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The use of microlearning in the educational field: an overview of worldwide scientific production

El uso del microaprendizaje en el ámbito educativo: una visión general de la producción científica mundial

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Abstract

This paper addresses the scientific production published worldwide on the Scopus indexer, aiming to understand the current state of scientific knowledge on the educational interfaces of microlearning. Based on an exploratory-descriptive bibliometric search using the descriptors microlearning and education on Scopus, the metadata was exported and processed using the bibliometric analysis program VOSviewer®. The quantitative search found 99 articles published mostly since 2019, from 37 countries, especially the United States. The qualitative discussion through content analysis revealed six thematic categories: formal educational innovations through microlearning; microlearning in the continuing education of health professionals; microlearning in informal education; the potential of microlearning; digital mobile microlearning; and methodologies for implementing and evaluating microlearning. We concluded that microlearning is transdisciplinary and is strengthened using active methodologies, superior design, short activity times, and the responsible use of artificial intelligence. Indeed, investing in teacher training for qualified work such as microlearning is crucial, as is stimulating studies in countries of the global south and east, where production is still scarce.

Keywords: *digital information and communication technologies, scientific knowledge, teaching and learning, micro-teaching, active methodologies*

Resumen

El artículo aborda la producción científica difundida mundialmente a través del indexador Scopus, con el objetivo de comprender el estado actual del conocimiento científico sobre las interfaces educativas del microaprendizaje. A partir de una búsqueda bibliométrica exploratoria-descriptiva utilizando los descriptores microlearning y education en Scopus, los metadatos fueron exportados y procesados utilizando el programa de análisis bibliométrico VOSviewer®. La búsqueda cuantitativa reveló 99 artículos publicados en su mayoría a partir de 2019, procedentes de 37 países, especialmente Estados Unidos. La discusión cualitativa a través del análisis de contenido reveló seis categorías temáticas: innovaciones educativas formales a través del microaprendizaje; microaprendizaje en la educación continua de profesionales de la salud; microaprendizaje en la educación informal; potencialidades del microaprendizaje; microaprendizaje móvil digital; metodologías para implementar y evaluar el microaprendizaje. Se concluyó que el microaprendizaje es transdisciplinario y se fortalece con el uso de metodologías activas, buen diseño, tiempos cortos de actividad y la asociación responsable de la inteligencia artificial. De hecho, es importante invertir en la formación de profesores para trabajos cualificados como el microaprendizaje y fomentar los estudios en los países del sur global, cuya producción es aún escasa.

Palabras clave: *tecnologías digitales de la información y la comunicación, conocimiento científico, enseñanza y aprendizaje, microenseñanza, metodologías activas.*

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1. INTRODUCTION

Contemporary education has experienced multiple challenges, driven by the mobility enabled using digital technological resources (Hug, 2020), as Digital Information and Communication Technologies (DICT) expand access to knowledge, they demand investments and professional skills that are compatible with these circumstances.

Within such complexity, the physical and virtual environments are intertwined, and a variety of technologies, such as artificial intelligence tools, have been increasingly incorporated into education, expanding, and deepening the possibilities applicable to the teaching-learning process (González González & Silveira Bonilla, 2022).

Digital tools have become an integral part of young people's daily lives (Romero Oliva & Ponce, 2019; Nascimento & Castro Filho, 2020). Generation Z, born between the mid-1990s and 2009, has peculiar traits, such as the intensive use of social networks as the main space for socializing. In fact, they value quick responses, a trend reflected by their preference for instant means of communication and see themselves as self-taught in the use of ICTs (Álvarez Ramos, Heredia Ponde & Romero Oliva, 2019).

Likewise, knowledge takes on an open approach, and its construction requires considering the diversity of people and learning styles. It is therefore the responsibility of education, at all levels and stages, to break with traditional paradigms and make itself flexible to new learning environments, in which students are given an autonomous role in managing their own learning (Agudelo Velásquez & Salinas, 2022). It is thus urgent that the curriculum adapts to cultural and technological realities and emphasizes the completeness of student development (Rueda Mateos & Amar Rodriguez, 2020).

Similarly, the initial and ongoing training of teachers should focus on training them for the digitalized world, seeking to transform training gaps into appropriate skills for the effective exercise of teaching (Marrón Fernández & Martínez-Aznar, 2023; Romero Oliva & Ponce, 2019; Nascimento & Castro Filho, 2020).

