompassed European countries such as Bulgaria, the Czech Republic, and Poland. The sixth pattern, centred around Saudi Arabia, included countries from the Arab region such as Jordan, the United Arab Emirates, and Egypt. In addition to strength in terms of

the number of publications, the robust connections observed among Arab countries or Spanish-speaking nations indicated the presence of regional or cultural approaches to quality assurance in ODE, further highlighting the diverse nature of collaborative efforts in this field.

# **Co-Occurrence Relationships**

After a comprehensive examination of the co-occurrence map, it was evident that quality assurance in ODE was predominantly discussed within the field of instruction. This map is presented in Figure 3.

# Figure 3

Co-Occurrence Map



The 20 keywords that appeared most often in the co-occurrence map are presented in Table 3, ordered by occurrences.

## Table 3

Top 20 Keywords

distance learning	blended learning
distance education	quality assurance
e-learning	evaluation
higher education	technology
COVID-19	assessment
online learning	information and communication technologies
	(ICT)
education	learning
online education	pandemic
open education	open educational resources
quality	massive open online courses (MOOC)

Examining Table 3 indicates that the primary focus among the top 20 keywords was on learning, teaching, and education, followed by concepts related to quality assurance and technology. The map depicted five distinct clusters, each highlighting strong relationships between human elements and technology, alongside pedagogical components. The first cluster addressed the correlations among distance learning, education, and the COVID-19 pandemic within the context of students, technology, and the learning environment. The second cluster predominantly covered pedagogical concepts such as interaction, assessment, evaluation, and effectiveness within the realms of distance education, higher education, and online learning. Quality and quality assurance concepts were also integrated within this cluster. The third cluster delved into the technological and pedagogical dimensions of e-learning. Although the fourth cluster primarily focused on technical aspects surrounding open education, it also significantly encompassed collaboration. The fifth cluster, with its central focus on learning, teaching, and education, addressed various educational levels, lifelong learning, as well as curriculum and instructional strategies.

Upon comprehensive examination of the map, it was observed that concepts related to learning were featured more prominently than those related to education. This suggests that the relationship between ODE and quality assurance has been explored in a much broader sense—encompassing open, distance, online, and digital learning processes rather than solely focusing on structured/organized education activities. The map revealed that the strongest relationships have been established between (a) distance learning and e-learning, followed by (b) distance education and higher education, (c) distance education and e-learning, and (d) distance learning and COVID-19.

Table 4 provides a thematic classification of key concepts pertinent to the relationship between ODE and quality assurance. This classification suggested that recent diversifications in the scientific perspective toward this field might herald a comprehensive transformation. Accordingly, in terms of learning-related concepts, there has been a noticeable shift toward understanding how learning takes place within these

environments, transcending the sole focus on open, distance, and online learning contexts. Furthermore, there has been an integration of additional elements associated with different disciplines or educational tiers within the concepts related to education. Moreover, some components were observed on an educational system basis. As a result, the relationship between ODE and the education system has undergone a nuanced and fortified evolution across both micro and macro scales.

Likewise, within the realm of quality assurance concepts, there has been a discernible deepening of understanding how to ensure quality. The innovation perspective inherent in the nature of ODE has evolved towards sustainability and flexibility focused on environmental adaptation along with renewal. Concurrently, within instructional concepts, there has been an expansion in methodological approaches. Our perception of instruction, considering environmental variables, effectiveness criteria, stakeholders, and so on, has transitioned towards a comprehensive view of instructional design that encompasses implementation, its constituents, and associated challenges. Regarding technological concepts, the focus has extended beyond digital applications towards the digital transformation of learning environments, with a pivotal role assigned to artificial intelligence. Within methodology concepts, there has been a broadening scope directed at comprehending learning behaviour and experiences. Moreover, there has been a noticeable shift from an open access viewpoint to an open science perspective.

## Table 4

	Concepts		
Theme	General	Emerging	
	(appeared in at least 10 texts with a total link strength of 10 or above)	(average publication year June 2018 to the present, appeared in at least five texts with a total link strength of 10 or above)	
Learning	adult learning, blended learning, collaborative learning, distance learning, e-learning, flexible learning, learning, lifelong learning, m- learning, mobile learning, telelearning, online distance learning, online learning, open and distance learning, open distance learning, open learning, virtual learning, Web-based learning.	active learning, connectivism, digital learning, distance learning/self-instruction, face-to-face learning, hands-on learning, hybrid learning, informal learning, interactive learning, project- based learning, self-education, self-regulated learning, social learning, student-centered learning, technology-enhanced learning.	
Education	adult education, continuing education, distance education, engineering education, higher education, modern distance education, nursing education, online education, open education, open university, physical education, secondary education, teacher education, tele-education, telehealth, telemedicine, university education.	dental education, digital education, education system, educational institutions, hybrid education, long distance education, medical education, virtual education, vocational education.	
Quality, quality assurance, sustainability	accreditation, capacity building, challenges, digital divide, educational quality, innovation, quality assurance, quality education, quality improvement, quality management, quality of education, quality, standards.	critical success factors, digital transformation, digitalization of education, educational innovation, flexibility, informatization of education, leadership qualities, learning quality, monitoring, quality criteria, service quality, standardization, sustainability.	
Pandemic	_	COVID-19, pandemic, COVID-19 pandemic, emergency remote teaching, remote learning, remote education, SARS-CoV-2.	
Instruction	assessment, collaboration, communication, course design, curriculum development, curriculum, digital literacy, effectiveness, evaluation, feedback, improving classroom	academic performance, accessibility, anxiety, attitude, community of inquiry, decision making, depression, digital competence, distance teaching, dropout, gamification, health professionals, instructional design, laboratory instruction, learning strategies,	

Themes and Key Concepts

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	teaching, interaction, learning design, learning outcomes, motivation, pedagogical issues, professional development, skills, student satisfaction, student support, teacher training, teachers, teaching, teaching/learning strategies.	online teaching, perception, primary school teachers, professional training, self-efficacy, stress, student experience, student success, students (general, undergraduate, college, university, medical, nursing), engagement, teaching methods, tele-mentoring, textbooks, transactional distance, vocational training, well-being.
Technology	cloud computing, computer-mediated communication, discussion forums, distance learning system, educational technology, ICT, Internet, learning analytics, learning management system (LMS), MOOCS, MOODLE, multicast, multimedia, online courses, open educational resources (OER), social media, technology, videoconferencing, virtual classroom, virtual learning environment, virtual reality, Web 2.0.	architectures for educational technology system, artificial intelligence, augmented reality, computational modeling, deep learning, digital educational environment, digital technologies, digitalization, fuzzy AHP, learning technologies, machine learning, mobile applications, sentiment analysis, usability, virtual mobility, WebRTC.
Methodology	survey, case study, open access, qualitative research.	systematic review, technology acceptance model, big data, data models, multidisciplinary, text mining, open science.

# Discussion

This study revealed the expanding global scope of scientific research into quality assurance in ODE. Two primary characteristics were prominently evident: de-centralization and ecological convergences. While countries long engaged in ODE and quality assurance appeared dominant in the co-authorship map, numerous new and influential actors have emerged, indicating a comprehensive, multilateral, and likely multicultural transformation. Among these new actors, novel and robust relationship structures were observed, suggesting the development of collaborative structures based on similar needs, expectations, or cultural norms. An essential issue in quality assurance practices, whether in program accreditation processes or institutional quality assurance systems and their external evaluation processes, is the reliance on a set of criteria and standards derived from the experiences of advanced countries. This inclination to adopt international standardized approaches (isomorphism) poses the risk of inadequately addressing local needs and problems (Bardakcı et al., 2023; Klassen & Sá, 2019; Ryan, 2015; Witte et al., 2008; Zapp et al., 2021). Within the ODE field of practice, another significant risk factor has come into play. Despite the presence of more concrete and shared assumptions, as well as acknowledging dimensions such as the infrastructures of open and distance learning systems, there has been a lack of common definitions and standards for instructional design, material development, assessment, and evaluation. Additionally, there has been an absence of shared definitions and standards for instructional method concepts such as student centeredness, engagement, and interaction (Jung, 2023; Marciniak, 2018). On the other hand, in a field as globally accessible as ODE, there is a need for a certain alignment among educational providers regarding quality assurance, as suggested by Jung (2023), necessitating a delicate balancing act. The characteristics of expanding collaborative structures in the scientific community indicated a direction that could potentially address these contemporary issues in quality assurance practice. However, this direction is not yet sufficiently robust. There is a need to further strengthen this trend, particularly enriching existing collaborative relationships based on cultural diversity.

# **Transforming ODE**

Another significant result of the study was to reveal the expansion and enrichment of quality assurance in ODE. When this expansion was evaluated comprehensively, two fundamental dimensions became evident. The first one was the multifaceted transformation of ODE within the scientific community, with emphasis on the quality of learning experiences, thereby prioritizing a method-oriented focus over infrastructure and tools. Efforts have been made to establish connections not only within the education system as a whole, but also with schools and levels; human elements have been given greater importance. Thus, the perception of ODE as an alternative or artificial learning environment is being dismantled; instead, ODE is evolving to become a natural component of the educational system with its own purposes and opportunities. On the other hand, the way in which this evolution has taken place leads us once again to the traditional media or methods debate (Clark, 1994; Kozma, 1994). ODE's mission to approach the quality of face-to-face education, traditionally concerned with technological and technical components, was changed with Kozma's (1994) proposition to seek learning and teaching methods suitable for the fundamental nature of ODE. As the reliance on technology has become normalized for all education communities, the focus in ODE shifts toward methods, as proposed by Clark (1994).

# **Quality Assurance in ODE**

The second dimension revealed in this study dealt with quality assurance in ODE. To evaluate the transformation in this dimension, the framework presented by Ossiannilsson et al. (2015) was valuable for discussing our results.

# Multifaceted

Although typically observed as a philosophy, when examined methodologically, research paradigms, methods, and tools are not sufficient to achieve a comprehensive view of quality assurance in ODE. From this perspective, data collection processes can be enriched using more diverse perspectives, as well as by incorporating qualitative methods such as case studies and phenomenology that encompass these multiple views.

# Dynamic

Beyond mere technological innovation, there has been an emphasis on sustainability and flexibility in integrating with the overall education system. However, within this dynamism, there has been insufficient discussion about the expectations of new generations and the presence of influential stakeholders such as society in general and the business world. The existing perspective on quality assurance has not adequately encompassed the current and near-future agenda and challenges of ODE, including aspects such as (a) micro-credentials; (b) massive open online courses (MOOCs); (c) integrating competencies acquired in these contexts into regular programs; and (d) the provider roles of universities and other educational institutions in such educational services, university alliances, joint programs, and new forms of virtual mobility (Raes, Detienne, et al., 2020; Raes, Vanneste, et al., 2020; Ubachs & Henderikx, 2023).

# Mainstreamed

There has been a trend towards ODE becoming a significant stakeholder in the process of digitizing education. The networks of relationships have been expanding to encompass educational systems,

institutions, educational levels, and individuals. However, local elements such as needs, expectations, sensitivities, and concerns have not been adequately addressed.

# Representative

The stakeholder set has been enriched with a diversity among teachers and students, as well as with a limited number of other professionals. However, this expansion has not accurately reflected the service spectrum of ODE today. While ODE currently serves as a component of regular educational activities, it also plays a significant role as a source for lifelong learning and micro-credential acquisition. Quality assurance processes should be capable of representing this wide variety for both internal and external stakeholders. In this regard, the representation of internal stakeholders, such as leaders, support services, and departments, as well as external stakeholders, including businesses, professional groups, graduates, society, and public institutions, should have a more robust presence (Ubachs & Henderikx, 2023).

# Multifunctional

Although encounters with sustainability codes have been noted, the quality assurance approach has not yet fully embraced a multifunctional structure. The current understanding still focuses more on meeting specific standards without integrating with the institutional culture. Despite encountering valuable endemic variables such as learning quality, these aspects are currently far from being robust. Methods such as benchmarking, peer interaction, and peer learning, which could improve quality assurance processes based on their own needs and to disseminate the quality assurance culture, are not being adequately used (Ubachs & Henderikx, 2023).

# Conclusion

Despite the richness and multidimensionality within the context of ODE, it is observed that quality assurance processes still maintain a strong technical focus on meeting specific standards. At this juncture, a fundamental issue arises from the common perception of quality assurance as an external monitoring and improvement layer outside the instructional design process. Educational institutions often strive to meet various externally imposed criteria, standards, and indicators within the quality assurance layer. However, this framework, shaped by the experiences of other cultures and institutions, may not hold significant meaning for internal stakeholders and is therefore not consciously understood. Contrary to this, quality assurance should be an integral part of both micro-level (i.e., course and program) and macro-level (i.e., overall structure of ODE system) instructional design processes. The philosophy of ensuring the quality of the education service should be reflected in the instructional design processes. This philosophy should transform all stages of developing and distributing learning and teaching activities to be more participatory, transparent, understandable for the target audience, and flexible in a sustainable manner. Van Valkenburg et al. (2020) used the term maturity to define such a transformation towards evidence-based continuous improvement decisions in instructional design, strategies, practices, and relevant institutional conditions. As expressed by Ubachs and Henderikx (2023), decision-making processes that are consciously applied and evidence-based have the potential to elevate the respective educational institution to the level of a learning organization that has internalized a culture of quality.
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# Socio-Demographical Variables as Predictors of Academic Self-Directedness

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## Abstract

This study explores whether a range of socio-demographical factors predict adult learner selfdirectedness in the context of South African open and distance e-learning higher education (ODeLHE). We observe significant differences between socio-demographical groups in the sub-dimensions of the Adult Learner Self-Directedness Scale. The study advances a theory on adult learner self-directedness in ODeLHE contexts. Educators should consider learners' support practices, particularly in the cases of women, Black Africans, and younger cohorts. ODeLHE practices should also consider learners' high school grades and proficiency in English, their library access, number of modules they are enrolled in, and who they support financially as factors influencing their level of self-directedness. Such considerations can be used to address the need for the translation of knowledge into policies and activities that improve educational opportunities for students.

*Keywords*: open and distance e-learning (ODeL), open and distance e-learning higher education (ODeLHE), higher education, adult learner, self-directedness, socio-demographic variables

# Socio-Demographical Variables as Predictors of Academic Self-Directedness

The context of this research is adult learning in the environment of open and distance e-learning higher education (ODeLHE). In the post-millennium business climate, every employee is expected to be a (potential) lifelong learner—able and willing to manage individual learning to remain competitive and employable in the 21st-century world of work (Botha, 2015; Cascio & Boudreau, 2016). This study investigates whether a range of socio-demographic variables of specific relevance to the ODeLHE environment significantly predicts adult learner self-directedness (ALSD). This study employs the following variables: employment status, occupation, socio-economic situation, financial support responsibilities, access to a library, access to a computer, proficiency in English, number of modules for which the learner was enrolled, and source of funding.

## **Literature Review**

Educators in all spheres have highlighted the necessity for inculcating self-directedness in adult learners to support the notion of lifelong learning in a rapidly changing and uncertain world. Self-directedness as a mastered capability is no less important in South Africa (Du Toit-Brits, 2019). Self-directed learners are assumed to be capable of self-reflection, taking responsibility for managing their learning, persevering with learning despite challenges, and critical questioning throughout their learning journey (Chen et al., 2022). Du Toit-Brits (2019) suggests that higher education students in South Africa demonstrate a deficiency in exhibiting curiosity, generating innovative concepts, participating in idea exchange, effectively leveraging constructive criticism for personal development, solving problems, making well-founded decisions rooted in factual information, adjusting to ongoing changes, employing knowledge to solve practical challenges, and participating actively in learning encounters relevant to the 21st century.

Learning in an ODeL context requires students to engage in meaningful practices that are reflective, constructive, and self-regulated. In addition, productive and efficient learning experiences engage students in creative thinking and active practice, thus driving the development of progressive mental models (Mudau & Van Wyk, 2021). By actively thinking about and participating in the learning activities offered, ODeLHE students build knowledge and understanding, avoiding the passive reception of knowledge transmitted from the teacher (Mudau & Van Wyk, 2021).

Self-directed learning (SDL) relates to a process whereby students progressively assume responsibility and control over their own learning by monitoring and managing their behaviour and metacognitive activities (Morris, 2019). Self-monitoring relates to how individuals create meaning from educational materials, while self-management focuses on how they use the learning context to achieve personal learning goals (Van Woezik et al., 2019). Both self-monitoring and self-management are collaborative practices, relying on internally and externally accessed information for success.

Therefore, the inculcation of SDL in higher education milieus depends on internal and external factors. Internal factors relate to students' motivation to learn, their perceived competence in the subject matter, their self-perceived beliefs in their capacity to manage their learning effectively, and their perceived autonomy to drive their own learning (Van Woezik et al., 2019). External factors relate to contact with peers and academic teaching staff and interaction with the learning environment (Van Woezik et al., 2019); however, socio-economic and socio-cultural circumstances also affect self-directedness.

Individual agency is central to the concept of learning self-directedness. Individual agency is a multidimensional concept, consisting of motivation-driven activity and the concomitant regulation of those activities. Schoon and Heckhausen (2019) indicate that individual agency develops through sociocultural interactions and argue that the development of agency is negatively affected by adverse personal socio-economic circumstances.

SDL has gained attention from educational practitioners and researchers over the past few decades, specifically within the ODeLHE environment. Because ODeLHE provides flexibility in terms of place, time, and pace of learning, adult learners must possess a high level of self-directedness. In the age of the fourth industrial revolution, when the ability to adapt easily to changing social and business circumstances is key, the capacity for self-directedness has become essential (Morris, 2019). The capacity to be self-directed is influenced by factors such as education level, prosperity, and individual autonomy, but it is not consistent throughout diverse contexts (Van Woezik et al., 2019). Furthermore, the data on whether gender and age affect the capacity for self-directedness is inconclusive (Loeng, 2020).

Various studies indicate that students' socio-economic background influences their academic success at residential universities (Coetzee et al., 2014; Fasce et al., 2013; Loeng, 2020; Subotzky & Prinsloo, 2011). Academic success can be described as the acquisition of subject-specific knowledge through navigating and mastering the learning process while also developing employability capacities (Cachia et al., 2018). Socio-economic circumstances include but are not limited to students' family income, the school attended before university, access to the necessary resources for successful study, and proficiency in the language of tuition. Specifically in multilingual countries where the business language and language of tuition for higher education is English, a lack of proficiency in English can create a barrier to successful higher education studies, as emphasized by Preece (2019). In addition to a lack of proficiency in the language of education, students' geographical location, access to financial resources, and quality of primary and secondary education affect successful ODeL study (Subotsky & Prinsloo, 2011). Örs (2018) reports that gender affects self-directedness in nursing students, while Lema and Agrusa (2019) indicate that previous work experience, type of work, and average grades obtained at university affect student self-directedness. The concept of SDL was proposed, described, studied, and advanced mainly in developed countries (Brookfield, 2003), giving it a Eurocentric slant that calls into question its assumption of universal applicability (Loeng, 2019). The reason for the focus on SDL in developed countries might be their higher level of access to resources, educational infrastructures, and research funding, facilitating the exploration and advancement of this concept. Students' socioeconomic situation may influence their capacity to practise SDL in ODeLHE learning contexts, where they are expected to actively drive their learning, independently identify their learning difficulties, and find ways to address those difficulties.

A paucity of research on the effect of socio-cultural background on ALSD in an ODeLHE context in developing countries (such as South Africa) necessitated a study that would include as many socio-cultural variables as possible to establish the vulnerabilities of adult learners in ODeLHE as accurately as possible.

## **Research Question**

Considering the above literature review, the following research question was formulated:

Do diverse socio-demographic characteristics of adult students enrolled in ODeLHE significantly predict adult learners' academic self-directedness? These characteristics include their age, race, gender, employment status, occupation, socio-economic situation, being depended upon financially, access to a library, access to a computer, proficiency in English, course load (number of modules they are enrolled in), and source of funding.

## **Research Method**

This study used a non-experimental research design to answer the research question. We used a quantitative, cross-sectional survey design (specifically descriptive, correlational and inferential statistical analyses) to realize the empirical research objectives.

#### **Population and Sampling**

The sample (N = 747) consisted of predominantly Black (African) women between the ages of 18 and 25 years old. This is the overall demographic of the specific institution. Most of the respondents were employed full time in administrative and skilled occupations. A significant percentage of the sample had no steady monthly income and were responsible for supporting themselves and more than two dependents. Further analysis of the sample indicated that the respondents not only had large family and financial responsibilities but also lived in constrained socio-economic circumstances. Since socio-economic and cultural variables affect adult learner success (Akala & Divala, 2016; Cincinnato et al., 2016; Välimaa & Nokkala, 2014), the influences on ALSD should be investigated in South Africa.

Only 32% of participants had access to the university's library, 25% had their own computers, and 23% had access to a computer at work. The limited access to a computer in an age when information is easily accessible through online platforms reveals challenges these adult students may experience in an ODeLHE context that is either fully online or uses a blended tuition and assessment approach (Halabi et al., 2014; Nguyen & Ikeda, 2015). Furthermore, easy access to the resources of academic libraries is vital for students who are required to use diverse sources in their studies to develop capability in academic inquiry and critical analysis (Soria et al., 2013).

The respondents overall reported a fair to poor final grade for high school English, indicating the possibility of struggling in an ODeLHE context where the language of tuition is English. Post-secondary students who struggle with the language of tuition may find it more challenging to complete their studies successfully (Desai, 2016). Furthermore, most of the participants indicated they were registered for more than four modules, resulting in a substantial academic workload in addition to their existing family and work responsibilities. The majority of the participants funded their tertiary studies themselves, demonstrating that the adult learners faced substantial challenges to meet their monetary commitments. It is evident that the participants in this study invested heavily in their futures in terms of time and money. Nevertheless, the participants possibly expected too much of themselves regarding the time required given the time they had available for successful ODeLHE outcomes. Time management is a considerable concern in SDL, and novice adult learners may struggle to accurately estimate the time needed for success (Anderson et al., 2014; Thibodeaux et al., 2017).

Extensive research is needed to understand the relationship between socio-demographic variables and academic self-directedness in ODeLHE. Such understanding may have practical implications for

ODeLHE providers, instructional designers, and educators. Providers and designers can tailor their instructional materials and delivery methods to meet the needs of learners with different sociodemographic characteristics. Educators can also use the findings to identify learners who may require additional support or interventions to enhance their self-directedness.

#### **Measuring Instruments**

In view of the cross-sectional survey design approach adopted for this study, we used self-report measuring instruments. A biographic questionnaire (including all the socio-demographical categories investigated in this study), along with the Adult Learner Self-Directedness Scale developed by Botha (2014), was used to gather the data. The questionnaire was validated by Botha in a South African context in 2018. The responses of the participants were imported and analyzed using SPSS Version 20.1.

## **Analysis of Research**

In this section, we discuss whether the various socio-demographic variables predict ALSD in ODeLHE. The variables we report on are as follows: gender; race; age; employment status; occupation; socioeconomic situation; being dependent upon financially; access to a library; access to a computer; proficiency in English; number of modules for which the participant is enrolled; and who is paying for the learner's studies.

As a first step, we report on the correlations between the variables and the three factors of the ALSD (Table 1). Thereafter, we report only on the socio-demographic variables that functioned as significant predictors (Table 2).

#### Table 1

Socio-demographic variable	Measures	Measures Factors in adult learner self-direct		
		Success	Active	Strategic
		orientation	academic	resource use
		for	behaviour	
		ODeLHE		
Employment status	Correlation	.033	025	103**
	coefficient			
	Sig. (2-tailed)	.366	.495	.005
	N	741	741	741
Occupation	Correlation	013	.034	.092*
	coefficient			
	Sig. (2-tailed)	.731	.355	.013
	N	731	731	731

Correlations Between Socio-Demographic Variables and the Factors in Adult Learner Self-Directedness

Socio-economic situation	Correlation	.062	034	103**
	coefficient			
	Sig. (2-tailed)	.094	.357	.005
	N	741	741	741
Financial dependents	Correlation	.096**	006	006
	coefficient			
	Sig. (2-tailed)	.009	.872	.070
	N	747	747	747
Access to a library	Correlation	.078*	.046	.054
	coefficient			
	Sig. (2-tailed)	.035	.219	.143
	N	733	733	733
Access to a computer	Correlation	.139**	.047	001
	coefficient			
	Sig. (2-tailed)	.000	.205	.970
	N	738	738	738
Grade in high school English	Correlation	.216**	021	.116**
	coefficient			
	Sig. (2-tailed)	.000	.205	.002
	N	721	721	721
Number of modules	Correlation	.064	043	.088**
	coefficient			
	Sig. (2-tailed)	.086	.245	.018
	N	725	725	725
Source of funding	Correlation	044	.048	.061
	coefficient			
	Sig. (2-tailed)	.238	.195	.100
	N	736	736	736
Gender	Correlation	176**	.027	015
	coefficient			
	Sig. (2-tailed)	.000	.311	.095
	N	746	746	746
Race	Correlation	.117**	.037	.016
	coefficient			
	Sig. (2-tailed)	.000	.466	.692
	N	744	744	744
Age	Correlation	.103**	.009	018
	coefficient			
	Sig. (2-tailed)	.006	.820	.640
	N	706	706	706

*Note*: \* correlations are significant at the .01 level; \*\* correlations are significant at the .05 level; ODeLHE = open and distance e-learning higher education.

Table 1 shows significant positive correlations between "success orientation for ODeLHE" and the sociodemographic variables access to a computer (r = .139, p = .000), grade for high school English (r = .216, p = .000), financial dependents (r = .096, p = .009), access to a library (r = .078, p = .035), race (r = .117, p = .000), and age (r = .103, p = .006). A significant negative correlation was found between "success orientation for ODeLHE" and gender (r = -.176, p = .000). No significant correlations were found between active academic behaviour and socio-demographic variables. In terms of "strategic resource use," we found significant positive correlations between occupation (r = .092, p = .013), grade for high school English (r = .116, p = .002), and number of modules (r = .088, p = .018). In addition, significant negative correlations were found between "strategic resource use" and employment status (r = .103, p = .005) and socio-economic situation (r = ..103, p = .005).

Based on the correlation analysis, the next step was to conduct stepwise regression analysis to determine the predictive values of the socio-demographic variables and self-directedness.

#### Table 2

Predictor	Success o	rientatio	n for	Active	academi	c	Overall a	dult learne	er self-
variable	OI	DeLHE		behaviour directedness					
	β	t	p	β	t	р	β	t	р
Grade in	.224	4.36	.000						
high school									
English									
Gender	.208	4.04	.000				.108	2.022	.044
Access to a				.135	2.556	.00	.112	2.130	.034
library						0			
Number of				111	-	.011			
modules					2.089				
Financial				.106	2.009	.045			
dependents									
Model	2 <sup>nd</sup> step		3 <sup>rd</sup> step		2 <sup>nd</sup> step				
statistics	Fp	17.	.39	Fp	4.97 (.	002)	Fp	4.33	(.014)
		(.0	00)						
	Adjusted		9	Adjusted	.0	3	Adjusted	.0	19
	<i>R</i> <sup>2</sup>			$R^2$			<i>R</i> <sup>2</sup>		

#### Multiple Regression Analysis Results

*Note:* \*\*\* correlations are significant at p = .001 level; \*\* correlations are significant at p = .01 level; \* correlations are significant at p = .05 level; ODeLHE = open and distance e-learning higher education.

Table 2 shows that the socio-demographical variables of grade in high school English, gender, access to a library, number of modules, and financial dependents are significant predictors of self-directedness. Table 2 also shows that the regression analysis produced an empirically significant model for the "success orientation for ODeLHE" factor with the gender and grade for high school English as predictor variables (F = 17.39, p = .000; adjusted  $R^2 = .09$ ; small practical effect). An empirically significant model was produced for the "active academic behaviour" factor with access to a library, number of modules, and financial dependents as predictor variables (F = 4.97,  $p \le .05$ ; adjusted  $R^2 = .05$ ; small practical effect).

Lastly, the overall scale also produced an empirically significant model with gender and access to a library as predictor variables (F = 4.33,  $p \le .05$ ; adjusted  $R^2 = .02$ ; small practical effect).

While the regression analyses yielded statistically significant results, indicating significant predictions (Salkind, 2010), it is noteworthy that the practical effects, as denoted by the adjusted  $R^2$  values, were found to be relatively small. This observation implies that the proportion of variance in self-directedness accounted for by the predictor variables included in the models is limited. Consequently, it is conceivable that additional factors, beyond those examined in the regression models, exert influence on ALSD in ODeLHE environments. The small practical effect size underscores the complexity of the phenomenon under investigation and suggests the presence of unexplored variables or nuanced interactions that warrant further inquiry.

The variance in "success orientation for ODeLHE" was positively accounted for by grade for high school English ( $\beta$  = .22, p = .000) and gender ( $\beta$  = .21, p = .000). Access to a library positively accounted for the variance in "active academic behaviour" ( $\beta$  = .14, p = .000) and overall self-directedness ( $\beta$  = .11, p = .03). Lastly, the variance in "active academic behaviour" was accounted for by number of modules for ( $\beta$  = .11, p = .01) and financial dependents ( $\beta$  = .11, p = .05).

## Conclusion

#### **Discussion of Findings**

The findings provide new insights into the research on self-directedness in South African higher education, since it appears that socio-demographic variables are significant in predicting ALSD in ODeL contexts. More specifically, the results revealed that the socio-demographical variables of the grade for high school English, gender, access to a library, number of modules registered for, and financial dependents significantly ALSD within the South African ODeLHE context.

Grade for high school English and gender were found to be significant predictors of the "success orientation for ODeLHE" factor. This suggests that learners who had higher grades for English and identified as a particular gender exhibited a greater success-oriented attitude toward their studies in an ODeLHE environment. These findings are consistent with previous studies that highlighted the importance of language proficiency (Garrison & Vaughan, 2008; Kim & Bonk, 2002) and individual characteristics (Elliot & McGregor, 2001) in promoting academic self-directedness.

Secondly, access to a library was found to be a significant predictor for both "active academic behaviour" and "overall self-directedness." These findings are consistent with Kuo et al. (2013), who emphasized

that learners who had access to information and learning hubs (such as a library) were more likely to engage in active academic behaviours and demonstrate higher levels of self-directedness. This suggests that the provision of adequate resources and learning environments is vital for supporting learners' autonomy and facilitating their engagement in SDL activities.

Furthermore, the number of modules enrolled in and the presence of financial dependents were found to be significant predictors of "active academic behaviour." Learners who were registered for a greater number of modules and who provide financial support for others exhibited higher levels of active academic behaviour. These findings are corroborated by Reeves et al. (2016), who highlight the influence of practical considerations on learners' engagement and SDL. This implies that learners with more modules and those who provide financial support may have a greater sense of commitment and motivation to actively participate in their studies.

Overall, these findings contribute to our understanding of the socio-demographic factors that influence ALSDin ODeL environments. Emphasis is placed on the importance of language proficiency, individual characteristics, access to resources, and practical considerations in shaping learners' engagement and success in SDL. The results underscore the need for educational institutions to consider these factors when designing and implementing supportive interventions and resources to enhance learners' self-directedness and promote successful academic achievements. It is, however, important to note that while the study did find statistically significant associations, the effect sizes were relatively small, indicating that socio-demographical variables explained only a limited portion of the variance in self-directedness. Future research should focus on exploring whether other factors, such as motivation, prior learning experience, and learning strategies, may have a more significant contribution in explaining self-directedness.

The results of this study contribute to the body of knowledge on best practice guidelines for the design and development of ODeLHE learning material to facilitate the inculcation of ALSD in previously disadvantaged adult learners. In addition, the results can be used in the design and implementation of workplace learning opportunities to facilitate the inculcation of ALSD. Specifically, the use of online and e-learning applications and delivery methods should be investigated thoroughly to ensure that vulnerable adult learners are not disadvantaged further by the use of these delivery methods.

#### **Implications for Theory and Practice**

Given the imperatives of the National Skills Development Strategy III, which aims to promote and support skills development and training in South Africa, knowledge about adult learners and the conceptualization of ALSD in the research literature are vital to contribute to skills development and the national development goals in the long term (Coetzee & Botha, Author 2013). The majority of students in South Africa study through ODeLHE. In addition, within the context of the skills development imperatives created by the National Skills Development Strategy III (Tshilongamulenzhe, 2010), research contributions in the form of recommendations and best practice guidelines in the design and delivery of online learning in both the tertiary and workplace learning environments may significantly enhance the practice of both through HRD interventions.

ALSD is influenced by socio-demographic factors such as culture, gender, and socio-economic environment. ODeLHE requires high levels of ALSD, and research has suggested that ODeLHE is the way for Africans to access tertiary education to improve their socio-economic circumstances and the economy of the continent as a whole (Mpofu, 2015). However, since socio-demographic factors

influence ALSD, it is possible that those learners who supposedly should benefit from improved access to tertiary education through ODeLHE, are in fact further disadvantaged (Mpofu, 2015).

### Limitations of the Study

The current study was conducted in one South African higher education institution. Because of contextual differences, the sample and the fact that the sample was composed mainly of African women mean that the findings cannot be generalized. Few studies have focused on ALSD, especially within developing countries, limiting information for comparison. The paradigmatic perspective of the research was limited to the interpretation of findings within the boundaries of adult learning in ODeLHE and workplace learning milieus. The cross-sectional design of this study limits any causal inferences. We recommend that future research involving different population groups in various educational and occupational settings be conducted before generalizations can be made to the broader population.

Another limitation of the study pertains to the small practical effects observed in the regression analysis, indicating a limited proportion of variance in self-directedness accounted for by the predictor variables. This underscores the need for further investigation into additional factors that may influence self-directedness among adult learners in the ODeLHE environment. As a result, future research endeavours should strive to elucidate the complex interplay of variables and potential interactions that contribute to the phenomenon of SDL in ODeLHE contexts.

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# Web-Based Nursing Care Documentation for Students to Support Online Learning

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## Abstract

Nursing care is the most critical element in nursing services, which aims to improve the patient's health status. Ineffective and inefficient care documentation can impact the quality of nursing services. However, the increasingly advanced development of technology provides freedom for the health world to improve the quality of patient-centered services. Educational institutions have also used information technology in learning process activities. As prospective health professionals, students must be equipped with competencies to support their performance. In this study, a web-based nursing care information system was developed to assist students in documenting care activities. The website application was designed to increase student competency in nursing documentation activities to provide high-quality nursing services even though learning is online. The waterfall model approach was used in application design. The design stage started with analyzing application requirements, followed by system design and coding. Next, using a Likert-scale questionnaire, a usability test was performed on 15 beta users to assess the functionality of the application. The results showed that the nursing care website application was easy to use and that students felt satisfied. It is hoped that the website application can be made more attractive by including a decisional support system to make it easier for students to enforce nursing diagnoses on patients.

*Keywords*: online learning, nursing education, nursing documentation, nursing information system, webbased application

## Introduction

Online learning methods have developed rapidly since the COVID-19 pandemic, supported by increasingly advanced communication and information technology. Online learning allows educators and students to meet using the Internet or in a Web-based learning environment, even though they are far apart (Kristiana et al., 2023).

Online-based learning is easy for lecturers and students; students can communicate and consult with lecturers without meeting them in person, and learning materials can be accessed anywhere and at any time (Joshua et al., 2022). On the other hand, online learning can also negatively impact students in ways that include too many assignments, Internet network problems, and learning material that is difficult to understand because it is less attractive and boring (Abidah et al., 2020; Laili & Setiawan, 2021). A study of 69 first-year nursing students showed that 46.4% felt severe burnout due to online learning (Rohmani & Andriani, 2021). Research has also shown that 47.2% of nursing students feel more stressed during online learning (Oducado & Estoque, 2021). College students have reported feeling more satisfied with a face-to-face course than an online one (Dinh & Nguyen, 2020).

