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Smart Learning Environments

REVIEW

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A literature review on the integration of microlearning and social media

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Abstract

The study aimed to perform a literature review to identify the trends, impacts, and challenges associated with the integration of microlearning and social media. A total of seven academic databases were used as sources for searching: Scopus, Web of Science, ACM, EBSCOhost, PubMed, ProQuest, and IEEE. A combination of keywords related to microlearning and social media was employed during the search process. No specific date limit was imposed, but only materials published in English were considered for inclusion. A total of 2312 articles were identified in the first phase of the search. Sixteen articles were selected during phase two after applying the inclusion and exclusion criteria. The reviewed studies encompassed various fields, including computing, programming, language, nursing, surgery, and radiology. Additionally, multiple social media platforms were identified, such as podcasts, chatbots, Facebook, Instagram, LinkedIn, MP3, TikTok, Twitter, YouTube, and Sina Weibo. The results indicate that the integration of microlearning and social media has the potential to enhance learning outcomes positively. These outcomes include increased learner satisfaction, expanded reach, improved learner engagement, and enhanced learning effectiveness. Additionally, the review highlights that the most significant benefits of combining microlearning with social media are increased reach and enhanced learner engagement.

Keywords: Microlearning, Nanolearning, Social media, Social network, E-learning, Mobile learning

Introduction

Technology has greatly changed how we access, memorize, share, and consume information. According to Statista's website, the number of smartphone users worldwide reached 6.378 billion in 2021 (Smartphone Users, , 2022). Simultaneously, the number of social media users reached 3.78 billion in 2021 (Number of Social Media Users, 2022). Currently, the world population is 7.7 billion people (Nations, 2022). Given these statistics, it implies that, on average, around 82% of the world's population use a smartphone, and 59% of these users actively access social media sites regularly. As a result, smartphones and social media play an important role in the daily life of many learners. Downes (2005) argues that Internet users have changed how they approach work, learning, and play. These learners are connected; they absorb information quickly; they prefer

"on-demand" access to media. "These changes are sweeping across entire industries as a whole and are not unique to education; indeed, in many ways education has lagged behind some of these trends and is just beginning to feel their wake." (Downes, 2005). These technological changes have altered formal and workplace learning. Opportunities for collaboration and communication have increased due to technology, and the availability of learning materials is now at one's fingertips. New teaching pedagogies have emerged such as Massive Open Online Courses (MOOC), self-paced learning, flipped classrooms, gamification, just-in-time learning, and blended learning (Valtonen et al., 2022). As learning becomes more personalized and on-demand and because of e-learning and mobile learning, microlearning has the potential to increase educational outcomes, engagement, satisfaction, and confidence (Jahnke et al., 2020; Shatte & Teague, 2020). For this reason, research on microlearning has increased in recent years (Leong et al., 2021). Leong et al. (ibid.) suggest that microlearning will become a major research area within the perspective of e-learning and mobile learning.

So, what exactly is microlearning? The word "microlearning" started to be used in 2002 (Hug & Friesen, 2009). There are many concepts and versions of microlearning (Hug, 2005). Hug (2005) argues that time, content, curriculum, form, process, mediality, and learning type represent the seven dimensions of microlearning. Hug and Friesen (2009) mentioned that learning could be viewed as having micro, meso, and macro levels. They say that microlearning can apply to micro aspects of different learning types and theories. For example, learning objects would be part of the micro level of course structure (Hug & Friesen, 2009). In the literature, microlearning is described as bite-sized or small learning materials. A microlearning lesson is between 30 s to 5 min long (Jahnke et al., 2020). Díaz Redondo et al. (2021) mentioned that lessons can be up to 15 min in length but that learning materials in video form exceeding 9 min result in students' attention drop. In their book, Torgerson and Iannone (2019) argue that the duration of microlearning content is only a guideline. Furthermore, they write that microlearning is brief content that supports learning and satisfies students' requirements. Their definition of microlearning is "any learning content that can be consumed in less than 10 min" (Torgerson & Iannone, 2019). These lessons can be made of videos, texts, micro-podcasts, blog posts, wikis, and short messages on social networks (Díaz Redondo et al., 2021; Semingson et al., 2015).

Microlearning and social media for the purpose of learning may facilitate learning, keep the learners engaged with the learning material, and increase knowledge retention. In point of fact, by repeatedly having users go over content, microlearning can increase retention in learners (Shail, 2019). Microlearning can promote and increase student learning when moving the classroom to the students' locations and using methods entrenched in theories of how the brain works when storing and retrieving information (De Gagne et al., 2019). According to Ichiuji et al. (2022), In surgery clerkship, the implementation of microlearning modules has the potential to enhance knowledge for students.

The use of social media in education and its advantages have been discussed in the literature. Learner outcomes can be positively affected by social media, and social media may be used without harm in medical education environments (Cheston et al., 2013). Social media as educational tools can improve communication between learners and

educators (Saqr & López-Pernas, 2022). Moreover, social media can promote engagement and encourage collaboration (Faizi et al., 2013). When used creatively and in a student-centered way within an educational environment, social media can assist and increase engagement, motivation, interactivity, soft skills, communication, and collaboration of learners (Lampropoulos et al., 2021). To facilitate learning, social media can be used by students to share learning resources. The sharing of learning materials resources in real-time is facilitated by the learners' social media communication devices (Ansari & Khan, 2020).

The authors recognize that scoping reviews and literature reviews have been done about microlearning and mobile microlearning in education (Shail, 2019), (Lee, 2021), (De Gagne et al., 2019), and (Taylor & Hung, 2022). However, these reviews do not focus on microlearning and social media. The main purpose of this literature review is to survey the existing research where microlearning contents and social media are used together in learning and ascertain its impact on learning and the learning experience. This study answers the following questions:

RQ1 What are the main attributes of the existing studies about microlearning using social media?

