Pedagogical strategies with open educational resources: review of proposals developed during the COVID-19 pandemic

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Abstract: The COVID-19 pandemic has transformed global education due to social isolation. The internet, which was already essential in contemporary times, has become an indispensable work tool for teachers, who have started to use virtual teaching environments more, often learning to use them on demand. This article maps, through a systematic review (7 articles, 2020-2023), pedagogical strategies with

Resumo: A pandemia de covid-19 transformou a educação global devido ao isolamento social. A internet, que já era fundamental na contemporaneidade, passou a ser instrumento de trabalho indispensável dos professores, que passaram a aderir mais aos ambientes virtuais de ensino, muitas vezes aprendendo a usá-los sob demanda. Este artigo mapeia, via revisão sistemática (7 artigos, 2020-2023), estratégias pedagógicas

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Open Educational Resources (OERs). It is concluded that OERs should be integrated into teaching, transcending instrumental use, promoting not only access, but also reflection, creativity, and equity.

Keywords: pedagogical strategies; open educational resources; pedagogical innovation; remote teaching; open source.

com Recursos Educacionais Abertos (REAs). Conclui-se que os REAs devem ser integrados ao ensino, transcendendo a utilização instrumental, promovendo não só acesso, mas reflexão, criatividade e equidade.

Palavras-chave: estratégias pedagógicas; recursos educacionais abertos; inovação pedagógica; ensino remoto; open source.

1. INTRODUCTION

The restrictive measures implemented to combat the COVID-19 pandemic led to significant changes in behavior, including within the educational landscape, in order to continue teaching activities remotely. This situation prompted many professionals, including teachers, to adopt alternative approaches to teaching to comply with the restrictive measures, thereby contributing to the globally mandated social distancing during this period[1].

One of the first strategies adopted to prevent the spread of the virus in schools was the suspension of in-person classes, underscoring the role of educational institutions in enforcing social isolation [2]. However, the interruption of face-to-face activities did not necessarily translate into a period of rest for professionals; on the contrary, it intensified an urgent need for professional development, both in terms of content and the use of available technological resources. The suspension of on-site teaching effectively did not represent a halt in educational activities but rather introduced a new way to sustain teaching without physical interaction, undeniably causing a profound disruption in education worldwide.

The internet had already held a significant place in contemporary societies; however, with the necessity of social isolation, its importance became even more pronounced. As in-person teaching was no longer an option, institutions were compelled to adapt to this new pandemic-driven reality[3]. Consequently, teachers increasingly adopted virtual learning environments, often having to learn how to operate them in order to continue their work. The pandemic demanded that pedagogical strategies, previously underutilized, be revisited and adapted to meet the emerging needs of education.

According to Machado *et al.*[4], the concept of pedagogical strategy is closely linked to several other terms, such as learning strategies, educational strategies, and teaching and learning strategies. It is essential to understand the elements that characterize these concepts, including the guiding educational paradigm,

1 VEIGA, Maicon Guilland. Direito à educação e os recursos educacionais abertos (REA) no auxílio às coordenações pedagógicas em época de pandemia. **Revista Educação Pública**, v. 22, n. 14, 2022. Available at: https://educacaopublica.cecierj.edu.br/artigos/22/14/direito-a-educacao-e-os-recursos-educacionais-abertos-rea-no-auxilio-as-coordenacoes-pedagogicas-em-epoca-de-pandemia. Accessed in: 22 Mar. 2025.

2.PEREIRA, Bruna Karen Grilo; CARVALHO, Jéssica Araújo; GOMES, Cláudia Aparecida Valderramas; JUNQUEIRA, Clara Cassiolato. Isolamento social e processos educativos à distância: limites e desafios para o conhecimento escolar. **Revista de Psicologia da UNESP**, v. 20, n. 1, p. 175-198, 2021. https://doi.org/10.5935/1984-9044.20210015. During the pandemic, different education systems adopted different strategies, reflecting inequalities in access to telematic networks. Some systems took longer to implement online teaching, while others had to resort to printed materials, collected in person at schools.