Students' satisfaction with online learning depends on synchronous and asynchronous learning. Synchronous online meetings via Web applications such as Zoom and Google Hangout allow students to meet face-to-face so they can discuss their difficulties and get feedback from the lecturer immediately. Meanwhile, with the asynchronous method, students learn through videos provided and watch the videos repeatedly as needed. Students become more engaged with the material provided through these two learning methods (Zeng & Wang, 2021). For this reason, the quality of the asynchronous component is essential. The materials studied should be accurately selected to increase analytical skills and decrease academic burnout and difficulty in learning new materials.

Web-based learning media are considered valid and practical for students (Figna et al., 2020). A study on nursing students showed that web-based learning effectively supported students' clinical learning process (Barisone et al., 2019). One of the skills that must be managed by a nurse is nursing documentation. Nurses must be able to provide nursing care to patients accurately, effectively, and efficiently in order to achieve patient safety. Nursing care skills have been learned since college by referring to applicable nursing care standards; for example, in Indonesia, there are the Indonesian Nursing Diagnosis Standards (SDKI), the Indonesian Nursing Outcome Standards (SLKI), and the Indonesian Nursing Intervention Standards (SIKI).

In general, students learn to document nursing care in paper form, where students write the results of patient assessments, interventions, implementation, and evaluation of nursing actions in the patient's medical record file. However, since the COVID-19 pandemic has forced educational institutions to develop learning media that can be used online to achieve the expected competencies, a web-based nursing care system application needs to be developed to achieve the expected competencies, even though learning is online.

## **Literature Review**

Nursing documentation is a record that contains all the information needed to determine a nursing diagnosis, prepare a nursing plan, and implement and evaluate nursing actions in a systematic, valid, moral, and legally accountable manner (Asmirajanti et al., 2019). Before 2002, nurses did not have standards for documenting nursing care, leading The American Nursing Association to develop guidelines as principles and standards in the nursing care documentation process (Sinaga, 2019). The Indonesian National Nurses Association has also developed a nursing care standard, the SDKI, for nursing diagnosis standards. Nurses have used this standard to reference nursing care at the hospital, health centre, community, and independent practice level.

Nursing documentation is used as a communication tool within the healthcare team to explain client care information, including individualized care, client education and the use of referrals for discharge planning. According to Potter et al., (2021), nursing documentation is closely related to nursing care, reflecting activities of the nursing delivery process in five stages: (Potter et al., 2021)

1. Nursing care assessment

The assessment focuses on identifying the client's past health status, current client health status, family history, bio-psycho-socio-spiritual-cultural status, data interpretation and grouping, and data documentation.

2. Nursing diagnosis

This stage is the decision-making stage of the nursing process, which includes identifying whether the client's problems can be eliminated, reduced, or changed through nursing plans and actions.

3. Nursing care plan

Planning considers the priority outcomes of patient diagnoses and collaborative problems, identifies patient-centred goals and expected outcomes, and determines appropriate nursing interventions for each diagnosis. The planning process involves the application of nursing knowledge, knowledge of the patient, clinical experience, standards, and critical thinking attitudes.

4. Implementation of nursing care

This stage involves the nursing performance and collaborative interventions necessary to achieve the goals and expected outcomes to support or improve a patient's health status.

5. Evaluation of nursing care

Evaluation is the fifth step of the nursing process, determining whether the patient's condition or well-being improves after nurses provide care. Nurses need to monitor a patient's clinical progress comprehensively and sustainably.

# Method

This research used the systems development life cycle (SDLC), a fundamental framework that regulates the software development process, encompassing planning, design, implementation, testing, deployment, and maintenance stages. In SDLC, several system development models include waterfall, iterative, and v-model.

The system development model implemented in this study was the waterfall model because in using the waterfall model, the software development process becomes more structured, transparent, and predictable. This model is very suitable for small-scale projects because of the ease of managing the software development process. The waterfall model identifies problems at the beginning of the planning process. Requirements must be identified in detail first, followed by each process, then proceeding to the design, implementation, testing, and release. The waterfall development model runs in sequential and continuous stages. Problems at a particular stage must be resolved first, and then the process can move to the next stage to make the system development process more organized. Thus, the four stages of web-based application development used in this research can be described as follows:

1. Requirements gathering and analysis

The first stage in the system development process was carried out by conducting a needs analysis. In a needs analysis, researchers involve stakeholders through discussions, interviews, and observations to obtain an overview of the needs of the software being developed. Apart from that, researchers also conducted a literature review as material for study and consideration in determining application needs. The stakeholders in this case were students and lecturers. The process started with the functional needs of lecturers when describing nursing care. The description of nursing care included the fact that it could be accessed online through a system in real time. The nursing care system was also packaged interactively with student involvement; in practice, students would know what needs and data would be used in nursing care.

2. System development

Implementation of system development started with translating the wireframe design into visualization. Wireframe design is an interface sketch design that describes the process of using the system. Users can directly see through the user interface and user experience design analysis stages. Some of the analysis results can be in the form of menus used as a result of feature implementation, forms used as a user interface for data acquisition needs, and data formats used to help translate the results into a user interface that is easy to understand. The users of this system would be lecturers and students. Because this system would be used in online learning, its availability was crucial, because every stage of nursing care carried out must be documented in real time. This is done when planning and implementing actions on patients. To ensure system availability remains realistic, a server would be needed to store data separately from the server used for the system's working process. Meanwhile, the need to translate the design into coding was coordinated directly with the lecturer and student representatives. This was to ensure compatibility between visualization and the processes implemented in the system.

#### 3. System implementation and coding

After the design of the nursing care system has been completed, it continues to the coding stage. Where the coding stage starts from translating the interface design into programming code. This is done so that computers can understand commands carried out by humans. The coding that has been applied will produce a system page interface that can be accessed directly by students and lecturers. Therefore, the programmer must ensure that the entire nursing care process has been translated into programming code in accordance with the system design. In coding, the programmer must be accompanied by a system analyst. This analysis system will help explain the aims and objectives of each nursing care process that has been designed to the programmer. This is done so that errors in the programmer's understanding of the design of the nursing care system can be minimized.

#### 4. Testing

The final stage was testing the application to ensure the code functioned according to specifications. Application testing was carried out using the black box testing method to assess the suitability of the application with the design and feasibility of the application being created. This black box testing was done directly on the application being worked on, so the programmer would immediately handle all improvements or non-conformities. This system testing involvement places more emphasis on usability testing. Usability testing was carried out on nursing students with the following inclusion criteria: had received nursing care process theory and Indonesian nursing standards, and had completed learning the nursing information systems. Beta testing involved users and end users of the application. There were 15 beta testers. The research results found that at least 10 beta testers could recognize 94.7% of all application usability problems (Muhamat et al., 2021). The beta testers also needed to fill out a questionnaire developed by Khairan et al. (2022) containing 18 questions related to usability, information, interaction, and satisfaction of the website application, which was validated using Pearson's product moment analysis with an *r*-value range of 0.342–0.766 and a reliability test result of 0.630.

## Results

The results are organized by the four development stages of the web-based nursing care application.

#### **Needs Analysis**

The first stage, analysis of information system needs, was carried out by involving the head of the nursing study program and nursing lecturers to get an overview of the information system needed. Results of the discussions showed that the nursing information system would be expected to facilitate students in documenting computer-based nursing care that is consistent with nursing care standards in Indonesia.

#### System Development

Based on the needs analysis, the second stage of development, information system development, was formulated. It can best be described based on aspects of system behavior as shown in Figure 1. The figure depicts the use case for the nursing care application that was developed in this study.

#### Figure 1

Use Case Diagram for a Web-Based Nursing Care Application



As shown in Figure 1, lecturers and students must log in first to use the nursing care system. After log in, the unique system service for students would be to access several features, including processing data related to patients, assessment, diagnosis, results, intervention, and implementation and evaluation. Meanwhile, the services that lecturers would access are data processing and nursing care results.

#### **Development Implementation System**

#### Log In Page

The log in menu page is the entrance for users of this information system. It is shown in Figure 2. Users need a username in the form of an email address and password to enter the system. Therefore, each user must be registered first if they want to access directly this nursing care system. If the user already has an email and password, the user can simply log in. The user's email is entered in the Alamat Email input form, while the password is added to the Kata Sandi input form. Both are mandatory. If the user does not have email or password data, the user is not permitted to access the system.

#### Figure 2

	Universitas Jenderal Achimad Yani Vigyakarta	
	Masuk	
Alamat Email *		
Kata sandi *		
📄 Ingat saya		
	Masuk	1

Log In Page of the Web-Based Nursing Care Documentation Application

#### Home Page

The home page or dashboard is the front page displayed after the user logs in to the application. This page displays all menus according to the level of entry access so that users can create data on new and treated patients and organize nursing care from assessment to evaluation. Lecturers can also see this data, and they can explain to students what steps need to be taken. Users at the admin level can see all activities in the information system. The home page is shown in Figure 3.

#### Figure 3

Home Page of the Web-Based Nursing Care Documentation Application

EX ON Universitas			
Dashboard     Student Upload	Dashboard		
<ul> <li>Patient</li> <li>Patient Treated</li> </ul>	A Welcome, Admin Go out		
<ul> <li>♡ Diagnosis</li> <li>Intervention</li> </ul>			
2 Outer			
SETTINGS ^ & Profile & User			
PROTECTOR ^ © Role (4)			

#### Patient Page

The patient page contains information on patients being treated and discharged. Meanwhile, the treated patients page contains data on patients being treated in the hospital who have yet to be discharged. The nurse can only see the dashboard menu, patients and treated patients, and the user profile. The patient page provides an overview of a patient's identity: medical record number, name, medical diagnosis, status,

admission date, and discharge date. Before providing patient nursing care, a nurse will enter data on the patient to be treated, including general patient information, medical history, head-to-toe assessment, and supporting examinations done for the patient. Furthermore, the assessment data determines patient nursing problems based on nursing care standards.

#### Diagnosis, Intervention, and Outcomes Page

This page, shown in Figure 4, contains nursing diagnoses that refer to current Indonesian nursing diagnosis standards. A diagnosis contains a code, diagnosis name, and category based on the system. After filling in the diagnosis, a user would continue filling in the expected results or goals to select nursing interventions. Nursing intervention reflects the nursing care plan provided to the patient. After filling in the nursing care plan, the nurse must fill out an implementation sheet based on the actions carried out on the patient. The completed implementation is then used as a form of evaluation by writing down subjective and objective data, analysis, and planning.

#### Figure 4

EX Wiversitas Legislati	Diagnosis / List			A
කි Dashboard ੳ Student Upload	Diagnosis			For
😤 Patient 🕐 Patient Treated				
🛇 Diagnosis	Code ~	Name ~	Category ~	
Intervention	D.0001	Ineffective Airway Clearance.	respiration	
면3 Outer ② Question	D.0002	Ventilator Weaning Disorders.	respiration	
SETTINGS ^	D.0003	Gas Exchange Disorders.	respiration	
A Profile	D.0004	Spontaneous Impaired Ventilation.	respiration	
읍 User	D.0005	Ineffective Breathing Pattern.	respiration	
PROTECTOR ^	D.0006	Aspiration Risk.	respiration	

Diagnosis Page for the Web-Based Nursing Care Documentation Application

#### Testing

Usability testing was carried out on 15 nursing students who tried out the application during the Nursing Information Systems course. At the end of the test, students were asked to fill out a questionnaire containing 18 questions. Their responses were rated using a Likert scale (1 = strongly disagree to 5 = strongly agree). Usability testing results are shown in Table 1.

#### Table 1

Theme	Questionnaire item number and wording	Average
		Score
Usability		
	1. The application website is easy to learn.	4.3
	2. The application website interaction is clear and easily understandable.	3.8
	3. The design of the application website is appropriate for system	
	information design.	4.1
	4. The application website is easy to use.	3.9
	5. Attractive appearance of the application website.	4.1
	Average for all items related to usability	4.0
Information		
	6. The application website information is accurate.	4.1
	7. The application website information can be trusted.	4.0
	8. The application website information is relevant.	3.9
	9. The application website information is easy to understand.	4.0
	10. The application website information is in line with expectations.	4.0
	Average for all items related to information	4.0
Interaction		
	11.The application website has a good reputation.	4.0
	12. Feel safe and comfortable using the application.	4.0
	13. The application website provides personalization space.	3.9
	14. The application website service corresponds to what is presented.	4.0
	15. The application website provides convenience and attracts attention.	4.1
	Average for all items related to interaction	4.0
Satisfaction		
	16. Are you satisfied with the quality of use of the application website?	4.2
	17. Are you satisfied with the quality of information on the application website?	4.0
	18. Are you satisfied with the quality of interaction/service on the application website?	4.0
	Average for all items related to satisfaction	4.1

Results of the Questionnaire on Student Perception of the Web-Based Nursing Care Documentation Application

*Note.* N = 15.

The results of information system testing show that the nursing care information system can provide convenience, accuracy, and engagement.

## Discussion

Nursing information systems are a combination of computer science, information science, and nursing science, which are designed to assist in processing nursing data, information, and knowledge to support nursing care practices for clients (Saba & McCormik, 2021). Through the use of nursing information

systems, there is an increase in nurses' knowledge of documenting nursing care (Saputra et al., 2020). In line with this research, the literature review shows that the use of information systems in nursing documentation provides satisfaction to nurses because they feel that information systems can make it easier to obtain information to support decision-making and make it easier to prepare nursing care (Riyani & Hariyati, 2022). Additionally, a nursing information system can make it easier for students to understand diagnoses in nursing care (Sinaga, 2019)

The use of web-based learning must be adjusted to users' needs. It is hoped that attractive web-based media can draw students to study independently. However, web-based media must also be easy to access, use, and understand so students can learn outside the classroom (Figna et al., 2020).

Based on the usability dimension, which shows an average value of 4.0, the website application has good quality for users and features that are easy to learn and understand, easy to use, and have a user-friendly appearance and design. This shows that the features on the website application can run according to plan when tested on users. Meanwhile, the average value for the information dimension was also 4.0. This means that the information shown on the application is accurate regarding patient nursing care. Apart from that, the website application can produce reliable information, and the information provided regarding assessment results and diagnosis, intervention, and outcome data is easy to understand and relevant for users.

The findings for the interaction dimension also reached an average value of 4.0. This means that the application website has good quality and user interaction. The website application gives a positive impression to users because users feel safe when operating it, and it can attract users' interest and attention. Finally, the findings on user satisfaction scored an average value of 4.1, which means the website application is designed very well and able to provide a sense of satisfaction for users, both in terms of the quality of interactions, the quality of information produced, and also the quality of interactions with users. Overall, the web-based nursing care application can help students carry out nursing care for patients easily and systematically. This aligns with research by Khairan et al. (2022), who revealed that usability, quality, and information in expert systems could influence the satisfaction of software users. Research conducted by Rustiawati et al. (2021) also revealed that using digital media in the learning process makes it easier for students to learn and respond quickly to complete their assignments due to its interactive nature.

## Conclusion

This nursing care information system was created to help nursing students understand nursing care for patients even though learning is online. This web-based information system was developed based on the needs of user partners through needs analysis. The web-based nursing care information system refers to the nursing care standards applicable in Indonesia.

The usability testing results show that the nursing care information system developed is easy to understand, learn, and user-friendly. Students generally feel satisfied with the web-based nursing care information system. The results of student satisfaction with the web-based nursing care application show that the

application can be used as a learning medium that helps students enrolled in online learning. However, developing a nursing care information system needs to be strengthened with a decision support system to make it easier for users to make diagnoses and provide nursing care. Besides, the stability of the Internet network in educational institutions must also be considered so that students can access web-based nursing care applications freely.

## **Declarations and Ethics Statements**

The authors have no conflicts of interest to declare relevant to this article's content.

The authors have approved the manuscript for submission.

All procedures performed in the current study involving human participants were in accordance with the ethical standards of the institutional research committee.

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

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# Teaching Reform and Practice Based on Four Dimensions and One Penetration for Sensing and Detection Technology

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#### Abstract

Sensing and Detection Technology is a core course in engineering specialties. Traditional sensor teaching methods have obvious deficiencies in cultivating students' ability. To better foster students' comprehensive qualities, this study explored a 4D1P (Four Dimensions and One Penetration) teaching mode. We independently developed an industrial sensor teaching platform with intellectual property rights, integrating classroom and sensor experiments to address the disconnection between traditional sensor teaching and practical application. This mode combined the teaching platform with SPOC (small private online courses) and Rain Classroom teaching software, enriching classroom teaching, students' horizons were broadened and their creative thinking enriched. The mode set up discussion-based learning in the classroom, making the class atmosphere lively. Throughout the teaching process, data-driven learning and teaching evaluation were consistently applied, allowing teachers to promptly understand students' learning situations. Data shows that under the backdrop of the COVID-19 pandemic, students' grades improved and they were satisfied with this teaching mode. This mode solves most current problems in university classroom teaching and significantly enhances students' practical abilities. It also has certain significance for education in other disciplines.

*Keywords:* blended teaching and learning, sensor teaching platform, integration of industry-university and research, student-centered learning, 4D1P

## Introduction

The sensor is a device that can detect change in measured information and convert information into an electrical signal to meet the requirements of information transmission, processing, storage, display, recording, and control (Yuan et al., 2015). As a tool for obtaining information, sensors are increasingly recognized to be important in today's information age. Sensor technology is the pillar of modern information technology and an important guarantee for the operation of automatic measurement and control systems. With social progress, the increasing degree of automation of modern industrial production, and the pursuit of intelligent and comfortable living environments, dependence on sensors in various fields will increase. Therefore, research into sensor technology has become a key field across the world, and sensor technology has also become a key factor in the new technological revolution (O'Flaherty & Phillips, 2015). The mastery and application of sensor principles and technologies is becoming a basic skill and literacy relevant for engineers and technicians. Therefore, sensor courses are offered in many engineering programs in Chinese universities, such as Instrument Science and Technology, Mechanical and Electrical Engineering, Telecommunications Engineering, and Automation.

Sensing and detection technology is a complex discipline, involving mathematics, physics, chemistry, circuits, computer technology and other disciplines (Byukusenge et al., 2023). At present, most textbooks focus on the working principle of the sensor, and the practical application of the sensor is briefly introduced. Additionally, most sensor teaching in Chinese universities is done using teaching tools such as PowerPoint, resulting in a boring atmosphere that lowers students' enthusiasm and initiative and prevents active participation (Christensen et al., 2013). Furthermore, the disconnection between classroom teaching and sensor experiments leads to students passively receiving knowledge without having the chance to apply classroom-learned sensor knowledge to practical scenarios (Owston et al., 2013).

Nowadays, the teaching philosophy of student-centered learning (Beichner et al., 2007) is becoming increasingly popular in China. More and more Chinese universities are incorporating a wealth of online educational resources into their sensor courses to enhance teaching effectiveness. These online resources greatly mitigate the drawbacks of traditional classrooms and enrich students' knowledge (Zhao & Luo, 2020). However, these resources are mostly focused on theoretical explanations and lack introduction to sensor experiments, leading to a disconnection between theory and practice (Song & Kapur, 2017). To address this, many universities in China have set up sensor laboratories (Beichner et al., 2007), allowing students to learn to operate sensors in the lab after studying the concepts. However, due to limited lab space, there might be a considerable delay between learning the theory and practicing in the lab, which could weaken students' grasp of theoretical knowledge. Moreover, because of the large number of students, lab instructors are unable to attend to each student adequately, resulting in less precise sensor operations and suboptimal outcomes (Darling-Aduana et al., 2022).

This study analyzed the current situation of sensor teaching modes and found four main drawbacks:

- 1. Some students are dissatisfied with the breadth and depth of knowledge.
- 2. The time interval between theoretical knowledge and sensor experiments is too long.

- 3. Students are not highly motivated to attend class.
- 4. Students are unclear about the use of sensors in scientific research and factories.

These shortcomings lead to the current poor teaching effect of sensors. In order to overcome these drawbacks, we proposed a Four Dimensions and One Penetration (4D1P) teaching mode. This mode has five superiorities:

- 1. The mode introduces multiple online teaching resources to enrich students' knowledge.
- 2. The mode has a sensor teaching platform upon which students can learn sensor operation experiments remotely in the classroom.
- 3. In order to motivate students, the mode allows students to take part in group discussions.
- 4. The industry-university-research (IUR) integration enhances students' insights on the use of sensors.
- 5. By running teaching evaluation throughout the entire student learning process, teachers can better grasp students' learning conditions and evaluate student performance from multiple perspectives.

Preliminary results show that students were satisfied with this teaching mode; students' achievement and employment rates also improved.

## **Literature Review**

Sensing and Detection Technology is a core course of engineering majors, which has a pivotal position in the curriculum of many majors (Gui, 2020). The teaching goal of the course is to convey the principles of sensors and develop students' ability to use sensors to solve practical problems.

Research has revealed that a variety of teaching modes are widely used in sensor education across Chinese universities. The classroom teaching mode is a traditional instructional approach. In this mode, the majority of the time is spent on teacher-led instruction, which limits active student participation (Antepohl & Herzig, 1999; Smits et al., 2003). A major drawback of this mode is the lack of sensor experiments, preventing students from engaging with real sensors and thus detaching theory from practice. With societal advancements, modern educational software is becoming increasingly common. The Lecture-Based Learning (LBL) teaching mode integrates SPOCs (Lu et al., 2012), massive open online courses (Hone & El Said, 2016), Rain Classroom (Da-Hong et al., 2020), edX (Scimeca et al., 2018), Coursera (Mukala et al. 2015), Khan Academy (Murphy et al., 2014), and other modern teaching platforms (Balog & Pribeanu, 2010; Oproiu, 2015). Although these platforms can enrich students' knowledge, their content mostly explains the principles of sensors and lacks teaching of sensor experiments (Zeng et al., 2020). To make students more active in the classroom, some scholars have proposed a team-based learning (TBL) teaching mode, dividing

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students into groups to discuss problems and learn from each other in the classroom. This teaching mode can mobilize students' enthusiasm for class (Okebukola & Jegede, 1988) and help students better understand classroom content (Silberman et al., 2021; Michaelsen et al. 2023). However, when the teacher's grouping of students is fixed, it may separate good students from bad students, making it difficult for poor students to get help and not significantly improving overall class performance. After analyzing many teaching cases in Chinese universities, some Chinese scholars have proposed the BOPPPS teaching mode, which consists of six stages: bridge, objectives, pre-assessment, participatory learning, postassessment, and summary (Brown et al., 2021). The BOPPPS teaching mode focuses on interaction and reflection, and can stimulate students' enthusiasm in the classroom, improve teaching efficiency, and make students the centre of the learning process (Liu et al., 2022). However, this mode does not reasonably arrange sensor experiments, separating theoretical knowledge from sensor experiments (Ma et al., 2021). Project-based learning (PBL) is a teaching mode that combines theoretical knowledge with practice. After mastering theoretical knowledge in the classroom, students conduct relevant sensor experiments in the laboratory (Shi et al., 2018; Shin et al., 2021). Affected by teaching conditions, many universities in China lack resources, and schools need to reasonably arrange students' class schedules to allow students to conduct sensor experiments. Still, there may be a long gap between theoretical knowledge learning and experimental operations. When students start experiments, they may have forgotten the theoretical knowledge they learned (Sari & Prasetyo, 2021).

Currently, Chinese universities teach students to conduct sensor experiments mainly through virtual teaching platforms or Internet of things (IoT) experimental platforms. The virtual teaching experiment can meet student requirements through the virtual instrument software that allows students to design their own sensor experiments to measure physical quantities, but this method gives students contact with only a virtual sensor. Hence, students remain unfamiliar with sensors when they encounter them in real life (Dong et al., 2022; Song et al., 2020). Most universities have set up special sensor laboratories where students can use IoT platforms to conduct sensor experiments (Lui et al., 2023; Tran et al., 2021). Although these experimental platforms can meet the needs of students for sensor experiments, most universities have more students and less experimental equipment, which leads to the issue of meeting the needs of all students in a timely manner (Honar Pajooh et al., 2022).

Since these teaching modes and platforms have shortcomings and are not well-suited for modern sensor education, we integrated the strengths of the LBL, TBL, BOPPPS, and PBL teaching modes and, in conjunction with a proprietary industrial sensor teaching platform, developed the 4D1P teaching mode. This mode was implemented in the sensor courses at Hunan University in 2021 and has received very positive feedback from students.

## **Theory and Methodology**

This innovative teaching mode, 4D1P, is shown in Figure 1. Four Dimensions includes blended learning, classroom sensor experiments, IUR integration, and discussion learning. One Penetration means that teaching evaluation is integrated throughout the entire instructional process. The coloured boxes outside
the circle show the four main drawbacks to current teaching modes which were listed in the Introduction section of this article.

### Figure 1

### 4D1P Teaching Mode Framework



*Note*. 4D1P = four dimensions & one penetration.

Before showing the results of this research, the four dimensions and teaching evaluation are discussed in the sections that follow, beginning with blended learning.

## **Blended Learning**

With the popularization of computers and the Internet, traditional textbook teaching can no longer meet current requirements. More universities are adding online educational resources to classroom learning, forming a blended learning mode (Boelens et al., 2017). This learning mode can combine the advantages of traditional learning with the advantages of online learning, each complementing the other to achieve the best learning effect (Newby et al., 2000).

Currently, there are various types of online learning tools around the world. After comparing multiple online learning tools, we developed and implemented a blended learning method based on SPOC and Rain Classroom (Chen et al., 2022). With this mode, before class, the teacher publishes the content that students need to preview on the SPOC software. For difficult and abstract parts of the lesson, the teacher uploads videos to the SPOC software, so students can understand these contents more easily. At the same time, in order to consolidate students' knowledge, SPOC software assigns some online questions. In class, Rain Classroom based on students' answers to the SPOC questions to further consolidate knowledge points. Students mark unfamiliar knowledge points on the Rain Classroom software. After class, students can also log on to Rain Classroom to review courseware and difficult content. The content that students have not yet understood or have forgotten in class can be reviewed this way as well. In addition, more than 30 courseware and short videos were made and uploaded in the SPOC software. The teacher analyzes the results of SPOC and Rain Classroom tests every semester, finds out students' missing knowledge points,

and focuses on these knowledge points in the next semester. The teacher will also find out students' most difficult to understand knowledge points based on browsing records, then supplement the corresponding knowledge points on the software and focus on introducing them in the next semester's teaching. After several years of experiments and adjustments, the blended teaching mode of offline SPOC and online Rain Classroom has been fully formed, strengthening students' knowledge foundation, expanding their horizons, and allowing students to acquire more useful knowledge.

## **Classroom Sensor Experiments**

### Sensor Teaching Platform

Sensing and detection technology is strongly an applied subject, where students need to learn theoretical knowledge as well as how to use sensors. In large teaching classrooms, students cannot see sensor experiments conducted at the front of the room very well. For example, students sitting at the back will not be able to see much detail. In the laboratory, students cannot understand how sensors are used in real industrial environments, as sensor experiments in a lab are disconnected from reality. To allow students to better watch sensor experiments in real industrial environments, we developed an industrial sensor teaching platform with intellectual property rights. A schematic diagram of the sensor teaching platform is shown in Figure 2; it consists mainly of industrial sensors, hardware, and software. Sensor data is collected through the collection terminal. The collected data can be transmitted to the teacher's computer via the RS485 communication protocol or to the student's computer via 5G. At the same time, the teacher's computer can also transmit operation videos, chat content, and experimental data to the student's computer via remote live broadcast and discussion functions.

This platform is suitable for industrial sensors with a 4-20mA output. Industrial sensors whose output is not 4-20mA can also be used on this teaching platform after conversion to 4-20mA through a converter. We purchased 10 types of analog sensors, covering most of the sensor knowledge points in sensing and detection technology, for use in this course.

### Figure 2



Schematic Diagram of the Sensor Teaching Platform

*Note*. RS485 is a communication protocol used in this platform.

The hardware part of this platform consists of a collection terminal and a communication module. The collection terminal is a multi-channel IoT collection terminal that can simultaneously collect data from multiple sensors. The communication module consists of an RS485 communication protocol and a 5G module. RS485 can transmit data collected by the terminal to the teacher's computer via a USB interface. The 5G module ensures that the teacher's operation screen and collected data can be displayed in real-time on a student's computer.

The software part of this platform is written in Python and PyQt. To more accurately display data on the software interface, it is necessary to calibrate the data collected by the collection terminal. Users need to set an accurate linear calibration formula according to the specifications of the sensor, and the calibration formula will be saved in the platform's database for direct use in the next experiment. In addition, an interface for displaying measurement data is designed, and the background will automatically produce a line chart of all data collected in the experiment for teachers and students to analyze. Through the video live broadcast function of this platform, students can immediately watch sensor operation experiments in real industrial environments, which will help students use sensors in future in real life. To better communicate and interact with students in the classroom during remote experiments, this platform has a discussion room. Students and teachers can promptly communicate any questions about operation experiments in the classroom.

We partnered with companies to mass produce this sensor demonstration platform, which universities can purchase at an affordable price. This demo platform is user-friendly and easy to operate. Users simply need to connect the sensor to the demonstration platform according to the operating instructions and then adjust the linear calibration to display sensor data in real-time on a computer. The platform also includes a database feature, which facilitates the retrieval of past operational data by teachers.

## Measurement Experiment

For this study, we applied the sensor demonstration platform to sensor courses offered at Hunan University. As the platform can collect experimental data from multiple sensors simultaneously, it aids in setting up comparative experiments to demonstrate the use of different sensors. Through this comparative approach, students can better understand the principles and characteristics of each sensor. Figure 3 shows an example of a comparison experiment being demonstrated and livestreamed and the role played by the sensor teaching platform in facilitating interaction between the laboratory teacher, the classroom teacher, and students.

### Figure 3



Sensor Experiment Demonstration Showing the 4D1P Teaching Platform

Sensor experiment

**Class presentation** 

The experiment shown in Figure 3 is a comparison experiment that used two different sensors to measure distance. Distance is a physical quantity that measures the length from one object to another. In daily life, various sensors can measure distance. In this demonstration experiment, an eddy current sensor and a laser distance sensor were used. The principle of distance measurement by the eddy current sensor is based on the eddy current effect produced by the movement of a metal plate. When a metal sheet moves near the sensor, the sensor will generate an induced current, and the current size can be converted into distance through a conversion formula. This sensor is a non-contact sensor with strong resistance to external interference, suitable for measurement in harsh environments, but it can only be used for current measurement on conductive materials. The theory of distance measurement by the laser distance sensor is to emit infrared rays from the sensor, which are reflected back to the sensor when encountering an object, and the time difference is converted into distance. This sensor is also a non-contact sensor, with a fast response time, capable of completing distance measurements in a very short time, suitable for applications requiring high real-time performance, but it is not suitable for use under strong light irradiation.

In the experiment shown in Figure 3, the teacher in the industrial environment used the eddy current sensor and laser distance sensor to measure the distance between objects. Through the communication module of

the sensor teaching platform, the operation video and sensor measurement data were transmitted to the classroom as the classroom teacher and the laboratory teacher jointly explained the experiment. Students could ask questions to the two teachers through the discussion room function. Some of these questions were directly answered by the experimental teacher's operation of the sensor, as students will better understand these problems when they see them rather than through mere theoretical explanation.

Through this platform, it was possible for the teacher to demonstrate the use of multiple different sensors in the classroom at the same time. Through different sensor measurement experiments on the same physical quantity, students could better understand the practical application of sensors in real life and have a deeper understanding of the principles and characteristics of sensors.

### **IUR Integration**

With the development of society, traditional school education can no longer meet social needs. In order to cultivate high-quality talent that meets market demands, some scholars have proposed a teaching mode that has a close cooperative relationship between schools and enterprises, integrating the actual needs of enterprises and students' knowledge and skills in the teaching process (Kinshuk et al., 2013). This mode could provide students with professional knowledge, promote effective communication between enterprise and schools, achieve improvement of teaching modes, and enhance discipline development and innovation. This mode could make full use of various teaching environments and resources among industries, universities, and research institutions, as well as their respective advantages in talent cultivation (Xie 2019). What's more, the mode could also organically combine school education focusing on imparting knowledge in the classroom with education forms that directly acquire practical experience and scientific research practices. This is a fundamental scheme to solve the problem of the disconnection between school education and social needs, narrowing the gap between school and society in talent cultivation, and enhancing the competitiveness of university students.

To help students better understand the application of sensors in laboratories and production industries, we organize students to visit the school's research laboratories and some sensor factories once a month, allowing students to master the use of sensors through actual cases of scientific research and industry and gain some innovative inspiration (Zheng et al. 2021). In addition, students are assigned sensor design homework, requiring them to choose sensors learned from a textbook for specific scenarios to solve practical problems in industry and scientific research. An example from this assignment would be how to use sensors to design a rainwater detection device. Students would first need to provide a solution, then build their sensor detection system based on this solution, and finally present the final detection effect in the classroom, while the teacher poses questions. This design homework is evaluated based on the detection effect of the student's solution and their response to questions. By completing this homework, students can solve actual problems through hands-on practice, while enhancing their understanding of classroom knowledge points.

### **Discussion Learning**

At present, university students' enthusiasm for attending classes is generally not high, leading to low

classroom efficiency (Larson & Keiper 2002). Although some teachers also introduce discussions into classroom teaching, they do not have many restrictions on student grouping, which can lead to students with good academic performance gathering in the same group, resulting in poor overall effectiveness of student group discussions, where some students are left behind.

In order to prevent high-achieving students from clustering, we dynamically group students based on the results of SPOC software tests. During class, teachers pose questions about sensor applications or experiments and ask students to discuss these within a designated time frame. Each group is then required to choose a representative to present their discussion results. If students have doubts about these results, they are encouraged to raise objections, fostering their ability to question. This method significantly enlivens the classroom atmosphere, stimulates students' interest in learning, and deepens their understanding of sensors. The 4D1P teachers also record the discussion and award points to the speaking representatives and those who raise questions, with the possibility of accumulating up to 10 points.

## **Teaching Evaluation**

Previously, traditional course evaluations relied mainly on final exams and homework, ignoring sensor experiments and classroom tests, bringing great limitations. To strengthen the evaluation of student learning outcomes, we developed a comprehensive multi-assessment system for this course, including midterm and final exams, sensor design homework, experiments, discussions, Rain Classroom tests, and SPOC tests. Before each class, the lecturer prompts students to preview and complete online questions using the SPOC software. Since this part primarily involves understanding students' pre-class preparation, the standardized scoring for this section is set at 10 points. In the classroom, open-ended questions promote group discussions, awarding points to speaking representatives and students who raise doubts, with this scoring standard accumulating also a total of 10 points. In addition, the teacher arranges classroom tests through Rain Classroom, and the scores obtained by students at the end of the course are converted into a standardized score of 10 points. In addition, half an hour before class, students present their sensor detection systems, and the lecturer scores them, based on the detection effect and Q&A situation, for another total score of 10 points. The midterm exam, arranged after six weeks of the course, evaluates students' learning situation, with a total score of 20 points. The final exam, arranged two weeks after the end of the course, evaluates students' learning situation in the semester, with a total score of 30 points. The cumulative score of these different evaluations is 100 points. By adopting this evaluation system, dividing the total score into the sum of scores of many small tasks, instructors ensure that students can concentrate on completing each small task, allowing students to participate in every part of sensor teaching. This diversified evaluation method aims to compensate for the problem of insufficient attention in the classroom and more comprehensively understand students' performance throughout the course. This evaluation system is applicable to courses other than sensor courses.