RQ2 What are the motivations for using microlearning in social media according to the literature?

RQ3 What characteristics differentiate microlearning from nanolearning with social media in the literature?

Research methodology

The authors used Okoli's guide for conducting a standalone systematic literature review. The guide focuses specifically on conducting systematic reviews for information systems research (Okoli, 2015).

In this guide, Okoli proposes eight essential steps to conduct a literature review, and those necessary steps are needed to conduct a rigorous review (Okoli, 2015).

Okoli's eight steps used for this literature review:

1. Identify the purpose of the review.
2. Draft a protocol and train the team.
3. Apply practical screen.
4. Search the literature.
5. Extract data.
6. Appraise quality.
7. Synthesize studies.
8. Write the review.

According to Okoli (2015), the author(s) of an SLR must be explicit and transparent about the method and process followed during the review to ensure that other researchers can reproduce the results using the same method and process. Okoli (2015) suggested that, with only one reviewer, there was no need for a protocol document or a

training session. Keeping Okoli's recommendations in mind, the authors of this SLR tried to search the literature as exhaustively and extensively as possible.

Databases

The authors used the following databases: Scopus, IEEE Xplore, Web of Science, ACM, EBSCOhost, PubMed, and ProQuest (Education Database). These databases are well respected and popular among researchers. In addition, they ensure that all potential journals and articles related to this literature review are included. These databases incorporate journals and articles from computer science, education, science, social science, and medical fields.

Keywords and search query

The keywords used in this query were identified first from the authors' early discussions, readings, and understanding of this research topic. The early known keywords were used in general searches to identify other common keywords referring to small learning units. Google Scholar was used in these initial queries. The same process was used to identify keywords related to "social media". A list of the most common keywords was created. Later, this list of keywords was used to form a query relevant to the main research question. To answer the questions of this literature review, the following query was used: ("nanolearning" OR "nano-learning" OR "microlearning" OR "micro-learning" OR "bite-sized" OR "nuggets" OR "chunking" OR "learning objects" OR "micro-content" OR "microcontent" OR "snippets" OR "just-in-time") AND ("social media" OR "web 2.0" OR "social networks"). This query was adapted to each database.

Inclusion/exclusion criteria

For each result returned by the databases, the title and abstract of each entry were read to determine if the paper should be included or excluded. If there were any doubts, the full text was read. Included papers were downloaded and added to a reference management software. Within the reference management software, a folder was created for each database. Included articles from each database results were saved in their respective folders for later review. No date range was used for the inclusion/exclusion process because the authors wanted to maximize the results returned by the databases. Additionally, the test queries showed that the number of entries returned was not excessively numerous. Thus, no filters were applied to the queries. The university's library was used to determine if an article was peer-reviewed, as this database has a flag for peer-reviewed articles. As permitted by the databases, each return set was exported as comma-separated values (CSV) files and imported into Excel. In Excel, each included article was highlighted in yellow, and each article not found online was highlighted in red.

Below are the inclusion criteria that the authors used to select each article:

1. **The article must be in English**. Some tests were made to see if any relevant literature written in French (as one of the authors is fluent in that language) could be found using scholar.google.fr. The test query was: "micro-apprentissage" AND "Média

social". The test result sets were not conclusive, and this option was abandoned. Additionally, most documents returned from the database searches were in English.

2. **The article was peer-reviewed**. To provide the best possible quality all articles selected for this literature review need to be published in peer-reviewed conference proceedings or academic journals.
3. **The article addressed the subject and goal of this literature review**. To meet this criterion, the article must discuss microlearning and social media.
4. **The article must be available online through the university library**. This literature review was done fully online with no possibility of physically visiting the university library.
5. **The article was not excluded**. Any articles that did not meet points 1,2,3, and 4 were considered excluded and would not be part of this literature review.

Results

The article selection process for this review has two main phases. During the first phase, the reviewer ran the query on each database; the reviewer read the title and the abstract of each article returned; the reviewer downloaded and added any potential article to Zotero for later review during phase II.

Result of phase I

During phase 1 of the search, 2,312 results were retrieved from all the databases, and 86 articles were selected for phase 2. This search ended on February 10, 2023. Table 1 below shows the breakdown of the searches for each database.

Rationale: *2,226 articles were excluded during the first phase because they were reports, not in English, did not have a full-text, search keywords were only found in references, the abstract did not promise to address the goal of this review. Moreover, excluded articles were mainly about social media use but not for learning purposes. In addition, microlearning is rarely conducted in a controlled environment and, therefore, not a subject of research. Book chapters have been considered during the first phase of this literature review. However, the reviewer did not find book chapters meeting the inclusion criteria. Some of the difficulties encountered during the book chapters search: online availability, database indexation, and time required to find materials*

During the second phase, the reviewer merged all the selected articles from each database into one folder in Zotero. Next, the reviewer deleted all the duplicate articles found in this folder. Finally, the reviewer fully read the articles and checked them against the inclusion/exclusion criteria. To be selected an article must discuss the use of microlearning and social media for learning purposes. Each paper was screened for the following

Table 1 Breakdown of the searches for each database

Database	Retrieved	First selection	Excluded
Scopus	430	30	400
Web of Science	147	13	134
ACM	171	7	164
EBSCOhost	147	11	136
PubMed	43	10	33
ProQuest	1305	10	1295
IEE	69	5	64
Total	2312	86	2226

four items: the assertions it presents, the supporting evidence it offers for these assertions, the justification for the provided evidence, and how the document reinforces the presented evidence (Okoli, 2015).