It is in this scenario that research interest in microlearning emerges, conceived as a microteaching experience enhanced by ICT, which occurs in short periods, with flexibility in terms of learning times and places. This approach strengthens student autonomy in the teaching-learning process (Agudelo Velásquez & Salinas, 2022) and is compatible with both formal and informal education (Hesse et al., 2019).

Benefits provided by microlearning are also seen in corporate environments and other social sectors. With both theoretical and practical reverberations, this methodology favors the assimilation of knowledge in various fields in a brief period, enabling people to solve problems of all kinds (Rios, Gomes, Alves, Pereira & Queiros, 2023). However, it is noteworthy that studies on microlearning are more vehement in higher education (Alias & Abdul Razak, 2023) even though it is a relevant and emerging topic, and the subject of interest and funding in different countries (Leong, Sung, Au & Blanchard, 2021). Empirically, based on this study, we observe a lack of research in some countries, showing that its interface with education is yet to be elucidated.

The question is: what is the state of scientific production on the interconnections between microlearning and education? To answer this question, we conducted a systematic survey using the bibliometric method, combined with content analysis to understand the current state of scientific knowledge regarding the educational interfaces of microlearning.

We believe this study could shed light on the trends, shortcomings, and patterns in the literature relating to the topic under discussion. The broadening of critical reflections on educational initiatives mediated by microlearning, through a contextualized and comprehensive analysis of publications from distinct parts of the world, can contribute to supporting political and institutional decision-making aimed at promoting quality education, while also being able to subsidize additional studies.

2. METHODS

This exploratory-descriptive study, using a systematic search, retrieves scientific production on the microlearning and education interface and, by applying a bibliometric approach, analyzes the content and critically synthesizes the evidence.

According to Gil (2008), exploratory studies highlight the research problem. Descriptive studies, as the nomenclature points out, describe the phenomenon under investigation and show the relationship between its variables. Therefore, researchers in the field of education who are engaged in practical work carry out exploratory and descriptive studies at the same time, to broaden their theoretical understanding and improve teaching performance (Hamel Quesada; Villavicencio Simón & Causse Cathcart, 2021). This articulation is achieved by using the bibliometric approach, as quantitative techniques are used to highlight the indicators of scientific production, allowing us to map and critically discuss production and analytically understand how microlearning has been developed in education (Vianna & Pinto, 2017).

The research comprised the following phases: 1) identifying the guiding question; 2) defining the search script with the terms linked by the Boolean operator “AND” and located in the titles, abstracts, and keywords of the production: “microlearning AND education”; 3) defining the eligibility criteria: including articles published on any date and in English, Spanish, German, Portuguese, Italian, or French; excluding documents other than articles, repeated and published in a language other than those mentioned; 4) selecting the records in the Scopus database on December 13, 2023; 5) exporting the metadata to the bibliometric analysis program VOSviewer®, version 1. 6.18; 6) processing of the records by VOSviewer®; 7) authorial interpretation of the formulations presented by the bibliometric software; 8) application of the content analysis method; 9) formulation and critical interpretation of the thematic categories.

The preference for Scopus is based on the relevance of the studies disseminated, with a multidisciplinary global scope, from journals qualified by high metrics and peer-reviewed texts. The Scopus interface was used to apply filters compatible with the inclusion and exclusion criteria, whose script consisted of: (TITLE-ABS-KEY (microlearning) AND TITLE-ABS-KEY (education)) AND (LIMIT-TO (DOCTYPE, “ar”)) AND (LIMIT-TO (LANGUAGE, “English”) OR LIMIT-TO (LANGUAGE, "Spanish")).

Content analysis, according to Bardin (2016), reveals the nuclei of meaning that are significant for understanding the object under investigation. This method is particularly useful in the data processing stage and is carried out in three stages: 1) pre-analysis; 2) exploration of the material; and 3) treatment of the results and interpretation. In the pre-analysis, a floating (meditative) reading covered the titles, abstracts, and keywords of all the articles that met the eligibility criteria. In the exploration of the material, the texts were thoroughly and deeply examined, identifying the thematic categories that synthesize the evidence. Finally, in stage three, the results were interpreted in the light of the theoretical framework.