3. VEIGA, *op. cit.*

4.MACHADO, Leticia Rocha; RIBEIRO, Ana Carolina; SONEGO, Anna Helena Silveira; BARVINSKI, Carla Adriana; TORREZZAN, Cristina Alba Wildt; SAMPAIO, Deyse Cristina Frizzo; FERREIRA, Gislaine Rossetti Madureira; BEHAR, Patricia Alejandra; GRANDE, Tássia Priscila Fagundes. Estratégias pedagógicas na educação a distância. **Revista Portuguesa de Educação**, Braga, v. 34, n. 2, p. 183-199, 2021. https://doi.org/10.21814/rpe.18550

the mode of delivery (virtual or hybrid), the technological resources available, and the educational methods required for their implementation.

In this pandemic context, in which online education became a fundamental pedagogical strategy[5], the use of Open Educational Resources (OER) also emerged as a key approach in educational activities, becoming increasingly relevant in contemporary discussions. The application of OER is broad and can be integrated into educational practices as a source of information, a tool for collaborative and practical activities, and a means for sharing among students. OERs can also be used individually or translated/adapted to the desired class or activity context, depending on the specific needs of the course or institution. This practice offers a strategic means of creating and sharing educational resources with colleagues, the school community, and beyond, while ensuring a commitment to democratic and quality education[6].

In this regard, this article aims to present a systematic review addressing the following research question: What pedagogical strategies have been developed by educators for the use of OER during the COVID-19 pandemic? To address this question, we conducted a mapping of pedagogical strategies focused on the use of OER developed by educators during the pandemic.

2. PEDAGOGICAL STRATEGIES FOR THE USE OF OER

Pedagogical strategies should be understood as a set of varied procedures, planned and implemented by educators with the purpose of achieving specific teaching objectives. To this end, they involve methods, techniques, and practices designed as means to access, produce, and express knowledge[7]. Within this context, OER have become a valuable form of educational material capable of enhancing collaborative processes. Particularly in the context of online education, or distance learning, such resources play an important role by fostering creativity through new creations and the sharing of teaching and learning processes.

The term Open Educational Resources was established in the early 2000s, arising from various conferences and declarations of the United Nations Educational, Scientific, and Cultural Organization (UNESCO), to define freely and openly available digital educational materials in the public domain, which could be legally used and adapted by others[8]. Originally, the English term *Open Educational Resources (OER)* refers to:

Teaching, learning, and research materials in any medium, digital or otherwise, that reside in the public domain or have been released under an open license that permits free access, use, adaptation, and redistribution by others with no or minimal restrictions[9].

The OERs are thus defined as all teaching, learning, or research materials that are in the public domain or released under an open license allowing their use and content production without proprietary claims. Their primary aim is to foster a common good by promoting equitable, free, and universal

5. MALLMANN, Elena Maria; JACQUES, Juliana Sales; SCHNEIDER, Daniele da Rocha; MAZZARDO, Mara Denize; MORISSO, Maríndia Mattos; ALBERTI, Taís Fim; LAUERMANN, Rosiclei Aparecida Cavichioli; ORNELAS, Norberto Quintana Guidotti de; WAGNER, Bruna Roberta; LAMBRECHT, Paula Karine Dolovitsch. **Formação de professores e recursos educacionais abertos (REA)**. São Paulo: Pimenta Cultural, 2022. Available at: https://www.pimentacultural.com/livro/formacao-professores-rea/. Accessed in: 21 Mar. 2025.

6. ORTIZ, José Oxlei de Souza; DORNELES, Aline Machado. Estratégias educacionais para a apropriação de Recursos Educacionais Abertos (REA): reflexões teóricas e potencialidades. **Revista EmRede**, v. 9, n. 2, p. 1-27, 2022. Available at: https://www.aunirede.org.br/revista/index.php/emrede/article/view/900/. Accessed in: 22 Mar. 2025.

7 HEREDIA, Jimena de Mello; RODRIGUES, Rosângela Schwarz; VIEIRA, Eleonora Milano Falcão. Produção científica sobre recursos educacionais abertos. Transinformação, v. 29, n. 1, p. 101-113, 2017. https://doi.org/10.1590/2318-08892017000100010

8 MORAIS, Kátia Gonçalves; RODRIGUES, Creuza Ferreira; CARVALHO, Lílian Amaral de Morais. Panorama do uso de Recursos Educacionais Abertos (REA) no contexto didático. Tecnia, v. 7, n. 2, p. 147-166, 2022. Available at: https://periodicos.ifg.edu.br/tecnia/article/view/23/. Accessed in: 22 Mar. 2025.