Result of phase II

In phase 2, twelve articles were found to be duplicates and were deleted. Some 86 articles were read, and 16 articles were selected for this review. Figure 1 shows the steps taken during Phase 2, and Table 2 shows the final selected articles.

Rationale: *58 articles were excluded because they did not talk about microlearning and social media together, did not apply microlearning methods and social media together in their studies, were not peer-reviewed, or were not accessible*

RQ1 What are the main attributes of the existing studies about microlearning using social media?

Table 2 shows that 11 articles are from journals, and 5 articles are from conferences proceedings. Six out of sixteen (37.5%) studies are from the U.S.A. 83% of the articles from the U.S.A. were published between 2020 and 2022.

Figure 2 shows the number of articles per year. A total of 11 out of the 16 (69%) articles were published between 2020 and 2022, which shows an increase in interest in using microlearning and social media by researchers. This increase in research might be due to the COVID-19 pandemic with the imposed restrictions on educational institutions.

Figure 3 shows the academic disciplines in which microlearning learning methods and social media were applied. Healthcare is the main area of study with 8 papers representing 50% of the total papers selected. Out of these 8 articles, 3 articles discuss surgical education. A possible motivation for using microlearning and social media in medical education is that e-learning can be as productive as formal lectures within diverse medical education environments (Ruiz et al., 2006). Furthermore, Briz-Ponce

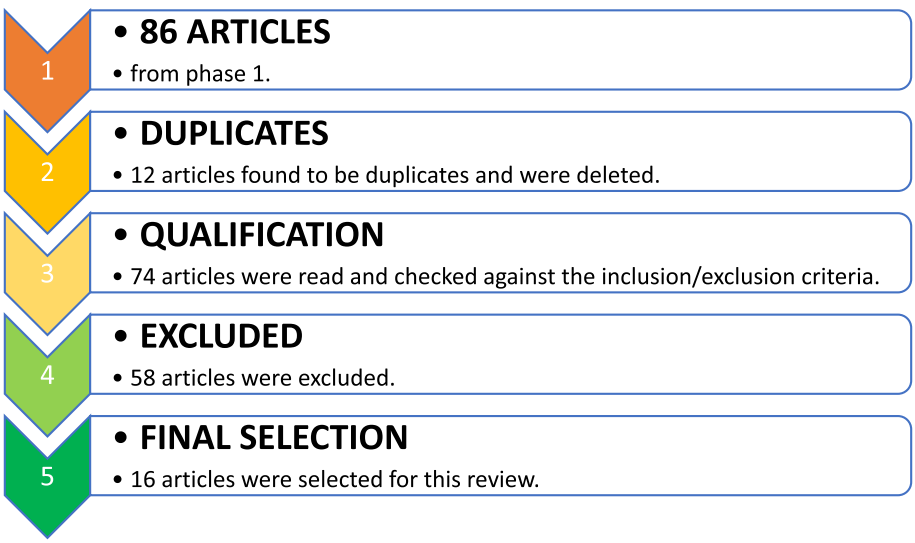

Fig. 1 The above chart shows the steps taken during phase 2 of the article selection process

Table 2 Final selected articles

Type of Article	Year	Country	Author(s)	Title
Conference	2012	UK	Coleman and Hine	Twasebook: a "crowdsourced phrase-book" for language learners using Twitter
Journal	2013	Kazakhstan	Aitchanov et al.	Application of microlearning technique and Twitter for educational purposes
Conference	2015	USA	Kovacs	FeedLearn: Using Facebook Feeds for Microlearning
Conference	2017	Australia	Grevtseva et al.	Social media as a tool for microlearning in the context of higher education
Journal	2018	Nigeria	Osaigbovo and Iwegim	Instagram: A niche for microlearning of undergraduate medical microbiology
Journal	2020	USA	Serembus et al.	Internet, Apps, and Tweets: Enhancing Clinical Learning Through Just-in-Time Training
Journal	2020	UK	Bannister et al.	Increased Educational Reach through a Microlearning Approach: Can Higher Participation Translate to Improved Outcomes?
Conference	2021	Sri Lanka	Yatigammana and Wijayarathna	Integrating Micro-lesson Metadata in ID3V2 of MP3
Journal	2021	UK	Rahman et al.	Big Data Analysis of a Dedicated YouTube Channel as an Open Educational Resource in Hand Surgery
Journal	2021	USA	Palmon et al.	Microlearning and Social Media: A Novel Approach to Video-Based Learning and Surgical Education
Journal	2021	China	Yin et al.	Conversation Technology With Micro-Learning: The Impact of Chatbot-Based Learning on Students' Learning Motivation and Performance
Journal	2021	USA	Tennyson and Smallheer	Using Social Media for Microlearning in Nurse Practitioner Education
Journal	2021	Palestine	Khlaif and Salha	Using TikTok in Education: A Form of Micro-learning or Nano-learning?
Journal	2022	USA	Chen et al.	Review of Learning Tools for Effective Radiology Education During the COVID-19 Era
Journal	2022	USA	Wakam et al.	Adapting to the Times: Combining Microlearning Videos and Twitter to Teach Surgical Technique
Conference	2022	Philippines	Garcia et al.	TikTok as a Knowledge Source for Programming Learners: a New Form of Nanolearning?

et al. (2016) stated that medical students using an anatomy mobile app fared statistically better than students who followed a traditional class.

This review shows that there is a disproportionated number of studies about microlearning and social media in medical education when compared with other educational fields. For instance, Microlearning and social media are applied to only four other non-medical studies. Two of these research articles are about language learning, one is on computing, and two are on programming language. As a result, researchers should investigate the use of microlearning and social media for learning in other academic disciplines.