The results were presented using VOSviewer®, Excel spreadsheet charts, and thematic categories. According to Van ECK and Waltaman (2022), VOSviewer® is a tool that establishes various bibliometric networks, such as the co-occurrence of keywords and co-authorship of countries and authors, allowing researchers to visualize, explore, and elucidate them.

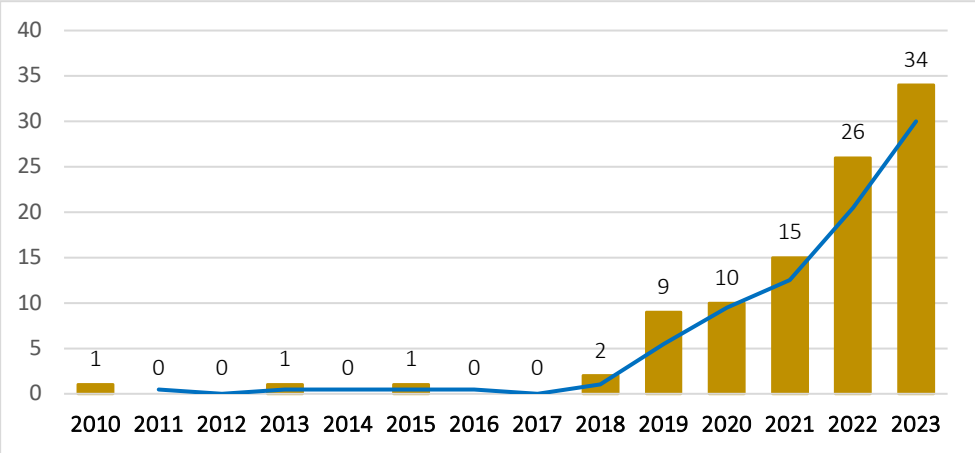
According to Brazilian law, this study was exempt from assessment and approval by the Ethics Committee as it did not directly involve human beings and worked with data that had previously been made openly available. The authors declare that they have complied with all the ethical and legal requirements applied to scientific research, such as respecting original ideas and the rights of the article holders. In addition, the set of metadata for this study is available at: https://doi.org/10.5281/zenodo.10446685.

3. RESULTS

The search in the Scopus database revealed 188 documents on microlearning applied to the educational context. Out of these, 99 articles met the selection criteria, both in English (n=93) and Spanish (n=6), as there were no documents in Portuguese, French, or Italian and the only one in German was repeated in English, which was the version considered. Figure 1 shows the annual productivity.

Figure 1

Year of publication and productivity trend curve (2010-2023)

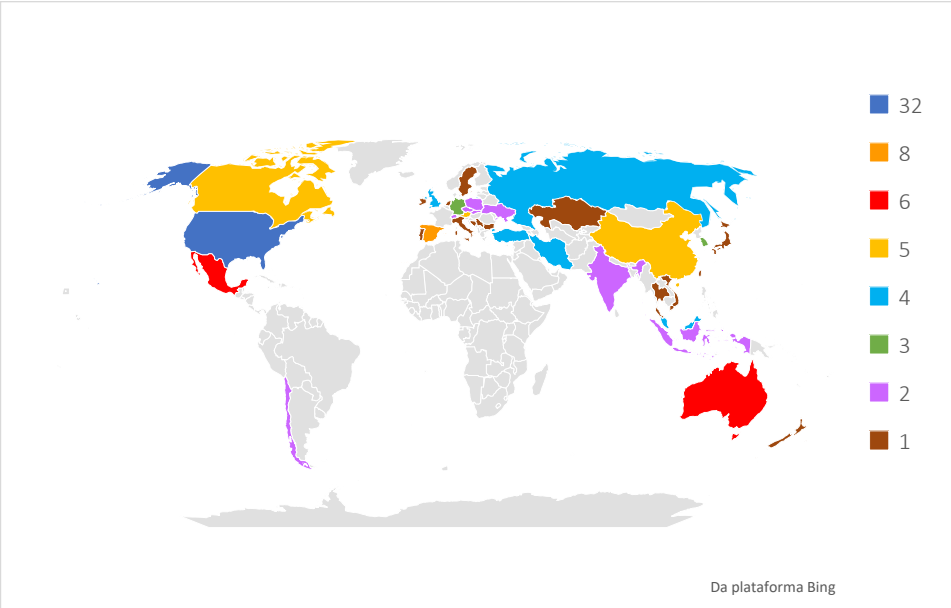


The oldest article was published in 2010. Up until 2018, only one article was found in 2013 and 2015, and the years 2011, 2012, 2014, 2016, and 2017 accounted for a few articles. The year 2018 accounted for two articles and, from 2019 onwards, with nine articles, production rose, sustaining the evolution of the trend curve.