### Table 1

Evaluation	Mid-	Final	Sensor	Sensor Process evaluation				
mode	term		design task	Е	D	RC	SPOC	
Points <i>n</i>	20	30	10	10	10	10	10	100

Multiple Evaluation System for the Sensor and Detection Technology Course

Note. E = experiment; D = discussion; RC = Rain Classroom test; SPOC = SPOC test.

## Results

Previous teaching methods for the Sensor and Detection Technology program have been diverse. However, since 2021, the 4D1P teaching mode has been widely used in Hunan University. In comparison to previous teaching methods, the 4D1P mode has resulted in significant improvement in students' academic performance, and students have gained a deeper understanding of sensors. Additionally, according to an anonymous survey distributed to students at the end of the semester, students are satisfied with the teaching mode and believe that their abilities have been enhanced.

### **Rain Classroom Test Data**

Rain Classroom is a teaching software for real-time classes. It can help students take class tests and consolidate knowledge learned in class. Since 2017, Rain Classroom has been used in the Sensor and Detection Technology course. As shown in Table 2, with the continuous improvement of Rain Classroom functions, the number of questions (NoQ) increased year by year. There were only 15 questions in 2018, but the NoQ in 2022 was 43; in just four years, the number of problems increased nearly threefold. The reason for this phenomenon is that the teacher supplements the questions based on students' learning situations.

### Table 2

Measure	2018	2019	2020	2021	2022
NoQ	15	34	30	39	43
AAR (%)	53.31	57.78	49.43	56.89	60.30

Rain Classroom Testing Results

*Note*. NoQ = number of questions; AAR = average accuracy rate.

In addition to the increase in the NoQ, the average accuracy rate (AAR) of students has also improved, with the exception of 2021. For example, the AAR in 2018 was 53% and the ARR in 2022 was 60%. The AAR was relatively low in 2020 because of the impact of the COVID-19 pandemic, when the school had to adopt online teaching, which greatly reduced the teaching effect. Besides the overall improvement in teaching,

there was increased accuracy for questions in three chapters which have sensor experiments. This improvement is shown in Table 3. Before 2021, the accuracy growth in Chapter 2 was relatively slow. After 2021, the 4D1P teaching mode was used. Despite the COVID-19 pandemic, students gained a deeper understanding of sensor experiments. This data suggests that the 4D1P mode helps students improve their mastery of the course knowledge.

### Table 3

Percent Accuracy of Student Responses to Questions Related to Demonstration Experiments

Chapter	2019	2020	2021	2022
2-1	6.3	12	11.3	29
2-2	17.5	14	12.1	41.0
2-3	40.7	70.5	52.5	73.0

### **SPOC Test Data**

After professors at the University of California, Berkeley proposed the concept of SPOC, teaching institutions around the world began incorporating the SPOC concept into the classroom. Currently, many SPOC online education platforms and corresponding software have emerged in China. In order to better broaden students' knowledge, SPOC software was introduced in this sensor course in 2020 for students' preclass preview. Before class, the teacher arranges for students to preview contents on the SPOC software, and at the same time, SPOC software offers some classroom tests to measure students' learning effectiveness. Table 4 shows the average scores for each weekly test in the 2020–2022 SPOC courses. As shown, the score of students is increasing year by year, from 93.09% in 2020 to 94.32% in 2022, which suggests that students have more profound understanding of theoretical knowledge and have greatly improved their learning efficiency.

### Table 4

2020–2022 Average scores for tests in the SPOC course

Week	2020	2021	2022
1	7.1/8	11.1/12	10.9/12
2		11/12	11/12
3	10.9/12	11.2/12	11.3/12
4	13.8/16	14.5/16	15.4/16
5	13.5/14	13.3/14	13.5/14
6	9.6/10	9.8/10	9.6/10
7	7.3/8		7.8/8

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8	11.7/12	11.6/12	11.5/12
9	9.6/10		9.6/10
10	9.6/10	8.9/10	8.9/10
11	9.3/10	9.4/10	9.2/10
Average score (%)	93.09	93.33	94.32

Note. Empty cells indicate there is no class in this week.

### **Final Multiple Evaluation**

Before 2021, the BOPPPS teaching mode was the main mode used in the Sensing and Detection Technology course at Hunan University. Since 2021, the teaching mode has changed to 4D1P. In order to better evaluate students' learning situation, we proposed a diversified course evaluation system. As was shown in Table 1, the overall course grades were composed of seven parts: midterm exam, final exam, sensor design assignment, sensor experiment, classroom discussion, Rain Classroom test, and SPOC test. These evaluation metrics correspond to the 4D1P teaching mode. This evaluation system has the potential to improve students' overall quality, students can improve practical skills through the experimental part, team cooperation ability through the discussion part, mastery of knowledge points through exams, and their ability to solve life and scientific research problems through sensor design homework. Table 5 displays the results of the final multiple assessments for the years 2018–2022, during which the course scoring system and course content did not change. From Table 5, it can be seen that compared to the BOPPPS teaching mode, the 4D1P teaching mode significantly improves students' grades and since the standard deviation has decreased, this result may indicate that this improvement is more consistent.

### Table 5

Year	Students n	Average score	SD
2019	67	80.4	6.8
2020	67	81.3	7.8
2021	68	82.1	7.0
2022	61	82.9	6.0

Results of Students' Final Marks Under the Multiple Evaluation System

## **Classroom Survey**

In order to understand students' views on the 4D1P teaching mode, an anonymous questionnaire was sent at the end of the 2021 semester to 62 students participating in the study through the WeChat group, and 48 responses were received. Several typical survey questions and their corresponding results are listed in Table 6. It can be concluded from these results that: (a) students recognize that this teaching mode can stimulate their interest in learning ; (b) they believe that this teaching mode can help them better master laboratory skills; (c) most students believe that this teaching mode can enable them to better master theoretical knowledge; (d) they think that they can better participate in classroom teaching; (e) most students are satisfied with this teaching mode ; and (f) they are also willing to share this teaching mode with other students. Students are quite satisfied with this teaching mode. In addition, they think the teaching mode is better for them to understand knowledge and master sensor experiments.

### Table 6

Resul	ts of	the S	Stude	nt Su	rvey A	About	the 4	4D1P	Teacl	ing I	Mode	?

Question	M	SD	Minimum
Do you think the teaching mode inspires your interest?	9.20	0.60	8
Do you think the teaching mode is helpful for your mastering of experiment skills?	9.42	0.51	9
Do you think the teaching mode is better for you to understand knowledge?	9.51	0.48	9
Do you think the teaching mode will enable you to better participate in the classroom?	9.38	0.67	9
Are you satisfied with the teaching mode?	9.19	0.85	8
Will you recommend the teaching mode to other students?	9.13	0.77	8

*Note.* n = 48. Survey scale ranged from 1 (*weakly*) to 10 (*strongly*).

# Conclusion

In alignment with the student-centered teaching concept, this research examined the 4D1P teaching mode applied to the Sensor and Detection Technology course of Hunan University. This teaching mode also solved the four drawbacks of the current sensor course:

- 1. Students' breadth of knowledge was enriched through the hybrid teaching method of SPOC+ Rain Classroom, the introduction of multiple courseware and videos from online courses, and the design of multiple courseware and micro-videos according to university requirements.
- 2. The sensor teaching platform brings industrial sensor experiments into the classroom, so that students can learn sensor operation by remote video live broadcast after learning theoretical knowledge. As a result, students become equipped to more conveniently use sensors to solve

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practical problems in their future lives.

- 3. Students' creativity was stimulated as a result of visiting the school's sensor research laboratory and sensor factory and seeing the practical application of sensors in scientific research and production.
- 4. Students were more able to participate in discussions in class since the teaching mode dynamically groups students according to their pre-study grades and sets up open-ended questions about sensor experiments in class, so that students' enthusiasm in class improved.

In addition, a diversified curriculum evaluation system that can better evaluate students' comprehensive qualities was introduced. This evaluation system runs through the entire process of learning about sensors. According to the results of the questionnaire and the grades of students, it can be seen that students are very interested in this teaching mode, and this teaching mode has a significant impact on improving grades. The 4D1P teaching mode can not only be applied to sensor courses, but also to courses such as optoelectronic detection, image processing, non-destructive testing, Structural Health Monitoring, fault diagnosis, and so forth. However, the 4D1P teaching mode still has the following drawbacks:

- 1. This teaching mode requires active participation from students and will consume a considerable amount of their spare time.
- 2. This teaching mode requires the support of the school's strong scientific research capabilities in order to provide students with a broad sensor experimental platform.
- 3. This teaching mode also requires a considerable amount of effort from the teacher, usually requiring the assistance of a teaching assistant.

Future sensor teaching should integrate more high-tech technologies to provide richer, personalized learning experiences. Schools will need to establish closer cooperation with enterprise to provide more practical opportunities to cultivate students' ability to solve practical problems.

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## Declarations

The authors declare that they have no competing interests.

# **Data Availability Statement**

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## **Informed Consent**

All participants were informed about the aim and scope of the study as well as the ways the data would be used. The respondents' participation was completely consensual, anonymous, and voluntary. Informed consent was obtained from all individual participants included in the study before they participated in the survey. The rights of respondents are safeguarded in this study in line with the Declaration of Helsinki.

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# Navigating Challenges in Remote Speaking Tasks: Unveiling Technical and Non-Technical Problems Faced by Students

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# Abstract

In today's digitally driven era marked by widespread remote communication, individuals grapple with diverse challenges when undertaking speaking tasks from a distance. Despite extensive research on communication dynamics in virtual contexts, the specific hurdles associated with remote speaking tasks remain understudied. This research addresses this gap by qualitatively exploring the complexities of such challenges and proposing practical strategies for effective communication in virtual environments. Employing a qualitative research approach, a survey with open-ended questions was administered to 19 students in the English Education program, and NVivo 12 was used for analysis. The findings highlight technical and non-technical challenges in remote speaking tasks, emphasizing the critical role of digital proficiency and a stable technical infrastructure. The study underscores the need to address personal and social aspects, suggesting solutions that encompass a precise and adaptive approach, including ensuring a reliable Internet connection, strategic use of digital resources, enhancement of technical skills, and a holistic strategy to tackle both technical and non-technical challenges. This research implies that educators should prioritize developing students' digital proficiency and adopt a comprehensive approach that tackles both technical and psychological challenges, aiming to boost confidence and interpersonal skills in virtual learning environments.

Keywords: remote speaking task, students' challenges, technical issue, non-technical issue

# Introduction

In the contemporary landscape shaped by the prevalence of remote communication, individuals grapple with various challenges when engaging in speaking tasks from a distance. This has become particularly pertinent in the face of ongoing global issues that have accelerated the shift toward virtual platforms. The intricacies of expressing oneself effectively in a digital realm extend beyond technical hiccups and encompass broader concerns. The absence of in-person dynamics, compounded by the limitations of virtual communication tools, poses obstacles to clear and impactful expression. In a world where crises and disruptions necessitate swift and effective remote communication, understanding and addressing these challenges becomes paramount for individuals and organizations as they navigate the complexities of articulating ideas in an ever-evolving digital landscape.

The importance of understanding and addressing the challenges associated with remote speaking tasks cannot be overstated in the contemporary digital landscape. With the pervasive shift towards virtual communication in both professional and personal spheres, individuals and organizations must grapple with the complexities that arise from the absence of traditional face-to-face interactions. Clear and effective communication in a remote setting is integral to professional success, educational outcomes, and the cultivation of strong interpersonal relationships. This study seeks to underscore the significance of navigating the nuances of remote speaking challenges. It provides valuable insights that can empower individuals to enhance their communication strategies and thrive in an environment increasingly characterized by virtual interactions. As the reliance on remote communication continues to grow, the ability to master the art of speaking effectively in virtual spaces becomes not just advantageous but imperative for success in various facets of modern life.

Scholars have investigated communication dynamics, contextual factors, and the broader implications of remote interactions across professional, educational, and personal contexts (Laske et al., 2023; Manurung et al., 2023). However, these studies have primarily focused on describing the phenomenon without explicitly delving into the challenges associated with remote speaking tasks. While contributing to a general understanding of virtual communication, there needs to be more clarity in identifying and addressing the specific hurdles and difficulties individuals may encounter in these scenarios. Thus, the research questions in this study are as follows:

- 1. What are the challenges faced by students in remote speaking tasks?
- 2. What strategies are used by students to overcome challenges in remote speaking tasks?

# **Literature Review**

## **Technology and EFL Speaking Skills**

In English language education, ongoing strategies are evolving to refine the speaking skills of English as a foreign language (EFL) students. Studies by Bakri et al. (2019), Encalada and Sarmiento (2019), and Lu et al. (2019) have offered valuable insights into effective approaches for enhancing EFL students' speaking

skills, including self-recording videos (SRV) and online video clips. These methods have shown benefits such as increased motivation, improved speaking abilities, and reduced communication apprehension. Incorporating visual, auditory, and kinesthetic (VAK) learning style activities has also been found to significantly improve fluency, comprehension, and accuracy in EFL instruction. However, it is important to note that while these strategies offer promising results, their effectiveness may vary based on individual student needs, teaching contexts, and technological resources available. Further research and adaptation of these strategies to suit diverse learning environments are essential for ensuring comprehensive and sustainable improvements in EFL speaking skills.

Moreover, research by Namaziandost, Nasri, and Keshmirshekan (2019) highlighted the role of social media in enhancing oral proficiency, while Takenouchi et al. (2019) revealed insights into smartphonebased English learning systems. These findings underscore the potential of technology, particularly social media and smartphone-based systems, in English language education. Studies by Altın and Saracaoğlu (2019) and Kanoksilapatham and Suranakkharin (2019) have emphasized the positive impact of varied instructional strategies and experiential approaches on language skills and learners' perceptions. Educators can benefit from these insights by integrating engaging and experiential methods into their teaching to cater to diverse learning preferences and enhance language learning experiences. The cited research provides valuable insights into the role of technology in language education, particularly social media and smartphone-based systems. However, the studies mentioned could benefit from more comprehensive evaluation of the long-term effectiveness and sustainability of these technological interventions. Additionally, there is a need for further investigation into potential drawbacks or limitations associated with over-reliance on technology in language learning contexts.

## **Innovative Approaches in Online Language Education**

In online language education, educators are increasingly adopting innovative methods to enhance student engagement and performance, focusing on the evolving perspective of remote speaking. Studies by Kusuma et al. (2021) and Kusuma and Waluyo (2023) have highlighted the potential of e-portfolios for evaluating speaking proficiency, observing active participation across cognitive, affective, and behavioral domains in online speaking courses, with significant improvements in speaking performance and self-efficacy noted through strategic e-portfolio use. Complementary research by Khotimah et al. (2022) explored podcastbased speaking activities, revealing students' enthusiastic involvement and resilience in overcoming technical challenges, particularly emphasizing the role of supportive learning environments and collaborative peer interactions. Pratiwi et al. (2022) and Wong and Yunus (2023) have demonstrated enhancements in speaking skills through the flipped classroom model and the Flippity tool, respectively, while broader insights from Falode and Mohammed (2023) underscored the positive impact of video-based courseware on retention and satisfaction in distance learning contexts. Saputra et al. (2023) and Li (2022) have highlighted positive perceptions of online learning platforms such as Google Meet, although challenges including family interference and financial difficulties, as discussed by Manurung et al. (2023), suggest the importance of a comprehensive approach that addresses technological infrastructure and socioeconomic factors for a holistic and inclusive landscape in online language education.

However, these studies have also underscored the need for further research on the long-term effectiveness and scalability of these innovative approaches to ensure sustainable improvements in online language education. While the studies mentioned showcase promising advancements in online language education, there remains a critical need for rigorous evaluation and long-term assessment of these innovative methods. The current literature highlights success stories and positive perceptions but lacks comprehensive analysis of potential drawbacks or limitations that could affect scalability and sustainability. Additionally, addressing challenges like family interference and financial barriers requires a more nuanced approach, incorporating broader socioeconomic considerations into the design of online language education strategies.

## Language Learning Challenges in Diverse Educational Settings

Effective online speaking in the modern digital world is fraught with difficulties, such as dealing with technical issues, reading non-verbal signs, and keeping an audience's attention (Fridland & Gotian, 2021; Prentiss, 2021). The absence of face-to-face interaction amplifies miscommunication risks, stressing the need for clarity and conciseness (Prentiss, 2021). However, a lack of depth in addressing specific online communication nuances such as cultural differences and linguistic barriers persists, often relying on vocal tone, body language, and visuals without considering potential limitations. Despite these challenges, online speaking offers global reach, flexibility, and accessibility (Kuzina et al., 2021; Prentiss, 2021). While online speaking presents advantages, its reliance on technology exposes vulnerabilities to disruptions, necessitating continual adaptation to evolving digital platforms and communication nuances and cultural sensitivities, potentially leading to misunderstandings or misinterpretations in diverse online environments. Moreover, the reliance on facial expressions in online speaking highlights the limitations in conveying nuanced emotions and complex messages, calling for further advancements in digital communication technologies for more effective online interactions.

In language learning, various studies have highlighted similar themes. The content and language integrated learning (CLIL) programs in Finland encountered proficiency challenges, indicating the need for additional support (Roiha, 2019). Similarly, interventions such as debating techniques in Jordan have underscored the importance of tailored support for effective learning outcomes (Huwari, 2019). Cooperative learning methods in Iran and cognitive strategies for second-language learners have also demonstrated positive impacts on oral skills and speaking proficiency, emphasizing effective teaching methods (Namaziandost, Shatalebi, & Nasri, 2019; Sreena & Ilankumaran, 2019). Moreover, challenges faced by Libyan EFL instructors, such as e-communication tool difficulties, align with the broader theme of needing enhanced technical skills for online teaching (Abdelatia et al., 2023). These findings collectively emphasize the need for improved support, customized content, and tailored approaches to address diverse challenges in online language teaching and learning environments. However, it is crucial to note that while these studies provide valuable insights, they often lack in-depth analysis of the root causes of these challenges and may not offer comprehensive solutions to address them effectively. More research focusing on the underlying factors contributing to proficiency issues, the specific mechanisms of tailored support, and the development of advanced technical skills is necessary to create sustainable improvements in online language education.

# Methodology

## **Research Design**

This study extensively explored challenges in remote speaking tasks and students' strategies. Using a qualitative approach with 19 students, we collected data through a questionnaire designed to understand students' challenges and strategies in addressing remote speaking tasks. The questionnaire, consisting of 10 items, drew from literature on remote learning and communication strategies, covering various aspects of students' experiences in virtual speaking environments. This approach ensured a comprehensive exploration of the research objectives while allowing detailed participant input.

## **Participants**

This study focused on 19 students in an English program during the third semester of the 2023–2024 academic year. They were studying English Education at a private university in Indonesia (Universitas Nahdlatul Ulama Sunan Giri). We intentionally chose this setting to understand how students feel about learning English at the university. By selecting students from an English program, we wanted to hear different perspectives on the challenges of learning English. Considering the semester timing helped us understand how feelings may have changed during the school year. This research aimed to help us learn more about teaching English, though it might also be useful for similar schools.

# **Data Collection**

An electronic survey with 10 open-ended questions (e.g., What is your general experience with remote speaking tasks? What is most interesting or challenging for you? Have you encountered any specific challenges during remote speaking tasks? How do you overcome these challenges?) was distributed to 19 students from the English Education program at Universitas Nahdlatul Ulama Sunan Giri to gather data. The questionnaire focused on understanding students' experiences with remote speaking tasks in English semantics courses held online. The types of remote tasks in these courses included making videos uploaded to YouTube. Importantly, the survey was administered at the end of the semester, allowing for comprehensive reflection on their experiences throughout the course. This contextual detail clarifies the research setting and the insights gained regarding students' experiences with remote speaking tasks in online English semantics courses.

# **Data Analysis**

The potential challenges faced by students that have been revealed in previous research can be categorized into technical challenges, such as technology-related obstacles and communication difficulties, and non-technical challenges, including pedagogical issues, psychological well-being concerns, and resource access limitations (Bashir et al., 2021; Hijazi & Alnatour, 2021; Olifant et al., 2022). In response to these challenges, students employ strategies such as enhancing technical skills, fostering motivation and engagement, improving communication and collaboration, adapting teaching methodologies, and addressing psychological and emotional factors to optimize their learning experiences in online and remote settings (Alasmari & Alkhamees, 2022; Hamad et al., 2021; Qi et al., 2021; Ta'amneh, 2021).

For qualitative analysis of these findings, we used NVivo 12 because it has been proven highly effective in providing insights and organizing data comprehensively (Bazeley, 2018, Chapter 1). Our initial step involved inputting the data into NVivo, followed by carefully identifying patterns and themes in the responses through a coding process. After the coding phase, NVivo 12 facilitated a thorough data exploration, assisting us in interpreting the factors influencing participants' perspectives. The software also produced visual representations of patterns and trends, making it easier to interpret the information. Ultimately, NVivo 12 was essential in presenting our findings as it was able to generate clear reports and visuals. This analytical approach aimed to uncover attitudes toward remote speaking tasks and provide valuable insights into language education within our specific context.

# Findings

# **Challenges Faced by Students in Remote Speaking Tasks**

The word count analysis of the research data (Figure 1) on remote speaking tasks revealed a comprehensive exploration of challenges and experiences in a virtual communication setting. The frequent mentions of "Internet" and "connection" underscore the crucial role of a stable digital infrastructure in facilitating remote communication. Moreover, the prominence of terms such as "editing," "video," and "storage" sheds light on the technical intricacies inherent in creating and managing video content, drawing attention to the multifaceted challenges faced by individuals engaged in remote speaking tasks.

Beyond the technical aspects, the narrative delved into non-technical challenges, as evidenced by recurring terms such as "challenging," "overcome," and "obstacle." These words signify the persistent hurdles individuals must navigate, emphasizing the resilience required for remote speaking tasks. Terms such as "confidence" and "communication" emphasize virtual communication's psychological and interpersonal dimensions, indicating potential impacts on individuals' self-assurance and effective interaction in the remote learning environment. Overall, the research findings depict a complex landscape where technical and non-technical challenges intertwine, providing valuable insights into the intricacies of remote communication and offering a foundation for developing strategies to enhance the effectiveness of virtual learning experiences.

### Figure 1

Frequently Occurring Words Used by Participants Identifying Remote Speaking Task Challenges



The identified obstacles (Figure 2) to remote speaking tasks are neatly categorized into two distinct domains: technical problems and non-technical problems. Students navigating remote learning environments encounter a myriad of challenges stemming from various factors. First, geographical disparities contribute significantly, with students living in remote rural areas often grappling with limited Internet access and connectivity issues. This can result in frequent disruptions during online classes, hindering the smooth flow of learning activities. Furthermore, the complexity of the curriculum adds another layer of difficulty, especially when students struggle to comprehend and internalize extensive texts. This challenge is exacerbated by limited cellphone storage capacities, particularly for those using older or less advanced devices, making it challenging to store and access educational materials efficiently. In addition to technological limitations, many students face hurdles in developing proficient video editing skills. The lack of familiarity with editing software and techniques hampers their ability to produce high-quality video assignments, impacting their overall learning experience. Moreover, the transition to online learning environments has highlighted gaps in students' technological literacy and usage. Some students are still in the process of adapting to using digital tools effectively for educational purposes, leading to inefficiencies and delays in completing tasks.

Another significant issue arises from the lack of dedicated study space at home. Many students find themselves working amidst family activities or in shared living spaces, leading to frequent interruptions and interference in voice transmission during virtual meetings and discussions. This not only disrupts the learning process but also affects the quality of communication and collaboration among peers. Addressing these multifaceted challenges requires a comprehensive approach that includes improving Internet infrastructure in rural areas, providing targeted support for topic comprehension and memorization techniques, offering alternative storage solutions or cloud-based resources for educational materials, implementing training programs for video editing and digital literacy skills, and creating guidelines or

resources to help students optimize their home learning environments for minimal disruptions and maximum productivity.

On the other hand, the non-technical challenges involve psychological and interpersonal factors such as nervousness, lack of interaction, lack of confidence, and anxiety. The causes of these factors can be multifaceted. Nervousness often stems from a fear of judgment or performance pressure, especially in situations such as public speaking or presentations. Lack of interaction can result from shyness, social anxiety, or feeling overwhelmed in group settings. Similarly, lack of confidence may arise from past negative experiences, self-doubt, or imposter syndrome, where individuals question their abilities despite evidence of competence. Anxiety, in this context, can be triggered by various stressors, such as deadlines, expectations, or unfamiliar environments, leading to heightened emotional responses and difficulty in managing stress effectively. These non-technical impediments underscore the significance of addressing personal and social aspects for successful remote speaking, emphasizing the need for strategies beyond technical competence to ensure effective and confident communication in virtual environments. The clear distinction between technical and non-technical problems provides valuable insights for devising comprehensive solutions to enhance remote speaking proficiency.

### Figure 2



Obstacles to Remote Speaking Tasks as Identified by Study Participants

In exploring the challenges inherent in remote speaking tasks, the research results shown in Figure 3 reveal a hierarchical structure that delineates the significance of various obstacles. At the forefront of technical challenges is the prominence of poor video editing, asserting the critical role of visual presentation skills in remote communication. Following closely are issues rooted in technological infrastructure, encompassing hurdles such as insufficient cellphone storage, problematic Internet connections, and difficulties in text memorization. These underscore the necessity of reliable connectivity and efficient content recall. The challenges of voice interference and unskillful technology usage further highlight the importance of seamlessly integrating audiovisual elements and mastering communication tools. Transitioning to the non-technical domain, lack of interaction emerges as a noteworthy challenge, indicating a pressing need for heightened engagement and connectivity in virtual settings. Lastly, psychological factors such as nervousness, lack of confidence, and anxiety assume a foundational role in the hierarchy, emphasizing the imperative to address both technical and human aspects for effective remote speaking tasks. This narrative interpretation unveils the intricate interplay of challenges, providing a structured understanding of their varying degrees of importance within remote communication endeavours.

### Figure 3

Hierarchy Chart of Obstacles in Remote Speaking Tasks



Note. This figure is hierarchy from the greatest obstacles to the lowest ones (left to right).

# Student Strategies to Overcome the Challenges in Remote Speaking Tasks

Strategies employed by students to address the multifaceted challenges encountered in remote speaking tasks necessitate a holistic and comprehensive approach. One of the primary hurdles faced by students is the geographical disparity that contributes significantly to limited Internet access, particularly in remote rural areas. To mitigate this, efforts must be directed towards finding and establishing a reliable Internet connection, ensuring uninterrupted participation in online classes and discussions. Additionally, the issue of limited cellphone storage capacity poses a considerable obstacle, hindering students' ability to efficiently

store and access educational materials. Deleting unnecessary apps to free up storage space can help alleviate this concern, facilitating smoother access to essential resources.

Another significant aspect is the complexity of the curriculum, which often presents challenges in comprehension and internalization, especially when dealing with extensive texts. Collaborative learning approaches, such as seeking help from peers or friends, can play a pivotal role in overcoming this obstacle. By fostering a supportive learning environment and engaging in group discussions or study sessions, students can enhance their understanding of complex topics and improve learning outcomes. Moreover, the transition to online learning environments has underscored the importance of technological literacy and proficiency. Many students face difficulties in developing proficient video editing skills, which are increasingly necessary for producing high-quality assignments and presentations. Accessing tutorials and resources from platforms such as YouTube can be instrumental in bridging this gap, empowering students with the knowledge and skills needed to navigate digital tools effectively. Furthermore, searching for additional references and materials can aid in enhancing topic comprehension and adapting to digital learning environments more seamlessly. By expanding their knowledge base and exploring diverse perspectives, students can enrich their learning experiences and strengthen their ability to engage critically with course content. Lastly, practicing speaking is paramount in addressing non-technical challenges such as nervousness, lack of interaction, and confidence issues. Regular speaking practice sessions, whether through virtual simulations or group discussions, can help students build confidence, improve their communication skills, and effectively navigate virtual speaking tasks with ease. An approach that students can independently undertake includes practical steps such as optimizing Internet connectivity, managing storage effectively, engaging in collaborative learning strategies, enhancing technological literacy, exploring diverse resources, and consistently practicing speaking skills. However, for a truly effective and comprehensive solution, it is crucial for larger players like the government and schools to also take action. This includes improving infrastructure, providing adequate resources, offering training programs, and creating supportive policies to address the broader challenges of remote speaking tasks, ensuring a more fruitful and enriching learning experience for students. Figure 4 is the visualization of this comprehensive approach.

### Figure 4



Student-Identified Solutions to Challenges Encountered in Remote Speaking Tasks

The hierarchy chart of the findings shown in Figure 5 reveals a structured approach students could undertake when tackling remote speaking challenges, emphasizing key strategies in order of significance. At the forefront is the critical priority of finding a stable Internet connection and seeking assistance from friends, showcasing their efforts' collaborative and problem-solving nature. Following closely is the strategic emphasis on leveraging good audio devices, underscoring the pivotal role of clear audio in effective communication. Proactive engagement with online tutorials, particularly on platforms such as YouTube, is highlighted as a crucial step, demonstrating a commitment to continuous self-improvement and technological proficiency. The findings further underscore the importance of practicing speaking, addressing technical and psychological hurdles, and showcasing a conscious effort to build confidence and fluency in virtual communication. Lastly, the comprehensive approach of searching for additional references and streamlining digital resources by deleting unnecessary apps is acknowledged, contributing to an overall information management and technology optimization strategy. This hierarchical interpretation illustrates a thoughtful and prioritized approach, reflecting a balanced consideration of technical and non-technical aspects for students navigating the challenges of remote speaking tasks.

## Figure 5

Solutions							
Finding good Internet connection	Asking for friend's help	Watching tutorial from YouTube	Searching more references				
	Using a good audio device	Practicing speaking	Deleting some apps				

Hierarchy Chart of Solutions for the Obstacles to Remote Speaking Tasks

Note. This figure is hierarchy from the most used solutions to the least ones (left to right).

# Discussion

# **Challenges Faced by Students in Remote Speaking Tasks**

The challenges identified in remote communication, particularly poor video editing, resonate with concerns raised in prior research into online speaking (Fridland & Gotian, 2021). Problems with technology and the necessity to keep an audience's attention have emerged as issues with virtual communication in the modern digital era. The challenge of poor video editing aligns with the broader theme of technical difficulties encountered in virtual communication.

Similarly, our findings on technological infrastructure challenges, such as insufficient cellphone storage and problematic Internet connections, align with broader challenges identified in discussions on online communication (Fridland & Gotian, 2021). Problems including technical difficulties and the requirement for constant audience participation have emerged with the rise of effective online speaking. These challenges underscore the necessity of reliable connectivity and efficient content recall for successful remote communication, complementing the emphasis on clarity and conciseness in online communication (Prentiss, 2021). The critical role of overcoming technical barriers for effective virtual communication, as highlighted in the broader context of online education (Jubran et al., 2023; Sha'Ar et al., 2022), adds to the complexity of addressing these challenges. Voice interference and unskillful technology usage challenges underscore the need to seamlessly integrate audiovisual elements and master communication tools (Bakri et al., 2019; Encalada & Sarmiento, 2019; Lu et al., 2019). Our findings emphasize the significance of incorporating technology into language instruction, showcasing preferences for self-recording videos (SRV; Namaziandost, Nasri, & Keshmirshekan, 2019; Takenouchi et al., 2019). The effectiveness of diverse instructional strategies, including visual, auditory, and kinesthetic (VAK) learning style activities, aligns with the specific challenges in online speaking, such as the absence of face-to-face interaction and reliance on vocal tone and visual aids, as highlighted in broader insights on the complexities of online language education (Kusuma et al., 2021; Prentiss, 2021). These studies underscore supportive learning environments, collaborative peer interactions, and the careful balance between technology and socioeconomic considerations in shaping effective and inclusive language education experiences (Manurung et al., 2023; Saputra et al., 2023).

Lack of interaction emerged as a significant non-technical challenge, indicating a need for heightened engagement and connectivity in virtual settings, which aligns with insights from English language education studies (Encalada & Sarmiento, 2019; Lu et al., 2019). As we delve deeper into effective approaches for enhancing speaking skills, such as integrated technology, authentic materials, and personalized learning styles, it becomes evident that consistency exists across these studies. Challenges in online language education, especially in remote speaking tasks, emphasize active engagement and connectivity, aligning with observations from studies on e-portfolios, podcast-based activities, and the flipped classroom model (Kusuma et al., 2021; Kusuma & Waluyo, 2023; Pratiwi et al., 2022). Diverse methodologies further underscore the significance of interactive and dynamic approaches in online language learning. Moreover, the challenges faced by educators and students in varied contexts, including workplace settings and mathematics education, reinforce the necessity for tailored support, refined teaching strategies, and addressing technical and socioeconomic issues (Abdelatia et al., 2023; Jubran et al., 2023; Hijazi & Alnatour, 2021).

Our findings identifying psychological factors such as nervousness, lack of confidence, and anxiety as foundational challenges in effective remote speaking tasks resonate with insights from English language education studies (Encalada & Sarmiento, 2019; Lu et al., 2019). Transitioning into preferences for SRV and the positive impact of social media and smartphone-based systems, it becomes apparent that the role of technology is vital in addressing psychological factors (Li, 2022; Takenouchi et al., 2019). The role of technology aligns with addressing multifaceted challenges in online language education (Takenouchi et al., 2019). Studies on e-portfolios and podcast-based activities underscore technology's potential to address psychological factors by enhancing speaking proficiency and self-efficacy (Kusuma & Waluyo, 2023; Pratiwi et al., 2022). These collective insights underscore the interconnectedness of technical and psychological factors, requiring a thoughtful integration of technology, pedagogical innovation, and responsive approaches in virtual language learning.

## Strategies to Overcome the Challenges in Remote Speaking Tasks

Recent findings emphasizing the critical importance of a stable Internet connection and collaborative problem-solving among students in addressing technical challenges in online language education align seamlessly with broader discussions on challenges and strategies. Within the dynamic landscape of English language education highlighted by Bakri et al. (2019), Encalada and Sarmiento (2019), and Lu et al. (2019),

technological tools such as SRV take centre stage in elevating speaking skills. This sounds a lot like problems we face today, like technical problems and the need to keep audiences interested (Fridland & Gotian, 2021), underscoring the need to also address technical intricacies. An array of studies exploring technology integration, encompassing social media (Namaziandost, Nasri, & Keshmirshekan, 2019), smartphones (Takenouchi et al., 2019), and innovative methodologies such as e-portfolios and podcast-based activities (Khotimah et al., 2022; Kusuma et al., 2021; Kusuma & Waluyo, 2023), illuminates the multifaceted nature of challenges and solutions in online language education. Furthermore, the importance of a dependable Internet connection echoes in Saputra et al.'s (2023) work, where Malaysian ESL students grappled with Internet speed and connectivity challenges. These findings underscore the intricate interplay of technological infrastructure, collaborative troubleshooting, and adaptive pedagogical strategies in effectively navigating challenges and fostering enhanced online language education.

The body of research underscores technology's pivotal role in advancing English language education, particularly in the domain of online speaking skills. The emphasis on using high-quality audio devices aligns with studies leveraging various technological tools, such as SRVs, online video clips, and activities integrating VAK learning approaches. Insights from Kusuma et al. (2021), Kusuma and Waluyo (2023), and Saputra et al. (2023) have shed light on the positive impact of technological interventions on students' speaking proficiency and self-efficacy, accentuating the importance of active student engagement. The literature further highlights the nuanced impact of technology, as cautioned by Takenouchi et al. (2019), advocating against assuming uniform benefits across all language skills. Collectively, these observations portray a pedagogical landscape where the strategic application of technology, coupled with diverse instructional approaches, aims to confront challenges and optimize opportunities for effective online language learning, especially in refining speaking skills.