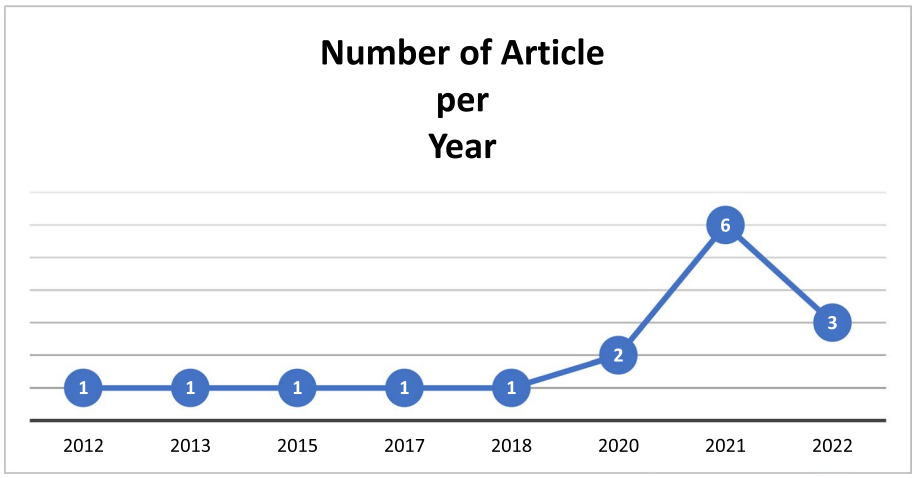

Fig. 2 Number of articles per year

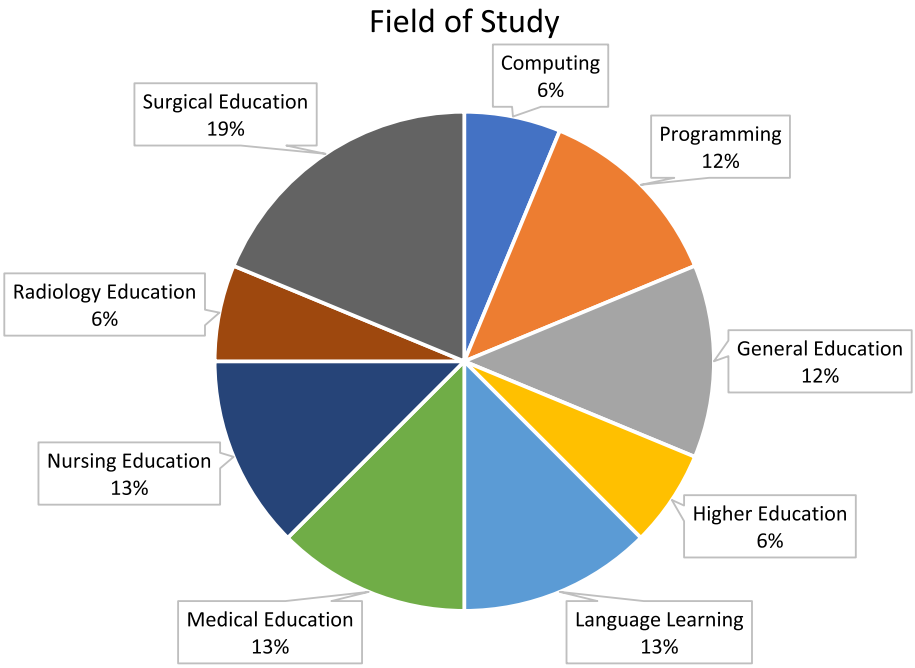

Fig. 3 Academic fields in which microlearning combined with social media is applied

Figure 4 shows the social media platforms mentioned in the studies. Twitter is the most used social media platform in these studies. YouTube is found in four papers and Facebook in three papers. TikTok is discussed in two articles. LinkedIn is mentioned in one article, and Sina Weibo is discussed in another study. It is worth mentioning that there is limited literature reporting on LinkedIn, despite the platform hosting a substantial amount of microlearning content. This might be because LinkedIn is a social media platform that primarily focuses on business and employment-related connections. LinkedIn is not commonly used by academics because academics have other platforms that are dedicated to their needs. Google Scholar, ResearchGate.net, and Academia.edu are examples of such platforms. Moreover, LinkedIn's primary age