The production studied came from 37 countries. Figure 2 shows a comparison of productivity by country.

Figure 2

Geographical distribution of articles by country

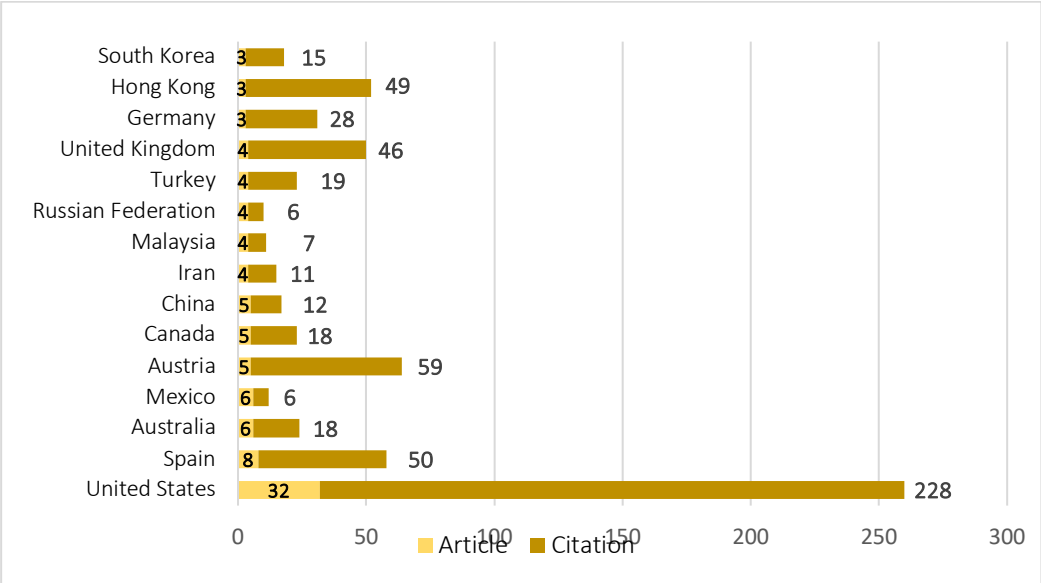


According to Chart 2, the United States (represented in dark blue) leads the way in terms of the number of articles (n=32). Spain (highlighted in orange) is in second place (n=8). Australia (n=6) and Mexico (n=6), both in red, share third place. Next in line are Austria, Canada, and China (in yellow), with five articles; Iran, Malaysia, Russia, Turkey, and the United Kingdom (in light blue), all with four articles; and Germany, Hong Kong, and South Korea (in green), with three articles each. The production count is completed with eight different countries (in pink) participating with two articles each, and another fourteen countries (in brown) contributing one article each.

Figure 3 shows the most prolific countries with three or more publications and their citation counts.

Figure 3

Number of publications and citations per country with three or more articles



As Figure 3 illustrates, the 32 articles published in the United States had the highest number of citations, totaling 228. Austria, with five articles, had 59 citations, while Spain, with eight articles, had 50 citations. Meanwhile, Mexican, and Russian production had the lowest number of citations, with six citations for each country.