Insights emphasizing proactive engagement with online tutorials, particularly on platforms such as YouTube, align with extensive research in English language education. Studies by Namaziandost, Nasri, & Keshmirshekan (2019)and Saputra et al. (2023) have illuminated the positive impact of technology, such as social media and online platforms, on language learning. The proactive approach to online tutorials mirrors multifaceted instructional strategies observed in task-based language teaching, the quantum learning model (Altın & Saracaoğlu, 2019; Kanoksilapatham & Suranakkharin, 2019), and innovative methodologies such as the flipped classroom model (Pratiwi et al., 2022). This commitment to continuous self-improvement reflects an awareness of the dynamic nature of language education, as seen in the exploration of podcast-based activities and e-portfolios (Khotimah et al., 2022; Kusuma & Waluyo, 2023). Moreover, acknowledging challenges in online speaking aligns with the broader theme of balancing technology with socioeconomic considerations (Manurung et al., 2023; Saputra et al., 2023). In essence, proactive engagement with online tutorials is integral to navigating the evolving landscape of language education, integrating technology effectively, and addressing the diverse needs of learners in the digital era.

Observations that underscore the importance of practicing speaking to build confidence and fluency in virtual communication resonate deeply with the broader context of enhancing speaking skills in English language education. Previous studies, including those by Bakri et al. (2019), Encalada and Sarmiento (2019), and Lu et al. (2019), advocated for diverse approaches, such as SRV and VAK learning style activities, to comprehensively enhance speaking skills. Moreover, Kusuma et al. (2021), Kusuma and

Waluyo (2023), and Khotimah et al. (2022) highlighted active participation and significant improvements in students' speaking performance through methods such as e-portfolios and podcast-based activities. These findings underscore the significance of hands-on, experiential learning approaches, aligning with the current emphasis on practicing speaking. In essence, they reinforce the need for educators to integrate dynamic activities and create supportive environments that actively engage learners in practicing and honing their speaking skills, especially in the evolving landscape of remote and online language education. The findings related to the comprehensive approach of searching for additional references and streamlining digital resources, including deleting unnecessary apps, align with the overarching theme of leveraging technology in English language education for optimal outcomes. The acknowledgement of the importance of technology optimization resonates with insights from Namaziandost et al. (2019), emphasizing the significant role of social media in enhancing oral proficiency. Transitioning into the complexities of online speaking, it becomes evident that honing verbal and visual presentation skills is crucial, as suggested in earlier studies (Kuzina et al., 2021; Prentiss, 2021). Addressing these challenges necessitates enhancing technical competency, especially in video editing, which is deemed crucial across diverse educational settings (Abdelatia et al., 2023).

# **Conclusion and Implications**

In conclusion, the challenges of remote speaking tasks are distinctly categorized into technical and nontechnical domains. Within the technical realm, issues encompass connectivity problems, text memorization difficulties, limited cellphone storage, deficient video editing skills, inadequate technology usage, and voice interference. These technical hurdles underline the importance of digital proficiency and a stable technical infrastructure for effective remote communication. Transitioning to the non-technical challenges, which include psychological factors such as nervousness, lack of interaction, confidence, and anxiety, we emphasize the need to address personal and social aspects. The clear delineation of technical and nontechnical problems provides valuable insights for comprehensive solutions.

Moving on to the solutions for remote speaking tasks, students offer a precise and adaptive approach to overcoming challenges. Beginning with prioritizing a reliable Internet connection, we acknowledge its foundational role in effective virtual communication. Further, strategic efforts, such as deleting unnecessary apps and seeking assistance from friends, demonstrate a commitment to optimizing digital resources and collaborative problem-solving. Simultaneously, using quality audio devices and engaging in online tutorials showcase a dedication to enhancing technical skills and proactive, self-directed learning. Moreover, searching for additional references and practicing speaking illustrates a holistic strategy. Collectively, these solutions present a nuanced approach to addressing technical and non-technical challenges, aiming for heightened effectiveness in remote speaking tasks.

The implications for distance education practices based on the identified challenges and solutions in remote speaking tasks are significant. Technical challenges highlight the crucial need for digital proficiency and a reliable technical infrastructure to facilitate effective communication in remote settings. Addressing connectivity issues, improving technology usage, and enhancing digital skills among students and educators are essential steps. Moreover, non-technical challenges, such as psychological factors, emphasize the

importance of creating supportive and interactive virtual learning environments. Strategies to boost student confidence, encourage collaboration, and provide resources for self-directed learning can greatly enhance the overall experience and success of distance education programs focused on speaking tasks.

Based on the implications highlighted in the text regarding distance education practices and the challenges and solutions in remote speaking tasks, a balanced approach to designing virtual learning environments can be achieved through several key strategies. First, it is crucial to address technical challenges by providing comprehensive digital literacy training and ensuring a reliable technical infrastructure. This includes teaching students how to use digital tools effectively and troubleshooting connectivity issues to facilitate seamless communication in remote settings. Second, creating a supportive and interactive virtual learning environment is essential. Implement strategies to boost student confidence, such as regular feedback sessions, peer collaboration opportunities, and virtual presentations. Encourage active participation and clear communication to develop effective interpersonal skills among students. Additionally, provide resources for self-directed learning, such as online tutorials and personalized learning paths, to empower students in exploring topics independently and enhancing their digital skills. These combined efforts will contribute to a dynamic and engaging distance education experience focused on speaking tasks.

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# Student Engagement, Community of Inquiry, and Transactional Distance in Online Learning Environments: A Stepwise Multiple Linear Regression Analysis

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# Abstract

This study explored the complex dynamics of student engagement, community of inquiry, and transactional distance in online learning environments. The study analyzed 1,281 participants' responses to identify the factors contributing to online learning outcomes. The research highlighted the crucial role that transactional distance and community of inquiry play in shaping students' behavioral engagement and provided insight into their significant impact on participants' learning experience. Through a stepwise multiple linear regression analysis, the research uncovered the complex relationships among these variables, thereby providing valuable insights for educators and institutions aiming to enhance the online learning experience. The results have significant implications for educational practitioners and policymakers, including practical strategies to increase student engagement and foster a lively community of inquiry in online learning environments. Ultimately, this research is a valuable resource for all those involved in online education, to help them understand the key factors that contribute to successful online learning experiences.

*Keywords*: student engagement, transactional distance, community of inquiry, online learning, regression analysis

# Student Engagement, Community of Inquiry, and Transactional Distance in Online Learning Environments: A Stepwise Multiple Linear Regression Analysis

Interest in the factors contributing to successful online learning has increased with its rapid growth. Numerous studies have examined various factors influencing online learning outcomes (Çebi, 2023; Yilmaz, 2017; Yu, 2022). The most researched factors that impact online learning outcomes are learner characteristics, support, motivation, satisfaction, participation, self-efficacy, engagement, interaction, and presence (Eom et al., 2006; Joksimović et al., 2018; Kauffman, 2015; Kucuk & Richardson, 2019; Kuo et al., 2013; Mitchell et al., 2021; Muilenburg & Berge, 2005; Shea & Bidjerano, 2009; Wu, 2016; Zilka et al., 2018). Among these factors, presence, interaction, and engagement are especially important in online learning environments, as they contribute to developing a sense of community and create opportunities for meaningful learning experiences.

Engagement refers to active involvement and participation in learning activities (Kucuk & Richardson, 2019). It is commonly recognized as crucial for achieving successful learning outcomes in traditional and online settings (Joksimović et al., 2018; Karaoglan-Yilmaz et al., 2022; Vaughan, 2010). Previous research has shown that student engagement influenced satisfaction, motivation, and learning outcomes in online learning environments (Baloran et al., 2021; Li et al., 2022; Natarajan & Joseph, 2022; Setyawati et al., 2022; Tadesse & Edo, 2020; Zapata-Cuervo et al., 2023). Presence refers to the perception of a sense of connection and being there in online learning environments (McCreery et al., 2013). It is important for students to feel a sense of presence to in order to actively engage in their courses (Shea & Bidjerano, 2009; Zilka et al., 2018). Presence is closely related to student satisfaction and positively impacts learning outcomes in online environments (Hajibayova, 2017). Interaction refers to the communication and collaboration among students and instructors in online learning environments (Starr-Glass, 2013). Interaction is essential for creating a supportive and collaborative online learning community (Oyarzun et al., 2018). Despite the abundance of research on these factors, there is still a need to further investigate their interrelationships and impact on student learning outcomes in order to enhance the design and implementation of online learning.

# **Student Engagement in Online Learning**

Student engagement (SE) in online learning is a multifaceted concept encompassing various aspects, such as cognitive, behavioral, and emotional engagement. Cognitive engagement involves the mental effort and investment in learning activities, including critical thinking, problem-solving, and deep information processing (Xiao et al., 2021). Behavioral engagement refers to active participation and involvement in online discussions, completing assignments on time, and consistent attendance (Bond et al., 2020). Emotional engagement relates to the affective aspects of learning, including interest, enthusiasm, and a sense of belonging in the online learning community (Xiao et al., 2021).

Research has indicated that SE strongly predicted academic achievement and learning outcomes in online learning. Students actively engaged in online courses tended to have higher satisfaction, motivation, and perseverance levels when facing challenges (Dewan et al., 2019; Sun et al., 2019; Xiao et al., 2021). Moreover, engaged students were more likely to develop a sense of belonging and connection with their peers and instructors, leading to a richer and more meaningful learning experience (Bond & Bergdahl, 2022; Sun et al., 2019).

Understanding the importance of SE in online learning is crucial for educators and instructional designers to create effective and engaging learning environments. Given the significance of engagement in online learning, educators and instructional designers can develop strategies to promote and support SE. By fostering cognitive engagement, instructors can encourage critical thinking and problem-solving skills in their students, leading to a deeper understanding and application of course material. Behavioral engagement can be promoted through clear expectations for participation, timely feedback on assignments, and opportunities for interactive activities. Emotional engagement can be nurtured by creating a supportive and inclusive online learning community where students feel valued and connected.

#### **Community of Inquiry in Online Learning**

Presence in an online learning community is a key component of the community of inquiry (CoI) framework. The CoI is a theoretical model highlighting the importance of three types of presence in facilitating meaningful learning experiences in online learning environments: cognitive, teaching, and social (Swan et al., 2009). Cognitive presence refers to how learners can construct and confirm meaning through reflection, discourse, and exploration of ideas. Teaching presence relates to the design, facilitation, and direction of instruction in online courses, including instructional strategies, feedback, and support provided by instructors. On the other hand, social presence focuses on the interaction and sense of belonging among participants in an online learning community (Garrison, 2007).

Cognitive presence plays a crucial role in enhancing online learning experiences. It is centered on constructing understanding through critical thinking, reflection, and discourse (Harb & Krish, 2020). In online learning, cognitive presence empowers learners to actively engage in knowledge construction and confirm meaning through discussions and exploration of ideas. Research has demonstrated that cognitive presence significantly impacted learning outcomes and SE in online learning environments (Doo et al., 2023). When students were encouraged to analyze and evaluate information critically, they were more likely to develop a deeper understanding of the course material and its practical application (Liu et al., 2022). Educators can foster a culture of inquiry by nurturing cognitive presence, promoting intellectual engagement, and empowering students to think critically and creatively (Hambali et al., 2022).

Teaching presence is a crucial component of the CoI framework, pivotal in facilitating meaningful learning experiences in online environments. It encompasses the design, facilitation, and direction of instruction in online courses, including instructional strategies, feedback, and support provided by instructors. Research has shown that teaching presence significantly influenced SE and learning outcomes in online learning environments (Zhao & Sullivan, 2017). Effective teaching presence provides students with clear instructions and guidance, and creates a supportive and collaborative online learning community (Richardson et al., 2016). When instructors actively facilitate online discussions, provide timely feedback on assignments, and offer support and encouragement, students are more likely to feel connected, motivated, and engaged in their learning (Shea et al., 2010).

In addition to cognitive and teaching presence, social presence plays a significant role in the success of online learning. Social presence is crucial for fostering a sense of community and belonging among participants in an online learning environment (Mayne & Wu, 2011). It involves the ability of learners to project themselves socially and emotionally, and to establish personal and meaningful connections with peers and instructors. Previous research has highlighted the importance of social presence in online learning, showing that it positively influenced student satisfaction, motivation, and overall learning outcomes (Lee & Pillai, 2022; Luthfiarini & Susandari, 2022; Supardi & Ashari, 2021; Xue et al., 2023). Students who feel a strong sense of social presence are more likely to engage actively in discussions, collaborate with their peers, and develop a supportive learning community. This, in turn, leads to a more enriched and meaningful learning experience for all participants.

Educators can create online learning environments that promote active engagement and meaningful learning experiences by understanding and applying the CoI framework. This can be achieved by fostering cognitive presence through stimulating and challenging discussions, and providing opportunities for reflection and critical thinking. Furthermore, instructors can enhance teaching presence by facilitating clear communication and timely feedback on student work. Additionally, instructors can cultivate social presence by promoting student interactions and creating a sense of community through group discussions and collaborative projects.

### **Transactional Distance in Online Learning**

Interaction plays a crucial role in reducing transactional distance (TD) in online learning environments. Moore's theory defines TD as the psychological and communication gap that learners may experience in a distance learning setting (Moore, 1993). It is influenced by factors such as the level of interaction with technology, peers, content, and instructors (Weidlich & Bastiaens, 2018). When TD is high, learners may feel isolated, disconnected, and lacking motivation and engagement (Fabian et al., 2022). However, when interaction is increased, TD can be minimized, and learners are more likely to feel connected, supported, and engaged in the learning process (Dharmadjaja & Tiatri, 2021).

In online learning, various interaction types play crucial roles in facilitating effective learning experiences. These interaction types include the student-to-interface, to content, to instructor, to student, and to the learning environment. The student-to-interface interaction encompasses the engagement and interaction of students with the learning platform or interface. It involves the navigation of the online learning environment, access to course materials, and the utilization of digital tools for learning. The ease of interaction with the interface can significantly impact SE and satisfaction with the online learning experience (Alhih et al., 2017). Content interaction involves the active engagement of students with the course materials, resources, and multimedia components (Martin & Bolliger, 2018). Students need to interact meaningfully with the content to comprehend and apply the concepts effectively. Well-structured and interactive course materials can foster SE and promote a deeper understanding of the subject matter (Picciano, 2002). The interaction between instructors and students is a fundamental component of online learning. Effective instructor interaction includes clearly communicated expectations, timely feedback on assignments, and active facilitation of discussions and activities. Instructor interaction is pivotal in guiding and supporting students, influencing their motivation, connection to the learning community, and overall satisfaction with the learning experience. Research has shown that interaction between the student and the

instructor was the most significant factor in predicting the students' perceived learning outcomes in an online learning environment (Kang & Im, 2013). Additionally, the lack of interaction between instructors and students is one of the most outstanding disadvantages of online teaching environments, making students feel isolated (Sarac & Doğan, 2022). Peer-to-peer student interaction is valuable for creating a collaborative and supportive online learning community. Group discussions, collaborative projects, and peer feedback mechanisms foster a sense of belonging and encourage active participation, leading to enriched learning experiences. Research has shown that peer feedback mechanisms, such as those applied in higher education contexts, have been frequently used as instructional methods to improve essay performance and student perceptions (Huisman et al., 2018). Additionally, studies have highlighted the positive effects of peer tutoring on interaction behaviors, particularly in inclusive physical education settings, emphasizing the social benefits of peer interactions (Klavina & Block, 2008). The interaction between students and the online learning environment significantly influences the effectiveness of online learning. Research has shown that the quality and quantity of student-learning environment interaction has impacted students' motivation, engagement, and overall learning outcomes (van Popta et al., 2017). Therefore, it is crucial for educators and instructional designers to understand the role of student-learning environment interaction in online learning and to create environments that facilitate meaningful interactions.

### Relationship Among SE, Col, and TD

The relationships among SE, CoI, and TD in online learning are complex and multifaceted. SE in online learning has been identified as a critical factor influencing the effectiveness of online education (Meyer, 2014). It has been found that the quality and quantity of SE can significantly impact students' motivation, persistence, and overall success in online learning environments (Hu, 2011). Moreover, the CoI model has been used to explore how online communication and discourse can facilitate higher-order thinking skills, closely related to SE (Vaughan & Garrison, 2006). The CoI model emphasizes the importance of cognitive, social, and teaching presence in fostering meaningful learning experiences and SE in online settings (Pardales & Girod, 2006). Additionally, peer interactions have been recognized as an integral component of SE, with studies showing that peer interactions have significantly impacted students' learning engagement and task efficiency (Moon & Ke, 2020). It is important to note that SE is not only limited to academic interactions but also extends to social interactions and family connections, which have been identified as supporting factors in student success and engagement (Buyarski et al., 2011). Moreover, the influence of SE on learning achievement and the different dimensions of SE, including behavioral, emotional, and cognitive engagement, have been studied, highlighting the multifaceted nature of SE in online learning (Febrinzky, 2020; Ramadhani & Wulandari, 2019). Overall, the relationship among SE, CoI, and TD in online learning are intricate and interconnected, encompassing cognitive, social, and emotional dimensions of student interactions and experiences.

There have been few studies on the relationship among SE, CoI, and TD. For example, Kucuk and Richardson (2019) analyzed the effects of CoI on SE. They found that cognitive and teaching presence significantly affected emotional engagement, while social presence did not. Cognitive presence also significantly affected cognitive and behavioral engagement. Doo et al. (2021) investigated the structural relationships between TD and learning engagement in a large university class using flipped learning. They found that TD had a significant positive impact on learning engagement. Xiaoxing and Deris (2022)

investigated the impact of students' perceptions of the teaching presence, social presence, and cognitive presence in the CoI on SE in online discussions. They found that teaching, social, and cognitive presence had a statistically significant impact on SE. Students' perceptions of teaching presence directly and indirectly impacted their engagement.

There is a need for an in-depth examination of the relationships among these concepts, which are important for online learning. This study aimed to examine the relationships among SE, TD, and CoI using stepwise multiple linear regression analysis. The research questions (RQ) were as follows:

- 1. How do transactional distance and community of inquiry predict students' engagement?
- 2. How do transactional distance and community of inquiry predict students' behavioral engagement?
- 3. How do transactional distance and community of inquiry predict students' emotional engagement?
- 4. How do transactional distance and community of inquiry predict students' cognitive engagement?

# Methodology

#### **Research Design**

We used the correlational survey design, one of the quantitative research methods, to determine the multiple relationships among SE, CoI, and TD. The correlational survey design is preferred for studies determining the change between two or more variables and the degree of change (Karasar, 2020). We tested the structural relationships among SE, CoI, and TD using stepwise multiple linear regression (SMLR) analysis. SMLR is a statistical technique used to select the most relevant variables from a larger set of potential predictors to build a regression model. This technique helps to eliminate irrelevant or redundant variables and focuses on variables with the strongest relationship with the dependent variable. SMLR helps improve the accuracy and interpretability of the regression model by iteratively adding and removing variables based on their statistical significance.

#### Participants

The study sample consisted of 1,418 undergraduate students studying at a state university in Turkey. Second-year (sophomore), third-year (junior), and fourth-year (senior) students studying in 30 different departments under eight faculties voluntarily participated in the study. First-year students were excluded from the sample because they had low distance education experience. Participants in the study were 42.1% (n = 597) second-year, 41.3% (n = 585) third-year, and 16.6% (n = 236) fourth-year students. Female students accounted for 53.9% of the sample (n = 765) and 46.1% (n = 653) were male. The sample included students between the ages of 19 and 29. Students took various courses via distance education, in periods ranging from one semester to eight. Table 1 shows the participants' demographic information.

#### Table 1

#### Demographics of the Participants

Faculty	Department	Gender	Age (years)	Distance
		( <i>n</i> )		education course
				experience (n)
Education	Educational Sciences, Mathematics and	M: 63	Mean: 21.17	Mean: 1.76
	Science Education, Special Education,	F: 183	SD: 1.53	<i>SD</i> : .69
	Primary Education, Turkish and Social			
	Sciences Education, Foreign Languages			
	Education			
Fine Arts and Design	Traditional Turkish Arts, Graphic Design,	M: 26	Mean: 21.72	Mean: 1.75
Faculty	Ceramic and Glass	F: 40	<i>SD</i> : 1.81	<i>SD</i> : .46
Economics and	Banking and Finance, Economy, Business	M: 76	Mean: 20.90	Mean: 1.71
Administrative	Administration, Political Science and	F: 76	SD: 1.55	<i>SD</i> : .61
Sciences Faculty	Public Administration, International			
	Relations, International Trade and			
	Logistics			
Theology	Philosophy and Religious Sciences,	M: 85	Mean: 21.62	Mean: 1.74
	Islamic History and Arts, Basic Islamic	F: 168	<i>SD</i> : 1.40	<i>SD</i> : .52
	Sciences			
Engineering and	Computer Engineering, Food	M: 163	Mean: 21.43	Mean: 1.78
Architecture	Engineering, Civil Engineering,	F: 85	<i>SD</i> : 1.62	<i>SD</i> : .60
	Mechanical Engineering, Landscape			
	Architecture			
School of Civil	Aviation Management	M: 84	Mean: 20.62	Mean: 1.72
Aviation		F: 85	<i>SD</i> : 1.05	<i>SD</i> : .54
Sport Sciences	Education of Coaching, Physical	M: 121	Mean: 21.39	Mean: 1.69
	Education and Sports Teacher Training,	F: 83	<i>SD</i> : 1.58	<i>SD</i> : .58
	Sports Management			
Tourism	Gastronomy and Culinary Arts, Tourism	M: 35	Mean: 21.12	Mean: 1.78
	Guidance, Tourism Management	F: 45	<i>SD</i> : 1.67	<i>SD</i> : .60

#### **Data Collection**

Data were collected with an inventory consisting of three scales (CoI, TD, and SE) and a demographics section. We used a CoI scale to measure students' perceptions of social presence, cognitive presence, and teaching presence in online learning environments. Arbaugh et al. (2008) developed the scale and Öztürk (2012) adapted it into Turkish. The scale's construct validity was examined with confirmatory factor

analysis. As a result, the fit indices were  $\chi^2$  (Chi-Square Goodness) = 996.25 (*SD* = 524, *p* < .001),  $\chi^2/SD$  = 1.90, RMSEA (Root Mean Square Error of Approximation) = .081, S-RMR (Standardized Root Mean Square Residual) = .072, NNFI (Non Normed Fit Index) = .80, CFI (Comparative Fit Index) = .81, GFI (Goodness of Fit Index) = .70, and AGFI (Adjusted Goodness of Fit Index) = .66. Cronbach's alpha coefficient of the scale was .97.

We used a SE scale to measure students' behavioral, cognitive, and emotional engagement in online learning environments. Sun and Rueda (2012) developed the scale, and Ergün and Koçak Usluel (2015) adapted it into Turkish. The scale's construct validity was tested with first- and second-level confirmatory factor analyses. Goodness of fit values were found as  $\chi^2(84, n = 393) = 453.93$ , p < .000; RMSEA = .072, S-RMR = .059, GFI = .89, AGFI = .86, CFI = .96, NNFI = .96, and IFI = .96. The Cronbach's alpha coefficient of the scale, which consisted of behavioral (five items), cognitive (eight items), and affective commitment (six items) factors, was calculated as .90. This value indicates high internal consistency (Cronbach, 1951).

We used a TD scale to measure students' perceptions of TD in online learning environments. Zhang (2003) developed the scale and Yılmaz and Keser (2015) adapted it into Turkish. The construct validity of the scale was examined using confirmatory factor analysis. The analysis results for the five-factor model were  $\chi^2(357) = 2360.91$ , (*SD* = 655, *p* = .000);  $\chi^2/SD = 3.60$ , RMSEA = .086, RMR = .11, SRMR = .086, GFI = .74, AGFI = .71, IFI = .93, CFI = .93, NFI = .90, and NNFI = .92. Cronbach's alpha coefficient of the scale was .92.

The research data were gathered by printing the inventory and administering it using paper and pencil. Ethical permissions were obtained for the research before the data collection process. Then, instructors in 30 different departments were interviewed and informed about the research and the data collection process. Instructors told their students they could fill in the data collection tool voluntarily. In addition, we placed a short informative text about the research and researcher information on the top of the inventory. The participants completed the inventory in about 15 minutes, and the data collection process took 25 days.

# **Data Analysis**

In this study, a total of 1,281 participants completed the survey, and prior to analysis, necessary statistical assumptions were verified. The data was analyzed using descriptive statistics such as frequency, percentage, and correlation. SMLR was also used. To identify outliers in the multivariate data, we computed the Mahalanobis distance which resulted in the removal of 13 outliers from the dataset. We then assessed the normality assumptions by examining the histogram and skewness/kurtosis values. We found that they were within the acceptable range of -1 to +1, confirming a normal distribution. A multivariate scatter diagram was employed to check for multivariate normality, and the assumption was found to be met. Furthermore, this normality test also provided some insights regarding multicollinearity. We computed bivariate correlation coefficients between predictor variables to examine multicollinearity in multiple regression analysis. The results indicated no issues (.70, .75, .78). Investigations into autocorrelation issues and model suitability were conducted through the application of the Durbin-Watson test, Cook's Distance, VIF, and tolerance.

# Findings

#### **Descriptive Statistics**

In this research, data pertaining to SE, TD, and CoI were collected. Descriptive statistics derived from students' responses to these variables are presented in Table 2.

#### Table 2

#### Descriptive Statistics

Scale	Number	Minimum Maximum		V	SD	$\overline{X}$	Skewness	Kurtosis
	of items	score	score	Λ	50	/k	DRC WIIC55	Ruitosis
SE scale	19	19.00	95.00	66.42	15.11	3.5	170	241
TD scale	38	50.00	190.00	130.11	24.98	3.42	055	.031
CoI scale	34	34.00	136.00	101.74	20.55	2.99	388	072

According to Table 2, the average SE scale score of participants was 66.42 (3.5 out of 5), the TD scale score was 130.11 (3.42 out of 5), and the CoI scale score was 101.74 (2.99 out of 4). From this point of view, it was concluded that the scores for SE, TD, and CoI scales were situated at a moderate level.

### **Correlations Among Scales**

Examination of relationships among SE, TD, and CoI scales involved computing Pearson correlation coefficients.

#### Table 3

Scale		SE	TD	CoI
SE scale	r	-		
TD scale	r	·75 <sup>**</sup>	-	
CoI scale	r	.70**	.78**	-

Correlations Among SE, TD, and CoI Scales

*Note.* \*\* indicates correlation is significant at the .01 level (2-tailed).

Based on the data presented in Table 3, it can be concluded that there was a positive, strong relationship among SE-TD, SE-CoI, and CoI-TD. The correlation coefficients were found to be SE-TD (r = .75, p < .01), SE-CoI (r = .70, p < .01), and CoI-TD (r = .78, p < .01). As per Pallant's (2001) classification, a correlation coefficient of r = .10 to .29 indicates a small relation, r = .30 to .49 indicates a moderate relation, and r =.50 to 1.0 indicates a strong relation. Therefore, the findings suggested that the relationship among SE-TD, SE-CoI, and CoI-TD was strong and positive.

# **Regression Analysis Results for Variables Predicting SE**

Predictors of SE were identified using SMLR; the results are summarized in Table 4.

#### Table 4

Model	Variable	В	Standard Error	β
1	(Constant)	7.749	1.501	
	TD scale	.451	.011	·75 <sup>**</sup>
	$R = .75, R^2 = .5$	6, F (1, 1266) = 1	584.047, <i>p</i> = .000	
2	(Constant)	3.681	1.488	
	TD scale	.305	.017	.50**
	CoI scale	.227	.021	$.31^{**}$
	$R = .77, R^2 = .5$	59, F (2, 1265) = 9	919.938, <i>p</i> = .000	

Stepwise Regression Analysis for Variables Predicting SE

*Note.* \*\* indicates correlation is significant at the .01 level (2-tailed).

Table 4 displays two models that significantly predicted SE. Upon examining Model 1, TD accounted for 56% of the total variance in SE (R = .75, R<sup>2</sup> = .56, F (1, 1266) = 1584.047, *p* = .000). Taken together, in Model 2, TD and CoI explained 59% of the total variance in SE (R = .77, R<sup>2</sup> = .59, F (2, 1265) = 919.938, p = .000). Examining the regression coefficients associated revealed that TD ( $\beta$  = .75, *p* < .01) and CoI ( $\beta$  = .31, *p* < .01) significantly contributed to SE. The results suggest that, based on the findings, TD emerged as the most crucial predictor of SE.

#### **Results for Regression Analysis Predicting Students' Behavioral Engagement**

Predictors of students' behavioral engagement were identified using SMLR, and the results of the analysis are summarized in Table 5.

#### Table 5

Model	Variable	В	Standard error	В							
1	(Constant)	5.164	.448								
	TD scale	.102	.003	.65**							
	$R = .65, R^2 =$	$R = .65, R^2 = .42, F(1, 1266) = 904.033, p = .000$									
2	(Constant)	4.630	.460								
	TD scale	.083	.005	.52**							
	CoI scale	.030	.007	.16**							
	$R = .65, R^2 = .43, F(2, 1265) = 469.253, p = .000$										

Stepwise Regression Analysis for Variables Predicting Students' Behavioral Engagement

Table 5 illustrates two models that significantly predicted students' behavioral engagement. In Model 1, TD accounted for 42% of total variance in students' behavioral engagement (R = .65, R<sup>2</sup> = .42, F (1, 1266) = 904.033, *p* = .000). Taken together, in Model 2, TD and CoI explained 43% of total variance in students' behavioral engagement (R = .65, R<sup>2</sup> = .43, F (2, 1265) = 469.253, *p* = .000). Analysis of the regression coefficients indicated that TD ( $\beta$  = .65, *p* < .01) and CoI ( $\beta$  = .16, *p* < .01) significantly contribute to students' behavioral engagement. Findings suggested that TD was the most crucial predictor of students' behavioral engagement.

### **Results for Regression Analysis Predicting Students' Emotional Engagement**

Predictors of students' emotional engagement were identified using SMLR, and results of analysis are summarized in Table 6.

#### Table 6

Model	Variable	В	Standard Error	β						
1	(Constant)	-5.889	.828							
	TD scale	.187	.006	.64**						
	$R = .64, R^2 =$	R = .64, R <sup>2</sup> = .41, F (1, 1266) = 890.487, <i>p</i> = .000								
2	(Constant)	-7.323	.843							
	TD scale	.135	.010	·47 <sup>**</sup>						
	CoI scale	.080	.012	.23**						
	$R = .66, R^2 =$	.43, F (2, 1265) =	482.537, <i>p</i> = .000							

Stepwise Regression Analysis for Variables Predicting Students' Emotional Engagement

Table 6 showcases two models that significantly predicted students' emotional engagement. Specifically, in Model 1, TD accounted for 41% of total variance in students' emotional engagement (R = .64, R<sup>2</sup> = .41, F (1, 1266) = 890.487, *p* = .000). Taken together, in Model 2, TD and CoI explained 43% of total variance in students' emotional engagement (R = .66, R<sup>2</sup> = .43, F (2, 1265) = 482.537, *p* = .000). Analysis of the regression coefficients revealed that TD ( $\beta$  = .64, *p* < .01) and CoI ( $\beta$  = .23, *p* < .01) significantly contributed to students' emotional engagement. Findings suggested that TD was the most crucial predictor of students' emotional engagement.

# **Results for Regression Analysis Predicting Students' Cognitive Engagement**

Predictors of students' cognitive engagement were identified using SMLR, and results of analysis are summarized in Table 7.

#### Table 7

Model	Variable	В	Standard error	β							
1	(Constant)	9.282	.787								
	TD scale	.200	.008	.60**							
	$R = .60, R^2 =$	.35, F (1, 1266) =	694.981, <i>p</i> = .000								
2	(Constant)	6.374	.830								
	TD scale	.117	.012	$\cdot 35^{**}$							
	CoI scale	.087	.010	.32**							
	$R = .63, R^2 = .$	$R = .63, R^2 = .39, F(2, 1265) = 409.552, p = .000$									

Stepwise Regression Analysis for Variables Predicting Students' Cognitive Engagement

Table 7 illustrates two models that significantly predicted students' cognitive engagement. In Model 1, TD accounted for 35% of total variance in students' cognitive engagement (R = .60, R<sup>2</sup> = .35, F (1, 1266) = 694.981, p = .000). Taken together, in Model 2, TD and CoI explained 39% of total variance in students' cognitive engagement (R = .63, R<sup>2</sup> = .39, F (2, 1265) = 409.552, p = .000). Analysis of the regression coefficients indicated that TD ( $\beta$  = .60, p < .01) and CoI ( $\beta$  = .32, p < .01) significantly contributed to students' cognitive engagement. Findings suggested that TD was the most crucial predictor of students' cognitive engagement.

# **Discussion and Conclusions**

This study examined the structural relationships among student engagement, transactional distance, and community of inquiry in online learning environments through multiple linear regression analysis. This revealed significant findings regarding the relationships among these constructs, including significant and high relationships among SE and CoI, SE and TD, and CoI and TD. The findings indicated that TD and CoI contributed significantly to SE. Specifically, the regression coefficients suggested that TD and CoI play important roles in predicting SE. These findings were in line with previous research that emphasized the importance of building a strong CoI to reduce TD and increase SE (Chatterjee & Parra, 2022; Li et al., 2023; Themeli & Bougia, 2016; Vaughan, 2010). Analysis of the prediction of SE in our first research question determined that TD and CoI made a major contribution. Regarding our second, third, and fourth research questions, we analyzed our predictions according to sub-dimensions of SE. As a result, relatively lower prediction coefficients were obtained. The effects of TD and CoI on behavioral engagement and emotional engagement were found to be higher than on cognitive engagement. This suggests that instructional interventions related to TD and CoI will have a greater effect on students' behavioral and emotional engagement.

Transactional distance, which was the most important determinant of students' SE, highlights the importance of minimizing the psychological and communication gaps between instructors and students in online learning (Karaoglan-Yilmaz et al., 2022; Moore, 2018). By reducing TD, educators can create a more conducive and engaging learning environment for students, ultimately lead to higher levels of engagement

and satisfaction with the online learning experience. Moreover, the positive contribution of CoI to SE emphasizes the importance of collaborative and interactive learning experiences in online environments (Li et al., 2023). Building a strong sense of CoI and fostering meaningful interactions between students and instructors can improve SE as well as overall learning outcomes.

The findings of this study underscored the critical roles of TD and CoI in shaping SE in online learning environments. By recognizing the importance of these factors, educators and instructional designers can implement targeted strategies to reduce TD, develop a strong sense of CoI, and increase SE in online learning. These strategies may include leveraging technology to facilitate meaningful interactions, encouraging collaborative activities, and providing students with adequate support and feedback. Furthermore, the study supports the need for ongoing research and practical interventions aimed at optimizing online learning experiences and maximizing SE.

It should be acknowledged that the study has some limitations. First, the study was conducted with undergraduate students studying at a university in Turkey. Future studies could examine the validity of our results by including participants from different universities, or participants of different ages and educational levels (e.g., adults, high school students). Finally, cross-cultural studies could be conducted to compare the results.

Overall, the findings contribute to the growing body of knowledge on effective online learning practices and provide valuable implications for educators, instructional designers, and educational policy makers who aim to create engaging and effective online learning environments. By addressing TD and CoI factors, institutions can strive to create enriching and supportive online learning experiences that promote student engagement, satisfaction, and academic achievement.