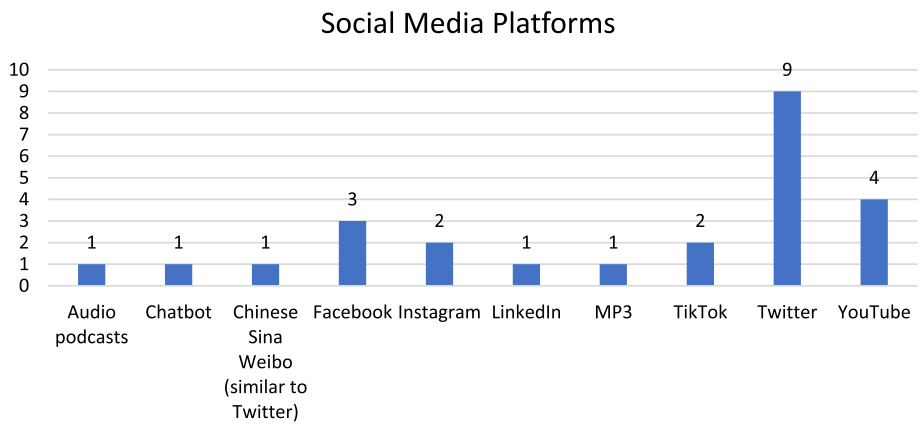

Fig. 4 Social media platforms mentioned in the studies

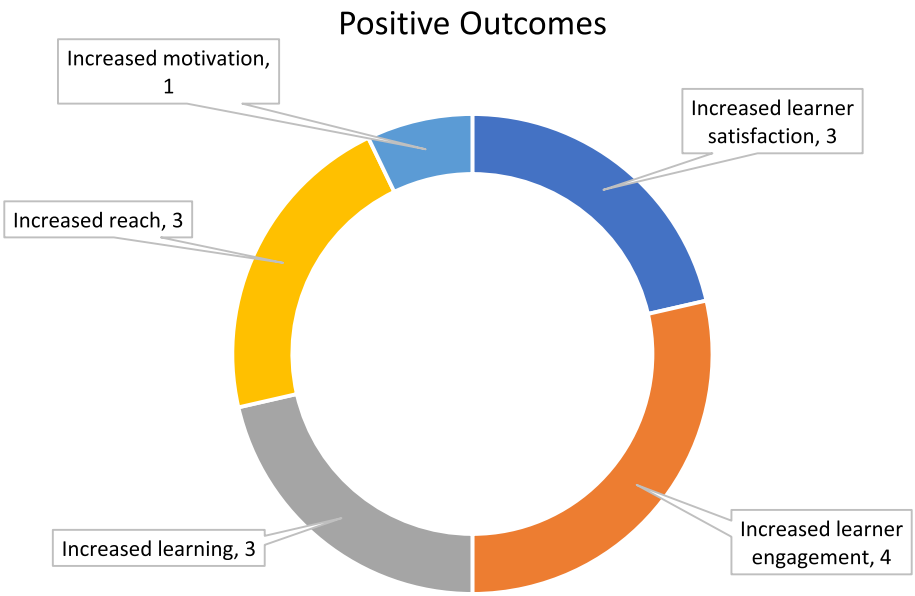

Fig. 5 Positive learning outcomes mentioned in the research

demographic falls within the 24–34 range, comprising 59% of its user base (LinkedIn, 2023). Consequently, LinkedIn may not be the social media platform of choice for younger students. Interestingly, some universities will offer access to LinkedIn Learning to their students, staff, and faculty. Users of LinkedIn Learning can take microlearning courses to learn in-demand skills and earn a certificate when a course is completed. The certificate can be displayed in their profile on LinkedIn. It is important to note that some studies have used or discussed multiple social media platforms. Out of the 9 papers that mentioned Twitter, 7 papers (77%) are related to medicine.

Figure 5 shows the positive learning outcomes mentioned in the research. Ten papers reported positive learning outcomes. None of the studies discussed any direct negative learning outcomes when using microlearning with social media.

Figure 5 shows that an increase in motivation was mentioned in only one article (Yin et al., 2021). In contrast, an increase in reach, learner satisfaction, learner engagement, and an increase in learning are similar in terms of the learning outcomes reported in the articles. An increase in engagement is the most mentioned outcome. It can be explained by the analytics tools available on specific social media platforms. For instance, Twitter and YouTube have tools that permit measuring the number of times a tweet was shared or measuring the number of times a video was viewed. (Bannister et al., 2020; Palmon et al., 2021; Rahman et al., 2021; Wakam et al., 2022).

RQ2 What are the motivations for using microlearning in social media according to the literature?

Communication and sharing learning materials

Twitter, as noted by Wakam et al. (2022), has become a preferred platform within the surgical field due to its capacity to foster concise discussions among students and faculty members, transcending time and location barriers (Palmon et al., 2021). Furthermore, Tang and Hew (2017) found that Twitter is often used to support communication and assessment. In addition, Aitchanov et al. (2013) highlight the role of scheduling tools in optimizing the management of communication on Twitter, particularly in the context of microlearning. Furthermore, Coleman and Hine (2012) draw attention to Twitter's multilingual capabilities, enabling users to engage in conversations in their preferred language, thereby broadening its accessibility. Lastly, Chen et al. (2022) introduce the utilization of the Chinese Sina Weibo platform, similar to Twitter, where students collaborate in groups to complete case studies and address various topics, including disease states, drug information, and patient plans, fostering effective communication and collaborative learning. However, security and privacy were also mentioned as potential challenges when using social media to transmit patient health information (Palmon et al., 2021). Also, in some instances, multilingual capabilities of social media apps can have negative outcomes in a medical environment. Automatic translation tools of social media apps might not always offer accurate translation. Additionally, bad translations can change the meaning of texts. Coleman and Hine (2012) pointed out that words with multiple meanings can result in wrong translation.

Twitter's significance extends further as it serves as a global platform for disseminating educational materials and providing just-in-time answers and clarifications in clinical settings (Palmon et al., 2021; Serembus et al., 2020). Tang and Hew (2017), in their review said that Twitter best use in education is as "push" technology. Facebook and LinkedIn also have been used to share learning materials. Facebook was used in Rahman et al. (2021) study to post YouTube video links. Rahman et al. (2021) mentioned in their paper that 2% of the traffic source was coming from Facebook. LinkedIn was used to distribute microlearning units in Bannister et al. (2020) research. YouTube, a leading video-sharing platform, plays a role as a repository for educational content, particularly in the medical domain (Palmon et al., 2021; Rahman et al., 2021; Wakam et al., 2022). It serves as a conduit for distributing health-related information and open educational resources (OER), amplifying the accessibility of learning materials and enhancing the overall learning experience (Madathil et al., 2015; Rahman et al., 2021). Because of the

duality of YouTube being a popular social networking site and a popular search engine, it is beneficial to understand the users' views of the platform as users will have different needs (Ammoura & Ertemel, 2021). This is especially true when trying to increase the number of views of videos or when trying to reach a certain category of users.

