Exploring the Role of Microlearning in Lifelong Learning: A Bibliometric Review

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ABSTRACT

This study explores the role of microlearning in supporting lifelong learning through a bibliometric review of existing literature. Microlearning, characterized by brief, focused learning sessions, has gained prominence as an effective strategy for delivering flexible and accessible educational content. The study highlights the alignment between microlearning and lifelong learning, emphasizing its potential for self-directed and informal learning in both personal and professional contexts. By analyzing key trends, authors, and emerging research areas, this review identifies the growing integration of microlearning with digital learning tools, mobile applications, and emerging technologies such as artificial intelligence and virtual reality. The findings also reveal challenges in microlearning, such as balancing brevity with depth, managing content fragmentation, and overcoming technological barriers to access and personalization. Future research directions include examining microlearning's impact on long-term retention, its pedagogical implications, and its integration into formal education systems. This study contributes to a deeper understanding of microlearning's role in lifelong learning and provides insights into its future development and applications in diverse educational settings.

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1. INTRODUCTION

The world is rapidly evolving, driven by technological advancements, changing economic structures, and the constant need for upskilling and reskilling the workforce. In such an environment, lifelong learning (LLL) has become a critical component of personal, professional, and organizational development [1]. Lifelong learning refers to the continuous, voluntary, and self-motivated pursuit of knowledge for either personal or professional development. It plays an essential role in ensuring that individuals remain adaptable to the challenges and opportunities presented by a fast-paced, knowledge-based society [2]. As individuals face an ever-changing job market, the need for a continuous learning approach has led to significant interest in various modes of learning, one of which is microlearning.

Microlearning, a learning approach that breaks down complex content into small, manageable learning units, has emerged as a promising tool to support lifelong learning. It involves short, focused segments of learning that can be accessed at any time and from

anywhere, making it highly flexible and suitable for modern learners [3]. The concept of microlearning is often associated with the use of digital tools such as mobile applications, online videos, and interactive quizzes, which enable learners to engage with content in a quick, efficient, and easily digestible manner. With the increasing prevalence of smartphones and digital technologies, microlearning has gained traction as an effective learning strategy that caters to the needs of busy, time-constrained individuals seeking to enhance their skills and knowledge [4].

Over the years, the integration of microlearning into educational and corporate settings has been accompanied by an increasing body of research aimed at understanding its effectiveness in fostering learning outcomes. Microlearning's potential to address gaps in traditional learning models, such as its ability to promote engagement, increase retention, and accommodate various learning styles, has made it a topic of increasing academic interest [5]. Research on microlearning has explored its role in both formal and informal learning environments, with particular emphasis on its applicability in organizational training, continuing professional education, and personal development [6]. The growing interest in microlearning within the context of lifelong learning necessitates a more comprehensive understanding of its role, effectiveness, and future prospects.

Despite the growing body of research, there remains a lack of a systematic, comprehensive overview of the current state of the literature on microlearning. A bibliometric review of the literature can provide a useful tool for mapping the development of microlearning as a field, identifying key trends, influential works, and emerging areas of research. Bibliometric studies have become a popular methodology for evaluating the volume and impact of scholarly literature, as they help researchers gain insights into the evolution of academic disciplines and the interrelationships between different research themes [7]. By applying bibliometric techniques to the study of microlearning, researchers can obtain valuable insights into the knowledge structure of the field, highlight its key contributors, and provide direction for future research efforts.

Furthermore, the role of microlearning in lifelong learning has yet to be thoroughly explored through a bibliometric lens. Given the increasing recognition of lifelong learning as a central pillar of personal and societal development, understanding how microlearning can support this process is critical. Lifelong learning extends beyond formal education, encompassing the informal and non-formal educational activities that individuals engage in throughout their lives [8]. Microlearning, with its emphasis on flexibility, accessibility, and learner-centeredness, appears well-positioned to align with the principles of lifelong learning. However, there is limited research that systematically reviews the literature at the intersection of these two concepts. This gap in the literature is the motivation for this study.