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# The Impact of OER's Continuous Improvement Cycles on Students' Performance: A Longitudinal Analysis of the RISE Framework

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# Abstract

Open educational resources (OER) have been praised for revolutionizing education. However, practitioners and instructors battle keeping OER updated and measuring their impact on students' performance. Few studies have analyzed the improvement of OER over time in relation to achievement. This longitudinal study uses learning analytics through the open-source Resource Inspection, Selection, and Enhancement (RISE) analysis framework to assess the impact of continuous improvement cycles on students' outcomes. Panel data (i.e., performance and use) from 190 learning objectives of OER of an introductory sociology course were analyzed using a hierarchical linear model. Results show that more visits to an OER do not improve student achievement, but continuous improvement cycles of targeted OER do. Iterative implementation of the RISE analysis for resource improvement in combination with practitioners' expertise is key for students' learning. Given that the RISE classification accounted for 65% of the growth of students' performance, suggesting a moderate to large effect, we speculate that the RISE analysis could be generalized to other contexts and result in greater student gain. Institutions and practitioners can improve the OER's impact by introducing learning analytics as a decision-making tool for instructional designers. Yet, userfriendly implementation of learning analytics in a "click-and-go" application is necessary for generalizability and escalation of continuous improvement cycles of OER and tangible improvement of learning outcomes. Finally, in this article, we identify the need for efficient applications of learning analytics that focus more on "learning" and less on analytics.

*Keywords:* open educational resources, OER, student performance, longitudinal analysis, learning analytics, higher education, RISE analysis

# Introduction

Open educational resources (OER) have been extensively used to create more equitable environments with the promise of closing the gap between historically underserved students and their peers (Caswell et al., 2008; Van Allen & Katz, 2020). Yet, students might find outdated OER that do not support actual learning despite the best efforts of instructional designers, practitioners, and institutions creating a sea of OER to share knowledge freely. Although practitioners can use, reuse, and remix OER to avoid reinventing the wheel, tools to help them identify which resources are updated or need attention are scant (Wiley, 2018). Ultimately, OER's sustainability is challenged by a lack of a streamlined continuous improvement process that can identify which OER need further work (Avila et al., 2020; Wiley, 2007). Despite researchers finding evidence of OER's effect on students' performance (Colvard et al., 2018; Grimaldi et al., 2019; Tlili et al., 2023), practitioners have difficulty measuring the impact of OER's continuous improvement on students' learning. This ultimately creates greater challenges in securing funding for OER sustainability.

In response to instructional designers, instructors, and practitioner's challenges in improving OER, Bodily et al. (2017) proposed the Resource Inspection, Selection, and Enhancement (RISE) framework that leverages analytics data and achievement data to categorize OER based on their effectiveness to support students' performance and then inform instructional designers and content developers which OER need enhancement. Despite the promise to advance sustainability and continuous improvement of OER, the improvement is still bound to cross-sectional analysis highlighting a lack of knowledge on RISE's long-term effects. Knight et al. (2017) called for greater emphasis on temporal analysis (e.g., longitudinal studies) in analytics-driven studies because educational research takes the passage of time as self-evident in learning processes but rarely conceptualizes or operationalizes it.

Accounting for time in analytics-supported educational research is crucial to estimate learners' interactions and eventually move to predictions that support learning (Castellanos-Reyes et al., 2023). In the field of OER, Wiley (2012) first introduced the concept of "continuous improvement cycles" to OER to account for temporality in resource improvement. Specifically, continuous improvement responds to the static perspective that quality assurance in educational resources is a one-time snapshot without accounting for "constantly getting better" (Wiley, 2012, para. 2).

Furthermore, existing assessment indicators of OER have focused on proxy measures of quality such as authors' credentials or interactivity rather than actual student learning. Avila et al. (2020) highlighted that most learning analytics work focuses on students' interactions with platforms and learning management systems (LMS) overseeing the role of resources themselves. Furthermore, little work has applied learning analytics to enhance OER and examine their relationship to students' performance. Therefore, it is essential to show practitioners and researchers the value of adopting learning analytic approaches that translate to efficient use of resources (i.e., labor and time) while evidencing gains in student achievement.

The purpose of this study was to explore how the continuous improvement of OER over time influences students' performance by using panel data of OER evaluation metrics through a growth curve model. The goal was to investigate how OER evolve through time when the RISE analysis is applied.

# **Literature Review**

#### Sustainability of Open Educational Resources

OER have been praised for revolutionizing education by providing open access to information at a meager cost to students (Winitzky-Stephens & Pickavance, 2017). Institutional implementation of OER instead of traditional textbooks translates into millions of dollars of savings (Martin et al., 2017) for already-in-debt college students. However, the openness of OER does not mean without cost. Griffiths et al. (2020) calculated that OER cost an average of \$65 per student to institutions. However, Barbier (2021) criticized that OER production comes with a high cost of free labor from instructors who often underestimate production costs (Aesoph, 2018).

An even more overlooked figure is the price of updating OER. The boom of open education in the early 2000s made educational institutions jump and devote resources to creating OER. Nowadays, countless digital repositories are developed at the highest quality in which academic rigor and resources are devoted to developing OER (Richardson et al., 2023). However, how these resources continue thriving and remain top-notch is a challenge. The production cycle that editorial houses and for-profit companies use to keep publishing updated and improved versions is well ahead of open-access counterparts. Therefore, it is crucial that instructors have the ability to estimate OER's impact not only on students' access to education but also on their performance to secure institutional and governmental funding.

Wiley (2012) questioned the sustainability of OER, specifically, the extent to which institutions devote funds to continue working on them after depletion and whether sustainability is at all part of the design and proposal of OER. If affordable continuous improvement is not part of the planning, OER and their repositories are unfortunately doomed to oblivion (Aesoph, 2018). Another risk of not accounting for the sustainability of OER is that institutions might fund endless OER and their repositories and create new products from scratch instead of improving what they already have (Müller, 2021)—in other words, reinventing the wheel. In part because developers need to show new products as proof of the value of their work and in part because it is challenging for institutions to show how the continuous improvement of OER ultimately benefits students' performance, it is essential for institutions to direct measures of OER quality on how they relate to students' actual learning. In response to these challenges, researchers and practitioners have proposed automated and learning analytic techniques to identify which OER need to be updated (Avila et al., 2017; Müller, 2021).

# Learning Analytics for Continuous Improvement of Educational Resources

Educational researchers and practitioners have used a variety of instruments to identify the need to update OER, such as user experience surveys and peer expert identification (Richardson et al., 2023). However, these processes are resource expansive due to the low survey response rate, the cost of paying experts to review OER, and the time it takes to complete the process. One popular way to overcome this obstacle is by using large scales of data—also known as learning analytics—to identify educational resources "at risk" and needing improvement, eventually increasing students' performance (Ifenthaler, 2015). For example, Giannakos et al. (2015) combined clickstream data, achievement data, and student log data from a LMS to identify which copyrighted videos needed to be updated. Likewise, Avila et al. (2017) first introduced the ATCE tool that focuses on creating and evaluating accessible OER. The ATCE tool supports teachers in

developing OER by leveraging automatic accessibility evaluation, expert evaluation, and LMS capabilities (Avila et al., 2020). These data are later condensed in a dashboard that informs teachers on how accessible the OER is. However, the ATCE evaluation focuses on proxy quality measures rather than actual student usage or performance.

Researchers have made similar efforts to apply learning analytics to improve OER. However, there is still a need to evaluate how OER specifically impact students' achievement and even so, if instructional designers' efforts to update OER are related to student performance. Contemporary to the work of Avila et al. (2017) with the ATCE tool, Bodily et al. (2017) highlighted the need to provide OER quality assurance tools that are independent from a LMS. Independence from a LMS allows instructors and practitioners in underresourced institutions to provide the highest quality of education with already available gratuitous platforms (Castellanos-Reyes et al., 2021). Bodily et al.'s (2017) answer to this need was the RISE framework and the subsequent publication of an open-source analytical package (Wiley, 2018) detailed in the following section.

# The RISE Framework for Continuous Improvement of OER

Bodily et al. (2017) proposed a learning analytic approach, called the RISE framework, that leverages digital trace data (i.e., number of views) and achievement data (i.e., scores in activities aligned to learning objectives) to identify resources that need further revision. The RISE framework is a two-by-two quadrant that classifies OER based on the relationship between students' performance and use. The y-axis represents students' performance on assessments aligned to a specific learning outcome (i.e., high vs. low grades), and the x-axis represents students' interaction metrics with resources aligned to the same outcome (e.g., page views, time, and OER ratings). Quadrant 1 includes OER with greater than average use and greater than average grades. This is the ideal situation for any OER because it implies that the resource supported the student to achieve the outcome and that practitioners' work on alignment between assessment and content was on target (Bodily et al., 2017). Quadrant 2 has OER with less than average use and greater than average grades. Potential explanations on why resources are in this quadrant include high student entry skills and knowledge, assessment was too easy (i.e., the difficulty parameter is below 0), and/or the resource failed to catch student attention (i.e., OER use) but allowed students to obtain a passing score (i.e., performance). Quadrant 3 identifies OER with less than average use and grades. Resources in this quadrant may indicate a lack of student engagement or challenging assessment items. Quadrant 3 may also indicate that resources were insufficient to support student assessment. Finally, quadrant 4 represents greater than average use and less than average grades. Although the RISE analysis is not interpreted as a continuum, resources in quadrant 4 are the ones that need priority attention from instructional designers as they indicate poor alignment between OER and assessment (Bodily et al., 2017). Figure 1 shows the RISE framework and its quadrants.

Simply falling into one of the quadrants that flag a need for further attention (quadrants 2–4) does not merit deploying resources for a continuous improvement cycle. On top of classifying an OER's learning objective into a quadrant, the RISE analysis also uses an additive *z*-scores approach to identify outliers and trigger an intervention (Bodily et al., 2017). A cycle of continuous improvement is completed each time an OER is identified as an outlier needing further development using the quadrant and modified. Practitioners and researchers can use the RISE framework via the open R package (rise) (Wiley, 2018) to identify OER

that need improvement based on the quadrant classification and apply an iterative approach towards OER sustainability.

Despite the RISE analysis practical application, Bodily et al. (2017) clarified that the framework focuses on flagging resources that need evaluation rather than providing pedagogical recommendations on how to improve them. It is up to the instructional designers' expertise to diagnose why the OER is not supporting students' outcomes as expected. The RISE analysis, as with most learning analytics approaches, does not provide an all-knowing ultimate verdict on learning (Pardo et al., 2015; Romero-Ariza et al., 2023) and, therefore, should be used with caution and evaluated on its effectiveness over time in students' learning.

#### Figure 1

RISE Framework for Continuous Improvement of OER



Note. RISE = resource inspection, selection, and enhancement; OER = open educational resources.

# **Purpose of the Study and Research Questions**

Although we know that the RISE analysis estimates OER's need for improvement (Bodily et al., 2017), we do not know whether applying the RISE analysis to improve OER significantly improves students' achievement over time. Remediating this gap is urgent as OER are significant instruments of social transformation in education (Caswell et al., 2008) and more so with the accelerated need to transition to digital education (Tang, 2021). Furthermore, estimating the effectiveness of the RISE analysis would augment its generalizability and application to other OER. Such need opens these questions:

- 1. Given that the RISE analysis uses OER use and performance metrics, to what extent is OER use related to a systematic growth in students' achievement across four consecutive semesters?
- 2. To what extent is the RISE analysis of OER related to a systematic growth in students' performance across four consecutive semesters?

# Method

### **Analytical Approach**

We used a multilevel approach (MLM), also known as hierarchical linear modeling, to estimate the effect of the RISE analysis on students' achievement over time. MLM is a type of regression analysis in which researchers can establish nested analyses that could be hierarchical (e.g., students within classes within schools). Researchers also use MLM to conduct longitudinal analysis in which the same units of analysis are followed over time, creating a nested sample. Such an approach is called a *growth curve model* (GCM; Raudenbush & Bryk, 2002). GCM for longitudinal analyses is useful to account for individual variations (i.e., growth) over time and to identify the predictors of growth using a multiple-time point design. Ultimately, longitudinal analysis aims to "understand and characterize changes in an assessment measure over time" (Boscardin et al., 2022). Unlike other repeated longitudinal approaches, like the repeated measures analysis of variance (ANOVA), GCM is a flexible approach, tolerant to discrete variables, missing data (Boscardin et al., 2022), unequal time point measurements, and time-varying covariates (Curran et al., 2010). Figure 2 shows the nested data structure.

#### Figure 2





*Note*. OER = open educational resources; LO = learning objective; T = time-wave.

# **Research Context and Data**

Data was collected from the OER-based curriculum of an undergraduate course titled Introduction to Sociology (https://lumenlearning.com/courses/introduction-to-sociology/) provided by the educational company Lumen over four consecutive semesters from spring 2020 to fall 2021. The units of analysis were 190 learning objectives associated with the OER used in the course. No granular student data was used in this study. Data was obtained from users' interaction (i.e., visits to an OER) and achievement (i.e., quizzes) with the OER associated with each learning objective. The course had 18 modules covering topics such as "Stratification and Inequality," "Population, Urbanization, and the Environment," and "Work and the Economy." Each module had between two and four learning objectives, with three being the most common number per module. Sample learning objectives included "Explain global stratification," "Distinguish mechanical solidarity from organic solidarity," and "Describe demographic measurements like fertility and mortality rates." All OER used in the course were aligned with individual learning objectives. Assessment items were multiple-choice questions and fill-in-the-blank questions. Many of the materials used in this course were based on the OpenStax Sociology 2e text (https://openstax.org/books/introduction-sociology-2e/pages/1-introduction-to-sociology).

The spring 2020 run of the course had 127 learning objectives, at which point 63 learning objectives were added to the remaining runs of the course for a total of 190. Sample learning objectives added included "Discuss how symbolic interactionists view culture and technology" and "Define globalization and describe its manifestation in modern society." The remaining three runs of the course had all 190 learning objectives. Despite the first wave of data having had fewer learning objectives, we decided to include it in the analysis to increase power in the sample size and improve statistical precision (Raudenbush & Liu, 2001). All materials were made available with the Creative Commons license CC BY 4.0, which indicates that users can share and adapt the material under the attribution terms. Readers can request access to the full course content and outcomes via the Lumen website (https://lumenlearning.com/courses/introduction-to-sociology/).

#### **Outcome and Predictor Variables**

#### **Student Performance**

Students' quiz scores related to each OER were used as performance data and were collected through an OER courseware platform. Assessment data from all questions aligned with the same learning objective was aggregated to obtain the average score. For each learning objective, the dataset contained an average student performance per academic semester (see Time—Wave).

#### OER Use

The pageviews that an OER received were used as a proxy measure for OER interaction and were collected through Google Analytics. Given that pageviews alone do not measure actual student use, OER's pageviews were normalized "by the number of students who attempted assessment" (Bodily et al., 2017, p. 111) for a learning objective. For each learning objective, there was a single value of OER use.

### Time-Wave

OER were assessed over four consecutive semesters from spring 2020 to fall 2021. Spring 2020 used as the reference wave. Our analysis focused on the OER aggregated end-of-semester metrics. The metrics collected at the end of each semester served to flag which OER needed further attention (i.e., update) before the start of the next semester. OER review and subsequent updates/changes were considered a continuous improvement cycle.

# **RISE Analysis of OER Learning Objectives**

RISE analysis classifies the learning objectives in the quadrants explained previously (see Figure 1 and Bodily et al., 2017). For this study, the RISE quadrant is a categorical variable. For the analyses below, dummy variables encoded membership in a particular quadrant (i.e., quadrants 2, 3, and 4). The reference category for all the dummy variables, encoded by zero, was quadrant 1.

### **Data Analysis**

In this study, we used GCMs to follow the change in students' performance on each learning objective over time with respect to OER use (RQ1, see Figure 2) and RISE analysis classification (RQ2). The R package "rise" version 1.0.4 (Wiley, 2018) was used for the RISE analysis classification. Two sequences of models, differing in their respective full models, were developed, one per each research question. Both sequences shared the same base *null model*, a model where average performance varies among OER. With this model, we sought to determine how much of the variance in students' performance varies across learning objectives. The following was the equation for the *null model*:

$$Performance_{ij} = \beta_{00} + r_{0j} + e_{ij} \tag{1}$$

where *Performance*<sub>ij</sub> was the average performance in learning objective j at wave i;  $\beta_{00}$  was the average performance across all learning objectives and waves,  $r_{0j}$  was the difference between the average performance of learning objective j and the overall average; and  $e_{ij}$  was the wave learning objective residuals.

The two sequences shared the model where time was incorporated into the model. The *growth model* sought to identify the change in performance over the four semesters. The equation that represents this model was:

$$Performance_{ij} = \beta_{00} + \beta_{10} Wave_i + r_{0j} + r_{ij} Wave_i + e_{ij}$$
(2)

where  $Wave_i$  was the wave,  $\beta_{10}$  was the average growth rate across all learning objectives, and  $r_{ij}$  was the difference between the growth rate of learning objective *j* and the average growth rate. All other terms are defined as in Equation 1, the null model.

The *full OER use* model was defined to determine to what extent OER use is related to a systematic growth in students' achievement across four consecutive semesters. It was obtained by adding a fixed slope for the standardized OER use measure and its interaction with the wave to the growth model. The resulting equation for this full model was:

$$Performance_{ij} = \beta_{00} + \beta_{10}Wave_i + \beta_{01}OERuse_j + \beta_{11}(OERuse_j * Wave_i) + r_{0i} + r_{ij}Wave_i + e_{ij}$$
(3)

where  $\beta_{01}$  was the fixed effect of OER use of learning objective *j* on performance and  $\beta_{11}$  was the fixed effect of the interaction of OER use of learning objective *j* and wave *i* on performance. All the other terms were defined in equations 1 and 2.

The *full RISE model* sought to identify to what extent the RISE analysis of OER is related to a systematic growth in students' performance across four consecutive semesters. The equation for this model was:

$$Performance_{ij} = \beta_{00} + \beta_{10}Wave_i + \beta_{02}Quadrant2_j + \beta_{03}Quadrant3_j + \beta_{04}Quadrant4_j + \beta_{12}(Quadrant2_j * Wave_i) + \beta_{13}(Quadrant3_j * Wave_i) + \beta_{14}(Quadrant4_j * Wave_i) + r_{0j} + r_{ij}Wave_i + e_{ij}$$

$$(4)$$

where  $\beta_{02}$ ,  $\beta_{03}$ , and  $\beta_{04}$  were fixed effects of the learning objective being classified in RISE quadrants 2, 3, or 4 on performance. Quadrant 1served as reference group in the model. The  $\beta_{12}$ ,  $\beta_{13}$ , and  $\beta_{14}$  were the interactions between a learning objective being classified in one of the RISE quadrants *j* and the wave *i* on performance. All other terms were defined in equations 1, 2, and 3.

A combined model using OER use and RISE classification was not developed because OER use and RISE classification are highly colinear due to OER use being part of the RISE classification analysis.

# **Results**

#### **Descriptive Results**

The RISE analysis following learning objectives over time allowed us to identify which learning objectives had consistently low performance. Line charts represented student performance in OER associated with specific learning objectives. The worst performing learning objectives fell in the outermost region of quadrant 4 based on the additive *z*-score approach implemented in the RISE analysis (Wiley, 2018). Potential multicollinearity issues were mitigated given that variables were standardized.

Table 1 shows the descriptive statistics per wave and the percentage of learning objectives classified in each quadrant. Columns one and two in Table 1 show that the highest OER use was in spring 2020; however, this was also the semester with the lowest performance which could be explained by the pandemic outburst. It is worth noting that fall 2021 had the lowest OER use average without sacrificing performance average, indicating an improvement in OER efficiency for student performance. Preliminary examination of resource classification using the RISE analysis indicates greater variation in quadrants 2, 3, and 4. The percentage of resources classified in quadrant 1 is somehow stable over time. Unlike quadrant 1, the other quadrants show variations in the percentage of resources classified. Quadrant 2 showed an upward trend in 2020 and a slight decrease in fall 2021. Quadrant 3 showed a decrease in fall 2020 and then an upward

trend until the last wave. Quadrant 4 indicated an increase from wave 1 to 2 and then a sharp decrease between wave 3 and 4.

#### Table 1

Descriptive Statistics Per Wave and Rate of Classified Learning Objectives Per Quadrant

Wave	Ν	OER use	Performance	Q1 %	Q2 %	Q3 %	Q4 %
		M (SD)	M (SD)				
Spring 2020	127	0.84 (0.26)	0.79 (0.13)	29.13	23.62	19.68	27.55
Fall 2020	190	0.74 (0.29)	0.8 (0.09)	30	23.15	16.84	30
Spring 2021	190	0.72 (0.33)	0.82 (0.08)	27.89	26.84	20.52	24.73
Fall 2021	190	0.33 (0.14)	0.81 (0.08)	29.47	25.26	25.78	19.47

*Note*. OER use and Performance are standardized. OER = open educational resources; Q1 = quadrant 1; Q2 = quadrant 2; Q3 = quadrant 3; Q4 = quadrant 4. M = mean. SD = standard deviation.

Table 2 shows the correlation among variables per wave. Waves 1 and 3, corresponding to spring 2020 and 2021 respectively, are displayed below the diagonal. Waves 2 and 4, that indicate fall 2020 and 2021, are above the diagonal. Preliminary inspection of correlations suggests that the largest negative correlations are between performance and quadrant 4 and between OER use and quadrant 1. As expected, the largest positive correlations are between performance and quadrant 1.

#### Table 2

Spring 2020 (Wave 1) – Fall 2020 (Wave 2)					Spring 2	021 (Wa	ave 3) -	- Fall 20	021 (Wa	ave 4)		
	1	2	3	4	5	6	1	2	3	4	5	6
1. Perf.	—	22	.53	.34	38	54	—	.12	.45	.42	58	34
2. Use	21	—	59	•45	37	.48	16	—	46	.55	49	.48
3. Q1	·54	54	—	36	29	43	.53	51	—	38	38	32
4. Q2	.39	.43	36	—	25	36	.35	.48	38	—	34	29
5. Q3	37	45	32	28	_	29	35	42	32	31	_	29
6. Q4	59	•54	40	34	31	—	59	.44	36	35	29	_

Correlations Among Variables During Waves 1 to 4

*Note.* The results for waves 1 (spring 2020) and 2(spring 2021) are shown below the diagonal, while waves 2 (fall 2020) and 4 (fall 2021) are above. Perf. = performance; Use = OER use; Q1 = quadrant 1; Q2 = quadrant 2; Q3 = quadrant 3; Q4 = quadrant 4.

Of the 190 learning objectives, 135 changed at least once. Figure 3 shows a line plot of the learning objectives that changed quadrant over time in relation to student performance. Colors indicate quadrant change. The dashed line shows the linear pattern that the data follows, indicating that over time there was a slight increase in student performance. Ideally, learning objectives should move down quadrants over time, indicating that continuous improvement cycles triggered by the RISE analysis are improving OER quality. Visual examination of the fourth wave of data shows a decrease in learning objectives classified in quadrant 4, suggesting quality improvement.

#### Figure 3

Trajectory of Learning Objectives that Changed RISE Quadrant Over Time (N = 135)



OER Individual Trajectories

*Note*. RISE = resource inspection, selection, and enhancement; OER = open educational resources.

# **Modeling Results**

The modelling results showing average score growth in the Introduction to Sociology course are displayed in Table 3.

# Nesting Effect

The average performance among learning objectives was 0.80, p < .001. The interclass correlation (ICC) calculated with the null model shows that the learning objectives explained 77% of the variance in performance. The larger the variation, the more appropriate the use of a GCM. A 77.2% of variation justifies

the nesting effect of the individual learning objectives over time. In other words, individual differences in performance per the learning objectives exist.

#### Unconditional Growth Model Results

As summarized in Table 1 in the Growth Model (unconditional growth model), the mean growth rate was statistically different from zero [ $\beta_{10} = 0.0074$ , t(189) = 3.172, p < .001]. The average performance for learning objectives was 0.796, p < .001. The average performance significantly increased by 0.0074 points every semester (p = .002).

#### **OER Use Model**

The results of the OER use model showed that the mean performance for learning objectives was  $0.837 [\beta_{00} = 0.837, t(189) = 46.92, p < .001]$ . For every view per OER, performance per learning objective decreased on average by 0.06 points [ $\beta_{01} = -0.059, t(189) = -2.772, p = .006$ ]. The mean growth rate of performance decreased on average for every semester by 0.01. However, this decrease was not statistically significant [ $\beta_{10} = -0.01, t(189) = -1.806$ ]. The student performance of learning objectives with higher OER use increases, on average, by 0.036 per semester [ $\beta_{11} = 0.0296, t(189) = 3.766, p < .001$ ].

In the OER use model, OER use per learning objective accounted for 4% of students' performance variance and 0.01% of students' performance growth rates variance. Although OER use is significant in explaining the initial point differences and variation in growth, the practical significance is small. It is likely that the significance was due to the large sample size, and therefore, OER use is trivial to an increased student performance over time.

#### **RISE Model**

The results of the RISE model focused on the relation between the RISE analysis classification and performance. Results showed that the mean performance was  $0.858 \ [\beta_{00} = 0.858, t(189) = 113.27, p < .001]$ . On average, performance decreased over time at  $0.0014 \ [\beta_{10} = -0.0014, t(189) = -.474, p = .635]$ . Quadrant 1 (i.e., high performance, high use) served as the reference category to compare the effect of the RISE analysis classification on performance. As expected, the effect of the RISE analysis on performance was negative for specific quadrants. Quadrants 3 {i.e., low performance, low use;  $[\beta_{01} = -0.1325, t(189) = -13.29, p < .001]$ } and 4 {i.e., low performance, high use;  $[\beta_{01} = -0.1312, t(189) = -13.16, p < .001]$ } were statistically significant, negatively associated with lower starting points in students' performance. However, the interaction between the RISE analysis classification and time showed that performance per the learning objectives classified in quadrant 3 significantly increased by  $0.0148 \ [\beta_{11} = 0.0148, t(189) = 3.22, p = .01]$  with respect to learning objectives in quadrant 1. Likewise, performance in learning objectives classified in quadrant 2 significantly by  $0.0213 \ [\beta_{11} = 0.0221, t(189) = 4.78, p < .001]$ . The results indicate that the classification of learning objectives using the RISE analysis triggered continuous improvement cycles of the OER, addressing quality issues and resulting in better students' performance over time.

In the RISE model, the data showed that using the RISE analysis classification in the model accounts for 65% of the variation in students' performance over time. Therefore, we conclude that the effect of the RISE analysis and subsequent continuous improvement cycles is moderate to large.

#### Table 3

Effect	Param eter	Null mo	odel	Growth		OER use		RIS	E
		Mode	l 1	Model	2	Model	3	Model 4	
		Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Fixed									
Performance (intercept)	$eta_{00}$	0.8081***	0.0062	0.7960***	0.007	0.837***	0.0178	0.8588***	0.0075
OER use	$\beta_{01}$					-0.0587**	0.0211		
Time—wave	$\beta_{10}$			0.0074**	0.002	-0.0108	0.0059	-0.0014	0.003
OER use $\times$ wave	$\beta_{11}$					0.0296**	0.0078		
Quadrant 2	$\beta_{02}$							-0.0112	0.010
Quadrant 3	$\beta_{03}$							-0.1325***	0.009
Quadrant 4	$\beta_{04}$							-0.1312***	0.009
Quadrant 2 $ imes$ wave	$\beta_{12}$							0.0026	0.004
Quadrant $_{3} \times$ wave	$\beta_{13}$							0.0148**	0.004
Quadrant 4 $\times$ wave	$eta_{14}$							0.0221***	0.004
Random		Variance Component	SD	Variance Component	SD	Variance Component	SD	Variance Component	SD
Individual intercept variance (between learning objectives)	r <sub>0j</sub>	0.0067	0.0826	0.0109	0.1044	0.01047	0.1023	0.0038	0.06181
Wave variance (within learning objectives)	r <sub>ij</sub>			0.0006	0.0255	0.0006	0.0255	0.0002	0.01515
Model summary									
ICC		72.2%		84.1%		84.2%		70.1%	
AIC		-1711.9		-1822.9		-1835.1		-2148.2	
BIC		-1698.3		-1795.6		-1798.7		-2093.6	

#### Linear Model of Growth in Average Standardized Score by OER Use and RISE Analysis Quadrants

*Note*. The number of observations were n = 697. Interclass correlation coefficient = .52. Model 1 is an unconditional growth model. Model 2 adds the main effect of OER use per learning objective. Model 3 uses RISE analysis as a predictor only. Model 4 shows interaction between RISE analysis and time. The ICC for Model 1 is 0.84. In Model 1,  $\beta_{00}$  was the average performance across all learning objectives and waves.

In Model 2 and 3,  $\beta_{10}$  was the average growth rate across all learning objectives. In Model 3,  $\beta_{11}$  was the fixed effect of the interaction of OER use of learning objective *j* and wave *i* on performance. In Model 4,  $\beta_{02}$ ,  $\beta_{03}$ , and  $\beta_{04}$  were the fixed effects of the learning objective being classified in RISE quadrants 2, 3, or 4 on performance. In Model 4,  $\beta_{12}$ ,  $\beta_{13}$ , and  $\beta_{14}$  were the interactions between a learning objective being classified in one of the RISE quadrants *j* and the wave *i* on performance. The random effects  $r_{0j}$  was the difference between the average performance of learning objective *j* and the overall average and  $r_{ij}$  was the difference between the growth rate of learning objective *j* and the average growth rate. OER = open educational resources; RISE = resource inspection, selection, and enhancement; ICC = interclass correlation coefficient; AIC = akaike information criterion; BIC = bayesian information criterion; SD = standard deviation; SE = standard errors. × = Interaction term. \*p < .05. \*\*p < .01. \*\*\*p < .001.

# **Discussion and Future Research**

This study examined the role of OER use on students' performance over time and how the RISE analysis classification was related to a growing trend in students' performance. A longitudinal multilevel model (i.e., GCM) was used to investigate growing trends based on data gathered at the end of four consecutive semesters. The results suggest that there is an inverse relationship between OER quality based on the RISE analysis classification and OER use. Furthermore, certain OER classifications based on the RISE analysis resulted in increased student performance over time. We assume that such improvement is presumably due to practitioners' efforts to improve OER quality through continuous improvement cycles. Furthermore, whilst improvements in student performance have been demonstrated by the models, other moderator variables may well account for this.

Resource use (i.e., accessing content, watching videos) is traditionally associated with higher performance (i.e., grades; Bonafini et al., 2017). In this study, OER use had a small but positive effect on students' outcomes at the initial measurement time, but the effect of OER use became negative over time. Although this study showed a negative association between OER use and students' performance, this result is not necessarily negative. The results may indicate that students who revisit OER need extra support and potentially that the OER is not enough to support the learner. We speculate that there is a need to shift the conversation from "mindless" engagement, in which more is better, to "meaningful engagement," in which efficiency is measured by reduced use. Although previous learning analytics work has used page views as the metric for user engagement (Bonafini et al., 2017) and proxy of OER quality, we argue that future research would benefit from questioning the meaning of student engagement regarding OER. Foundational work in the field of distance learning opened the conversation about meaningful ways to approach students' engagement and interaction by positing that "interaction is not enough" (Garrison & Cleveland-Innes, 2005, p. 133). Echoing their perspective, we now shift the focus to "views are not enough" in OER.

Unsurprisingly, quadrants 3 and 4 showed a negative effect on students' performance. However, the interaction between quadrants 3 and 4 and time increased students' performance over semesters, suggesting that OER classified in these two quadrants were efficiently improved. Rather than making causal claims, we speculate that the RISE analysis classification could be positively related to students' performance when intentionally applied over time and when developers and instructional designers deploy their expertise for OER improvement. Assuming that flagged OER are intentionally improved, the RISE analysis helps practitioners and authors to focus their efforts on quality improvement activities. Furthermore, this is a cost-savings opportunity for educational institutions that often struggle with budgetary constraints, even more so with open education initiatives. Altogether, our findings in Model 3 suggest that RISE analysis classification is positively correlated with students' performance when accounting for time, specifically with quadrants 3 and 4. Considering that only quadrants 3 and 4 showed statistically significant improvement, we suggest that a potential simplification of the RISE framework that includes only three categories could be worth examination. Future work on the RISE analysis could focus on more algorithmic-driven classifications through unsupervised machine learning to validate or improve the current classification.

As educational interventions tend to account for minor variances in performance (Hattie et al., 2014), we are confident that the RISE analysis is an efficient and cost-effective intervention for OER implementation
#### The Impact of OER's Continuous Improvement Cycles on Students' Performance: A Longitudinal Analysis of the RISE Framework Castellanos-Reyes, Camargo Salamanca, and Wiley

that directly influences students' learning. Given that the RISE classification accounts for 65% of the growth of students' performance, suggesting a moderate to large effect, we speculate that the RISE analysis could be generalized to other contexts and result in greater student gain. Our findings are consistent with the premise that RISE analysis improves OER quality and, eventually, students' learning (Bodily et al., 2017). We believe the RISE analysis answers the call from researchers in the learning analytics community who urge researchers and developers to focus more on "learning" and less on the analytics.

We call on researchers for the development of a user-friendly (i.e., click and go) application in which practitioners can run the RISE analysis in a cross-sectional and longitudinal fashion to evaluate whether the continuous improvement efforts are fruitful. Like the ATCE tool proposed by Avila et al. (2017), RISE aims to inform practitioners and educators about OER quality. Although Avila et al.'s (2017) work focused on using platforms for quality improvement of OER, those platforms are often targeted at specific learning management systems and include an array of variables. The RISE analysis is an efficient system that is already open access, can be adapted to a plethora of platforms, and requires minimal guidance. However, RISE analyses of OER are still subject to back-end data preprocessing before practitioners can use them. Even though RISE analysis is an open-source package, practitioners still need familiarity and data literacy skill to exploit its full potential. Therefore, future work for practitioners and researchers can focus on building integrated dashboards and applications to respond to such needs. This need is critical since RISE analysis is not meaningful if practitioners do not have buy-in to implement it in their everyday workflow.

Finally, in agreement with previous work that calls for temporal analysis of educational data (Castellanos-Reyes et al., 2023; Knight et al., 2017), this study calls for integrating granular temporal data that allows for continuous feedback on OER quality. In this way, researchers and practitioners could address improvement opportunities faster, meeting the learning analytics claim of informing educational decision-making in real time (Ifenthaler, 2015).

## Limitations

Given that the RISE framework includes students' performance to make the learning objective classification, we addressed potential threats of multicollinearity by inspecting the correlations among variables and investigating model estimation changes with and without adding the RISE classification. Specifically, in Model 3 (OER use), the intercept and the growth rate output reflected the same results of Model 2 (RISE), showing that multicollinearity does not have a particularly adverse effect in these measures. This study focused on data from the humanities. Therefore, further exploration needs to be done in STEM disciplines. No interactions at level two were explored in this GCM model, given the limited number of independent variables and repeated measures. Future work could explore the role of different types of learning objectives following a taxonomy to observe the interaction between potential second-level predictors. However, taxonomies for learning objectives have been criticized (Owen Wilson, 2016); nevertheless, practitioners widely implement them.

## **Conclusion and Scholarly Significance**

More visits to OER do not increase performance per the learning objectives, but continuous improvement over time of flagged OER does. This study shows strong evidence that the iterative RISE analysis using learning analytics is related to improving students' performance over time. Further studies might investigate if the trend holds when accounting for the interaction between the type of OER's learning objective and student performance. OER significantly benefits students who have been historically underserved in higher education (Colvard et al., 2018), such as racialized minorities and students in developing regions (Castellanos-Reyes et al., 2021; Castellanos-Reyes et al., 2022). We believe that a closer look at leveraging the continuous improvement of OER will ultimately benefit the populations systematically priced out of access to high-quality education and educational resources (Spurrier et al., 2021).