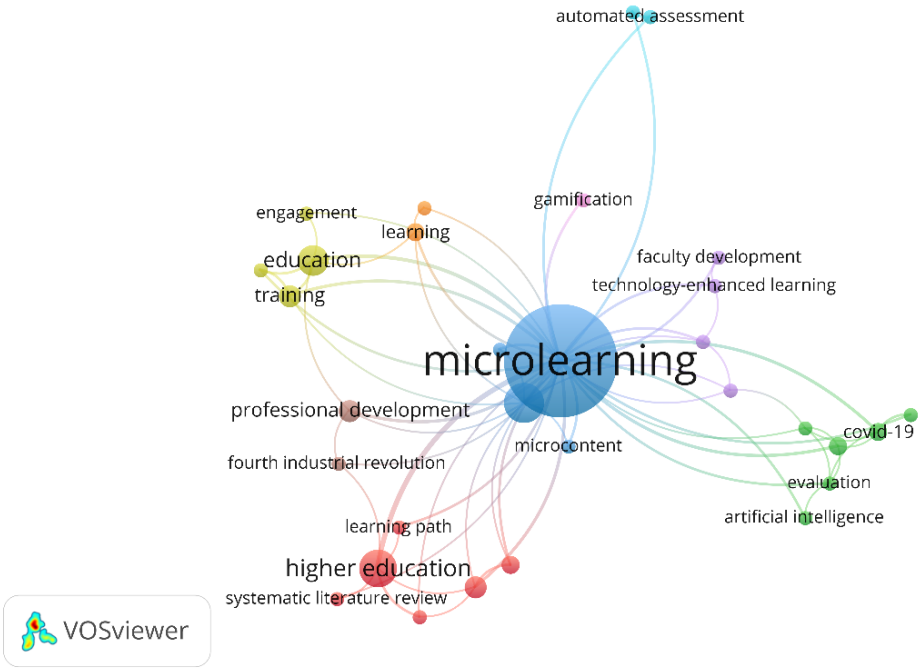
The United States, with the highest number of articles (n=32) and citations (n=228), achieved only 7.12 citations per article. On this issue, Hong Kong was better placed, with 16.33 citations per article, followed by Austria with 11.8 citations per article, the United Kingdom with 11.5 citations per article, and Spain with 10 citations per article.

The articles were categorized, both individually and cumulatively, into 21 different areas of knowledge, most notably Social Sciences (n=61), Computer Science (n=25), Medicine (n=21), Nursing (n=9), and Engineering (n=9).

The authors of the analyzed production used 329 keywords to indicate the theme of the 99 articles. Among these, we selected those with a frequency equal to or greater than two to build the co-occurrence network, based on the "network visualization" format. In this format, the keywords belonging to the same cluster are identified using similar colors, differentiating them from the other clusters. Thus, the network shown in Figure 4 is comprised of 31 keywords and nine clusters.

Figure 4

Keyword co-occurrence network



In addition to providing information on the average year in which the articles were published, the bibliometric study grouped the 31 keywords into nine clusters, revealing the strength of the connections between them. According to Van ECK and Walteman (2022), in clusters, the size of the node (the sphere representing each keyword) is directly proportional to the frequency of the keyword in the entire text corpus. In addition, the items (keywords) are interconnected by links, where the strength indicates the number of links the keyword has in all the articles. The closeness of the clusters, in turn, indicates greater similarity in the content analyzed. Table 1 summarizes the results of processing the keyword networks.

Table 1

Breakdown of keyword clusters in terms of occurrences, link strength, and annual mean of publications

Clusters	N	Keywords	Occurrence	Link strength	Annual mean
1 Red ■	1	Higher education	10	14	2022.50
	2	Learning analytics	3	5	2021.67
	3	Learning path	2	3	2022.00
	4	Online learning	4	8	2023.00
	5	Systematic literature review	2	2	2023.00
	6	Teaching innovation	2	4	2023.00
2	1	Artificial intelligence	2	3	2021.50

Clusters	N	Keywords	Occurrence	Link strength	Annual mean
Green	2	Covid-19	3	8	2022.67
	3	Distance learning	2	4	2023.00
	4	Evaluation	2	6	2022.50
	5	Medical Education	3	6	2022.33
	6	Pandemic	2	5	2022.00
3 Dark blue	1	E-learning	11	18	2020.64
	2	Microcontent	2	3	2020.00
	3	Microlearning	61	73	2021.39
	4	Social media	2	3	2022.50
4 Yellow	1	Education	7	11	2020.29
	2	Engagement	2	2	2020.50
	3	Hospitality management	2	6	2021.50
	4	Training	4	8	2020.75
5 Purple	1	Digital learning	2	4	2020.50
	2	Faculty development	2	3	2021.50
	3	Mobile learning	2	5	2014.50
	4	Technology-enhanced learning	2	4	2016.00
6 Light blue	1	Automated assessment	2	4	2020.50
	2	Introductory programming courses	2	4	2020.50
7 Orange	1	Learning	3	5	2021.67
	2	Nursing	2	2	2021.50
8 Brown	1	Fourth industrial revolution	2	4	2020.50
	2	Professional development	2	4	2020.50
9 Pink	1	Gamification	2	2	2022.00

Nine clusters grouped the most significant keywords to reproduce the theme covered in the studies. Cluster 1 (red), composed of six keywords, highlighted “higher education” as the most recurrent (n=10) and with the highest total link strength (14). The mean number of publications ranged from 2021.67 to 2023.0, and the content analysis resulted in category 1: "**Formal educational innovations through microlearning**".