Although microlearning has been widely recognized as an effective strategy for enhancing learning outcomes, especially in informal and non-formal settings, its specific role in supporting lifelong learning remains insufficiently explored. Despite a growing body of research on microlearning, there is no comprehensive bibliometric review that consolidates the existing literature on how microlearning contributes to the broader concept of lifelong learning. This gap in the literature makes it difficult for educators, policymakers, and organizations to fully understand the potential of microlearning in fostering continuous, lifelong development. This research aims to (1) analyze the trends and patterns in the microlearning literature, (2) identify the key authors and influential works in the field, (3) evaluate the relationship between microlearning and lifelong learning, and (4) provide a framework for understanding how microlearning can be further integrated into lifelong learning strategies.

2. LITERATURE REVIEW

2.1 *Microlearning: Definition and Concepts*

Microlearning has been conceptualized in various ways in the academic literature. While there is no single, universally accepted definition, most scholars agree on the core characteristics of microlearning: brief, focused, and learner-centric educational experiences that provide quick bursts of learning content. [9] defines microlearning as the process of learning through short, easily digestible segments that typically range from a few seconds to a few minutes in length. This type of learning is designed to be flexible, allowing learners to engage with content when and where it is most convenient. It contrasts with traditional educational models, which often require long periods of sustained attention and are typically designed for formal settings.

Microlearning's emphasis on brevity and accessibility makes it an ideal strategy for supporting lifelong learning. According to [10], microlearning allows learners to engage in continuous, just-in-time learning, enabling them to acquire new knowledge or skills without having to dedicate substantial amounts of time to formal educational programs. This characteristic is especially beneficial in the context of the rapidly evolving job market, where individuals need to constantly update their skills to remain competitive. Furthermore, microlearning is often delivered through digital platforms, such as mobile apps, e-learning courses, and video tutorials, which aligns well with the increasing integration of technology into everyday life [11].

The rapid expansion of microlearning as a learning strategy has led to the identification of several models and approaches that frame how microlearning should be implemented. One of the most notable models is the "4C/ID" model, which combines cognitive load theory with instructional design to create a framework for designing microlearning experiences. This model emphasizes the importance of creating content that is contextually relevant, concise, and aligned with specific learning outcomes [12]. Microlearning's alignment with cognitive theories of learning, such as spaced repetition and retrieval practice, also contributes to its effectiveness [13].

2.2 *Microlearning in the Context of Lifelong Learning*

Lifelong learning has become an essential concept in contemporary education, as it emphasizes the continuous pursuit of knowledge and skills throughout an individual's life. This process is not limited to formal education; rather, it includes informal and non-formal learning experiences that contribute to personal and professional growth [14]. In this context, microlearning has been identified as a promising tool for supporting lifelong learning. The flexibility and accessibility of microlearning are especially advantageous for individuals who may not have the time or resources to participate in traditional, time-intensive educational programs [15].

Microlearning supports the principles of lifelong learning in several ways. First, it encourages self-directed learning, which is a key feature of lifelong learning [16]. Learners can engage with microlearning content whenever they feel the need to acquire new knowledge or skills, without the need for structured, instructor-led sessions. This autonomy is particularly appealing in the context of adult learners, who often balance educational pursuits with work and family responsibilities. Second, microlearning fosters an environment where learners can access content at their own pace, enabling them to revisit material as needed for reinforcement. This is particularly important in the context of lifelong learning, as individuals may return to learning after extended periods of absence and need

opportunities for review and consolidation of knowledge [17].

Recent studies have highlighted the potential of microlearning to address the challenges faced by lifelong learners. For instance, [18] argues that microlearning can enhance learner engagement and motivation, two factors that are crucial for sustaining lifelong learning behaviors. By providing learners with bite-sized, manageable learning experiences, microlearning reduces the cognitive load and time commitment typically associated with traditional educational formats, making it a more appealing option for busy, adult learners. Additionally, microlearning can be easily integrated into the everyday lives of learners, allowing them to acquire new skills or knowledge in short, incremental bursts [19].

2.3 Effectiveness of Microlearning

Numerous studies have investigated the effectiveness of microlearning in comparison to more traditional learning methods. Findings indicate that microlearning can significantly improve learner engagement, knowledge retention, and overall satisfaction [20]. One of the reasons microlearning is particularly effective is its alignment with cognitive load theory, which suggests that learners can only process a limited amount of information at any given time [21]. By breaking down complex content into smaller, more manageable units, microlearning reduces cognitive overload, enabling learners to focus more effectively on the material at hand.