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# Book Review: Academic Quality and Integrity in the New Higher Education Digital Environment: A Global Perspective

Editors: Upasana Gitanjali Singh, Chenicheri Sid Nair, and Rashmi Watson (Chandos Publishing, 2023, 212 pages) ISBN: 978-0-323-95423-5

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## Introduction

In an era in which digital technologies are profoundly reshaping the landscape of higher education, *Academic Quality and Integrity in the New Higher Education Digital Environment: A Global Perspective*, edited by Upasana Gitanjali Singh, Chenicheri Sid Nair, and Rashmi Watson, emerges as a timely contribution. This edited volume explores the intricate relationship between academic integrity and quality assurance in the digital environment. It addresses a pressing and relevant subject that educational institutions around the world are struggling with, particularly due to the widespread use of artificial intelligence (AI).

With the growing importance of digital platforms in education, the difficulties of upholding academic honesty and preserving the standard of education have become more prominent and complex. The COVID-19 pandemic accelerated the shift to online learning. This shift, along with the introduction of language model processing and other forms of generative AI, has further magnified these difficulties. This book is an essential addition to current discussions in educational theory and practice.

The relevance of this edited volume extends beyond academic circles into the practical realm of educational administration and policy making. It provides a timely exploration of how digital technologies not only offer new opportunities for learning and engagement but also present novel avenues for addressing academic misconduct. The authors' viewpoints emphasize the universal nature of these difficulties, surpassing regional and cultural limitations. Having a global perspective is crucial for promoting international cooperation and discussion on the most effective methods for maintaining academic honesty in the era of digital technology.

This collection of essays provides valuable insights and a wide range of perspectives and case studies. Throughout the book, the writers have thoroughly analysed, making it a focused and significant contribution to the field of knowledge. Hence, this book will prove valuable to all stakeholders in academia, such as students, staff, researchers, instructors, administrators, and regulators.

## **Review of Chapters**

This edited volume is divided into nine chapters. The following section briefly summarises the chapters and their contributions to the topic.

The first chapter, "An autoethnography and analysis of Australian academic integrity policies amidst threats," by David Morgan, embarks on a critical exploration of Australian academic integrity policies through the lens of autoethnography. Morgan demonstrates the deficiencies in present frameworks when faced with contemporary difficulties like contract cheating and AI-generated content by blending personal experiences with a thorough analysis of policy formation. The author's account traces the development of academic integrity policies, highlighting the disparity between the creation of these policies and the actual experiences of academic staff and students.

The methodological approach presented in this chapter provides a unique and original contribution to the discussion on academic honesty. Morgan's use of autoethnography not only adds a personal touch to the examination of policy efficacy but also functions as a potent instrument for promoting policy improvements. The chapter serves as a strong and urgent appeal for a policy-making process that is more comprehensive and adaptable, specifically designed to tackle the swiftly evolving nature of academic misconduct. Moreover, it emphasises the capacity of personal narratives to enhance our comprehension of academic integrity, opening up possibilities for forthcoming research that is simultaneously deeply personal and intellectually rigorous.

The second chapter, "Reimagining academic integrity through the lenses of ethics of care and restorative justice," by Janus van As and Marike Kluyts, addresses the widespread problem of student readiness in South African higher education institutions (HEIs). It examines academic integrity within the larger framework of educational fairness and student assistance. The authors contend that the conventional criteria for academic misconduct fail to consider the fundamental conditions that contribute to such behaviours, such as limited access to resources and insufficient academic support. The authors advocate for a comprehensive strategy to promote academic integrity by studying the ethics of care and restorative justice. This approach prioritises empathy, understanding, and community rather than punishment.

The chapter greatly enhances the discussion on academic honesty by placing it within a wider educational and ethical context. Van As and Kluyts's endorsement of an ethics of care and restorative justice in academic contexts questions traditional disciplinary methods and proposes a change towards more supportive and inclusive educational practices. This study not only adds to the continuing discussion regarding the most efficient methods to maintain academic honesty but also provides practical recommendations for institutions aiming to foster an atmosphere that supports ethical researchers.

The third chapter connects generic academic integrity modules to professional integrity through curriculum design. The authors, Jen Tindale, Sandra Noakes, Elen Seymour, and Joan Lynch, critically assess the efficacy of generic online academic integrity modules employed by Australian higher education providers. The authors argue that although these modules are essential in familiarising students with the concepts of academic integrity, they frequently do not establish a significant link to the students' professional and disciplinary settings. The chapter examines case studies in law and nursing to see how incorporating academic integrity education with professional values and identities can improve students' comprehension and dedication to ethical behaviours.

This chapter provides a detailed and nuanced viewpoint on academic integrity education by connecting the divide between general integrity modules and specialised professional requirements within different disciplines. The authors' emphasis on the interaction between academic and professional integrity offers valuable perspectives on how curriculum design might be used to encourage a more profound involvement with ethical ideals. The chapter provides specific instances of successful incorporation of professional relevance into academic integrity education in the fields of law and nursing. This serves as a valuable resource for educators and administrators seeking to enhance the quality of their academic integrity education.

Chapter four, "Developing an all-voices plan: A case study of embracing community to uphold academic integrity," by F. Elizabeth Gray and Jennifer Scott, presents a compelling case study of the Melbourne Business School's response to the challenges of upholding academic integrity in the wake of COVID-19. The All-Voices Plan described in the chapter is an innovative community-driven plan that combines the efforts of staff, students, and administrators. The authors provide a comprehensive account of the plan's creation and execution, emphasising the significance of transparent communication, reciprocal regard, and collective accountability in cultivating a culture characterised by honesty and ethical behaviour.

The study highlighted in this chapter is notable for its inventive method of tackling academic integrity concerns by involving the community. The All-Voices Plan demonstrates how academic institutions can effectively respond to unexpected difficulties by cultivating an inclusive culture that appreciates the contributions of all individuals. This case study not only contributes to the existing information on effective integrity tactics but also provides a model that may be replicated by other institutions dealing with similar difficulties. The focus on community involvement and common principles offers a new viewpoint on academic honesty, highlighting its function as a collaborative effort rather than a sequence of individual actions.

Chapter five, titled "Addressing academic misconduct through embedding academic skill development in subject teaching: A collaborative approach" is about addressing academic misconduct by embedding academic skill development in subject teaching. Written by Lauren Bliss, Mei Li, and Alex Griffin, the chapter explores innovative programmes aimed at mitigating academic misconduct by integrating academic skill development directly into the curriculum of a media and communications foundation subject at the case study HEIs in Australia. This study thoroughly examines the collaboration of experts in different academic disciplines and teaching specialists, revealing how integrating the development of skills inside topic teaching can significantly decrease occurrences of academic misconduct. The programme prioritises improving students' comprehension of academic standards and the intricate demands of their fields, thereby cultivating a more profound respect for academic honesty. Bliss, Li, and Griffin provide a clear plan for educators who want to address academic misbehaviour by demonstrating how to enhance academic skills within a practical context. Their approach emphasises the importance of teaching practices that provide students with the essential skills to ethically handle academic difficulties. Moreover, the chapter questions conventional beliefs about addressing academic misbehaviour only

through punishment and emphasizes the significance of instructional design in fostering honesty. This work is highly useful because it suggests that academic integrity can be developed through careful curriculum planning and multidisciplinary collaboration.

The following chapter, titled, "Retooling online proctoring technology in the Fourth Industrial Revolution Learning Contexts—from big brother to learning buddy" is on retooling online proctoring technology in the Fourth Industrial Revolution Learning Context. Norwell Zhakata, the author, critically examines the contentious use of proctoring technology (PT) in assessments, especially in the context of the Fourth Industrial Revolution's impact on education. Zhakata explores the ethical, pedagogical, and practical issues related to PT, arguing for a reassessment of its function from a surveillance instrument to a supportive "learning companion." Through the presentation of four assessment scenarios, the author examines how PT may be used to facilitate ipsative assessment approaches. This transforms PT into a valuable tool that improves the assessment process for students by offering immediate feedback and assistance.

This chapter makes a substantial contribution to the current discussion about the role of technology in maintaining the honesty and fairness of assessments. The author suggests a change in how PT is understood and used, which not only tackles the ethical challenges of monitoring technologies but also offers creative solutions that are in line with contemporary educational requirements. This paper promotes an innovative method of thinking about how technology might be used to enhance the concepts of academic honesty and teaching efficacy. Zhakata's progressive approach to proctoring technology as a fundamental part of a nurturing learning environment encourages additional investigation and discourse on the incorporation of technology in education.

Pete Leihy and José M. Salazar's chapter, "'Linkage with the midst': Digital impact and institutional identity in Chile," investigates the digital strategies employed by Chilean HEIs to communicate their societal contributions, focusing on the concept of *linkage with the midst*. The chapter examines how these institutions use digital media to strengthen their institutional identity and academic credibility, actively involving diverse audiences to increase the visibility and influence of their academic and civic responsibilities. The authors view the digitalization of academic enterprises as a dual prospect, presenting both a threat to academic integrity and an opportunity to strengthen academic integrity on a global scale.

Leihy and Salazar provide a unique perspective on the impact of digitalization on academic integrity and institutional identity. Their analysis of the Chilean setting offers valuable perspectives on how HEIs might effectively traverse the digital realm to promote their core principles and contributions. Focusing on the concept of *linkage with the midst*, a term used widely in Chili to demand HEIs demonstrate their contributions to society, Leihy and Salazar expand the discourse on academic integrity beyond the limitations of conventional academic environments, to emphasise the capacity of digital platforms to cultivate a more involved and open academic community. This contribution is especially significant in a time when the online presence of educational institutions is becoming increasingly important for their reputation and influence on society.

Chapter eight, on the "Development of doctoral student perceptions of plagiarism and academic integrity: The roles of agency and aspirational identity," written by Minh Ngoc Tran, Stephen Marshall, and Linda

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Hogg, delves into the complex process by which doctoral students in New Zealand develop their perceptions of academic integrity. The chapter emphasises the impact of human agency, identity formation, and the learning environment on moulding the comprehension and attitudes of doctoral students towards scholarly practices, as well as their views of plagiarism. Applying Marginson's theory of international student self-formation as a framework, the authors conduct a detailed investigation of how international and local doctoral students navigate their identities and ethical positions over their academic journey.

The chapter provides insights into the concept of academic integrity specifically in the context of PhD studies. The authors shed light on the complex relationship between human agency, institutional culture, and academic expectations by examining how doctoral candidates shape their own development. This study provides useful insights into the methods by which institutions might organize doctoral education to facilitate the growth of ethical academics. Moreover, the focus on the responsibility of supervisors in guiding the ethical and scholarly growth of doctoral candidates highlights the significance of mentorship and support structures in fostering academic integrity.

The final chapter of the volume, "Open academic systems as key levers of integrity and quality assurance for assessments at the Université des Mascareignes." The Author Nirmal Kumar Betchoo explores the capacity of open academic systems to maintain high standards and honesty in assessments. Betchoo evaluates the difficulties and advantages of using dissertations, group-based assignments, coursework, and online assessments to uphold academic standards in the digital era. The author assesses how open systems, which have less direct supervision and more flexibility, can yet maintain strict quality assurance and integrity standards through innovative practices and regulations.

Betchoo's contribution to this volume is especially important because it carefully examines how traditional ideas of quality assurance and academic integrity might need to be adjusted to fit the changing nature of higher education. This chapter gives us a few crucial insights into how open academic systems can keep and maybe even raise educational standards in the digital world by looking at the systems and strategies used at the HEIs that were studied. More than that, Betchoo's chapter makes us think again about the the links between assessment methods, the requirement for flexibility, and academic integrity.

## Conclusion

Academic Quality and Integrity in the New Higher Education Digital Environment: A Global *Perspective* stands at the crossroads where the digital meets the physical. The book significantly contributes to the discourse on navigating the challenges of academic integrity and quality assurance in an increasingly digital yet predominantly brick-and-mortar-based educational landscape. It presents a comprehensive review of these topics from a global perspective, providing educators, administrators, and policymakers with important insights as they endeavour to adjust to the changing requirements of higher education. The book's inclusion of a wide array of case studies and perspectives underscores the complex and multifaceted characteristics of the issues under consideration, placing particular emphasis on the necessity of a cooperative and flexible strategy to safeguard credibility and excellence in higher education.

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The critical relevance of this work in contemporary times cannot be understated. As higher education continues to evolve under the influence of digital technologies, the insights provided by Singh, Nair, Watson, and their contributors offer a roadmap for navigating these transformations ethically, responsibly, and effectively. Their work underscores the importance of developing robust policies, pedagogies, and practices that leverage the benefits of digital technologies while safeguarding academic standards and integrity.

However, critical consideration of developing trends and technologies that affect academic integrity and quality assurance would have been a welcome addition to this conversation. An exploration of the potential use of adaptive learning technology, gamification, and blockchain to create more engaging and safe educational environments could have deepened the discussion. This edited volume is noteworthy because it comes at the perfect time. When much discussion about digital higher education is concentrated on technologies, the editors decided to bring the focus back to the quality and integrity of the learning.

Academic Quality and Integrity in the New Higher Education Digital Environment: A Global Perspective, therefore, provides a crucial foundation for understanding and addressing the challenges of academic integrity in the digital age. The ever-evolving nature of technology and pedagogy calls for ongoing exploration and adaptation. The book marks an important step in this continuous journey, inviting further research and dialogue to explore the uncharted territories of digital higher education.



November – 2024

# Distance Education Practices During the COVID-19 Lockdown: Comparison of Belgium, Japan, Spain, and Türkiye

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## Abstract

During the COVID-19 pandemic, many things changed in people's educational lives as individuals transitioned to remote learning. While technologically advanced countries swiftly adapted to the new normal, less developed countries encountered substantial obstacles. This study aimed to compare distance education practices during the lockdown in four OECD countries (Belgium, Japan, Spain, and Türkiye) and provide future-oriented suggestions. A systematic literature review was conducted using OECD documents on distance education practices accessed through the OECD iLibrary database with a keyword search. Nine papers out of 1,294 meeting inclusion criteria were thoroughly reviewed, focusing on categories such as general information, sample practices, implementation challenges, conducting courses, supporting students during the lockdown, and evaluation and national examinations. A descriptive analysis was performed based on coding categories. Findings revealed that school closure durations varied by country and educational level, with each country adopting approaches suitable for distance learning. Online learning platform development was similar across countries, except for Japan, which has a distinct curriculum structure. Challenges, including technological limitations and resistance to change, were common, exacerbated by a lack of expertise and the need for rapid adaptation. Distance education primarily relied on computers, television, and homework, with radio use varying. Decisionmaking processes differed across countries, with centralized decision-making observed in Türkiye. Supporting disadvantaged students and addressing learning losses were prioritized, and national exams were postponed with changes in content and the number of questions.

Keywords: COVID-19 lockdown, OECD, distance education, country policy

## Introduction

The COVID-19 pandemic has changed individuals' educational lives due to emerging conditions. UNESCO (2020) reported that 363 million students from the pre-primary to tertiary level, including 57.8 million learners in higher education, were affected and had to stay away from schools. During the pandemic, remote learning became necessary worldwide, posing challenges for technologically underdeveloped countries but prompting swift adaptation in developed ones. Around the globe, school closures, which lasted around 95 days on average, from March 11, 2020 to February 2, 2021, significantly impacted education. Latin America and the Caribbean, South Asia, and East and South African countries experienced the longest closures, with averages of 158, 146, and 101 days respectively (UNICEF, 2021). Despite disruptions, the lockdowns also spurred the use of alternative educational tools such as television, radio, and telephone (Li et al., 2022). During lockdown, distance education's significance increased. This event, which has initiated a paradigm shift, has demonstrated to the world that face-toface education alone is not sufficient during times of crisis. With the increasing interest in COVID-19 and its effects on education, various studies have been done, including systematic literature reviews. While some studies have dealt with higher education-related issues from local and global perspectives (Aristovnik et al., 2020; Bao, 2020; Crawford et al., 2020; Iglesias-Pradas et al., 2021), others have presented research about teachers and teacher education (Kim et al., 2022; König et al., 2020; Kulikowski et al., 2022; Marek et al., 2021; Ozamiz-Etxebarria et al., 2021). Systematic literature review studies have illustrated: the transition from face-to-face education to distance education, practices, and its effects (Abu Talib et al., 2021; Divjak et al., 2022; Huck & Zang, 2021; Walugembe et al., 2022); distance and online learning in different fields (Cevikbas & Kaiser, 2023; Muhaimin et al., 2023; Soon & Aziz, 2022); students' and teachers' experiences (Ahmad Shazli et al., 2023; Ibda et al., 2023; Westphal et al., 2022); technology use (Saikat et al., 2021); and research trends (Al Balushi et al., 2022; Bond, 2020; Husamah et al., 2022; Sianes-Bautista et al., 2022). These studies have generally covered global data or data related to only one context. These have also illustrated that some countries, already familiar with distance education, were able to make rapid arrangements, while other countries experienced many obstacles and needed time to arrange education. For this reason, the educational process during the COVID-19 pandemic was named with different terms in different countries (e.g., distance education, e-learning, online education, homeschooling, emergency remote teaching, etc.; Bozkurt et al., 2020). The most popular term used was emergency remote teaching or education. Therefore, evaluating the first distance teaching practices from this perspective enables people to understand countries' priorities for education and their perspectives on distance education during a time of crisis. Such an evaluation can show what should come next to improve distance education practices. For this reason, the difference between emergency remote teaching and distance education is discussed first in this study. After explaining the difference, a systematic literature review examines what has been done by countries during the COVID-19 lockdown, and we have provided a comparison of four countries' educational practices.

## **Theoretical Framework**

#### **Distance Education**

Distance education provides a structure that gives learners responsibility, flexibility, and choice rather than simply transferring specific content to them. In distance education, learners' needs, the learning context, and the availability of tools are important (Bozkurt & Sharma, 2020). Careful planning for

distance education includes deciding the content to cover and carefully evaluating how to enable different types of interactions that are important to the learning process (Barbour et al., 2020). The instructional designer must consider modality, pacing, pedagogy, students' and instructors' roles and numbers, synchronization of communication, evaluation, and feedback (Means et al., 2014). Moreover, in this type of education, individuals must manage their learning process and be motivated to do so (Anderson, 2020). Distance education is generally defined by the dominant technologies used for instructional delivery, such as letters, television, radio, audio, video, web, and so forth. Anderson and Dron (2011) approached distance education pedagogies as three generations: cognitive-behaviorist, social-constructivist, and connectivist pedagogy. Cognitive-behaviorist distance pedagogy, centered on the teacher, employs postal services and message redistribution but lacks social and cognitive presence. Social-constructivist pedagogy, using email, bulletin boards, and the Web, fosters student-student and student-teacher interaction, albeit at a high cost. Connectivist pedagogy goes further, leveraging digital technologies for collaborative, self-directed learning. It encourages active engagement with diverse sources but lacks standardized goals, making implementation challenging in some contexts. These pedagogies are also evolving with different technological improvements.

Whatever technologies are used for the delivery of instruction, distance education results from careful design and planning using a model. During the lockdowns, the rapid shift to online left little time for either design or planning. The form of education delivered, while labelled distance education by many, did not exhibit its usual characteristics. Mishra and his colleagues (2021) searched research trends in online distance learning during the pandemic and found that studies mostly covered remote teaching, the assessment of distance learning, emergency online teaching, virtual learning environments, and student readiness topics. Researchers in the field added remote education as a new term to define both distance and online learning.

#### **Emergency Remote Teaching**

Emergency remote teaching refers to temporarily adapting instructional delivery methods to respond to crises. This includes using fully remote teaching approaches for courses normally conducted face-to-face or through blended learning (Barbour et al., 2020). The intention is not to replicate a comprehensive educational environment but to swiftly establish access to instruction and support services during emergencies like the COVID-19 pandemic. Once the crisis subsides, instruction typically returns to its original format. Al Lily and his colleagues (2020) called it crisis distance education and summarized the differences between traditional distance education and crisis distance education as follows: it was a sudden change derived from unforeseen needs and without preparation; it had an international concern and popularity; it was used even in primary schools because of an obligation; it included both theoretical and practical courses; and so forth. This process increased teachers' responsibility since, during the crisis, many teachers had no experience or education related to distance education and schools did not adopt strategies to apply remote teaching (Bergdahl & Nouri, 2021). It also showed the importance of teacher training. A study done with pre-service teachers showed that they did not conceptualize online learning comprehensibly; they only associated it with technology without thinking of pedagogy, skills, and more (Tarchi et al., 2022). Considering the differences between distance education and emergency remote teaching, it is believed that actions taken in an unprepared process could provide a foundation for unforeseen events that may occur later. It is essential to think about possible scenarios for the future based on the contemplation of present data (Aladsani et al., 2022). Making decisions about the next steps without a deep understanding of what has been done can lead to problems. It is essential first to evaluate the decisions made by countries during the lockdown and the consequences of these decisions.

This way, the areas that need improvement can be identified. Considering that five years have passed since the pandemic's beginning, it is essential to assess past experiences closely to contribute to distance education theories and practices. Thanks to technological developments, it is inevitable that distance education will be used intensively from now on. Hybrid and blended learning are becoming prominent post-pandemic (Aladsani et al., 2022) because they support learners' potential and involvement in education (Tong et al., 2022). As a requirement of comparative education, it is crucial to know how effectively the countries in this process take the necessary measures and steps, what kind of information exchange takes place internationally, and how governments and education systems will be affected by this situation.

## **Current Study**

This study aimed to comparatively examine the distance education practices during the COVID-19 lockdown in Belgium, Japan, Spain, and Türkiye selected within specific criteria and present suggestions for the future in this direction. Based on this aim, answers to the following questions were sought:

- 1. How did school closures due to the pandemic vary across countries?
- 2. What distance education practices were implemented during the lockdown?
- 3. What challenges were encountered in terms of educational practices during the lockdown?
- 4. How were courses conducted during the lockdown?
- 5. How was the process of supporting and assessing students carried out during the lockdown?
- 6. What are the similarities and differences in all dimensions among Belgium, Japan, Spain, and Türkiye?

## Methodology

In this study, a systematic literature review was carried out. A systematic literature review is necessary to identify studies and show where new ones are needed (Petticrew & Roberts, 2006). This study was conducted to clarify the impact of the COVID-19 lockdown on educational practices in various countries during the period from 2019 to 2022. The aim was to investigate what occurred during this time and to identify areas where further research is needed. In this study, Xiao and Watson's (2019) steps were used for the review process: determining the research problem, specifying the protocol for performing the search, undertaking a literature review, limiting according to the inclusion criteria, evaluating the quality, obtaining the data within the purpose, analyzing and synthesizing the data, and creating the report. First, the study aimed to examine distance education practices during COVID-19 lockdowns in four different countries. In line with this purpose, the database for the review was determined, and the countries for comparison selected. The OECD iLibrary database (books, papers, and statistics published by the OECD) was chosen due to its diversity of international reports and data on various countries. It serves many as a foundation for international planning and studies and is readily accessible to all (OECD, 2024a). Since the COVID-19 pandemic led to unplanned and rapid changes in the education

systems, what the world tried to do to prevent its adverse effects on education and, specifically, all students became important. For this reason, three different countries with various levels of development were selected based on the education category of OECD's Better Life Index (Figure 1), and our own country was added as the fourth country.

#### Figure 1

#### OECD Better Life Index-Education



*Note*. Adapted from "Education- OECD Better Life Index," by OECD, 2024b (<u>https://www.oecdbetterlifeindex.org/topics/education/</u>). Copyright 2024 by OECD.

As seen in Figure 1, Türkiye is the least developed among the chosen countries in terms of education. It is followed by Spain, Japan, and the most developed, Belgium. Since education is associated with other sectors such as health, policy, and economy, it is an essential indicator to evaluate countries' development, quality of life and well-being by researchers, policy makers or various organizations. After deciding on the countries, "pandemic" and "COVID-19" were chosen as keywords for the review, with the expectation of accessing more sources. Criteria were established to decide which documents to include in the study. These criteria are as follows:

- presented in the form of a report
- is about education
- includes common issues related to the selected countries
- covers COVID-19 and its aftermath
- published in English or Turkish.

After establishing the inclusion criteria, the first query with the keywords was conducted. The systematic literature review process is summarized in Figure 2.

#### Figure 2

Steps of Systematic Literature Review on Distance Education in Four Countries During the COVID-19 Pandemic



The nine documents included were reviewed superficially to determine the categories for comparing countries. The documents can be seen in Table 1.

#### Table 1

Eligible Study Documents

Reviewed documents	Type of document	Language
How Learning Continued During the COVID-19 Pandemic: Global Lessons from Initiatives to Support Learners and Teachers	Book	English
Implications of the COVID-19 Pandemic for Vocational Education and Training	Report	English
COVID-19: The Second Year of The Pandemic	Chapter in Education at a Glance 2022	English
Using Digital Technologies for Early Education during COVID-19: OECD Report for the G20 2020 Education Working Group	Report	English
Lessons for Education from COVID-19: A Policy Maker's Handbook for More Resilient Systems	Book	English
The State of Higher Education: One Year into the COVID-19 Pandemic	Report	English
The State of Global Education: 18 Months into the Pandemic	Report	English
The State of School Education: One Year into the COVID-19 Pandemic	Report	English
How Prepared Are Teachers and Schools to Face the Changes to Learning Caused by the Coronavirus Pandemic? Teaching in Focus	Report	English

After reviewing these documents, the coding categories were determined as follows: general information, sample practices, implementation challenges, conducting courses, supporting students during the lockdown, evaluation, and national examinations. The documents were examined in detail based on these categories first, and necessary information was saved per the determined criteria for each country. A descriptive analysis was conducted, and then a joint report was presented by comparing the data in each country's report prepared by the authors. Finally, the authors evaluated the analysis through discussions until they reached a consensus. For ethical considerations, permission was obtained from the Social and Human Sciences Ethics Committee of Ondokuz Mayis University.

## Findings

The findings are presented under headings that correspond with the coding categories used in the review.

#### **General Information**

As the COVID-19 pandemic spread globally, many countries closed schools as a preventive measure. School closures and the related decisions made in this period are summarized in Table 2.

#### Table 2

Country	School closure duration – K-12 (days)	Closure duration in higher education (days)	Restrictions on online learning	Changes in vocational training
Belgium	~50	~30-40	No restrictions	40-day closure, adjustments in 2020- 2021
Spain	<50	~50	No restrictions	45-day closure, compensatory training provided
Türkiye	Preschool: ~90 Primary: ~120 *Secondary: ~140 High School: >200	From 2020 to February 2021	Restrictions on all levels	Around 110-day closure, prioritized changes
Japan	Primary: ~35 No other school closures	Optional	Undergraduate and short-term programs	Adjustments made regionally, no closure in vocational high schools

Summary of School Closures in the Studied Countries

\**Note*. In Türkiye, secondary school includes grades 5 to 8 and high school includes grades 9 to 12. Secondary school provides general education while high school offers specialized education in academic, religious, vocational programs and fine arts.

According to an OECD report (2021a), Belgium closed its schools for about 50 days, nearly half of the OECD average, with no differentiation by educational level. High schools closed for five days between January and May 2021. Belgium avoided transitioning to distance education for preschoolers, keeping preschools open in the Flemish region. In Türkiye, school closures lasted longer than the OECD average, with preschools closed for 85-90 days and primary schools for about 120 days, secondary schools for approximately 140 days, and high schools for more than 200 days. Japan experienced a brief closure of around five weeks for primary schools but kept preschools open, using digital technologies extensively. Spain had shorter school closures (less than 50 days), and by May 2021, all levels were fully open despite the country having had the highest number of cases in Europe (OECD, 2021a; OECD, 2021b; OECD, 2021c; OECD, 2021d).

Regarding higher education, in Belgium, universities were closed from March 16 to May 18, 2020, with limited reopening in November and December 2020. Türkiye experienced closures until February 2021, while Japan did not mandate closures, allowing universities the option to postpone in-person classes as needed. In 2020, Türkiye had no face-to-face higher education classes, while students in Belgium mostly attended online classes. However, Belgium allowed face-to-face exams with protocols (OECD, 2021b). Spain's universities were closed from March 14 to May 22, 2020, with partial closures continuing into 2021. Higher education had approximately 50 days of closure in Spain in 2020 (OECD, 2021b).

The OECD noted that Japan and Türkiye imposed restrictions on the scope of publicly permitted online learning, whereas Belgium did not. In Türkiye, restrictions were applied to undergraduate, graduate, and postgraduate levels, while Japan restricted mainly undergraduate and short-term programs (OECD, 2021b). Changes in Japan's higher education calendar and programs were regional, with additional funding allocated for the 2019 and 2020 academic years. Belgium and Spain increased funding for higher education between 2019 and 2021, but Türkiye's decisions on academic calendar changes were centralized without increased funding (OECD, 2021b). Vocational and technical schools in Belgium and Spain experienced 40 and 45 days of closures, respectively, while Türkiye had approximately 110 days of closure (OECD, 2021e). Distance education in vocational training was limited in the Flemish Community, with specific arrangements made in the 2020–2021 academic year. Japan made regional changes to vocational education, with closures only in technical colleges. Belgium, Japan, and Spain provided compensatory training for vocational students, with Belgium offering additional workplace training days and increased incentives for employers. At the same time, Spain allowed regional exceptional measures for training programs (OECD, 2021e).

#### **Sample Practices**

During the lockdowns, countries implemented specific changes and sometimes strengthened certain practices in their education systems. First, in Belgium, KlasCement, managed by the Flemish Ministry of Education and Training, supported teachers and pre-service teachers with professional learning and online teaching activities. Established in 1998 as a teacher-focused network, KlasCement allowed teachers to share educational resources and ideas via forums. Following school closures in March 2020, KlasCement expanded its website to include sections for distance education and learning, edited existing resources, and sought additional support from partners.

In Japan, when schools closed in March 2020, Obiyama Nishi Elementary School in Kumamoto City launched a YouTube video series to implement the curriculum without ignoring the "tokkatsu" (Japanese non-subject education) included in it normally. Teachers made a study plan to discuss what children needed to know according to their classes during school closures and then developed and edited the videos. Children were given timetables to reach resources. Each morning and afternoon, classes started with exercise activities or dancing. LoiLoNote School was seen as helpful in conducting collaborative online interactive courses, and MetaMoJi ClassRoom and Zoom applications that allow collaboration were used in the classrooms.

In Spain, during the lockdown, the ProFuturo digital education program implemented the #SeeYouInDigital contingency plan to ensure teacher education and student learning continuity outside classrooms. This plan provided accessible courses and resources for all, adjusted for students without technology or Internet access. Additionally, the Spanish Ministry of Education and Vocational Education launched the Aprendo en Casa (Learn at Home) initiative within 10 days, offering quality educational resources and online tools for teachers, families, and students.

In Türkiye, the Education Information Network (EBA) and TRT School channel delivered distance education. The Ministry of National Education developed a mobile app to support students with special needs, providing specific resources for parents or caregivers. This app also offered technical features to accommodate various dysfunctions (on-screen text reading, sign language, dyslexia-friendly fonts) and created a social network for users to share their work (Vincent-Lancrin et al., 2022).

#### **Implementation Challenges**

While countries adopted different sample practices, they faced some implementation challenges, as summarized in Table 3.

#### Table 3

Country	Challenges	
Belgium	ICT infrastructure tools	
	Coordinating remote work on KlasCement	
	Privacy issues with video and audio platforms	
	Quick transition to new platforms	
Japan	Internet access issues	
	Technological device limitations	
	Challenges with online teaching tools	
Spain	Limited Internet access in remote areas	
	Lack of devices among teachers	
Türkiye	Challenges in assembling an expert team	
	Mobilizing resources	
	Application development	
	Difficulty reaching students with special needs at home	

Distance Education Challenges Faced by Four Countries During the COVID-19 Pandemic

*Note*. Information and Communication Technology (ICT) includes a wide range of technological tools and resources to access, create, store, and share information.

The implementation challenges of KlasCement in Belgium mainly occurred in ICT infrastructure tools and the need for the team to coordinate work on the platform remotely. Due to privacy issues, KlasCement had to stop using chosen video and audio platforms for teacher webinars. The transition to a new video and audio platform had to be done quickly, which brought additional challenges. Considering this experience, the government then decided to invest in new tools and purchase a server to facilitate the organization of webinars and other similar activities. Remote coordinated work on KlasCement with limited social contact among team members created extra challenges regarding time and plans.

In Japan, these challenges included problems related to Internet access, technological devices, and online applications used for teaching and learning.

In Spain, the pandemic posed a significant challenge as ProFuturo operated in remote areas where teachers did not always have Internet access and, in most cases, did not have a computer or even a smartphone. To solve this, resources were printed and distributed door-to-door, complemented by interactive presentations, podcasts, audio and video courses for radio and TV broadcasting, and WhatsApp forums. For Aprendo en Casa, the implementation challenge was primarily the need for more resources.

In Türkiye, gathering a team of experts for the implementation, mobilizing appropriate resources, and developing the application were quite challenging. After the application was presented, reaching students with special needs at home became the most difficult part. To overcome this challenge, the application was introduced through various channels (Vincent-Lancrin et al., 2022).

#### **Conducting Courses**

To conduct courses, countries generally used similar solutions with some differences. Table 4 outlines how courses were conducted and the decision-making process regarding educational practices during the pandemic.

#### Table 4

Course Delivery Mode and Decision-Making Processes in Four Countries During the COVID-19 Pandemic

Country	Delivery mode	Decision-making process
Belgium	Online platforms	School-level decisions
	Correspondence-based homework	Decisions included closing/opening schools, educational resources, teacher competencies, and pedagogical approaches
	Television	
	Smartphones	
	Radio (Flemish Community)	
Japan	Online platforms	Local-level decisions within a general framework
	Correspondence-based homework	Regional-level decisions on teachers' teaching and learning requirements
	Television	School-level decisions on teaching activities and approaches
	Smartphones	
	Radio	
Spain	Online platforms	National, regional, and local authorities collaborated
	Correspondence-based	Regional-level decisions on school closures
	homework	Decisions on available resources at all levels
	Television	Regional-level decisions on teacher qualifications
	Smartphones	Decisions on course delivery during school re-opening at all levels
Türkiye	Online platforms	All decisions made at the center
	Correspondence-based homework	
	Television	
	Smartphones	
	Other modalities	

According to the OECD (2021c) report, online platforms, correspondence-based homework, television, and smartphones were used in the French Community of Belgium, while the Flemish Community also employed radio training. In Türkiye, in addition to these, other distance education modalities such as apps or video conferencing were used, and priority was given to reading and mathematics. Regarding decision-making, schools in both Belgian communities had autonomy over closure/opening decisions, educational resources, teacher competencies, and pedagogical approaches, whereas decisions in Türkiye were centralized (OECD, 2021c). In Japan, the same delivery modes were used. The lockdown made partaking of Japan's non-subject curriculum challenging, as it typically relies on extensive in-person interactions (Vincent-Lancrin et al., 2022). The decisions were taken at the local level within the scope of a general framework. Decisions regarding teachers' teaching and learning requirements were handled at the regional level. Decisions at the school level were about which teaching activities and approaches teachers would adopt.

In Spain, education during this period prioritized the disadvantaged, with arrangements made for the 2020–2021 academic year regarding the education process and curriculum content. Online platforms, correspondence-based homework, television, and smartphones were used, with no use of radio. National, regional, and local authorities collaborated to support education continuity. While regional authorities decided school closures and teacher qualifications by themselves, decisions on course delivery during school reopening and resource allocations were taken at all levels (OECD, 2021c).