Cluster 2 (in green), with six keywords, highlighted "COVID-19" (n=3), with a total link strength of 8, and "medical education" (n=6), with a total link strength of 6, as the most substantial keywords for understanding the content. The studies belonging to this cluster were published from 2021.50 to 2023.00 and referred to category 2: "**Microlearning in the continuing education of health professionals**".

Cluster 3 (in dark blue), with four keywords, listed the main word of all the clusters: "microlearning", with 61 occurrences and a total link strength of 73. This set collected studies published from 2020.00 to 2022.50 and addressed category 3: "**Microlearning in informal education**".

Cluster 4 (in yellow), with four keywords attributed to research published around 2020.29 to 2021.50, indicated "education" as its main keyword, which conveyed category 4: "**Potential of microlearning**", with 7 occurrences and a total link strength of 11.

Cluster 5 (in lilac), with four keywords and publications from around 2014.50 to 2020.50, showed all its keywords recurring twice, with "mobile learning" showing the highest link strength (5). This cluster generated category 5: "**Mobile microlearning**".

In addition to these five clusters with the highest number of keywords, combined with Table 1, figure 1 shows smaller clusters, with two to one keyword, attached to the most significant cluster, which is dark blue.

"Fourth industrial revolution" and "professional development," both with an occurrence of two and a total link strength of four. Finally, cluster 9 (in pink) has a single keyword, "gamification", which has both an occurrence and a total link strength of two. In general, the articles compiled in clusters 6 to 9 were published around 2020.50 to 2022.00, comprising category 6: "**Methodologies for implementing and evaluating microlearning**"

4. DISCUSSION AND CONCLUSIONS

Scopus is a database of abstracts and citations with more than 91 million records and more than 27,950 peer-reviewed titles, providing a comprehensive overview of worldwide production in multidisciplinary areas (Elsevier, 2023). Therefore, although this study only covers the scientific production contained in this database, given its scope, we may infer that microlearning, as an educational methodology, has achieved greater scientific interest in the most recent years (2019 to 2023), especially with the prominent use of ICT to mediate the teaching-learning process made impossible in person during the social isolation imposed by the COVID-19 pandemic. Alias and Abdul Razak (2023) corroborate these findings identifying that most studies on microlearning practices have been published since 2020.

According to the earliest article included in this bibliometric study, published in 2010, microlearning was seen as a useful strategy inherent to technological, social, and cultural transformations, but in need of didactic improvement, especially if traditional educational models were to be overcome (Hug, 2010). This evidence points to the evolution of the educational appropriation of microlearning, which, according to the quantitative and qualitative aspects collected in the articles analyzed, the formal and informal educational use

of microlearning has achieved greater prominence in recent years, albeit unevenly between countries.

Chart 2, allocating the studies by country, shows that, apart from Chile, with two articles, research on the microlearning and education interface has been concentrated in the more developed continents, being absent in Africa and Central America, and limited in South America.

Notably, Brazil, the largest country in South America, was not included in the results. Alias and Abdul Razak's survey also found no studies on microlearning practices in South and Central America or Africa (Alias & Abdul Razak, 2023). However, during the COVID-19 pandemic, there has been an increase in microlearning initiatives in Latin American and Caribbean educational systems, with the massive delivery of micro-content via social networks (Borrego Ramírez & Ruiz Cansino, 2023). Therefore, it is inadvisable to state that microlearning is not used in the locations that have not emerged in this research, as it is more plausible that it is less frequent or simply not documented in the studies available in the databases investigated with the same descriptor.