Microlearning also promotes better retention of information. Research by [22] indicates that microlearning aligns with the principles of spaced repetition, a learning technique that involves reviewing material at increasing intervals over time. This technique has been shown to enhance long-term retention and recall, making it a powerful strategy for learners engaged in lifelong learning. Furthermore, microlearning's emphasis on active learning and interaction—such as through quizzes, games, or videos—has been shown to increase learner engagement and motivation, which further contributes to improved learning outcomes [23].

However, some studies suggest that the effectiveness of microlearning may depend on several factors, including the learning context, content type, and learner characteristics. For example, research by [24] found that while microlearning is highly effective for procedural and factual knowledge, it may not be as suitable for complex or abstract learning tasks that require deep processing and extended reflection. Additionally, the delivery platform and technology used to facilitate microlearning play a significant role in its effectiveness. For instance, mobile devices and apps have been identified as effective tools for delivering microlearning content, as they enable learners to access content on-the-go [25]. However, the limited screen size of mobile devices may pose challenges for certain types of content, such as text-heavy or graphically complex materials.

3. METHOD

This study employs a bibliometric review methodology to explore the role of microlearning in lifelong learning. Bibliometric analysis was chosen due to its ability to systematically analyze published research, identify trends, and map the development of scholarly work in a given field. The data for this review were obtained from leading academic databases, including Scopus, Web of Science, and Google Scholar, focusing on articles, conference papers, and book chapters published between 2005 and 2025. A comprehensive search was conducted using keywords such as "microlearning," "lifelong learning," "microlearning effectiveness," and "microlearning in education." Articles were then screened based on relevance to the study's aims, and inclusion criteria focused on peer-reviewed

publications that discuss the intersection of microlearning and lifelong learning, either as primary or secondary subjects. Citation analysis was conducted to identify key authors, influential studies, and emerging trends in the literature. Additionally, co-occurrence analysis of keywords was performed to map the thematic structure of the microlearning and lifelong learning research domains.

4. RESULT AND DISCUSSION
4.1 Results
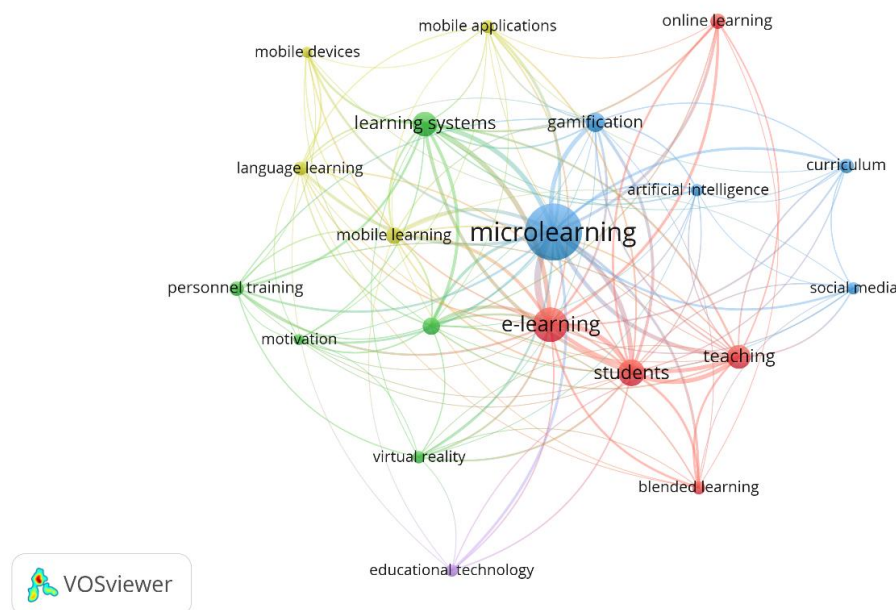#### a. Keyword Co-Occurrence Network

Figure 1. Network Visualization
Source: Data Analysis, 2025

The largest and most central node in the network is labeled "microlearning," which serves as the focal point of the network. This indicates that microlearning is a primary concept or keyword in the examined literature. The surrounding nodes are connected to "microlearning," suggesting that research on microlearning is deeply interconnected with a range of related topics, such as e-learning, mobile learning, and learning systems. These interconnections indicate that microlearning is frequently studied in relation to other educational technologies and strategies, which are highlighted in the network. The network shows strong links between "microlearning" and "e-learning" (highlighted in red), indicating that