9 UNESCO. Declaração REA de Paris. Paris: UNESCO, 2012. Available at: https://unesdoc.unesco.org/ark:/48223/pf0000246687_por. Accessed in: 25 Dec. 2023. p. 2.

education through collaboration and knowledge sharing, with minimal copyright restrictions[10].

In its *Education for All* report, UNESCO emphasized that the availability of books and equipment is essential to improving the quality of the entire educational system. The opportunity to access educational materials essential for promoting free and quality education is, in many cases, financed by families, particularly in developing countries[11].

To address the challenge of access to teaching materials, an organic movement has emerged within the teaching community of each field, leveraging digital technologies to consult, use, and adapt new high-quality materials through alternative means of distribution and production, ensuring that these materials can be used non-commercially and free of charge[12]. This movement contributed to the development of internationally discussed documents, primarily by users of educational repositories, which in turn spurred the growth of repositories and libraries offering OERs.

With the expansion of OERs, access to information has enabled users to make more informed choices and has reinforced the understanding of OERs as an instrument in both in-person and distance education processes. These resources promote collaboration, sharing, and the development of educational equity worldwide, through their materials or objects of learning, teaching, outreach, and research. They encompass any medium or electronic format, including courses, modules, books, research articles, videos, software, and any other tool, material, or technique that supports knowledge access and is either in the public domain or openly licensed[13].

In Brazil, discussions on OER began in 2008, initiated by a group of representatives from different fields of knowledge who developed a Brazilian OER Project entitled PROJETO REA.br[14], driven mainly by public universities. In 2011, the *REA Handbook* for primary and secondary school teachers was launched[15]. In 2014, the concept of OER was included in Goal 7 on Basic Education in the National Education Plan; however, the consolidation of its use still depends on the promotion of conditions that enable broader access to the digital realm[16].

Resolution No. 1, of March 11, 2016, issued by the National Education Council, establishes national guidelines and standards for the provision of Higher Education Programs and Courses in distance learning, including in Article 2, Section 4, the guidance on the production and availability of OER. Ordinance No. 183, of October 21, 2016, requires that Higher Education Institutions within the Open University of Brazil System adopt open licensing for all teaching materials produced by scholarship holders. Furthermore, Ordinance No. 451, of May 16, 2018, stipulates that all educational resources for basic education financed with public funds must have an open license and, when digital, must be made available on web platforms[17].

Since 2018, Brazil's Ministry of Education (MEC) has mandated the adoption of the Creative Commons license CC-BY-NC for equipment and teaching support materials used in educational robotics projects procured through public

10 ZANIN, Alice Aquino. Recursos educacionais abertos e direitos autorais: análise de sítios educacionais brasileiros. **Revista Brasileira de Educação**, v. 22, n. 71, e227174, 2017. https://doi.org/10.1590/S1413-24782017227174

11 *Ibid.*

12 HEREDIA; RODRIGUES; VIEIRA, *op. cit.*; UNESCO, 2021; ZANIN, *op. cit.*

13 UNESCO, 2012; Zanin, *op. cit.*

14 PROJETO REA.br. **Iniciativa Educação Aberta**, 2022. Available at: https://aberta.org.br/projeto-rea-br/. Accessed in: 22 mar. 2025.

15 VEIGA, *op. cit.*

16 MORAIS; RODRIGUES; CARVALHO, *op. cit.*

17 BRASIL. Ministério da Educação. **Resolução nº 1 de 11 de março de 2016**. Establishes National Guidelines and Standards for the Provision of Distance Learning Programs and Courses in Higher Education. Brasília: Presidência da República, 2016. Available at: http://portal.mec.gov.br/docman/marco-2016-pdf/35541-res-cne-ces-001-14032016-pdf/file. Accessed in: 22 Mar. 2025.

purchases. Additionally, MEC calls for proposals in 2019 and 2020 included clauses requiring the use of the CC-BY-NC license for digital supplementary material accompanying teachers' manuals. Law No. 14.180, of July 1, 2021, established the *Connected Education Innovation Policy*. This policy mandates the provision of free digital teaching materials, preferably open, in the public domain, and under open licenses, developed with the active participation of education professionals and aimed at fostering the development and dissemination of digital teaching resources, preferably in open formats[18].