ICT is essential for microlearning. The gaps identified in the most impoverished continents may also be the result of digital exclusion and poor digital teaching skills linked to social inequalities, as demonstrated by Fialho and Neves' (2022) and Neves, Machado, and Fialho's (2022) recent studies. Overcoming this scenario requires inclusive education (Mendonça, Viana & Nascimento, 2023) and incorporating digital technological teaching knowledge, with the engagement of public and private entities, aimed at a positive impact on student learning (Romero Oliva, Ponce & Trigo Ibáñez, 2020; Nascimento & Castro Filho, 2020).

Regarding the relationship between productivity by country and citations, the citation algorithm reproduces the influence of production in the academic and scientific environment (Nascimento, 2020). However, even in countries with a reasonable number of articles on the subject in question, the influence mentioned in citation metrics lacks growth. This highlights the importance of analyzing bibliometric indicators together. Production visibility parameters alone may not precisely measure the influence of production on the scientific community and should be compared with other data such as productivity, as well as expanded to include more indexers and databases.

Currently, researchers from various fields of knowledge – health, engineering, and social sciences – are enthusiastic about the educational potential of microlearning. It is enough to correlate the various areas of knowledge in which the studies analyzed were cataloged with the timing and subjects of the studies.

Category 1, "**Formal educational innovations through microlearning**", covers the evidence obtained from empirical and theoretical research identifying and analyzing the experiences of students, especially in higher education, regarding microlearning.

Microlearning could increase student motivation, especially in out-of-class activities (Fidan, 2023), but it is essential to promote innovation in learning spaces (Salas-Díaz & Gonzáles-Bello, 2023). On evaluating the performance of their peers using an asynchronous microlearning

application called Pebasco for foreign language teaching, Japanese university students found a positive impact on spoken English (Gorham, Majumdar & Ogata, 2023). A virtual consultation training model was implemented for medical students through asynchronous and synchronous simulation-based microlearning, in which 95.7% of university students found the module beneficial and 95.9% reported increased effectiveness in virtual consultation. Thus, combining microlearning and practical simulation was effective for undergraduates to acquire skills for future practice (Liew et al., 2023).

Microlearning is helpful for students in general who need to reconcile studies and work as it requires short-term dedication in environments outside the school/university setting, allowing students to play a leading role in building knowledge (Salas-Díaz & Gonzáles-Bello, 2023), which is in line with active learning methodologies.

For high school students, Pande, Jadhav, and Mali (2023) assessed the attitudes of Indian students towards artificial intelligence tools and inferred that although these technologies have changed the way we learn and teach, the teacher remains essential in guiding students.

Category 2, "Microlearning in the continuing education of health professionals", focuses on microlearning methodologies, associated with artificial intelligence or other DICTs, to support the education of health team members after basic training, once they are in the workplace, including during the Covid-19 pandemic.

A mobile video-based microlearning strategy for healthcare professionals providing direct care to patients during the COVID-19 pandemic proved highly valuable for training doctors and nurses on the front line of the pandemic scenario without the time to train for the unusual situation (Zamorano et al., 2022).

In the nursing field, a pilot study by researchers in Tennessee, United States, identified significant improvements in knowledge, attitudes, and practice of antimicrobial stewardship by nurses who took an asynchronous course on a microlearning platform aimed at continuing health education (Bobbitt et al., 2023).

As such, microlearning in this category reveals its professional and social nature and is aimed at promoting improvements in health care. This is achieved by training members of the multi-professional team in their roles and providing the population with more qualified care.

Category 3, "Microlearning in informal education", revealed a wide variety of informal educational possibilities through microlearning, especially courses with micro-content disseminated through social media. In this category, the term informal education refers to the teaching-learning process that occurs outside the official education system of a country, which does not provide a degree but, in its broadest sense, inserts people into plural learning experiences throughout their lives.

Microlearning, when associated with DICTs, is not limited by the barriers of time or space, becoming accessible in the most distant places if devices with internet connectivity are available and attract the interest of the participants. Hesse et al (2019) studied e-learning among dairy farm owners, employees, veterinarians, and others. The participants took mobile-accessible courses on colostrum (first milk) management with an elevated level of engagement.

They themselves rated the learning as good and particularly good for the benefit of their work performance.

Microlearning can bring together people from distinct parts of the world linked by a common educational curiosity. Hegerius, Caduff-Janosa, Savage & Ellenius (2020) reported that an e-learning course in pharmacovigilance, based on microlearning, brought together 2,067 students from 134 countries, most of whom were workers in the pharmaceutical industry, but there were also medical students. Although the course was primarily aimed at beginners, many of the students were veterans who spontaneously embraced the opportunity to update their knowledge.