the majority of microlearning research is framed within the broader context of online and digital education. Additionally, "mobile learning" (green) and "mobile applications" (yellow) are closely connected to microlearning, which aligns with the understanding that microlearning is often delivered through mobile technologies and apps, making it highly accessible for learners. The close proximity of these terms suggests that much of the microlearning research focuses on using mobile devices to deliver small, focused learning units.

Surrounding nodes like "gamification," "learning systems," and "virtual reality" (green and yellow) illustrate the diverse approaches and tools integrated with

microlearning in contemporary educational research. For instance, "gamification" suggests that some studies explore how game mechanics can enhance microlearning experiences, increasing learner engagement and motivation. "Learning systems" and "educational technology" point to the technological frameworks used to implement microlearning strategies, showing that this field intersects with broader technological advancements in education. Terms like "students," "teaching," and "curriculum" (red and blue) indicate the educational context of the research. These terms suggest that microlearning is not only studied in the realm of technology but also in terms of how it influences and supports pedagogical strategies. The connections to "students" and "teaching" indicate a strong interest in understanding how microlearning affects student learning outcomes and

how it can be integrated into teaching practices. Meanwhile, the node labeled "curriculum" suggests that microlearning is also being explored for its role in structuring educational content and courses.

The presence of terms like "artificial intelligence," "social media," and "blended learning" (blue and purple) points to emerging areas of interest in microlearning research. For instance, "artificial intelligence" suggests that future research may explore how AI can be used to personalize microlearning experiences. "Social media" indicates the growing interest in using social platforms as tools for delivering or supporting microlearning. Lastly, "blended learning" suggests that microlearning is being increasingly studied within hybrid learning environments, where both traditional and digital learning methods are integrated.
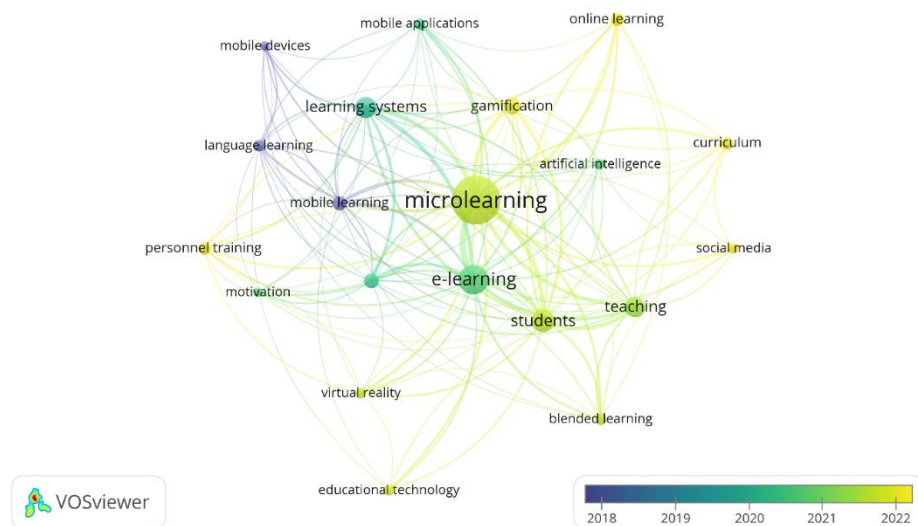

Figure 2. Overlay Visualization
Source: Data Analysis, 2025

The second visualization is a network map showing the relationships between various keywords related to microlearning, with an additional color gradient indicating the time progression of the research between 2018 and 2022.

Similar to the previous visualization, "microlearning" remains the central node, indicating it as the core theme of the literature. Surrounding this central concept are other related keywords like "e-learning," "mobile learning," and "learning systems,"

showing that microlearning is often discussed in the context of broader educational technologies. The size and intensity of the connections surrounding "microlearning" imply that much of the literature focuses on how this concept interacts with other established trends in education, such as mobile learning, e-learning, and the adoption of new educational tools and systems. The centrality of microlearning is consistent with its role in shaping contemporary learning strategies.