It is important to emphasize that educational resources are diverse and receive different designations. In Brazil, the MEC[19] defines the distinctions among the terms educational resource, digital *educational resources, open educational resources,* and *free educational resources*, as follows:

> I – educational resource: a digital or non-digital resource that can be used, reused, or referenced during a process of technological support for teaching and learning;
>
> II – digital educational resources: teaching, learning, research, pedagogical or school management materials in digital format, including e-books, booklets, guides, applications, software, platforms, electronic games, and digital content;
>
> III – open educational resources: those in the public domain or registered under an open license that allows free access, use, adaptation, and distribution by third parties. Whenever technically feasible, open educational resources should be developed and made available in formats based on open standards;
>
> IV – free educational resources: those that, although made available under closed intellectual property arrangements, allow unrestricted technical access and cost-free use for an unlimited period.

According to Zanin[20], as well as Mazzardo, Nobre, and Mallmann[21], open licenses allow copying, reuse, adaptation, remixing, and redistribution of materials without the need for prior authorization. Teachers are able to rework or adapt materials, considering both the concept of adjustment and that of transformation. To the student, the material may appear as a ready-made resource, but in fact, it has been disassembled and reassembled by the teacher when creating the activity using modules they produced, reworked, remixed, and redistributed from the repository[22]. The same author further states that when a teacher reuses a module—whether produced by themselves or by colleagues—the system creates a copy to be reworked, leaving the previous version intact. This means that modules have, at the very least, the potential to be improved over time, generating activities not only adapted to specific contexts but also potentially more effective.

However, despite the advantages mentioned for the use of OER, one of the limitations identified in their implementation was highlighted in a study conducted by[23] Morais *et al.* with 71 teachers. Regarding their knowledge of OER, the results revealed low levels of usage, as teachers often experience difficulties

18 ZANIN, op. cit.; MALLMANN et al., *op. cit.*

19 PROJETO REA.br. Iniciativa Educação Aberta, 2022. Available at: https://aberta.org.br/projeto-rea-br/. Accessed in: 22 mar. 2025.

20 VEIGA, *op. cit.*

21 MORAIS; RODRIGUES; CARVALHO, *op. cit.*

22 BRASIL. Ministério da Educação. **Resolução nº 1 de 11 de março de 2016**. Establishes National Guidelines and Standards for the Provision of Distance Learning Programs and Courses in Higher Education. Brasília: Presidência da República, 2016. Available at: http://portal.mec.gov.br/docman/marco-2016-pdf/35541-res-cne-ces-001-14032016-pdf/file. Accessed in: 22 Mar. 2025.

23 MORAIS; RODRIGUES; CARVALHO, op. cit.MORAIS; RODRIGUES; CARVALHO, *op. cit.*

in determining whether a material is freely licensed, which creates significant apprehension about committing plagiarism. This, in turn, inhibits the use of internet-based materials, including those with open licenses.

3. METHODOLOGY

This study consists of a systematic literature review conducted in 2024, aiming to summarize and/or present the findings of prior research addressing a specific scientific question, employing a methodologically rigorous approach[24]. The methodology encompasses the identification of pedagogical strategies developed by teachers during the COVID-19 pandemic, between 2020 and 2023, which made use of OER. To achieve the stated objective, the methodological pathway was organized into three stages: (i) description of the protocol adopted; (ii) data collection from the Scopus and SciELO databases; and (iii) presentation of the results obtained.

The first stage of the methodological pathway involves presenting the research model, including a description of the protocol used. This protocol outlines the research steps to ensure replication by other researchers and serves as a reference that the process follows predefined and respected procedures[25]. According to the authors, these procedures may involve more or fewer steps, depending on the specific study.

The adopted protocol included the following items, summarized in Table 1: (i) objective: definition of the research problem; (ii) search equations: keywords and/or expressions combined using the Boolean operators AND and OR; (iii) research scope: selected databases; (iv) inclusion criteria: parameters accepted by the study; (v) exclusion criteria: parameters excluded from the study; and (vi) results: steps and impacts of the selected works. The stages of this approach are regarded as "[…] balanced, feasible, and applicable within the scope of research conducted in the field of Educational Sciences."[26]

24 RAMOS, Altina; FARIA, Paulo M.; FARIA, Ádila. Revisão sistemática de literatura: contributo para a inovação na investigação em Ciências da Educação. **Revista Diálogo Educacional**, Curitiba, v. 14, n. 41, p. 17-36, 2014. https://doi.org/10.7213/dialogo.educ.14.041.DS01

25 *Ibid*

26 *Ibid.*, p. 23.