Wakam et al. (2022) noted that Twitter and YouTube have native and third-party analytical software that permits the assessment of engagement. However, clicks and likes do not tell if learning really happened. Comments or tweets analysis could provide more information about the quality of the learning materials and how it is received by the learners. One of the challenges mentioned by Bannister et al. (2020) and Rahman et al. (2021) is the difficulty in assessing knowledge gain since social media platforms such as YouTube do not offer the possibility to do in-video evaluations. The lack of evaluation data is a problem for Continuing Medical Education (CME) providers because higher Moore's level grades are synonymous with higher quality education (Bannister et al., 2020). One possible solution proposed by Bannister et al. (2020) is to use "micro-evaluation" by asking a single, short question before and after bite-sized learning. The problem with this solution is, as mentioned earlier that social media platforms do not offer a mechanism to easily conduct evaluations.

In parallel, Instagram has emerged as a potent tool for microlearning, especially in healthcare and nursing education. Tennyson & Smallheer (2021) discuss how Instagram empowers asynchronous microlearning, empowering students to enhance their knowledge and gain confidence in their respective fields. Furthermore, Osaigbovo & Iwegim (2018) demonstrate the effectiveness of Instagram and Facebook in surmounting the limitations of traditional teaching approaches, leading to increased engagement and participation among students. These platforms offer visually appealing and interactive avenues for microlearning, catering to diverse learning preferences and needs.

Beyond conventional platforms, innovative approaches expand the horizons of communication and resource sharing. TikTok, favored by Generation Z, has the potential for nano-learning, delivering concise, engaging content aligned with nano-learning principles (Khlaif & Salha, 2021). Educators can leverage TikTok's brief video duration to deliver impactful learning content. Additionally, Garcia et al. (2022) illustrate how TikTok offers both entertaining and informative content for programming learners, showcasing its potential as a nanolearning platform. Carpenter & Krutka (2015) shed light on Twitter's role as an invaluable tool for educators in professional development, emphasizing its efficiency, accessibility, and user-friendliness for knowledge sharing and collaboration. Innovative platforms and methods continue to reshape the educational landscape. MP3-based content, proposed by Yatigammana & Wijayarathna (2021), caters to students with limited internet access, facilitating content dissemination. Other studies did not fully explore the possibility that students might not have access to the Internet or the social media platforms used. Also, they did not discuss the type of smart devices needed to access these platforms. Not all students can afford a modern device. Some obvious connectivity and software issues plague older devices. Chatbot-based micro-learning systems, championed by Yin et al. (2021), enhance motivation and learning outcomes, especially in scenarios without continuous face-to-face instruction. They stated that when using chatbots with microlearning, the accuracy of the chatbot's responses can influence the users' attitude toward

the conversation agent. Additionally, WhatsApp plays a role in sharing educational materials and fostering communication among students. Rahman et al. (2021) note its use in sharing educational videos among trainees, indicating its potential for disseminating learning materials. Agbo et al. (2021) demonstrate WhatsApp's effectiveness in computing education, with students forming closed groups to discuss topics and share knowledge, ultimately enhancing learning achievements and motivation. WhatsApp's user-friendly nature and informality further enrich the learning experience.

These studies mainly show the positive aspects of using microlearning in social media platforms. However, the potential negative aspects of using microlearning in social media should be discussed further. For instance, other non-educational content in social media can be a distraction and prevent learning. Also, the appropriateness of content can be an issue with some social media platforms. This might prevent the use of social media in an educational context. Furthermore, research should explore the pedagogical strategies needed for each social media platform used. Grevtseva et al. (2017) argue that social media platforms are perfect channels for microlearning. They highlight three learning frameworks that support microlearning with social media. This list includes conversational framework, connectivism theory, and cognitive theory of multimedia learning. Furthermore, in their paper, Grevtseva et al. (2017) looked at thirteen different types of social media: blogging tools, enterprise social media networking tools, social gaming, social networks, social bookmarking tools, forums, photo sharing tools, business networks, collaboration project tools, service and product reviews, microblogging tools, video sharing tools, and virtual worlds. Based on their research, they proposed a "checklist for formulating microlearning content for social media."

RQ3 What characteristics differentiate microlearning from nanolearning with social media in the literature?

The main characteristic of microlearning's method highlighted by the selected articles is that complex or large learning tasks, are broken down into small manageable learning units. Equally important is that focused bite-sized learning units are distributed over time and can be repeated within a short period. Bite-sized information can be more easily stored in short-term memory and, as a result, improves long-term memory retention (Chen et al., 2022; Serembus et al., 2020). However, microlearning might not be suited to learning complex skills, processes, or behaviors (Rahman et al., 2021).

Furthermore, Serembus et al. (2020) wrote:

> *If rehearsal does not take place, the brain is burdened with too much information over too short a period, slowing information processing such that key data cannot be stored and the information present in short-term memory will be permanently lost. (p. E33)*

The above statements are based on the cognitive load theory associated with John Sweller's work. It is important to note that the cognitive load theory framework is one framework supporting microlearning, as microlearning's main method is to

reduce cognitive load. Sweller (2020) wrote that the cognitive load theory (CLT) is relevant to technology-assisted learning, and CLT's instructional procedures are hard to use without the support of educational technology. For that reason, "the theory can provide a guide to appropriate uses of technology-assisted learning" (Sweller, 2020) (p.14). Future research could investigate how CLT could improve microlearning outcomes when combined with social media. As an example, we could point to CLT's split-attention effect when designing mobile microlearning learning modules. So far, in this review, microlearning has been understood within an individualized learning environment. However, Computer-supported collaborative learning (CSCL) takes place when microlearning is combined with social media. For the reason that, social media supports collaborative learning by allowing students to share learning resources (Ansari & Khan, 2020). As a result, future research could investigate how collaborative cognitive load theory principles can help improve the outcomes of collaborative learning when microlearning is combined with social media. As per Kirschner et al. (2018), high transaction costs can cancel any advantages gained from sharing a difficult task within a collaborative learning environment.