The color gradient, which ranges from blue (2018) to yellow (2022), illustrates how certain topics have gained prominence over time. In particular, "artificial intelligence," "online learning," "curriculum," and "social media" have become more prominent in recent years, as they are marked by a yellowish hue. This suggests that these topics have increasingly intersected with microlearning research, pointing to the growing role of AI and social media in facilitating learning in smaller, more flexible units. In contrast, earlier concepts like "language learning" and "mobile devices" are shown in a cooler color range (blue to green), reflecting their earlier focus in the literature and their foundational role in the development of microlearning as an educational strategy.

The terms "gamification," "blended learning," and "students" are also increasingly connected to microlearning, showing that research is expanding into the pedagogical aspects of microlearning, such as its potential to motivate students and its integration with blended learning models. The appearance of terms like "personnel training" and "motivation" with the older color gradient indicates that research on microlearning in the context of corporate and personal development has been a significant area of focus since its early days. The gradual shift toward newer topics like "artificial intelligence" and "curriculum" suggests that there is growing interest in how emerging technologies and educational frameworks can influence the future of microlearning.
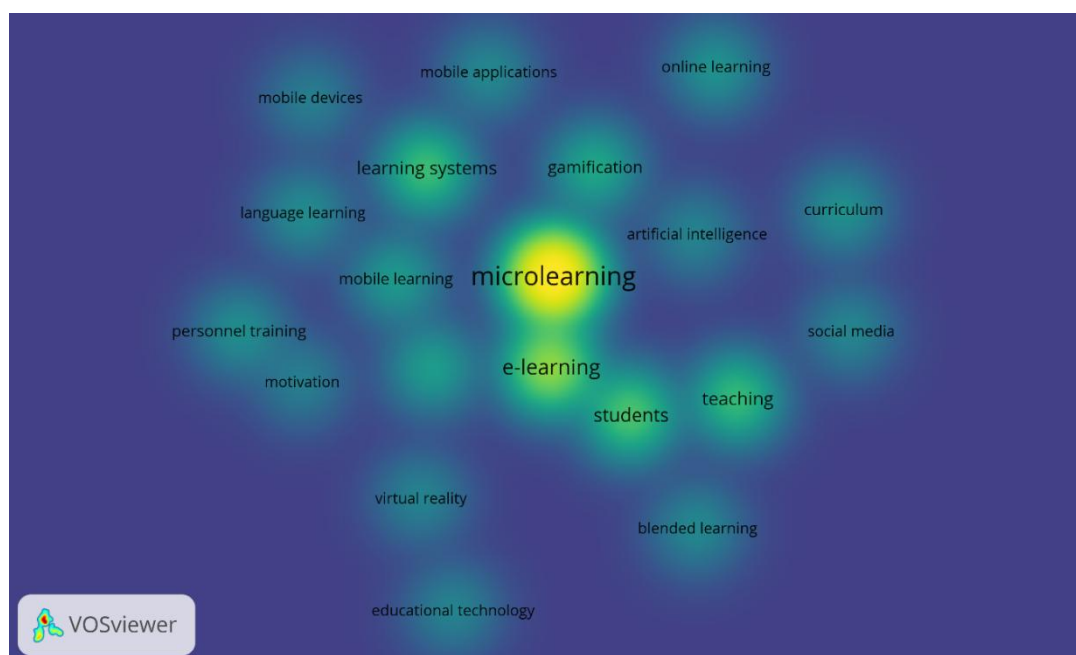

Figure 3. Density Visualization
Source: Data Analysis, 2025

As in previous visualizations, "microlearning" is the central term, highlighted in yellow, indicating its dominant role in the research landscape. The bright yellow color suggests that microlearning is a key focus in the network, with strong associations to other concepts like "e-learning," "mobile learning," and "learning systems." These connections suggest that microlearning is deeply embedded within the broader trends of digital and mobile education. The strong connections between "microlearning" and "e-learning" in particular reinforce the idea that microlearning is primarily situated within the digital learning paradigm.