Table 1: Description of systematic review items

Systematic Review Items	Description
Objectives	To map strategies developed by higher education faculty during the pandemic using OER
Search equations	"*digital technologies*" OR "*open educational resources*" OR "*educational tools*" OR "*modern technology*" AND "*higher education*" OR "*ICTs*" AND "*teaching practices*"
Search scope	Scopus and SciELO
Inclusion criteria	Only articles published between 2020 and 2023, written in Portuguese, English, or Spanish
Exclusion criteria	Studies that did not focus on presenting practices and/or strategies applied in classroom settings and developed within higher education, articles not published after 2020, or texts not written in Portuguese, English, or Spanish
Results	To present the pedagogical strategies identified in the selected studies, as well as the impacts generated/achieved by these strategies

Source: Prepared by the authors.

The second stage of the methodological framework involved the search for studies in the Scopus and SciELO databases, based on the items described in Table 1. These two databases were selected to encompass both national and international studies. The document search in both databases occurred in three sub-stages: (i) an initial broad search using all search equations; (ii) refinement of the initial search within the databases by applying exclusion criteria filters; and (iii) screening of titles, abstracts, and results of the retrieved studies to further refine, based on the exclusion criteria, the selection for full-text reading.

The studies selected from the Scopus and SciELO databases correspond to the final stage of the methodological process. Each article was read and analyzed in full, with particular attention to the methodology, analysis, discussion of results, and final considerations sections. For each selected study, data were extracted on: (i) publication year; (ii) title; (iii) research objectives; (iv) pedagogical tools and/or strategies presented; and (v) results and conclusions. The data and discussion of results are presented in the following section.

4. ANALYSIS AND DISCUSSION OF RESULTS

To present the findings in line with this study's objective—mapping educational strategies adopted by higher education faculty during the pandemic through the use of OER—this section is structured into three stages. The first stage comprised the qualitative detailing of the database search. The initial

search, with no inclusion filters, yielded 97 studies: 58 from Scopus and 39 from SciELO. Subsequently, after applying the inclusion criteria, the number of studies was reduced to 41, with 28 from Scopus and 13 from SciELO. From these 41 studies, titles, abstracts, and results were screened to refine the selection based on the exclusion criteria. This final refinement resulted in seven selected studies: five from Scopus and two from SciELO.

In the second stage, each of the seven studies included in the systematic review is described, presenting their objectives, the pedagogical strategies developed using OER, and the outcomes achieved. The third stage provides a synthesis and a general discussion of the findings.

The article "*NoresteOnline: experiencia del CENUR Noreste en contingencia COVID-19*" by Casnati *et al.*[27], reports on the work of a group of faculty members from the Universidad de la República. Their initiative aimed to support faculty in the region in designing and redesigning online teaching and learning activities through support and advisory mechanisms, fostering the creation of a learning community using OER. Following data collection with faculty, various strategies were proposed to address the identified needs. One such strategy focused on online assessment processes, emphasizing formative assessment, student learning, and the use of rubrics. Broadly, the *NoresteOnline* initiative is structured around three areas: (i) developing pedagogical subjectivity and identity in teaching with ICTs; (ii) fostering pedagogical and communication skills for ICT-based teaching; and (iii) establishing a community of practice and learning to promote faculty professional development.

The article "Start@unito as Open Educational Practice in Higher Education"[28] aimed to analyze the virtual learning environment (VLE) and demonstrate its alignment with open educational practices. aimed to analyze the virtual learning environment (VLE) and demonstrate its alignment with open educational practices. *Start@unito* integrates tools that promote autonomous and effective learning, providing users with a repository of openly licensed content via *Creative Commons*. The platform offers 50 online courses. One of its tools is the Automated Formative Assessment, which provides students with immediate and interactive feedback, enhancing interactivity and adaptability. Future challenges and opportunities for this model include: (i) implementing tutoring to foster collaborative and peer learning; and (ii) creating micro-credentials to enable students to enrich their academic portfolios with specific topics and skills. These elements promote greater adaptability and engagement in remote learning.