In the field of health education, seen as educational initiatives to empower the general population to take preventive self-care of diseases (Neves, Machado, Fialho & Sabino, 2021), corroborating the breadth of possibilities of microlearning, Janssen et al. (2023) instructed patients in an Australian hospital suffering from advanced lung cancer about the side effects of chemotherapy and the management of these adversities.

Category 4, "**Potential of microlearning**", includes research emphasizing the effects of microlearning, enhanced by active methodologies, between teachers and students. From this perspective, Fidan (2023) focused on the effects of the flipped classroom supported by microlearning applied to teachers in training at a university in Turkey. When comparing the learning performance of two groups of participants – the experimental group (taught using microlearning and a flipped classroom) and the control group (taught traditionally, without a flipped classroom or microlearning) – a higher level of performance and motivation was found in the first group.

The results were satisfactory for higher education in hospitality. University students who studied microlearning expressed a desire to continue and expand this teaching model (Dolasinski & Reynolds, 2023).

Category 5, "**Mobile microlearning**", highlights the role of mobile devices in microlearning.

Through mobile devices, microlearning can be offered in multiple formats, including videos, gamification, info charts, and social media (Alias & Abdul Razak, 2023). However, it is worth noting that the teachers' attitude towards this educational reality makes all the difference to the results. As Pence (2020) rightly points out, learning technologies such as smartphones, cloud computing, and artificial intelligence are an adjunct to teaching and not a substitute for the teacher.

The materialization of microlearning requires the co-participation of political decision-makers (Leong & Sung, 2021), whose implementation strategies must be based on the best scientific evidence. In addition, it is essential to have the expertise of teachers and others involved in quality education.

Category 6, "**Methodologies for the implementation and evaluation of microlearning**", guides the implementation of microlearning in various educational scenarios, covering the application and assessment of different platforms, the fourth industrial revolution, and some active methodologies, such as gamification.

Good microlearning practices invest in both the educational material (content design) and the learning of this content (instructional flow) (Alias & Abdul Razak, 2023). A focus group with students from a college of education in the United States, according to McNeil and Fitch (2023), showed that superior design is essential for planning and applying microlearning, as well as students finding the content relevant to their real lives.

Microlearning platforms must be customized to the particularities of the recipients (Janssen et al., 2023). Students in the same classroom are not homogeneous, so these tools must be in tune with their individualities (Salas-Díaz & Gonzáles-Bello, 2023).

When implementing microlearning, a key factor that is not widely agreed upon is the length of time. Pence (2020) recommends a period of between 5 and 10 minutes, arguing that shorter pieces of information followed by reinforcement are better memorized. However, McKee and Ntokps (2022) found variability of 5 to 30 minutes in microlearning courses, warning that the ideal is 5 to 10 minutes, as students are more involved in the first few minutes. One of the most advantageous features of microlearning is its short duration as it allows it to be integrated into the daily lives of students and other members of society (Alias & Abdul Razak, 2023), like the implementation reported by Hesse et al (2019), in which 2/3 of the participants studied during their leisure time.

The association between microlearning and active learning methodologies based on ICT is highly productive. Orwoll et al. (2018) showed that a microlearning application aimed at practices to prevent circulatory chain infections caused by central catheters associated with gamification (competition between groups) optimized learning, intensified the involvement of professionals, and reverberated practical results, reducing infection rates. As mentioned above, the flipped classroom (Fidan, 2023) also enhanced learning.

The bibliometric study associated with the categorical analysis revealed shortcomings in scientific production, highlighting educational work with microlearning in countries of the Global South and East, while demonstrating regular patterns in countries that work in this category, such as the recommended time (5 to 10 minutes). Such a scenario shows the importance of using active methodologies such as gamification, videos, info-charts, and social media, superior design, and the urgency of investing in teacher training. It has also identified relevant trends, such as its transdisciplinary nature and the need to incorporate artificial intelligence responsibly into microlearning activities. Therefore, in the educational field, we can no longer ignore the fruitful learning opportunities that can be developed by using microlearning in times when students, whether in basic or higher education, are looking for quick and qualified information that requires little time for concentration and practical use in the context of individual life, for which teachers need to be professionally prepared to mediate with quality.

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