The heatmap also highlights peripheral topics like "artificial intelligence," "curriculum," and "social media," which are not as central but still show moderate levels of intensity in the connections. These keywords represent emerging areas in microlearning research, reflecting the increasing integration of technologies like AI and social media in learning experiences. The heatmap's color intensity shows that while these topics are still growing, they are gaining traction in recent literature. In contrast, terms like "personnel training" and "motivation" appear more in the periphery with lighter green shades, indicating they are relatively less central but still present in the research.

b. Citation Analysis

Table 1. Most Cited Articles

Citation	Author and Year	Title
4718	[26]	Breastfeeding in the 21st century: Epidemiology, mechanisms, and lifelong effect
3583	[27]	The lifelong effects of early childhood adversity and toxic stress
2827	[28]	Problem-based learning: What and how do students learn?
2035	[29]	Defining and assessing professional competence
2032	[30]	Continual lifelong learning with neural networks: A review
1780	[31]	Accuracy of physician self-assessment compared with observed measures of competence: A systematic review
1409	[32]	The use of flipped classrooms in higher education: A scoping review
1254	[33]	Summary of the evidence on modifiable risk factors for cognitive decline and dementia: A population-based perspective
1092	[34]	The relation between 21st-century skills and digital skills: A systematic literature review
1015	[35]	The ABET "professional skills" - Can they be taught? Can they be assessed?

Source: Scopus, 2025
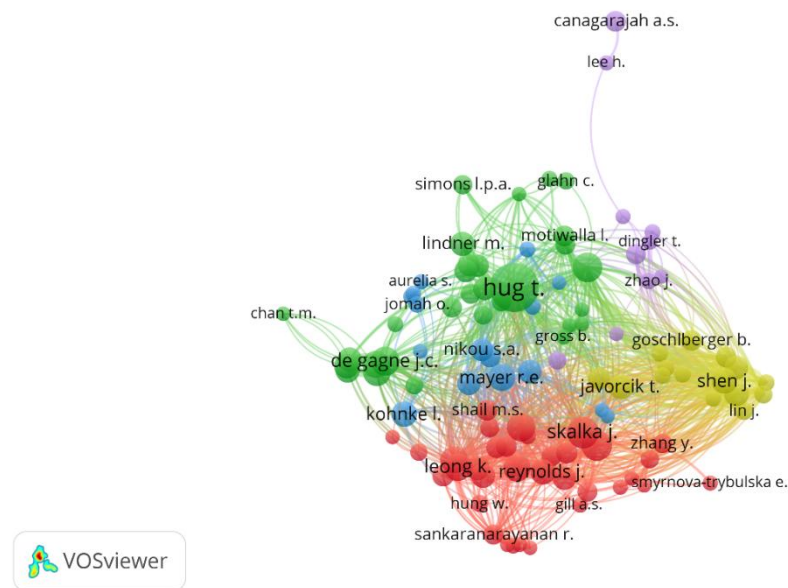
c. **Co-Authorship Network**

Figure 4. Co-Authorship Visualization
Source: Data Analysis, 2025

This visualization is a network map representing the collaboration or citation relationships between various researchers in the field of microlearning. The nodes in the map correspond to individual researchers, with the size of the node reflecting the prominence or influence of that researcher based on the number of connections or citations. The colors represent different clusters or groups of researchers that are closely connected to each other. The most central node, "Hug T.," is surrounded by a significant number of other researchers, indicating that Hug is a key figure in the field of microlearning research, with numerous collaborations or citations in this area. The large green cluster surrounding Hug suggests that many influential studies are related to his work, highlighting his impact on the development of microlearning theory and applications. Other clusters, such as the red and yellow ones, represent different groups of researchers who are also actively contributing to the field, but with less direct association to Hug. The scattered nodes in the upper corners (purple and other colors) represent individual researchers who may not have as many direct connections with the main clusters but are still involved in microlearning research.
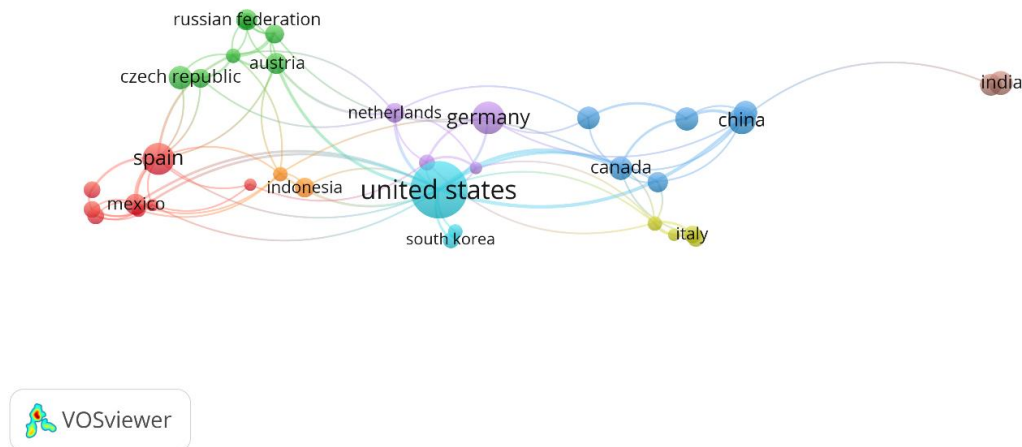
Figure 5. Country Visualization
Source: Data Analysis, 2025