The article "Art History: exploring the motivations and practices of faculty using Open Educational Resources in lower-level and general education art history courses"[29] sought to examine why, how, and for what purposes a diverse group of art historians utilize OER and related practices in their teaching. In this process, seven distinct possibilities for OER use and related practices were identified. The first involved searching for specific collections through Google, including museum resources. The second focused on courses offered by Saylor Academy.

27 CASNATI, Ana María; GALVÁN, Mariana Porta; SOLANA, Virginia; MARRERO, Cecilia. NoresteOnline: experiencia del CENUR Noreste en contingencia covid-19. **Inter-Cambios:** Dilemas e transições do Ensino Superior, v. 7, n. 2, p. 129-139, 2020. https://doi.org/10.29156/INTER.7.2.13.

28 MARCHISIO, Marina; SACCHET, Matteo; RABELLINO, Sergio. Start@ unito as Open Educational Practice in Higher Education. **Journal of e-Learning and Knowledge Society,** v. 16, n. 4, p. 46-55, 2020. https://doi.org/10.20368/1971-8829/1135354

29 CHTENA, Natascha. "Opening" art history: exploring the motivations and practices of faculty using Open Educational Resources in lower-level and general education art history courses. **Journal of Interactive Media in Education**, v. 1, n. 23, p. 1-16, 2021. https://doi.org/10.5334/jime.677

Beyond courses, the third included essays and videos provided by *Smarthistory.org*. The fourth consisted of digital textbooks published by Boundless (available through Lumen Learning). The fifth resource was the podcast *A History of the World in 100 Objects* from the British Museum. The sixth included documentary series such as *Civilizations* by BBC/PBS and the Metropolitan Museum of Art's *Heilbrunn Timeline of Art History*. The seventh consisted of excerpts from anthologies and scholarly journal articles available in their university or college libraries. The study critically assessed the claim that engaging with OER inherently entails radically new pedagogies. The collected and analyzed data indicate that "[…] no significant changes were observed in the use of instructional resources, in pedagogical thinking, or in teaching practices as a result of OER adoption."[30]

The article "*La producción de Recursos Educativos Abiertos como práctica docente no presencial en el Profesorado en Biología*," by Allendes and Gómez[31] aimed to present the OER developed during the teaching practicum experience of a group of students enrolled in the course *Information Technologies in Science Teaching*, offered in the second year of the Biology Licentiate Program at the National University of San Luis. The intervention benefited from the substantial contribution of the course instructor and was conducted within a non-presential educational system at both secondary and university levels. Based on eight outlined topics, specific learning objectives guided the resource search, utilizing web tools, including videoconferencing. The materials developed were published on a dedicated website, with proper licensing, and were subsequently used by the instructor.

The article "Creative use of information and communication technologies according to university professors and students," by Vilarinho-Pereira and Fleith[32] aimed to investigate the role of technologies in fostering creativity and student motivation, according to university professors and students. Nine professors were interviewed across three distinct groups: (i) those who creatively employed information and communication technologies; (ii) those who used such technologies traditionally; and (iii) those who did not use them. The OER mentioned by the professors during the interviews included: (i) literature research on the Internet; (ii) use of the *Modular Object-Oriented Dynamic Learning Environment* (Moodle); and (iii) recorded and recommended YouTube videos. In the analysis and discussion of results, the professors' teaching practices were categorized into three dimensions: continuous updating, strategies, and planning. The "continuous updating" category highlights how professors strive to improve their practices by sharing their expertise with students. The "strategies" category encompasses the various tools and activities selected to deliver content and develop students' skills for their future professional practice, including the use of ICTs, combined strategies, and analog methods. The "planning" category concerns how instructors design their curricula and the extent to which they are willing to adapt them to students' needs, with some being flexible and others more structured. These planning approaches were further divided into two subcategories: *Flexible* and *Structured*. In the phase of the study where students completed an inventory of good practices, those whose

30 *Ibid.*, p. 23.

31 ALLENDES, Paola Andrea; GÓMEZ, Cintia Lorena. La producción de Recursos Educativos Abiertos como práctica docente no presencial en el profesorado en Biología. **Revista Iberoamericana de Tecnología en Educación y Educación en Tecnología**, Buenos Aires, n. 28, p. 127-132, 2021 https://doi.org/10.24215/18509959.28.e15

32 VILARINHO-PEREIRA, Daniela Rezende; FLEITH, Denise de Souza. Creative use of information and communication technologies according to university professors and students. Estudos de Psicologia, Campinas, v. 38, e190164, 2021. https://doi.org/10.1590/1982-0275202138e190164

instructors did not use ICTs rated teaching practices more positively with respect to fostering creativity. A second key finding indicated that the integration of technologies in the classroom should be carefully planned according to the intended learning objectives.