## Supporting Students During the Lockdown

To support different groups of students, countries differentiated their policies and practices. These are summarized in Table 5.

#### Table 5

Country	Measures taken for disadvantaged groups during lockdown	Measures against learning losses during school reopening	Policies and support measures implemented in 2022
Belgium	Internet support through GSM operators Asynchronous courses Infrastructure improvements for remote learning Tablets and computers Special efforts for students in migrant, seasonal worker, or refugee camps and with disabilities	Assessed learning losses Compensatory education Special measures for disadvantaged (students at risk of dropping out, immigrant, ethnic minority and refugee students, vocationally-oriented students)	Extended instructional time Psychological counseling services Grouped students based on competencies for targeted instruction (French community)
Japan	Support for lower-income students (cash-transfer) Internet support through GSM operators Asynchronous courses Infrastructure improvements for remote learning Special efforts for students in migrant, seasonal worker, or refugee camps and with disabilities Tablets and computers	Assessed learning losses Compensatory education Special measures for disadvantaged (students at risk of dropping out, vocationally-oriented students, students taking national exams and transitioning between ISCED levels)	Nationwide psychological counseling services Strengthened water sanitation Cash transfers, curriculum adjustments, extended instructional time, personalized instruction, and improved nutrition services at the local level
Spain	Support for lower-income students (cash-transfer) Internet support through GSM operators Asynchronous courses Infrastructure improvements for remote learning Tablets and computers Special efforts for students with disabilities	Assessed learning losses Compensatory education Special measures for disadvantaged (students at risk of dropping out, immigrant, ethnic minority and refugee students, vocationally-oriented students, students taking national exams and transitioning between ISCED levels)	Warning systems for students at risk of dropping out Automatic re-enrollment mechanisms Curriculum adjustments, extended instructional time, personalized instruction, campaigns to attract students to school, financial and emotional support for tutoring, counseling services, systems for directing students to specialized services and strengthened water sanitation at the local level
Türkiye	Internet support through GSM operators Asynchronous courses	Compensatory education Special measures for disadvantaged (immigrant, ethnic minority and refugee students, students taking	Accelerated education programs Campaigns to attract students to school Cash transfers

Measures Taken to Support Students in Four Countries During the COVID-19 Pandemic

Distance Education Practices During the COVID-19 Lockdown: Comparison of Belgium, Japan, Spain, and Türkiye Akkan and Eminoglu Kucuktepe

Infrastructure improvements for remote learning Special efforts for students in	national exams and transitioning between ISCED levels)	Financial and emotional support for tutoring Counseling services
migrant, seasonal worker, or refugee camps and with disabilities Tablets and computers	Automat mechar Strength Systems to speci	Automatic re-enrollment mechanisms
		Strengthened water sanitation
		Systems for directing students to specialized services

*Note.* International Standard Classification of Education (ISCED) serves as a reference to organize education programs and associated qualifications based on levels and fields internationally.

Measures taken for disadvantaged groups were mentioned in the OECD report (2021c). The first measure in all four countries was to provide Internet support through Global System for Mobile Communications (GSM) operators. In addition, asynchronous courses were offered in all countries, and flexible learning opportunities were offered to students. Infrastructure improvements were made for students living in remote areas and those living in the city but needing help connecting to classes due to overloading. Special efforts were made to ensure access to education for students residing in migrant, seasonal worker, or refugee camps except in the case of Spain and the Flemish Community's primary level. Moreover, tablets and computers were provided to students, and necessary arrangements were made for students with special needs. While those with low socioeconomic status were ignored in Belgium and Türkiye, students who spoke minority languages were supported only in Türkiye.

The same report outlined measures taken against learning losses when schools reopened in 2020, similar in Belgium's Flemish and French communities, Spain, and Japan. These measures included assessing learning losses, providing compensatory education, and taking special measures for disadvantaged students, those unable to participate in distance education, and students at risk of dropping out or grade repetition. Spain and Japan also supported students taking national exams and transitioning between International Standard Classification of Education (ISCED) levels. However, Japan did not directly address immigrants, ethnic minorities, or asylum seekers, nor did it develop materials for speakers of minority languages. Türkiye made efforts at all levels except for assessing learning losses, remedial measures for vocational students, and economic support such as cash transfers, unlike Japan and Spain (OECD, 2021c). Regarding policies during the pandemic, the countries prioritized various support points. For example, Belgium, Japan, and Spain prioritized ensuring all students' educational participation and benefit, focusing on student well-being, assessment approaches, and addressing learning losses. The French region of Belgium, Japan, and Türkiye adapted policies to changing circumstances by supporting educators and expanding remote learning capacity. Additionally, Belgium's French region and Türkiye fostered collaboration with stakeholders beyond educational institutions, while Japan emphasized personalized and flexible learning approaches like Spain, unlike Belgium (OECD, 2020).

When examining OECD (2022) data to see what kinds of support were provided in the year 2022, a number of observations can be made. In the French-speaking region of Belgium, efforts were made to increase the time allocated to education and teaching through activities such as summer schools and extending school hours. Students were grouped based on their competencies rather than age, enabling targeted instruction. Psychological counseling services were also offered to students.

In Japan, nationwide psychological counseling services and strengthened water sanitation were implemented alongside local measures such as cash transfers, curriculum adjustments, and extended instructional time. Spain developed warning systems for identifying students at risk of dropping out and established automatic re-enrollment mechanisms, along with local campaigns to attract students to school and provide financial and emotional support for tutoring. Special services were created for students with special needs. Türkiye implemented accelerated education programs but did not address nutrition, targeted instruction, extending instructional time, or curriculum adjustments like other countries (OECD, 2020).

#### **Evaluation and National Examinations**

Other critical issues interrupted during the lockdowns were evaluations and exams. Belgium did not hold standardized examinations in 2020 and 2021. It took a similar stance to Japan, Spain, and Türkiye. National exams held in Türkiye were postponed, and adjustments were made for the content, as in Spain. As a result of the postponement, new dates were determined for the exams, which were carried out under certain precautions (OECD, 2021a). In Spain, the number of questions in national exams was also modified.

OECD (2021a) data show that extra health and safety measures were taken in Belgium, namely, in the Flemish Community, conducting online exams and in the French Community, cancelling exams. Different evaluation techniques were adopted. Teachers in Belgium and Spain assessed learning losses through formative assessment at the primary and secondary levels.

Moreover, OECD (2022) data shows the impact of school closure on learning outcomes in lower secondary education in 2021 and 2022. In Türkiye and Japan, studies have been conducted into national exam outcomes, while no research has been carried out for the results of school exams. In Spain, no work has been done in either dimension. As for Belgium, low number of participants or missing data make it difficult to assess the impact of school closures on outcomes.

## **Conclusion, Discussion, and Future Directions**

This systematic literature review on distance education practices during lockdowns revealed the various measures taken. First, it was found that closure durations varied across countries, with Japan having the shortest closure and Türkiye the longest, reaching nearly two years (Ozer et al., 2022). Despite high case numbers, Spain had shorter closure periods, supported by studies emphasizing low infection risks in education centers (Filgueira-Vizoso et al., 2022). Belgium, Spain, and Japan did not favor distance education for early childhood education, leading to regional closures. Türkiye faced challenges in reopening schools due to its large student and teacher population (Ozer et al., 2022). Studies on Türkiye highlighted the need for improved distance education tools and resources, especially for early childhood education (Alan, 2021). Vocational education saw shorter closure periods across all countries, with compensatory education implemented in Belgium, Spain, and Japan. The International Labor Organization (2021) explained the need for compensatory education in a report. It described how training programs were disrupted, especially work-based learning, which suffered due to business closures, alongside the cancellation of assessment and certification exams. Higher education budget increases were observed in some countries but not in Türkiye, indicating the influence of various factors on lockdown decisions across different sectors such as economy, health, policy, and education.

Second, different adaptations and practices were seen in the countries in the short term. It was observed that teachers, students, and families outside Japan used online learning networks or platforms. Japan

focused on trying to continue remote implementation of non-subject education practices. Additionally, remote education tools that enable collaborative learning were highlighted in Japan. Kang (2020) found that in primary, secondary, and high schools, distance education spread more slowly than in higher education, and most schools, with few exceptions, conducted teaching based on textbooks and paper teaching materials. Many concerns were observed regarding the perceptions of students and parents toward distance education. Included among these were whether students could achieve self-regulated learning, whether parents could support their children in learning at home, whether inadequate homeschooling would hinder learning development, whether and how children should socialize with classmates while being homeschooled, and whether students have a sufficient Internet environment to support distance learning.

In Türkiye, an important initiative was implemented for individuals with special needs, enhancing the educational experiences of disadvantaged groups. Unlike other countries, which primarily focused on making learning content accessible to individuals with special needs, Türkiye's approach went further by creating a special application. Also, Türkiye and Spain attempted to mitigate disadvantage by making content accessible to everyone on the learning platforms, even without Internet access. When examining the challenges encountered throughout such sample practices, it was observed that the rapid adaptation process and the inequality created by using distance education devices and technology posed significant issues. The unfamiliarity of teachers, students, or families with distance education and its tools further complicated the situation in all countries.

During this period, countries faced similar challenges in delivering lessons, primarily relying on online platforms, homework, television, and smartphones, with radio occasionally used as a supporting tool. Türkiye stood out by prioritizing mathematics and reading courses, reflecting its perspective on key subjects. Dede (2019) found that Turkish students prioritized math because of the national exams, daily life use, the relationship between math and other subjects, future careers, and games. Decision-making processes varied among countries, with Belgium adopting a school-by-school approach, while Japan and Spain addressed issues at multiple levels. In contrast, Türkiye centralized all decisions due to its existing education system. Teachers played a crucial role in using technology for teaching, with Türkiye exhibiting high self-efficacy and openness to change. This contrasts with Japan, where reluctance to adopt digital technologies persisted despite Japan's technological prowess (Kang, 2020).

Lastly, countries prioritized different areas to support students' daily lives and education. In Spain, Belgium, and Japan, addressing learning losses and providing targeted instruction was key, leading to curriculum and instructional changes. Japan also emphasized nutrition and well-being, while Spain focused on preventing dropouts. Belgium adopted competency-based classification for students. Türkiye implemented an accelerated education program to compensate for lost time but lacked economic support compared to other countries. Evaluation methods for national exams varied, with Belgium focusing on logistics, Türkiye on postponement and hygiene, and Spain on question quantity and content. Precise information on school exams was lacking in most countries except for Türkiye and Japan. Since school exams were not conducted in most countries, students were evaluated using different approaches. Protecting students from stress and the difficulty of conducting exams were among the reasons. However, during this period, many students were given grades similar to previous periods (Smith, 2021). In light of the data obtained, it was seen that the practices carried out by the countries in distance education were entirely about saving the moment, and context was an important factor that affected decisions. Since countries had their priorities, they shaped education to fit those priorities. However, in light of the success of the process, these future directions can now be considered.

- Countries can evaluate the practices implemented during the pandemic comprehensively and from various dimensions to identify areas that need improvement.
- Conducting studies about the collaboration between developed and developing countries can enhance the quality of these practices.
- Studies, particularly focusing on early childhood education, special education, and vocational training, can be conducted based on distance education practices during and after the pandemic.
- Future studies can investigate the longer-term effects of school closures resulting from the pandemic.
- Future studies can compare different countries.
- An in-depth analysis of how school exams were conducted in different countries can contribute to the evaluation dimension of distance education.
- A deeper systematic literature review can be conducted using different databases and document types.

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# Fostering 4.0 Digital Literacy Skills Through Attributes of Openness: A Review

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## Abstract

During the last decade, a growing interest in open educational resources (OER) has developed among educational researchers worldwide. This trend involves the examination of possible effects over diverse learning domains such as the development of literacy and digital skills in the context of the fourth industrial revolution. To address this matter, a systematic literature review was conducted using PRISMA processes on 62 research articles published in high-impact peer-reviewed journals indexed in two major academic databases (Scielo and Scopus). Data collected during this literature review showed certain conditions that must be met to ensure a successful learning setup when OER are involved. Moreover, qualitative analysis revealed that certain attributes of openness are often more influential than others in the development of adequate literacy skills for the artificial intelligence era; also, there is an overall positive perception, from students and teachers alike, about the introduction of the attributes of openness and open materials into learning practices.

Keywords: open educational resources, OER, open education, literacy skills, literature review

## Introduction

As the fourth industrial revolution reshapes our world through the fusion of digital, physical, and biological systems, Education 4.0 emerges as a critical paradigm. Education 4.0, driven by advanced technologies such as artificial intelligence, big data analytics, and the Internet of Things, is saturating students with vast digital databases and online content (George-Reyes et al., 2023). To emerge from this enormous avalanche of information, students must cultivate skills in searching and filtering relevant information, evaluating its credibility, synthesizing ideas, and collaborating. This can be achieved with a self-directed and technology-enhanced approach, which is crucial for lifelong learning and considered an essential resource for skillfully navigating digital seas of data (Kirschner & Stoyanov, 2020).

This underscores the need for comprehensive literacy processes, beyond reading and writing, empowering students to efficiently manage information in a digital-centric, complex context (Zan et al., 2021). This complexity means that information resources are deployed in various formats and media, with their corresponding languages and different ways to access them (Setiasih et al., 2021).

Due to this situation, a type of literacy known as digital literacy has been proposed, encompassing a set of knowledge and skills that include not only the use of specific tools but also the ability to understand the underlying logic in the production, communication, and application of digital information (List, 2019). Given the current exponential growth in the use of generative artificial intelligence systems and other technologies of the fourth industrial revolution (Liu & Siau, 2024), media literacy skills are becoming more complex, reaching the point of being termed *4.0 literacy skills*, and increasingly relevant within modern learning approaches. This growing prominence is partly due to the presence of new digital forms, resources, and processes that are not easily observable or explainable through traditional digital literacy techniques (Valero et al., 2015).

In response to the increasing demands and complexity that have characterized digital educational environments over the past two decades, a particular way of organizing digital information has been developed to facilitate its production, updating, and dissemination, which is known as OER, or open educational resources (Semenikhina et al., 2019).

Although in some cases they include printed resources, especially in contexts with technological constraints, OER are currently understood as part of a historical evolution of digital educational materials, which began in the late 1990s with learning objects (LO) and have, over time, consolidated as educational resources that incorporate some of the main attributes of openness, applied in their creation and use (de Oliveira et al., 2021). In addition to OER, these attributes of openness are reflected in another complex form of digital educational content organization: the massive open online course (MOOC; Edumadze & Govender, 2024).

#### **About OER Attributes of Openness**

Generally speaking, in the context of open education, the concept of openness is primarily characterized by five fundamental attributes beyond free access: adaptation, sharing, collaboration, redistribution, and remixing. These interconnected attributes collectively foster a flexible, inclusive, and dynamic educational ecosystem, facilitating the free exchange, modification, and enhancement of knowledge by a global community of educational stakeholders (Ramírez Montoya, 2013).
### Adaptation/Reuse

Adaptation refers to the process of modifying and customizing educational materials to meet the specific needs and contexts of different learners and educators. This can include altering the content, format, and delivery methods to enhance accessibility, relevance, and effectiveness. In this context, adaptation and availability of digital resources play a crucial role in the design of OER. Thus, Baker et al. (2009) referred to this customization process as the sum of different operations, such as the design of product patterns, the standardized use of certain tools, and the customization of formats based on product purposes.

For there to be an engaging and effective learning scaffolding, teachers must take part in the design of highquality resources (McLoughlin & Lee, 2010). This praxis must involve the teacher's instruction about the technological design of OER and the recognition of three levels of design: information design, interface design, and interaction design (Liu et al., 2016). Furthermore, the involvement of teachers in adaptation processes not only shapes the resource's quality but also promotes the personal and professional development of teachers, allowing them to gain professional skills, mainly through discussions with peers (Borthwick & Dickens, 2013).

The reviewed research also suggests that the adoption of OER leads to important progress in terms of social and economic factors (Prince Machado et al., 2016). In this respect, adapting is a particularly valuable attribute for addressing special education needs (Tonks et al., 2013, p. 261), allowing children to learn at their own pace and obtain materials suited to their needs.

#### Remixing

Remixing refers to the process of taking existing educational materials and combining them in new ways to create customized resources. This can involve integrating content from multiple sources, reordering sections, adding new information, or altering the format to better suit the needs of a specific audience or educational context, allowing educators to tailor OER to provide more relevant, engaging, and effective learning experiences (Kessler & Pérez-Berenguer, 2023).

This attribute of openness is visible in school research processes, revision of materials, as well as in OER development and monitoring. Fernández-Díaz et al. (2017) addressed the issue as follows:

It is important to seek remixing and learning through the organization of tasks that require more applied work and the organization of authentic exchanges of ideas and experiences through the different communication tools available on the platforms that host the courses and also those available externally. As some studies have suggested, it is essential that beyond the possibility of connecting to a greater number of people we seek and design strategies aimed at promoting interaction between participants in these types of experiences. (p. 28)

#### Redistributing

Redistribution practices entail the dissemination of original, revised, or remixed open contents. To benefit from such practices, actors involved in educational processes should make full use of technologies based on open learning strategies. These methods are associated with a variety of factors described in detail by Ganapathi (2018):

OER-providing organizations approached for this research demonstrated their commitment to open education through initiatives that go beyond the mere provision of online content. They utilize a range of strategies to address barriers to access, infrastructure, technology, and equitable distribution of education and educational content, which are specific to the context of literacy and primary education in developing nations, and hence, may not apply to developed nations or tertiary education. (p. 119)

Also, as mentioned by Stranger-Johannessen & Norton (2017), redistributing also implies the creation of collaborative networks involving a vast range of identities.

#### Sharing

In many ways, sharing could be mistaken for a synonym of redistributing; nevertheless, there's an important difference between these attributes. While redistributing focuses on third parties' right to benefit from accessible resources, sharing dwells on creators' attitudes toward their original resources. In this sense, educational designers are encouraged to be part of learning communities and distribute their products to peers and other stakeholders.

Sharing learning strategies and open resources should let users gain access to a wide range of cultural and technological practices. This perspective also incorporates dialogue between teachers, the establishment of learning communities, and the creation of cross-border communities (Zhang et al., 2016). Within this context, sharing and redistributing involve similar effects on learning practices which means that both are congruent with certain educational objectives, such as critical thinking, as well as learning about negotiation strategies and communication in a multicultural environment.

#### Collaboration

The collaboration includes but is not restricted to the peer review of open contents and the curation of educational resources. Since students' engagement is an important element in ensuring OER success, the establishment of numerous collaborative instruments must be ensured to foster creative production, spaces for dialogue, feedback strategies and the emergence of social learning networks (Rienties et al., 2018).

Another topic of interest regarding collaborative work involves the introduction of peer review and peer evaluation of developed products in every single element related to the design of OER (Dixon & Hondo, 2014). This precondition gives increasing space to practices such as peer assessment and project-based learning strategies.

According to Peeters (2018), collaborating strategies involve four types of communication: cognitive, metacognitive, organizational, and socio-affective interactions. Collaborative authoring must be promoted, as it is one of the main features of openness. Collaborative authoring was one of the most mentioned features in designing open textbooks (Baker et al., 2009).

#### **History to Consider**

According to Bhatia et al. (2023), Education 4.0, OER, and MOOCs play a crucial role in fostering appropriate learning for this new era, highlighting the importance of developing adequate literacy skills. In this context, the attributes of openness encompass the creation of learning spaces (online or face-to-face)

where learners develop knowledge-oriented communities, interact with peers, adapt, design, reuse content, and share their learning. These activities build an enriched environment that positively influences students, teachers, and the broader community. Consequently, adapting, sharing, remixing, redistributing, and collaborating are considered representative features of openness (Chiappe & Adame, 2018).

As a continuation of the conceptual development of learning objects, the OER, and later, MOOCs, have powerfully drawn the attention of both educational researchers and teachers (Hajri et al., 2019). In fact, these are research topics that have grown widely, especially since the 2000s, and that in recent years have become an educational research trend, as shown in Figure 1. The growth in the production of scientific articles published about these topics in peer-reviewed journals, as indexed in major databases such as Scopus and Scielo, is illustrated.

#### Figure 1



Articles Published in Scopus-Indexed Journals About OER and MOOCs

*Note.* OER means Open Educational Resources; MOOC means Massive Open Online Courses and Education 4.0 means the education that is conducted in the frame of the fourth industrial revolution and is mediated by its most representative technologies such as Artificial Intelligence or Internet of Things.

This paper intends to address published research through a systematic literature review using Scopus and Scielo as major databases to identify the attributes of openness, through OER, that have generated effects on 4.0 literacy skills.

# Method

Systematic literature reviews are studies in which the information is not obtained from people or through direct observation of a phenomenon, but rather from the exploration of documents (López et al., 2016). In this sense, Sampaio and Mancini (2007) pointed out that a systematic review is useful to achieve an understanding of a particular topic, based on the extraction of data from a set of studies on this topic.

This review was conducted using the six steps of Okoli and Schabram (2010) shown in Figure 2.

#### Figure 2

Review Method Design Based on Okoli and Schabram (2010)



#### Step 1: Set Up the Review's Purpose

The review focused on identifying the main attributes of openness related to OER that have been especially relevant to 4.0 literacy skills. To drive this purpose, two guiding review questions were established:

- 1. What attributes of openness have been related to OER in the 4.0 literacy skills context?
- 2. What have been the effects of such attributes on the 4.0 literacy skills?

To achieve results consistent with the questions, both in English and Spanish, the following string of search descriptors was defined: TITLE-ABS-KEY ("OER" OR "open educational resources" OR "recursos educativos abiertos").

#### Step 2: Define the Review Protocol and Execute Training for Reviewers

In this step, two reviewers, taking into account some references in the literature, established agreement on the review protocol and tested it. As a result of the reviewers' interaction, some details regarding the protocol were adjusted, especially those related to criteria, scope, and delimitation of the review.

During the review protocol design, it was decided to choose Scopus and Scielo as the main sources of information. This decision was supported by the recommendations of Dorta-González and Santana-Jiménez (2018) and Falagas et al. (2008), who stated that Scopus is a recommended source of information for topics such as those addressed in this review. Scopus provides an extensive list of journals characterized by rigorous peer-review protocols and high-quality editorial processes, as well as useful metrics and analytics for the review process. On the other hand, Tennant (2020) pointed out that using Scielo in addition to Scopus offers a broader perspective to reviews, balancing possible biases from non-Western countries and non-English language sources.

#### Step 3: Initial Search of the Literature

In this step, a time window, the relevant types of documents, and sources were defined. Only research articles published between 2010 and 2023 in peer-reviewed journals indexed in Scopus and Scielo were considered for review.

An initial search applying the descriptor string in those databases yielded a first set of 10,547 documents (10,488 in Scopus and 59 in Scielo). A ten-year time filter (up to 2023) reduced the set to 8,536 items (8,488 from Scopus and 48 from Scielo). Then, a subject filter (social sciences and computer science) was applied, finally reducing the set of documents to 1,634 items.

#### Step 4: Screening

To determine a more manageable number of documents for the subsequent abstracting and in-depth reading process, we calculated how many documents would be needed for a representative sample based on 95% reliability and 5% error. This yielded 312 documents, which were selected by ordering the results of the databases by applying the "highest citation" filter.

Our next step consisted of the application of two basic criteria to determine the inclusion and exclusion of documents, through what is known as the abstracting process. These criteria were: (a) the article should refer to an OER and literacy; and (b) the article should present research results. As a result, only 62 documents were enabled for the next step of the review.

#### **Step 5: Data Extraction**

In this stage of the review, the 62 articles underwent thorough examination. Data relevant to answering the two guiding questions were extracted from each article and recorded in a matrix shared by reviewers. The matrix was structured with columns capturing the bibliographic information of the reviewed articles, pertinent citations, openness attributes presented in each article, and identified effects stemming from such

attributes. This systematic approach ensured comprehensive data collection and analysis across selected studies.

#### Step 6: Data Analysis

Data analysis was conducted through two combined processes of categorization (data grouping by familiarity or direct relationship) and counting or frequency analysis.

### Results

#### **Bibliometric Outcomes**

Published articles related to literacy strategies involving OER showed consistent growth between 2010 and 2023, a period which accounts for 98.8% of the total published studies, beginning in 1999.

The review revealed a highly diverse range of contributing journals (n = 44), averaging 1.41 articles per journal, with only 7 journals contributing multiple articles. Table 1 showcases the top 10 contributing journals, along with their academic quality indicators: the SJR (Scimago Journal Ranking) impact factor and the CiteScore quartile.

To provide context, the Journal Citation Reports (JCR) impact factor is a measure of the frequency with which the average article in a journal has been cited in a particular year. It is used to gauge the relative importance of a journal within its field, with higher impact factors generally indicating greater journal prestige. CiteScore, developed by Scopus, is another metric for measuring journal impact. It calculates the average number of citations received per document published in a journal over a four-year period. Journals are then ranked into quartiles based on their CiteScore, with Q1 representing the top 25% of journals in a field.

It's worth noting that while Table 1 only displays the top 10 contributing journals, all articles consulted in this review originate from high-quality scientific publications as indicated by these metrics.

#### Table 1

Top 10 Indexed Journals With the Greatest Contribution to the Review

Journal	%	2023 SJR ImpFactor	CiteScore quartile
The International Review of Research in Open and Distributed Learning	12.90	0.860	Q1
Computer Assisted Language Learning	11.29	2.370	Q1
CALL-EJ	3.23	0.512	Q1

Fostering 4.0 Digital	Literacy Skills	Through Attributes of C	penness: A Review
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International Journal of Emerging Technologies in Learning	3.23	0.536	Q1
Journal of Interactive Media in Education	3.23	0.760	Q1
Psychology Learning and Teaching	3.23	0.830	Q1
Open Learning	3.23	1.062	Q1
Journal of Information Literacy	1.61	0.271	Q2
American Journal of Distance Education	1.61	0.836	Q1
Australasian Journal of Educational Technology	1.61	1.000	Q1

*Note.* SJR ImpFactor means the impact factor that Scopus calculates through Scimago Journal Rankings. Also, CiteScore quartile represents the location of the journal within the general set of journals in the same subject of knowledge.

#### **Results Related to the First Review Question**

Regarding the first review question, Figure 3 illustrates the prevalence of attributes of openness in literacyoriented projects based on OER. Adaptation, through customization of products, communication channels, and learning strategies (Baker et al., 2009) plays a significant role in OER development. Collaborating and sharing follow as the second and third most prevalent attributes, respectively. Both attributes offer new and consistent methods to enhance literacy-related skills. In contrast, redistributing and remixing are less prominent. Notably, with the exception of these last two, the other trending attributes of openness are present at least once in each of the reviewed articles.

#### Figure 3

Prevalence of Appearance of the Attributes of Openness



Number of mentions of the attributes

#### About Adaptation/Reuse and Literacy Skills

Regarding the conditions to be met to generate successful literacy-oriented learning practices based on OER, 62.9% of the reviewed documents suggested that the characteristics of the learning community as well as personal conditions should be kept in mind to design customized materials and effective educational platforms. Therefore, a holistic view of the learner is required to engage a whole group of students and, at the same time, meet their individual expectations through adaptation.

In addition to considering adaptation as a convenient process to create customizable educational resources to learn to read or write, it also contributes positively to the design of learning activities, especially related to the development of writing skills.

It is well known that facing a blank page is one of the greatest obstacles to achieving fluency in writing (Alvarez et al., 2017) and thereby developing writing skills. Taking this into account, writing about what others have written, that is, adapting or reusing a text and rewriting it is a very convenient strategy.

The concepts presented in Zhang et al. (2016) can be contextualized within the framework of literacy skill development through several key aspects. Primarily, their emphasis on the significance of self-directed learning in educational design aligns with contemporary approaches to literacy instruction that emphasize learner autonomy and metacognitive skill development. Also, the reference to students' prior knowledge resonates with established literacy theories that posit the importance of building upon existing cognitive schemas in reading and writing acquisition (Brydon, 2016).

Furthermore, the discussion of autonomous practices among language students with communicative skills correlates with advanced literacy development where proficient readers and writers engage in self-regulated learning processes (Hooshyar et al., 2020). The emphasis on constant and immediate feedback, which is provided by adapted resources, particularly for less experienced learners, aligns with research on formative assessment in literacy education, which has demonstrated the critical role of timely feedback in improving reading comprehension and writing skills (Mallampalli & Goyal, 2021).

Moreover, the noted positive perception resulting from effective feedback corresponds with motivation theories in literacy development, where positive attitudes towards reading and writing are crucial for sustained engagement and skill improvement (Muluk et al., 2022).

Some studies regarding OER adaptation related to literacy skills are Baker et al. (2009), Dixon and Hondo (2014), Dizon (2016), Lee et al. (2013), Liu et al. (2015), Marcus-Quinn (2016), Marcus-Quinn and McGarr (2014), Marín Gonzalez et al. (2017), McLoughlin and Lee (2010), Rodríguez and Chiappe (2018), Thoms and Thoms (2014), Tonks et al. (2013) and Whitworth et al. (2011).

#### **About Remixing and Literacy Skills**

The concept of remixing in the context of OER can be intrinsically linked to the multifaceted development of literacy skills. Primarily, remixing necessitates active learner engagement with educational materials, aligning with constructivist approaches to literacy development. This active involvement has been shown to enhance reading comprehension and critical thinking skills (Ronimus et al., 2022). Furthermore, the process of remixing OER to specific learning practices parallels the importance of contextualizing literacy instruction, thus supporting the development of culturally responsive literacy practices that can improve learner engagement and comprehension (Dajani & Meier, 2019).

Moreover, the constant revision of contents inherent in remixing practices mirrors the iterative nature of the writing process, thereby reinforcing the importance of drafting, revising, and editing in developing strong writing skills (Landrieu et al., 2021). Concomitantly, the focus on improving existing materials' quality through remixing can foster critical evaluation skills, an essential component of advanced literacy (Česnienė, 2015).

As noted by Lenters (2007), remixing promotes increased interaction between peers. This aspect aligns with sociocultural theories of literacy development, which emphasize the role of social interaction in language and literacy acquisition (Johnson, 2003). Additionally, the enhanced interaction between teachers and students in remixing activities can support guided participation in literacy practices, facilitating the gradual release of responsibility in reading and writing tasks.

Some studies regarding OER remixing related to literacy skills are Coughlan (2020), Cuttler (2019), Fernández-Díaz et al. (2017), Grissett and Huffman (2019), MacKinnon and Pasfield-Neofitou (2016), Mason and Kimmons (2018) and Rodríguez and Chiappe (2018).

#### About Redistributing and Literacy Skills

The relationship between redistributing OER and the development of literacy skills is multifaceted and significant in the contemporary educational landscape. Redistribution, as a key principle of OER, facilitates the widespread dissemination of literacy-focused materials, thereby democratizing access to high-quality educational content (Ofoegbu et al., 2021). This increased accessibility has profound implications for literacy development across diverse populations. Primarily, the redistribution of OER enables educators to share and disseminate literacy resources beyond traditional institutional boundaries. This expanded reach allows for the proliferation of diverse texts and literacy-enhancing materials, which is crucial for developing a wide range of reading skills and strategies (Dixon & Hondo, 2014).

Moreover, the redistribution principle fosters a collaborative approach to literacy instruction. As educators share and adapt resources, they contribute to a growing pool of literacy materials that reflect diverse pedagogical approaches and cultural perspectives. This collaborative aspect aligns with sociocultural theories of literacy, which emphasize the importance of social and cultural contexts in literacy acquisition (Carmiol et al., 2020). Consequently, the redistribution of OER can lead to more culturally responsive literacy instruction, enhancing learner engagement and comprehension.

Additionally, the practice of redistributing OER can significantly impact digital literacy skills. While learners and educators engage with digital platforms to access, modify, and share resources, they inherently develop competencies in navigating digital spaces and evaluating online information (Hajdarovic, 2023). These skills are increasingly essential in today's information-rich society and contribute to a more comprehensive understanding of literacy that extends beyond traditional print-based concepts.

Furthermore, according to Knight and Thompson (2022), the redistribution of OER can support the development of critical literacy skills, as learners encounter diverse perspectives and approaches through

redistributed materials, encouraging them to analyze, evaluate, and synthesize information from multiple sources.

Some studies regarding OER redistributing related to literacy skills are Coughlan (2020), Cuttler (2019), Ganapathi (2018) and Grissett and Huffman (2019).

#### **About Sharing and Literacy Skills**

Sharing, as a fundamental principle of OER, has the potential to substantially impact the development of literacy skills, particularly in foreign language learning contexts. In this sense, sharing-based learning practices are characterized by cultural integration, enhanced engagement, and the development of essential language skills such as speaking, writing, and listening (Girmen & Kaya, 2019). This holistic approach to language acquisition aligns with contemporary theories of literacy that emphasize the importance of authentic, context-rich learning experiences (Gee & Gee, 2007).

However, the implementation of successful sharing practices in OER is not without challenges. These include the need for standardized formats, quality assurance of content, and improvements in readability (Kellner, 2001). Regarding this, addressing these challenges becomes crucial for ensuring that shared resources effectively support literacy development across diverse learner populations.

Furthermore, Shoba and Denvers (2015) have drawn attention to the financial and social aspects that impact the efficacy of sharing practices in literacy development. They emphasized that learners from low-income backgrounds may require additional support to develop communicative skills in foreign language acquisition. These observations highlight the need for a nuanced approach to sharing in OER, one that takes into account the diverse needs and backgrounds of learners.

Some studies regarding OER sharing and some aspects related to literacy skills are Ayuni Akhiar and Shaidatul Akma (2019), Borthwick and Dickens (2013), Cinganotto and Cuccurullo (2016), Dixon and Hondo (2014), Hernández (2018), Lee et al. (2013), Liu et al. (2015), Lyons and Tappeiner (2010), MacKinnon and Pasfield-Neofitou (2016), Morgan and Carey (2009), Rebmann (2018), Stranger-Johannessen and Norton (2017) and Zhang et al. (2016).

#### **About Collaboration and Literacy Skills**

According to Di Lauro and Johinke (2017), collaboration fosters an environment conducive to enhancing various aspects of literacy, particularly when considering the concept of collaborative writing. Thus, as learners engage in collaborative activities, they are exposed to diverse perspectives and ideas, which encourages critical thinking and analytical reading (De-Navascués-Martín, 2023). This exposure aligns with sociocultural theories of literacy, which emphasize the importance of social interaction in language and literacy acquisition (Johnson, 2003. Furthermore, collaborative engagement with OER often requires learners to evaluate, synthesize, and integrate information from multiple sources, thereby enhancing their information literacy skills (Lankshear & Knobel, 2011).

Besides, Storch (2013) has indicated that in the realm of collaborative writing, which is often facilitated by OER platforms, learners engage in a process that significantly contributes to the development of various literacy skills. Thus, collaborative writing involves the joint production of a text by multiple authors,

encompassing activities such as brainstorming, drafting, revising, and editing, which enhances writing skills but also promotes the development of metacognitive strategies essential for effective communication. Moreover, collaborative writing in OER contexts often involves the use of digital tools, thereby contributing to the development of digital literacy skills crucial in the 21st century (Arono et al., 2022).

Additionally, collaboration in OER environments fosters the development of communicative competence, a key component of literacy. In this regard, as learners work together to create, modify, or use OER, they engage in meaningful dialogue, negotiation of meaning, and peer feedback processes (Novakovich, 2016). These interactions contribute significantly to the development of both receptive and productive language skills (Klimova & Pikhart, 2019).

The collaborative aspect of OER also supports the development of intercultural literacy. As OER are often created and used by diverse global communities, collaboration in this context exposes learners to various cultural perspectives and communication styles (Kukulska-Hulme et al., 2020). This exposure not only enhances cultural awareness but also develops the ability to navigate and communicate effectively across cultural boundaries, an increasingly important aspect of literacy in a globalized world.