This visualization is a network map illustrating the global connections between different countries in the context of microlearning research. The nodes represent countries, and the connections between them indicate collaborative or citation relationships in the field of microlearning. The United States is centrally located, with many countries connected to it, signifying its dominant role in microlearning research. The countries are grouped into clusters based on similar regions or research connections, with countries like Canada, Mexico, and Spain in close proximity to the United States, forming a North American and Latin American cluster (colored in red and orange). Other clusters include European countries such as Germany, Austria, and the Netherlands, which form a separate network (green and purple). China and India appear more distantly connected, with China being part of a blue cluster and India having minimal connections. Overall, this map highlights the global nature of microlearning research, with significant contributions from North America and Europe, and growing involvement from Asia and other regions.

4.2 Discussion

a. The Role of Microlearning in Lifelong Learning

Microlearning's primary appeal lies in its flexibility and accessibility, two attributes that align perfectly with the concept of lifelong learning (LLL). Lifelong learning, which refers to the continuous process of acquiring knowledge and skills throughout an individual's life, is crucial in today's fast-paced, ever-changing world. The findings of this study suggest that microlearning is an ideal tool for supporting LLL due to its ability to deliver learning content in short, easily digestible chunks. As seen in the network visualizations, microlearning is closely connected to e-learning and mobile learning, which provide the technological infrastructure needed for anytime, anywhere learning. These connections reflect the increasing importance of mobile technologies and digital platforms in promoting LLL, as they enable learners to engage with content on their own terms. Microlearning's impact on lifelong learning is further supported by its ability to foster self-directed learning, a key feature of LLL. Self-directed learning allows

individuals to take control of their learning journeys, choosing when and how they engage with educational content. The flexibility inherent in microlearning enables learners to access information when it is most relevant to them, without the need for long, formal learning sessions. This aligns with the growing trend of informal learning, where individuals learn from a variety of sources, including online resources, peer interactions, and workplace experiences. As the bibliometric review revealed, research on microlearning increasingly focuses on its role in both formal and informal educational settings, underscoring its capacity to support diverse learning needs. Another aspect of lifelong learning that microlearning supports is its ability to cater to different learning styles. Research suggests that microlearning is particularly effective for learners who benefit from active engagement and immediate application of knowledge. This is particularly important for adult learners, who may have limited time to devote to learning due to work and family commitments. The study's findings indicate that microlearning, particularly through mobile applications, helps learners to integrate learning into their daily routines, thus enhancing their motivation and engagement. Furthermore, the ability to revisit content multiple times, a feature offered by many microlearning platforms, helps reinforce retention, making it a valuable tool for continuous skill development and knowledge acquisition.

b. **Challenges in Integrating Microlearning into Lifelong Learning Strategies**

Despite its potential, there are several challenges associated with integrating microlearning into lifelong learning strategies. One major challenge identified in the literature is the need for an appropriate balance between content brevity and depth. While microlearning's short learning segments are effective for delivering concise information, they may not be suitable for complex or abstract concepts that require deep reflection and extended engagement. The research suggests that microlearning is best suited for teaching procedural knowledge, practical skills, or foundational concepts, rather than for in-depth exploration of complex topics [36]. This limitation underscores the need for a nuanced approach to implementing microlearning, where it is used in conjunction with other learning methods, such as traditional courses or blended learning models, to provide a more comprehensive educational experience.