The article "ChatGPT – a challenging tool for the university professors in their teaching practice," by Kiryakova and Angelova[33] aimed to explore the opinions of university professors from a Bulgarian institution regarding the possibilities and challenges of using ChatGPT in their teaching activities. The collected data indicated that the use of ChatGPT in the classroom encompassed: (i) the production of teaching materials and presentations; (ii) the development of questions and quizzes to assess students' knowledge; (iii) the creation of practical exercises and assignments for students to complete; (iv) the design of exercises for students to revise and improve; (v) student assessment; and (vi) personalized feedback.

The article "Insights into a community of inquiry that emerged during academics' emergency remote university teaching of chemistry in response to concern for students"[34] examined the experiences, perceptions, and teaching approaches of chemistry professors in the Philippines during the COVID-19 pandemic. The strategies employed by the professors included: (i) using ICT tools to present slides; (ii) using online platforms to share slides; (iii) employing online quizzes to initiate classes; and (iv) utilizing Jamboard to present problems and stimulate student participation in discussions. According to the professors, although the pandemic negatively impacted classroom experiences, they reported being able to continue delivering their teaching responsibilities and managing student concerns. The negative impact was primarily attributed to the Philippines' ongoing struggle to establish robust infrastructure to support online and technology-enhanced learning. Consequently, the pedagogies and practices developed had to ensure accessible learning experiences for students by curating online tools that required minimal bandwidth and low data consumption.

Following the analysis of the seven articles, Table 2 presents the pedagogical strategies employed by faculty during the COVID-19 pandemic, noting that, in some cases, only the OER used was listed.

Table 2: Educational strategies and/or OER used in the articles included in the systematic review

Authors and Year	Title	Strategies and/or OERs used
Casnati *et al.* (2020)	NoresteOnline: experiencia del CENUR Noreste en contingencia covid-19	(1) Assessment tool within the VLE, emphasizing formative assessment with a focus on student learning and the use of rubrics.

33 KIRYAKOVA, Gabriela; ANGELOVA, Nadezhda. ChatGPT—A challenging tool for the university professors in their teaching practice. **Education Sciences**, v. 13, n. 10, 1056, 2023. https://doi.org/10.3390/educsci13101056

34 REYES, Charisse T.; THOMPSON, Christopher D.; LAWRIE, Gwendolyn A.; KYNE, Sara H. Insights into a Community of Inquiry that emerged during academics' emergency remote university teaching of chemistry in response to concern for students. **Research in Science & Technological Education**, v. 42, n. 4, p. 1042-1068, 2023. https://doi.org/10.1080/02635143.2023.2202387

Marchisio *et al.* (2020)	Start@unito as Open Educational Practice in Higher Education	(2) Automated Formative Assessment tool within the VLE, providing students with immediate and interactive feedback, thereby enhancing interactivity and adaptability.
Chtena (2021)	Art History: exploring the motivations and practices of faculty using Open Educational Resources in lower-level and general education art history courses	(3) Search for museum collections via Google; (4) MOOCs (Massive Open Online Courses); (5) Videos; (6) Digital textbooks; (7) Documentary series; (8) Academic articles;
Allendes; Gómez (2021)	La producción de Recursos Educativos Abiertos como práctica docente no presencial en el profesorado en biología	(9) Use of videoconferencing
Vilarinho-Pereira; Fleith, (2021)	Creative use of information and communication technologies according to university professors and students	(10) Online literature search; (11) Use of Moodle; (12) Pre-recorded and recommended YouTube videos.
Kiryakova; Angelova (2023)	ChatGPT—A challenging tool for the university professors in their teaching practice	Use of ChatGPT for: (13) producing teaching materials and presentations; (14) developing questions and quizzes to assess students' knowledge; (15) creating practical exercises and assignments for students to complete; (16) designing exercises for students to revise and improve; (17) assessing students' performance; (18) providing personalized feedback.
Reyes *et al.* (2023)	Insights into a community of inquiry that emerged during academics' emergency remote university teaching of chemistry in response to concern for students	(19) Use of ICT tools to present slides; (20) Use of platforms to share slides; (21) Use of online quizzes to initiate classes; (22) Use of Jamboard to present problems and stimulate student participation in discussions.