Another stressed characteristic of microlearning is the possibility of anywhere anytime learning (Aitchanov et al., 2013). Additionally, adult learners prefer short, cumulative educational interactions over long formal learning activities (Bannister et al., 2020). Also, Bannister et al. (2020) stated that microlearning helps learners investigate subject matters at their own pace. Rahman et al. (2021) wrote:

> *The advantages of microlearning are that it is performed in short time bursts, allowing learners to be alert; requires little effort from individual sessions; involves simple and/or narrow topics; is fun and engaging; allows for continuous updates; allows for multitasking; is casual and informal. (p.3)*

The motivation to apply microlearning methods for adult learners in a non-formal setting, can be explained by the busy working environment where the learning activities take place. For instance, nursing students are always on the move with few opportunities to use books for clinical information (Serembus et al., 2020). Microlearning's short and focused learning formats help to take hold of learners' attention and keep it (Chen et al., 2022). Bannister et al. (2020) used a blended approach consisting of microlearning content with eLearning educational material to increase reach and participation in a full programme.

Nano-learning is a concept inspired by nanotechnology, featuring complete, small, and unified chunks (Khlaif & Salha, 2021). Nanolearning revolves around the idea of offering easily understandable and compact learning modules, ideally at the time and place where students need them (Garcia et al., 2022). Khlaif and Salha (2021) describe nanolearning as smaller units of micro-learning that focus on a single goal by breaking down microcontent into small pieces. Moreover, micro-learning content can be composed of different nano-learning units (ibid., p214). An interesting point made by Khlaif and Salha (2021) is that micro-learning can be utilized in both formal and informal learning settings, whereas nano-learning is exclusively applicable to informal learning environments. Microlearning and nanolearning enhance learning by providing agility in learning, reducing cognitive load, reinforcing the source materials, and increasing

retention. The difference is that microlearning delivers these benefits in about 15 min, while nanolearning does it in less than two minutes (Garcia et al., 2022). A point of contention in the previous statement is the lack of consensus regarding the specific duration of lessons when defining microlearning. Some researchers argue that a microlearning lesson is between 30 s and 5 min long (Jahnke et al., 2020). Others state that the duration of microlearning content is only a guideline (Torgerson & Iannone, 2019). One limitation of considering TikTok as a platform for supporting nanolearning is that TikTok has progressively expanded the maximum video length over time.

Discussion

Synthesis, reflection and future research opportunities

Much of the literature on using microlearning in social media platforms has been developed from a learner engagement perspective. As per Halverson and Graham (2019), learner engagement correlates with learning outcomes such as academic achievement and satisfaction. Therefore, it is important to measure engagement. These studies have considered two main themes: communication and sharing learning materials. Researchers considered many different platforms for their studies. However, some social media platforms are preferred for communication, while others are preferred for sharing learning materials. Some preferences are due to the popularity of the social media platform with the users, although other platforms are selected because of technical practicalities. Twitter and YouTube emerged as the two main social media platforms in this study. Twitter is favored for communication, and YouTube is used as a repository of learning materials in the form of videos. Other platforms are emerging as potential tools for microlearning. TikTok is one of them. However, TikTok, because of its short format videos, is more appropriate for nanolearning.

This review shows ongoing research in the area of microlearning with social media in recent years. Social media-based microlearning can be a powerful tool for delivering just-in-time training and learning materials. It is especially true when this tool is used to teach learners who can not always attend face-to-face classes, such as medical students, nurses, and adult learners. The articles in this literature review suggest that microlearning with social media can improve learning and the learning experience by reducing cognitive load. It can also facilitate communication among learners, peers, and educators, and keep the learners engaged and focused. Microlearning with social media permits the delivery of focused bite-sized learning units over time, anywhere, and at any time. Perhaps, the most consequential outcomes of combining microlearning with social media are the increase in reach and engagement. Furthermore, social media adds the possibility to learn from and teach peers, potentially increasing the cognitive learning level to a level above remembering. In Bloom's digital taxonomy, Churches (2010) shows that twittering, for example, would fit within the understanding level of Bloom's taxonomy. Twitter is one of the most mentioned social media in this review. Moreover, it is the principal social media platform for medical education (Ranginwala & Towbin, 2018). Ranginwala & Towbin (ibid.) mentioned the following characteristics of Twitter: brief but direct communication and the possibility of embedding media. However, it should be noted that microlearning and social media have some drawbacks. For instance, microlearning does not work well for complex learning and in-depth understanding of a

specific idea. Regarding social media, in recent years, some major social media platforms have become polarized and politicized. Further, privacy is also a concern when using social media. Some researchers have mentioned the possibility of academic distraction because of the use of social media (Dontre, 2021).an.

The results of this review suggest that microlearning and social media work well together to facilitate learning. However, more research is needed to understand how microlearning with social media can help educators and learners. Microlearning with social media provides opportunities for researchers to bridge, combine, and connect many academic fields, such as e-learning, educational neuroscience, computer science, and pedagogy (Shail, 2019). As a result, microlearning with social media offers many possible research paths. Below are some possible research paths.