Another challenge in adopting microlearning is the issue of content fragmentation. While breaking down learning into small, digestible units is one of microlearning's strengths, it can also lead to a fragmented learning experience if not designed thoughtfully. The research revealed that microlearning is often used in corporate training and professional development, where the emphasis is on practical skills and knowledge application. However, when applied to more holistic learning goals, such as developing critical thinking or fostering deep understanding, microlearning may not provide the necessary depth or coherence. This challenge highlights the importance of instructional design in microlearning, as well as the need for a well-structured curriculum that guides learners through progressive learning stages.

Moreover, technological limitations may present barriers to

the widespread adoption of microlearning. While mobile learning technologies have made microlearning more accessible, not all learners have equal access to these technologies. The digital divide, particularly in low-income regions, can exacerbate educational inequalities, limiting access to microlearning opportunities. This issue is compounded by the need for personalized learning experiences, which require advanced technologies such as artificial intelligence (AI) and data analytics to tailor content to individual learners' needs. The bibliometric review highlighted the increasing interest in AI and other emerging technologies, but their application in microlearning remains in the early stages. Overcoming these technological challenges will require significant investment in both infrastructure and the development of adaptive learning systems that cater to a wide range of learners.

c. **Future Directions for Microlearning Research**

The findings of this bibliometric review also highlight several promising areas for future research on microlearning, particularly its role in supporting lifelong learning. One key area for future exploration is the integration of microlearning with emerging technologies, such as artificial intelligence, virtual reality (VR), and augmented reality (AR). These technologies offer the potential to enhance microlearning experiences by providing more interactive, immersive, and personalized learning opportunities. For instance, VR and AR can provide learners with experiential learning environments that simulate real-world scenarios, while AI can be used to analyze learners' behaviors and provide personalized feedback. As the research on microlearning continues to evolve, there is a need for studies that investigate how these technologies can be seamlessly integrated into microlearning platforms to improve learning outcomes. Another promising area for future research is the exploration of the impact of microlearning on long-term retention and behavior change. While microlearning has been shown to improve short-term learning outcomes, its effectiveness in promoting long-term learning and behavior change remains underexplored. Future studies could investigate how microlearning can be used to foster sustained engagement and ensure that learners apply the knowledge they have gained in real-world contexts. This could involve examining the role of microlearning in continuous professional development, where learners are required to update their skills regularly to keep pace with changing industry demands. Additionally, more research is needed on the pedagogical implications of microlearning, particularly in relation to its integration into formal education systems. The bibliometric review revealed that much of the microlearning literature focuses on informal and corporate learning contexts. However, as microlearning becomes increasingly popular in education, it is essential to explore how it can be effectively incorporated into traditional educational frameworks. This could involve investigating how microlearning can complement traditional teaching methods, such as face-to-face instruction and classroom-based learning, and how it can be used to support flipped classrooms or blended learning environments.

5. CONCLUSION

This study has explored the role of microlearning in supporting lifelong learning through a bibliometric review of the existing literature. The findings reveal that microlearning is increasingly recognized as an effective tool for delivering flexible, accessible, and engaging learning experiences that align with the principles of lifelong learning. Its ability to deliver content in small, manageable chunks makes it particularly well-suited for informal and self-directed learning, allowing learners to acquire and reinforce skills continuously throughout their lives. However, the study also highlights several challenges, including the need for balance between content brevity and depth, the potential for fragmented learning experiences, and technological barriers related to access and personalization. Despite these challenges, the growing integration of microlearning with emerging technologies like artificial intelligence and virtual reality presents exciting opportunities for enhancing its effectiveness. Future research should focus on overcoming these challenges, investigating the long-term impact of microlearning on retention and behavior change, and exploring its integration into formal educational frameworks. As microlearning continues to evolve, it holds significant promise for shaping the future of lifelong learning and supporting the continuous development of individuals in a rapidly changing world.

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