Source: Prepared by the authors.

Based on the 22 strategies identified, including those related to assessment and/or the use of OER, it is evident that 10 of them—linked to four articles—reflect innovative pedagogical practices: (i) formative assessment tools employing rubrics and immediate feedback; (ii) use of ChatGPT; (iii) use of online quizzes; and (iv) use of Jamboard to stimulate student participation in discussions. Regarding the use of rubrics in formative assessments, Nicola and Amante[35] emphasize that their application represents one of the pathways to achieving quality in higher education, being particularly significant in student-centered assessment activities guided by well-defined performance criteria.

35 NICOLA, Rosane de Mello Santo; AMANTE, Lúcia. Rubricas: avaliação de desempenho orientada às competências na educação superior. **Estudos em Avaliação Educacional**, v. 32, e07582, 2021. https://doi.org/10.18222/eae.v32.7582

From a student-centered perspective, the use of ChatGPT also enables the development of innovative pedagogical strategies. Its integration enhances students' learning experience and fosters greater interaction between students and instructors. "As its possibilities are further explored and understood, the application of ChatGPT in education reveals significant potential to transform teaching and learning methods."[36]

The remaining items listed in Table 2 primarily include OER, the use of which can be deemed either traditional or innovative depending on the pedagogical strategies employed. From a broader perspective, the analysis indicates that strategies leveraging analog resources often promote greater student creativity. Moreover, Virtual Learning Environments (VLEs) and their associated tools have not demonstrated innovative pedagogical actions, largely adhering to models already established and utilized before the pandemic.

Overall, it is observed that while some articles, such as "*NoresteOnline: experiencia del CENUR Noreste en contingencia covid-19*," evidenced significant advances in the pedagogical use of OER, others, such as "Art History: exploring the motivations and practices of faculty using Open Educational Resources in lower-level and general education art history courses," were limited to describing the adoption of resources without critically engaging with their application in more robust pedagogical strategies. Additionally, the article "ChatGPT – a challenging tool for the university professors in their teaching practice," highlights that the use of ChatGPT reveals an emerging field of possibilities with considerable potential to transform pedagogical practices. This underscores the need to ensure that OER are integrated into pedagogical strategies not only as instrumental tools but also as enablers of reflective, creative, and equitable teaching practices.

Finally, the studies demonstrated that higher education institutions sought to ensure that the OER made available were accessible to students within the constraints of existing infrastructure. Thus, based on the seven articles analyzed, it is evident that although OER are intended to foster innovative pedagogical strategies, their adoption does not always result in significant changes in teaching and learning processes.

5. FINAL CONSIDERATIONS

Reflecting on the impact of OER on teaching practices, it can be concluded that their use has been documented at least since 2020, playing a fundamental role in democratizing access to knowledge and promoting more inclusive and collaborative educational strategies. When incorporated into lesson planning and delivery, OER not only enrich the repertoire of resources available to students and teachers but also stimulate creativity, personalized learning, and the sharing of knowledge.

The OER has significant educational and collaborative potential when effectively integrated into pedagogical strategies, offering a wide range of

36 MONTENEGRO-RUEDA, Marta; FERNÁNDEZ-CERERO, José; FERNÁNDEZ-BATANERO, José Maria; MENESES, Eloy López. Impact of implementation of ChatGPT in education: a systematic review. **Computers**, v. 12, n. 8, 153, 2023. https://doi.org/10.3390/computers12080153

teaching materials free from copyright restrictions. This enables educators to adapt and remix content to meet the specific needs of their students, fostering more meaningful and context-driven learning experiences. Additionally, the importance of OER in overcoming economic barriers that often prevent students from accessing quality educational materials cannot be overstated. By expanding learning opportunities for students from diverse socio-economic backgrounds, OER contributes to greater educational equity.

However, it must be acknowledged that the effective implementation of these resources in learning requires specific knowledge on the part of both teachers and students to ensure their full potential is realized. If we aspire to a world with opportunities for all, it is our responsibility as education professionals to foster an open-source culture.

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