Some studies regarding collaboration using OER and some aspects related to literacy skills are Adi Kasuma and Ai Lin Tan (2019), Auh and Sim (2019), Cuttler (2019), Dalsgaard and Gislev (2019), Grissett and Huffman (2019), Kannan and Munday (2018), Lambert (2019), Mortimore and Baker (2019), Nerantzi (2019), and Okada and Sherborne (2018).

#### **Results Related to the Second Review Question**

In the context of OER, the effects of the attributes of openness on 4.0 literacy skills have been widely studied. A substantial proportion of the examined studies (72.5%) describe positive effects on literacy skills after the implementation of OER. Notably, the most prominent advantages contributing to enhanced literacy skills include greater access to high-quality learning resources that can improve reading and comprehension abilities, as well as the acquisition of digital literacy skills through the use of open materials. This issue of the impact of access can be seen in Bertot (2016) and Golenko et al. (2023).

Besides, 19.3% of the articles suggested that successfully integrating the attributes of openness to build literacy skills is contingent upon several factors, including customization of materials to literacy levels, appropriate learning approaches, and the quality and availability of literacy-focused resources, along with scaffolding strategies tailored to literacy skill development. Students' focus, prior literacy experiences, and teachers' openness to technology and innovative practices were also cited as important influencers. These factors are presented in Kerbs et al. (2024) and Croxen et al. (2024).

Furthermore, the attributes of openness displayed a key role in literacy skill development by allowing students to develop foreign language literacy through materials providing specific, customized support (Zhang et al., 2016). This openness effect also aided students in transitioning from passive reading to more flexible, engaged use of materials to build literacy. Also, OER showed potential to impact literacy in poor and distant communities by breaking distribution and access barriers to literacy resources (Ganapathi, 2018). Correspondingly, a notable 25.8% of the articles suggested that learners' engagement and positive attitudes, which are key for building literacy, were enhanced through open practices and materials involving

factors such as resource design tailored to literacy levels (MacKinnon & Pasfield-Neofitou, 2016), incorporation of gamification components rendering literacy practice more engaging (Osipov et al., 2015), facilitation of dialog between students centered around literacy texts (Bailey et al., 2017), as well as proximity and relevance of open literacy materials to learners' contexts (Gambo & Aliyu, 2017). By addressing factors pertaining to resource design aligned with literacy proficiency levels, integration of gamification elements to foster interactive engagement, promotion of collaborative discourse regarding literacy texts, and ensuring contextual applicability of the open literacy resources, these practices and materials exerted a positive influence on learners' engagement and attitudes, thereby supporting their literacy skill development.

The data also indicated that OER benefited literacy instruction practices through the construction of communities where teachers collaborated on designing literacy learning resources and engaging students in multicultural literacy practices, as described in 12.9% of the articles reviewed.

Conversely, a small proportion of articles (4.8%) described no positive literacy effects or adverse impacts from introducing openness attributes, linked mainly to lack of effective feedback mechanisms in some MOOCs which could hinder literacy development (Shoba & Denvers, 2015). An additional 3.2% showed no clear results related to OER or open attributes impacting literacy skills.

Overall, the research evidence suggests that while amenable implementation is crucial, the attributes of openness in educational resources tend to have a positive impact on literacy skills and emerging multiliteracies in the digital age.

#### **Other Relevant Findings: Involvement of Digital Platforms**

The results pertaining to the technology platforms used for OER have interesting implications for literacy skill development. In this regard, 22.5% of the reviewed articles referenced the use of a learning management system (LMS), with recent studies highlighting the inclusion of artificial intelligence components. This aspect presents a substantial challenge regarding the adoption of OER for literacy instruction, as both users and developers should exhibit a certain level of expertise and knowledge about these systems to leverage their potential.

In fact, 14.5% of the reviewed articles addressed this constraint which can be mitigated through the use of social networks, which are frequently mentioned in the reviewed literature. Social networks are generally easier to grasp and use, due to their widespread popularity, potentially offering a more accessible avenue for integrating open resources and practices into literacy education. Apart from e-textbooks, mentioned in 12.9% of the reviewed studies, other platforms were employed in very limited cases, indicating a need for further exploration and diversification of technology tools for open literacy resources.

Remarkably, massive open online courses (MOOCs) were not highly prioritized (3.2%) in the reviewed literature, despite their potential for delivering open literacy instruction at scale. This finding suggests an opportunity for further research and implementation of MOOCs specifically tailored for literacy skill development.

Notably, intelligent tutoring systems and smart interactive tools have proven to be effective ways to improve learners' literacy performance (Belazoui et al., 2021).

Crucially, these tools share a common aspect: the incorporation of attributes of openness as a component of their pedagogical approach, aligning with the principles of OER and open practices. This integration of openness attributes into intelligent literacy tools holds promise for enhancing literacy skill acquisition and personalized instruction.

# Discussion

The systematic review highlights the positive impact of integrating attributes of openness on the development of literacy skills, along with favourable perceptions from educational communities towards OER-based learning strategies. This suggests promising avenues for literacy instruction, democratizing access to quality literacy resources and bolstering self-directed literacy learning. Moreover, emphasizing the indispensability of digital literacy skills, it underscores their role in maximizing the effectiveness of digital content-based literacy learning, enhancing conceptual understanding of texts, and fostering student engagement with literacy materials.

As previously mentioned, the adaptation, collaboration, and sharing features of OER play significant roles in its adoption for literacy-oriented learning. While other attributes may have minor impacts on literacy learning practices, their effects on OER could be underestimated in reviewed research. In this regard, further investigation is necessary to discern the functions of remixing and redistributing features for literacy skill development. Although OER is a trending topic in language learning platforms, its full potential in developing reading, writing, and overall literacy skills remains unexplored, offering new perspectives in elementary education for literacy acquisition and strategies for selecting and comprehending digital information.

Besides, research indicates that customization and feedback strategies are essential for successful OERbased literacy learning practices. However, MOOCs face a relevant challenge in providing effective feedback due to their large enrolment numbers, necessitating the enhancement of human capital among literacy educators and the development of intelligent automated technologies for literacy assessment. These requirements are particularly crucial for students with limited technology access, inadequate prior literacy education, or language comprehension issues, as such students are more prone to struggling with literacy learning in digital environments. On the other hand, students with a basic understanding of literacy tend to benefit more from OER than those without prior knowledge, highlighting the importance of technological proficiency for both students and teachers to ensure continuous literacy skill development.

# **Conclusions and Future Research**

The adoption of attributes of openness to learning strategies focused on language competencies has shown a positive impact on the development of literacy skills, including reading, writing, and overall communication abilities. Accordingly, based on these results, it is advantageous to establish literacy learning practices based on the introduction of attributes of openness; not only will such practices reduce costs and improve the quality of literacy materials, but they will also enhance the chances of achieving better literacy outcomes from students and teachers' practices. Both of these features are highly suitable for developing countries, remote areas, and rural populations, facilitating constant progress in literacy.

Even though the present review indicated that the adapting, collaborating, and sharing features have a prominent place regarding the adoption of OER in literacy-oriented learning practices, it is suggested not to ignore the remixing and redistributing features. These features have not only proven to have a beneficial impact on certain language and literacy practices, but they may also have been overlooked throughout the reviewed articles due to different factors, such as research objectives, current trending topics, and the perception of such attributes as part of collaborative phenomena.

In the same direction, innovative educational strategies based on OER could improve literacy learning practices in developing nations. Therefore, the adoption of such open practices in new spheres of knowledge would boost the development of better and more appropriate literacy educational methods worldwide.

Currently, OER is a trending topic in the design of foreign language learning platforms. However, the deployment of OER on practices involving learning processes regarding first- and second-language literacy is yet to be fully explored. Further investigation should examine the suitability of literacy learning strategies based on the insertion of OER in first- and second-language courses. Such studies should answer questions including: Is it necessary to develop digital platforms specifically for teaching first- and second-language literacy? Or, to what extent may attributes of openness influence the learning of first- and second-language literacy skills?

A broad range of researchers have pointed out that customization and feedback strategies are required to develop fully functional and successful literacy learning practices based on OER.

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# Are We Asking Too Much of OER? A Conversation on OER from OE Global 2023

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### Abstract

This paper examines the pervasive discourse of disruption in OER literature by recounting a facilitated conversation hosted at the 2023 Open Education Global conference held in Edmonton, Alberta. This dialogue used Bacchi's "what is the problem represented to be" (WPR) approach to structure the conversation in four movements. The first movement problematized the concept of OER by discussing the educational challenges OER supposedly addresses, such as the high cost of textbooks. The second movement considered the genealogy, historical development, and philosophical underpinnings of OER. The third movement accounted for the disruptors within the OER movement, exploring what OER have disrupted and discussing if disruption is even a legitimate goal of OER. The fourth and final movement pivoted to examine resistors and forms of resistance to OER, including the protection of intellectual property rights, copyright concerns, and Marcuse's idea of repressive tolerance. This single conversation generated a small but important piece of social intelligence within a much larger dialogue about open education, open pedagogy, and OER during a time of flux (characterized by intense politicization, the relentless progression of educational technology, the intensification of marketization, and the growing popularity of all-inclusive textbooks). This social intelligence can be used to guide the next transition phase for OER development. While the conversation does not offer tidy solutions or even clear recommendations, it does suggest that the next wave of OER practitioners would always do well to focus on the goals OER can achieve, not what they hope to disrupt.

Keywords: open education resources, OER, Carol Bacchi, disruption, textbooks

# The Discourse of Disruption in OER

Some experts peg the start of the open education movement to the 1997 founding of MERLOT at California State University (Bliss & Smith, 2017). Others refer to Wiley's coining of the phrase open content in 1998 (Wiley, 2006). Still others point to Massachusetts Institute of Technology's landmark decision in 2001 to put its entire course catalog online as the move that created a new intellectual commons and launched a new model for the dissemination of knowledge and scholarly collaboration, now called open education (Bliss & Smith, 2017). The confluence of activity at the turn of the twenty-first century was propelled by support from the Hewlett Foundation, which accelerated rapid growth and interest in open educational resources (OER), specifically targeting the production of high-quality OER in the developing world, building OER infrastructure, and "developing a world movement for OER" (Bliss & Smith, 2017, p. 14). It is impossible to comprehensively chart the development of each of these strategic pillars here, but each has seen rapid growth, evidenced by the development of OER sites, such as the World Digital Library, OpenStax, LibreTexts, and BCCampus. MERLOT, for example, now has over 40,000 curated items, and OpenStax textbooks have been used in over 38,000 classrooms, saving students over \$1.2 billion USD since publishing its first textbook in 2012 (Falk, 2021). The robust establishment of a world movement for OER is perhaps best captured by the development of Open Education Global, the main venue for open education practitioners, policy builders, advocates, researchers, students, and decision-makers to discuss the latest trends, challenges, and opportunities in open education to shape its future direction (Open Education Global, n.d.).

Whenever the OER movement started, it began with a discourse of disruption, and this essay shares the details of a conversation held at OE Global 2023 on the problematization of OER designed to unpack this disruption. OE Global's 2023 conference theme, Building a Sustainable World through Open Education, recognizes that "the global community is facing crises on several fronts that point to an unsustainable future" (OE Global, 2023, para. 1). This theme suggests the present educational model is unsustainable and that OER is part of building a more sustainable future. Another way to express this theme would be to say that open education can disrupt the increasingly unsustainable and unequal model of higher education and OER can play an important role in building a new structure. Seen in this way, the 2023 OE Global conference theme is grounded in a decades-long discourse of disruption.

As early as 2007, Casserly asked, "Is OER a disruptive innovation in the education marketplace?" (p. 14). Would OER, for example, lead to the creation of OER-based virtual universities that would serve the roughly 100 million people who would otherwise be denied access to education (Casserly, 2007)? Or is OER fully compatible with traditional forms of education? Casserly's key question is, "Does making high-quality educational content freely available compete with traditional school structures and higher education?" (p. 19). Some, such as Anderson and McGreal (2012), have offered hopeful visions that OER would alleviate a gap not filled because of traditional educational constraints. OER could fill this role because the dissemination of knowledge is "expensive and often encumbered with traditional rights and responsibilities of tenure, promotion, commercialization, and mobility of faculty members" (p. 381). They argued that some higher educational institutions would be wise to follow the "low-cost, no frills" (p. 380) model as an alternative to other major service providers, and they suggested that OER was beginning to disrupt classroom and distance education models of courseware production and distribution, suggesting that there

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are sufficient open educational resources available for an OER-based virtual university to offer a Bachelor of Arts in popular discipline areas (Anderson & McGreal, 2012).

It is easy to find articles suggesting that free and inexpensive course materials are changing the traditional textbook landscape in fundamental ways because they are far less expensive and can be adapted easily, and that this alone will make education more affordable, and hence more accessible. At first glance, this argument appears legitimate. Jhangiani and Jhangiani (2017) discovered that 54 percent of students in British Columbia do without at least one of their required textbooks, while 27 percent of students take fewer courses, and 17 percent drop courses because of high textbook costs. Many instructors are aware that their course textbook costs exceed \$100 per course, and students with high textbook costs (over \$400 per semester) are less likely to take a full load of courses (Bliss et al., 2013). The students who forego textbooks or take fewer courses are more likely to hold student loans, work more hours per week, and self-identify as a visible minority (Jhangiani & Jhangiani, 2017). The case between affordability and accessibility seems strong. But after two decades, even as faculty implementation of OER has increased, this floodgate of educational accessibility has yet to happen. During the COVID-19 pandemic, as a recent example, when many people were economically and educationally disrupted, OER adoption lagged, and this "bodes less well for the future of open educational resources" (Lederman, 2021, para. 10). Jeff Seaman observes, "We just don't know vet who benefits most from a more aggressive shift to digital: OER or the publishers" (Lederman, 2021, para. 11). The COVID-19 pandemic was a disruption that caused everyone to move online and embrace digital forms of education in ways they may have previously resisted, and the OER movement also accelerated the shift to digital curricular materials. In response, publishers shifted the traditional textbook business model to "all-inclusive" textbooks that reduce costs, increase sales, and ensure students have access to their materials on the first day of class. Textbook publishing efforts have moved to neutralize the impacts of OER on textbook sales and profits (Seaman & Seaman, 2023).

This discourse of disruption that underpins OER's capabilities is itself problematic. Is OER disruptive to the current model of higher education? Is it compatible with the current model? Or does it reinforce existing inequalities? To discuss this complicated and contradictory milieu, we submitted a conference proposal to host a conversation with fellow OER advocates and practitioners at OE Global 2023, held in Edmonton, Alberta, October 16 to 18, 2023. As OER authors and advocates for over a decade, we had actively celebrated this first-wave movement of OER as a disruptive force, and we believed the time was right to revisit the underlying assumptions and implications of this movement. A conference conversation offered the opportunity to generate social intelligence, which arises when alternative viewpoints are brought to bear on a common problem (Kadlec, 2008). Social intelligence "sees the irredeemable instability of our world as a hard fact that must be faced through concerted and often agonizing effort" (Kadlec, 2008, p. 64). We selected Carol Bacchi's "what's the problem represented to be?" (WPR) approach to face these hard facts and structure the conversation because WPR offers a lens to interrogate and reassess prevailing narratives and paradigms shaping OER's role in education.

# What Is the Problem Represented to Be?

In educational policy and practice, OER has been hailed as a revolutionary tool for democratizing knowledge access, and the Hewlett Foundation set a policy direction to foster a worldwide movement to publish high-quality open educational resources in developing countries with a suitable and sustainable infrastructure. However, the uncritical acceptance of OER warrants a deeper analysis. This is where Bacchi's "WPR approach becomes a useful tool. WPR moves from a problem-*solving* paradigm to a problem-*questioning* paradigm (Tawell & McCluskey, 2022), and this shift from solving to asking invites practitioners to scrutinize the underlying assumptions and implications of OER policies. Applying WPR to OER, the conversation sought to uncover the latent dimensions and potential challenges posed by its current framing as a disruptive pedagogy and movement.

#### Bacchi's WPR approach

presumes that some problem representations benefit the members of some groups at the expense of others. It also takes the side of those who are harmed. The goal is to intervene to challenge problem representations that have these deleterious effects, and to suggest that issues could be thought about in ways that might avoid at least some of these effects. (Bacchi, 2009, p. 44)

Taking the side of those who are harmed aligned with OE Global's conference theme, but Bacchi's (2009) main point is that the way a problem is represented may play a role in constructing, reproducing, and manifesting the problems that policies set out to solve. This counterintuitive result sounds like Dr. Tony Bates (2011) when he says, "I increasingly fear that the open educational movement is being used as a way of perpetuating inequalities in education while purporting to be democratic" (para. 1). Or like Selwyn's (2014) assessment that open educational resources are celebrated as counterhegemonic because they are based on a variety of political, social, and cultural agendas that desire to reorientate the power relations in postsecondary, but in fact, "one of the more likely outcomes of the increased use of open products and practices in education is the increased exploitation of individuals" (p. 81). If OER does indeed play a role in constructing and reproducing the very problems it claims to be solving, OER practice would work at cross purposes to its philosophical goals. Bacchi's WPR approach was selected to frame the conversation because it is designed to surface these unintentional and internal contradictions.

#### **Understanding the WPR Approach**

Carol Bacchi's WPR approach (2009) is a critical policy analysis tool that emphasizes examining how problems are represented within policies. The crux of WPR lies in its inversion of traditional policy analysis; instead of asking how policy addresses problems, it asks how policy constructs problems. Bacchi (2009) argues that how a problem is framed or represented inherently shapes and limits the solutions considered. This framing often includes hidden assumptions and blind spots that can have significant implications. Government policies, especially, have a privileged role that causes them to *stick*; government versions of problems "take on lives of their own. They exist *in the real*" (Bacchi, 2009, p. 33). The WPR method is not merely an analytical tool but a lens through which the intricacies and influences embedded in policy representations can be explored and understood. WPR concentrates its focus on policy, and the surrogate for policy analyzed in this conversation is the production of high-quality open educational resources in the

developing world, building OER infrastructure, and "developing a world movement for OER" that corrects presently unsustainable practice.

#### The Six Questions of WPR

WPR works through six guiding questions, each delving into different aspects of problem representation:

- 1. What's the problem represented to be in a specific policy? This question initiates the inquiry into how the policy context defines the problem.
- 2. What presuppositions or assumptions underlie this representation? Here, the focus is on uncovering the underlying beliefs and assumptions that inform the problem representation.
- 3. **How has this representation come about?** This question encourages an exploration of the historical, cultural, and social contexts that have shaped the problem representation.
- 4. What is left unproblematic in this problem representation? Where are the silences? Can the problem be conceptualized differently? This critical inquiry looks for what is not addressed or questioned within the problem representation.
- 5. What effects are produced by this representation of the problem? It examines the intended and unintended consequences of the problem representation.
- 6. How/where has this representation of the problem been produced, disseminated, and defended? How has it been (or could it be) questioned, disrupted, and replaced? The final question probes into the dissemination and defence mechanisms of the problem representation and explores avenues for its challenge or change (Bacchi, 2009, p. xii).

#### **Problematizing OER through WPR**

Applying the WPR framework to OER, we can critically analyze its current representation and implications. A worked WPR example for OER might look like this:

- 1. **Representation of OER:** OER is predominantly represented as a solution to educational resource inequality, aiming to provide universal access to quality educational materials. As Anderson and McGreal (2012) suggest, OER could be used to disrupt the expensive, faculty-dependent, bricks-and-mortar educational model with a cheaper, no-frills model.
- 2. Underlying assumptions: This representation presupposes universal Internet access and technological literacy. It assumes that OER, often developed in affluent, Western contexts, is universally applicable and pedagogically effective across different cultural and socioeconomic backgrounds, or that it would be easy to remix Western content into non-Western learning environments. It assumes that the development of OER alone can create greater access to education.

- 3. **Historical context:** The rise of the Internet and digital technologies have facilitated the development and distribution of OER, influenced by ideologies promoting open access and knowledge sharing. OER arose in the same era as Christensen's work on disruptive innovation (Bower & Christensen, 1995) that suggested smaller entities could successfully challenge well-established businesses such as textbook publishers, as well as the hopeful aspirations of open-source technology. Neither disruptive innovation or open source technology have come to have the impact originally envisioned.
- 4. **Unaddressed issues and silences:** The OER narrative often overlooks the cultural relevance of content, the need for local language translations, and the pedagogical adaptability to diverse learning environments. It also underplays the significance of teacher training and support in effectively using OER. The exclusive focus of OER as textbooks has also displaced the original vision of modularized open courseware.
- 5. **Consequences of this representation:** While aiming to democratize education, this representation could inadvertently perpetuate colonialism where Western pedagogical models and content dominate. It may also lead to an overreliance on digital resources, neglecting traditional and context-specific teaching methods.
- 6. **Production and challenge of this representation:** The promotion and adoption of OER have been largely driven by educational institutions, international organizations, some governments, and technology companies. There is room to question this representation by emphasizing context-specific educational needs, promoting local content creation, and addressing infrastructural disparities.

This brief application of Bacchi's WPR approach to OER reveals both its potentially disruptive impact and the limitations that could, in effect, reinforce the currently unsustainable model of higher education provision.

Using Bacchi's WPR approach and the analysis above, we invited individuals to participate in a structured conversation at OE Global 2023. A conference conversation aligns with the WPR approach because WPR employs a form of social constructivism by directing attention to the way participants make sense of the world as active participants in the creation and production of the policy problems and solutions in which they are involved as agents (Bacchi, 2009).

# The Conversation

Ten OER practitioners and leaders participated in an hour-long conversation that consolidated WPR's six questions into four movements. In planning the facilitation, the authors used the word *movement* in a musical sense: a movement is a self-contained part that could be listened to individually but makes the most sense within the whole. The four movements organized the topics in a sequence that enabled us to pull out contrasts and continuations about how practitioners represent the problem in their daily lives, what problems they are presently working to solve, and what assumptions guide their daily practice. An

important element of the WPR method is genealogy, so it was important to include a movement on the origin of open education and OER. After two decades, OER practitioners have created a new future envisioned at the start of the OER movement, but this desired future has faced anticipated and unanticipated forms of resistance. The four movements of the conversation were also contrived to account for Bacchi's main questions at the same time that they accounted for the present, the past, and progress and resistance to the future of OER practice. The conversation is recounted like a dialogue, in the words of the participants as transcribed.

# First Movement—Present: What Problems Is OER Trying to Solve in Your Educational Context?

"Relevance. Most of the time, faculty only use pieces of textbooks, but students need to purchase the whole book. An OER can be purpose built for a course or a learning module within a course."

"Faculty feel like they have to have a textbook and they have to assign readings, but students may not need to do the readings to pass or even to get a good grade. I think relevant OER can be used more effectively than textbooks often are."

"For me, it's to reduce cost. There are so many things we can't control. We can't control housing, tuition, food, but we can control textbooks. OER textbooks or freely available learning resources are a malleable barrier in a world of fixed ones."

"But it's more than just cost."

"Yes, agreed, but even if it only solved the cost problem, that would be worth it."

"In our context, some of our best OER development and implementation is with extension studies. OER help create a more informed workforce when they are used in the workplace. They learn the content of the OER in the micro-credential and then take that learning and the text with them."

"I'm still inspired by the efficiency that can be gained in remixing and adapting so that people don't need to start from zero. OER can be built by a community of practitioners. I like that co-creation and the idea of building upon something someone has already done."

"OER aligns with the spirit of public service and good governance. We continually hear about the dual government priorities of access and affordability, and our current government has expressed a commitment to OER, backed with real investment. It makes sense for us to align our efforts and capitalize on this commitment."

The conversation then shifted naturally from the problems OER sought to solve to the problems OER development has generated.

"We need ongoing investment because there's a cost to sustaining the resource. Faculty adopted a psychology textbook that now needs to be updated. I still think the cost of adopting and implementing OER has yet to be fully institutionalized."

"As a librarian and champion of OER, the proliferation of OER has been awesome. It's great that some have taken resources and done what was intended, adapting and remixing. But now there is a growing problem with bibliographic control, tracking versioning history. Discoverability remains difficult, and it may have even gotten harder. Being open and customizable is a great trait, but we now have fifty adaptations of some OER. This causes a challenge for authority. There's a tension if you want to find, track, and control so you can match faculty with the latest or most local resource."

# Second Movement—Past: How Have OER's Historical and Philosophical Origins Shaped the Current Understanding?

"The whole open pedagogy movement started with open courseware. The promise, the excitement, the hope was that you don't have to apply to go to MIT. Then there was Coursera and EdX, which were free, and then all of a sudden in 2012, all of the attention moved to open textbooks. The trajectory now is moving back to ancillary resources, tests, and open courseware, but that's where it started."

"When did publishers start to offer ancillaries and all-inclusives?"

"I don't know, but I do know we're always playing market catch-up. We need to lessen the burden to faculty because the publishers are outcompeting us there."

"You know, I'd argue that the open education movement didn't start as an affordability issue. It started with open-source software, and that's the philosophical connection with the open education movement. We should do what people were doing with open software with learning objects and resources. Someone created this cool thing; I want to build on that. I can edit their stuff, and I want to make it better. Affordability came later. Affordability became the bait. But now affordability has become the only goal. Textbooks have also become a whole, rather than these little modular pieces."

"I agree. The pedagogical case got lost and is now coming back. Workload is an honest issue. Development, remixing, adaptation, updating—all that takes time."

"Why are faculty lone-wolfing it? Because it is hard to collaborate, and I think a lot of faculty see themselves as independent operators."

"I don't want to call academic freedom a barrier, but we cannot tell them what to use, and I don't want to tell them what to use. Faculty should have the right to choose their materials. But is it academic freedom to assign a \$400 textbook that an instructor uses in pedagogically questionable ways, or doesn't use at all? When students don't need to buy the textbook to get an A? I think academic freedom was supposed to mean more than that."

# Third Movement—Future Progress: What Are OER and Open Pedagogy Trying to Disrupt? Have They Been Successful?

"An area where OER has been successful is in representation. OER solves representation in textbooks by providing different voices and points of view, and that is a disruption that OER can still bring."

"I think it has also disrupted academic publishing by reducing the barrier to entry. You don't need to have published a lot of things before you can create an OER. You can be a young scholar who creates a dynamite resource that lots of people adopt and use. It's an alternative form for getting your work and your thoughts out there."

"Indigenization is local, and OER can be more authentic and more local in its decolonization efforts. Textbooks on Indigenous history, as good as they are, may or may not reflect local peoples, experiences, traditions, or ways of knowing."

"And let's face it, OER did force publishers to adapt their business models. We did disrupt how they were doing business."

"But as long as OER are textbooks, we are going to constantly be working in response mode to what publishers are doing. We're following the publishers. To be successful disruptors, we need to jump ahead of them. I think we are coming out of a period where OER and open education lost its oomph. We have hit a status quo. What is it that we need to do now?"

"We need to continue to disrupt. We need to empower the innovators through funding and policy. We need to get back to asking the question, 'What are we trying to do here?'"

"Open education got lost in a melee of bigger issues—COVID, police brutality, et cetera. I feel more reinvigorated. There is a public good here that needs to be reaffirmed. It's not just about cost—it is about who is education for, and what should we be doing. It's about the moral element."

"Why don't we look to see where education should be going instead of looking over our shoulders at what the publishers are doing?"

"OER is not disrupting pedagogy. Selecting a low-cost or free OER to replace an expensive textbook to build and offer final exams is not disrupting anything. We need to move from building materials to changing practice. That's the big disruption that hasn't happened. I'm not sure anything has really been disrupted."

# Movement Four—Future Resistance: Who Are the Main Resistors of OER? Why and How Do They Resist?

"Resistors are everywhere—other faculty who still think OER mean poor quality, deans that don't support faculty creation, and the CFO who asks what's the return on investment of OER development."

"To make progress, we need to consider, 'What is the sustainable development goal you are trying to achieve?' It is not for someone else to figure out. It is for us to figure out. Equity, access, affordability, inclusion—you will find all these words in any postsecondary strategy. Same with disability access framework and Indigenization. OER is connected to all of these, and all these movements face their own individual sets of resistors. The most effective form of resistance I think is a system that just doesn't give enough time for us to achieve our mission in the best possible way."

# **Concluding Discussion**

As we reflected on this facilitated conversation using the WPR approach, we recognized in the conversation Bacchi's (2009) assertion that policy sometimes creates the very problems it seeks to solve. Government investment in OER, for example, creates the need for ongoing (and perhaps increased) government investment in OER to develop new resources and maintain existing ones. Capitalizing on government commitment to support OER also means individuals consciously or unconsciously accept the way government perceives the problem of access and affordability (and the funders' conception of education as a private or public good). The emphasis on facilitating access by reducing textbook costs in higher education risks becoming one-dimensional, failing to address the multifaceted educational funding model. If faculty take OER and remix and adapt it, the proliferation of OER may create an environment where discoverability becomes an even more intensive challenge. To lessen the adoption burden to faculty (a cost of time, energy, and effort), other individuals will need to match interested faculty to appropriate OER, and this infrastructure has a cost. As Bates (2011) observes, "We don't expect teachers or university lecturers to work for nothing, so we immediately have a tension between the ideal and the reality of public education. There are costs in the system, and they have to be paid for, one way or another" (para. 9). If OER is primarily about cheaper textbooks and open courseware, the problem becomes competing with textbook publishers, which (according to participants in the conversation) causes OER practitioners to shift their focus from the philosophical foundation of OER, and postsecondary institutions may not be equipped to compete with these providers. The genealogy of OER's origins and its present practice highlights how subtly (but quickly) the problem-to-be-solved can shift.

Questions also arise about whether access to postsecondary education has genuinely changed as a result of OER, or if OER has led to improved learning outcomes, a challenging aspect to quantify in any situation. The paradoxical situation of OER policy creating the very problems it sets out to solve underscores the necessity of a more holistic approach in OER policy and practice. In reflecting upon the dialogue from the four movements at the OE Global 2023 conference, it becomes evident that the landscape of OER is both dynamic and complex. The first movement of the conversation illuminated the various aspirations within educational contexts, highlighting the need for OER to address issues beyond cost, such as relevance, voice and representation, adaptability, and using texts in pedagogically meaningful ways. It also revealed that there are many reasons why individuals might embrace OER, and not all of them are cost or problem oriented. The second movement delved into OER's historical and philosophical roots, underscoring the nuanced shift from open access to an emphasis on affordability, yet reminding us of the need to revisit and realign with the other foundational values of open education, such as trust, community, creativity, and pedagogical innovation.

In the third movement, the conversation critically assessed the extent of OER's disruption in the educational sphere, questioning whether OER has genuinely transformed educational practices or merely altered the surface. OER adoption has only partially created the future it imagined, in part, because the final movement highlighted the various forms of OER resistance, illustrating the nuanced landscape of opposition that OER proponents must navigate, depending on what a particular OER is for. This last movement of the dialogue, especially, could have gone on much longer and will transcend the time restrictions of a single conference session. Taken together, these dialogues underscore the necessity of a holistic dialogue to OER policy development and implementation that is cognizant of the multifaceted

nature of education reform. Much more could be done with Bacchi's WPR approach to analyze existing OER policies at national, provincial, and institutional levels.

The conversation affirms the need to resist the dilution of OER's ethos, where 'openness' is narrowly redefined as '*free*' or 'online,' a deviation from its original, more liberating vision. As Weller (2014) writes,

They [open education advocates] are despondent about the reinterpretation of openness to mean "free" or "online" without some of the reuse liberties they had envisaged. Concerns are expressed about the commercial interests that are now using openness as a marketing tool. Doubts are raised regarding the benefits of some open models for developing nations or learners who require support. At this very moment of victory it seems that the narrative around openness is being usurped by others, and the consequences of this may not be very open at all. (p. xx)

Weller's lament resonates with Marcuse's (1969) concept of repressive tolerance, which argues that radical ideas are accepted in the marketplace as long as they do not fundamentally disrupt established norms and power structures. Marcuse (1969) observed that "freedom of speech and assembly was granted even to the radical enemies of society, provided they did not make the transition from word to deed, from speech to action" (para. 8). For open education practitioners and OER advocates, repressive tolerance would suggest that the system tolerates OER and the radical message of openness as long as it does not actually disturb the system, so long as OER proliferation leaves the status quo intact, or insofar as OER can be made to serve the status quo's purpose by providing the illusion that grassroots movements can arise and create meaningful change; that "the system" is malleable and open to influence. Marcuse observed that the market had a knack for absorbing and swallowing up threats. OpenStax may be a rival to the Big Three (Cengage, McGraw-Hill, and Pearson) (Seaman & Seaman, 2023), but has OER impacted their bottom line? As of 2022, educational books generated over \$8.79 billion in sales revenue in the United States alone, growing by 9.46 percent compared to 2021, the second-best year for educational sales. Overall, educational book sales have grown 25.04 percent over the past five years (Curcic, 2023). The market absorbs, swallows up, and neutralizes the impact of OER by co-opting the language of inclusive access and the pedagogical rationale of OER.

The discourse of disruption, then, allows for the appearance of competition and progress at the same time it neutralizes any real disruption to existing inequalities. Applying this to the OER movement implies that the educational superstructure may embrace OER only as long as it does not challenge or change the existing educational paradigm. If this analysis is correct, then this dynamic sets the stage for a critical discussion: the educational community must proactively shape OER's role, ensuring it is not just an accessory to buttress the current system but a tool for genuine structural transformation. This requires challenging market-driven narratives of cost and reassessing OER's impact beyond mere economic metrics and the money students save on textbooks. It may also mean accepting OER can continue to play an important role within the flawed educational structure that exists because OER is intentionally built for educational purposes, whereas publishers act self-interestedly.

This concluding discussion is neither end nor beginning. It is, after all, only one conversation with 10 committed OER practitioners at a single conference, which was itself part of a much longer, ongoing dialogue. Because of its limited scope, several pressing and emerging issues, such as student-generated and

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generative-AI-produced OER, are beyond commentary in this piece. If this small conversation at OE Global suggests anything, it may indicate the need for a phase transition (Lent, 2021), a maturing dialogue that critically reassesses the role and goal of OER. At a time when 65 percent of students report going without textbooks (Nagle & Vitez, 2021), perhaps a more modest ambition for OER practitioners (one that could have a profound and lasting impact) would be striving to ensure a greater percentage of educators use their texts in pedagogically meaningful ways. This transformation alone might cause structural change.

Social movements begin by questioning the moral legitimacy of certain practices (such as student textbook costs) that temporarily destabilize existing structures. Over time, the activist group reinstitutionalizes the legitimacy of the movement with norms and practices (den Hond & de Bakker, 2007). OpenStax, Zero Textbook Cost courses, multiple academic journals dedicated to OER scholarship, and OE Global are significant accomplishments worthy of celebration that represent a new, reinstitutionalized phase of OER development and infrastructure. Textbook publishers have also adapted to this first phase of disruption. In answer to Casserly's (2007) question, the generation of high-quality content that is freely available is not disruptive in and of itself, but fully compatible with the existing structures of higher education, and certain institutions may even gain prestige through OER adoption. Accepting this reinstitutionalization of the first phase of disruption invites a more nuanced understanding of OER capabilities and limitations to emerge. A new phase for OER dialogue is needed to respond appropriately to this "ecosystem under extreme stress" (Bretag et al., 2019, p. 1838). The problem is not just expensive textbooks; the problem may also be the disruptive discourse that OER can save the world. Ending the discourse of disruption is part of a more mature phase of OER development that ensures OER becomes a true catalyst for educational transformation, embodying the spirit of openness in every aspect of learning and teaching.
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