Microlearning and social media are not new. Many studies have been done on each of these subjects. However, there are few studies on microlearning with social media in formal education. Microlearning itself has gained traction within the business world in recent years (Sankaranarayanan et al., 2022; Taylor & Hung, 2022). A quick Google search on microlearning will return numerous links about microlearning in corporate training. Formal education institutions lag behind corporations (work-based learning) when incorporating microlearning techniques in their available teaching toolsets (Díaz Redondo et al., 2021). Educators in formal education institutions could leverage mobile devices owned by their students, especially smartphones, when implementing microlearning with social media in their courses. Microlearning with social media does not work well in all learning activities, especially for complex concepts and in-depth studies (Rahman et al., 2021). However, microlearning with social media has its place in formal education in courses that require students to remember specific information and terms over a long period. For instance, microlearning with social media could help first-year students in anatomy, chemistry, biology, law, and other disciplines where remembering specific information and terms is the most important to acquire future knowledge in these subject matters. In addition, the need for investigating the use of social media and microlearning is arguably evident with the recent pandemic such as COVID-19 where most learning could not take place in person. Surprisingly, only one article by Chen et al. (2022) indicates the use of social media for microlearning in the context of medical education during the COVID-19 pandemic. Consequently, studies should be conducted to further explore and assess how microlearning with social media can help these learners.

In this review, the research articles do not discuss pedagogy in detail. Therefore, we know little about which pedagogy approach would work best when implementing microlearning principles with social media. Future research on this knowledge gap will be needed to help educators implement microlearning with social media in their courses and decide which pedagogy approach to use for a specific learning goal.

Most of the results from the research articles of this review are from descriptive surveys. More results from students' course assessments are needed to support the claim that microlearning with social media improves learning outcomes. One issue mentioned in the studies that made assessment difficult is that the major social media platforms do not have a mechanism for micro-evaluation. Research could explore how to implement "just-in-time assessments" to evaluate students' knowledge during or just after a microlearning with social media lesson.

The microlearning methodology lacks scientific support. One theory that supports microlearning is the Cognitive Load Theory (CLT). Another theory that supports microlearning with social media is Computer-supported collaborative learning (CSCL). Research exploring how CLT and CSCL could help improve the learning outcomes of microlearning combined with social media. An interesting point is that we can measure cognitive load by examining pupillary response or measuring heart rate and blood pressure. Researchers could investigate how wearable technologies could provide feedback on the cognitive load of learners.

Microlearning with social media could support personalized learning when used within an e-learning environment. A possible study would be to investigate how personalized learning could help lifelong learners when using microlearning combined with social media.

Microlearning and social media profit from new technologies. Studies could explore how microlearning with social media could be implemented within a virtual environment using virtual reality or augmented reality. For example, remote coworkers or a remote group of students could meet in a social virtual reality (VR) environment and watch a short learning video. During and after the video, these learners could ask and answer questions about the video they watched. This type of immersive interaction could be helpful to medical students.

Limitation

An important limitation of this review is the small size of the selected articles included here. Only sixteen articles passed the inclusion/exclusion criteria. It is possible that other databases not used in this scoping review and different keywords could have increased the number of articles included. A larger sample size is needed to validate the findings of this review. This small sample size shows that combining microlearning and social media for learning is new in research. Therefore, more empirical studies should be done in the future to support the results. Another limitation is the selection criteria that focused only on journal and conference articles written in English. An effort was made to include articles in a different language without success. It is important to note that this study is not exhaustive but represents an initial effort to grasp the characteristics of utilizing microlearning with social media in the realm of education.

Conclusion

This literature review was conducted to explore how microlearning and nanolearning combined with social media have been applied and appraised. The findings show that microlearning combined with social media has the potential to positively increase learning outcomes, such as increase learner satisfaction, increase reach, increase learner engagement, and increase learning. Furthermore, the results of this review show that the two most positive outcomes of using microlearning with social media are reach and engagement. However, there are some concerns about the effectiveness of microlearning with social media. Also, some researchers have discussed the potential negative impact of social media on learners' attention and motivation.

The integration of microlearning and social media into education presents several challenges and opportunities. Challenges include the difficulty in assessing knowledge

gain due to the lack of in-video evaluations on social media platforms like YouTube, concerns regarding security and privacy when sharing patient health information with students, and the limitation of microlearning for acquiring complex skills or deep understanding. Additionally, the polarization and politicization of major social media platforms raise further issues. Nevertheless, microlearning with social media can be beneficial, particularly in courses where remembering specific information is crucial for future knowledge acquisition. For instance, microlearning with social media could help first-year students in anatomy, chemistry, biology, law, and other disciplines where remembering specific information and terms is the most important to acquire future knowledge in these subject matters.

The preference for certain social media platforms varies based on communication needs and technical practicalities, with Twitter and YouTube emerging as primary platforms for communication and content sharing, respectively. Moreover, certain preferences stem from the widespread usage of social media platforms among users. Age demographics can also influence the choice of preferred social media platform. For instance, TikTok may be more appealing to a younger audience. Furthermore, TikTok's emphasis on short-format videos makes it particularly suitable for nano-learning purposes.

This study contributes to knowledge by unraveling the potential of social media and microlearning in fostering learning experience and further provides highlights on critical research gaps that future research must address. For example, current literature could not clearly demonstrate the pedagogical and theoretical underpinning of social media and microlearning studies. Therefore, the findings in this study could spark further research interest and discussions in this domain.

Abbreviations

MOOC	Massive Open Online Courses
SLR	Systematic Literature Review
CSV	Comma-separated values
OER	Open educational resources
CME	Continuing Medical Education
CLT	Cognitive load theory
CSCL	Computer-supported collaborative learning
VR	Social virtual reality

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