

Systematic Review

Contribution of Microlearning in Basic Education: A Systematic Review

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Abstract: This systematic review analyzed the role of microlearning in basic education, identifying the most widely used Digital Information and Communication Technologies, relevant learning theories, and the role of social technologies from a Science, Technology, Society, and Environment (STSE) perspective. Following PRISMA 2020, searches were conducted in Web of Science, Scopus, ERIC, and IEEE Xplore databases. Studies on microlearning were selected based on previously defined eligibility criteria. The review process in Rayyan involved deduplication, screening, and full-text analysis. Data were qualitatively analyzed using content analysis, and methodological quality was assessed with CASP and the Downs and Black. The findings highlight that microlearning, integrated with digital tools such as online platforms, mobile apps, and short videos, significantly enhances student motivation, performance, and interaction; content in short modules facilitates knowledge retention and connects concepts to real-life situations. Promising trends include mobile technologies and gamification, which foster active, meaningful learning. Grounded in theories like Self-Determination, Constructionism, and Constructivism, microlearning personalizes teaching and promotes engagement, critical thinking, and accessibility, contributing to inclusive and sustainable education. From a STSE perspective, social technologies enhance autonomy, social interaction, and ethical–environmental awareness. In Brazil, further research on digital platforms and gamified strategies is needed to drive innovative educational practices.

Keywords: digital information and communication technologies; teaching methodology; social perspective; teaching theories; online platforms; mobile technologies; digital tools; active learning



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1. Introduction

Basic education plays a fundamental role in developing essential skills for the future, especially in a scenario marked by the rapid technological and social transformations of the 21st century. In today's knowledge society, education is decisive in transferring scientific and technological knowledge and analytical and professional skills (Gylfason, 2001). In this context, education is widely recognized for placing the student at the center of the learning process, valuing the development of skills such as creativity, communication, collaboration, critical thinking, and cultural awareness (Nasution, 2022; Tan et al., 2022). The advance of the

digital age has brought to light the need to incorporate digital technologies into the educational environment to keep up with new learning demands (González-Salamanca et al., 2020).

Digitalization has transformed the way knowledge is transmitted and acquired, requiring an adaptation of both teaching methods and students, who need to develop skills related to the use of Digital Information and Communication Technologies (DICTs), as well as skills such as critical thinking, problem-solving, and adaptability (Díaz-García et al., 2022). In this context, it is essential that education evolves and incorporates approaches that correspond to the new social and technological demands to promote progress in digital development towards the Sustainable Development Goals (SDGs) defined in the United Nations 2030 Agenda (United Nations, 2024).

Faced with these changes, educators have reinvented teaching methods, seeking new ways to engage students and promote effective learning. Traditional teaching, previously focused on face-to-face and sequential practices, no longer fully meets the needs of the digital generation, which has led to the adoption of approaches such as hybrid teaching and mobile learning (Chilton & McCracken, 2017; Martin et al., 2011). These methods, which integrate digital technologies into the teaching–learning process, transform the role of both the teacher and the student, promoting more active, participatory, and flexible learning (Kaushik & Verma, 2019). The need for pedagogical innovation is urgent, and adapting teaching methods to technological advances has been vital for developing more effective and engaging approaches.

In this scenario, microlearning stands out as an innovative educational strategy. Defined as an approach that delivers content in small, easily consumable units, microlearning facilitates both the learning process and student engagement (Hug, 2005). This process facilitates learning and student engagement by breaking down content into smaller, more accessible parts (Alias & Razak, 2023; Sozmen, 2022). The strategy used by this method is to provide small portions of content that can be absorbed in short periods, which makes it a viable option in various educational contexts, including basic education (Langreiter & Bolka, 2005), enabling a more gradual and effective absorption, taking advantage of students' limited time to promote continuous and flexible learning (Filatro & Cavalcanti, 2022).

However, its effectiveness depends on the student's characteristics and the teachers' ability to adapt to digital technologies (Sozmen, 2022), i.e., technological intervention alone is insufficient (Kabilan et al., 2023). For microlearning to be effective, it requires a careful design of the content and instructional flow, with specific, well-structured materials organized in such a way as to enhance the learning experience (Alias & Razak, 2023). Digital tools such as podcasts, short messages, and social networks make microlearning a versatile approach capable of adapting to different educational scenarios (De Gagne et al., 2019). Various strategies, such as gamification (Ko et al., 2016), adaptive learning paths, and instant feedback, can be adapted to personalize this approach and maximize its benefits (Chomunorwa et al., 2023). In addition, microlearning can foster collaboration between students, especially when integrated into team learning projects, contributing to the development of collaborative skills (Lin et al., 2023).

Microlearning in basic education has great potential to increase student engagement, improve information retention, and promote greater flexibility in the teaching–learning process. In an increasingly digital educational environment, this approach is particularly effective for the new generation of students (Choudhary & Pandita, 2024; Mohammed et al., 2018; Zavodna et al., 2024), who are already immersed in digital contexts (Choudhary & Pandita, 2024) and accustomed to rapid and fragmented interactions. By integrating digital tools such as podcasts, short messages, and social networks, microlearning enables students to access content more personalized and at their own pace.

According to Self-Determination Theory (Deci et al., 1999)—also known as SDT—it is the environment that promotes autonomy, competence, and relationships and can also encourage students to be more effectively motivated and engaged in their activities (Ruesch & Sarvary, 2024). This flexibility facilitates learning and meets the demands of a generation that values autonomy and control over their own educational process. Thus, there is evidence that cognitive flexibility positively impacts student autonomy, promoting greater independence, and the development of this skill is directly associated with students' ability to adapt to new educational challenges (Orakci, 2021). Incorporating these principles into education can generate benefits for students of the current generation (Ruesch & Sarvary, 2024) because by promoting intrinsic motivation and implementing effective practices to support it, we can counteract the challenges of shorter attention spans and high anxiety (Ryan & Deci, 2000).

Although microlearning is widely adopted and studied in contexts such as higher education and the corporate environment, it still lacks further investigation to ensure its suitability for the specific needs of other groups, such as primary school students (Zavodna et al., 2024). Furthermore, its integration with other pedagogical strategies that foster engagement, interaction, and more effective monitoring by educators must be explored in greater detail, increasing its potential impact on the teaching–learning process (Zavodna et al., 2024). From this perspective, previous systematic reviews have highlighted its use in different educational contexts, where each one has focused on a specific aspect of microlearning, how microlearning is being adopted in corporate, higher education and secondary school environments (Cruz et al., 2022; Rios et al., 2023), the key components for effective implementation in e-learning environments (Rahutomo et al., 2023), microlearning practices in higher education versus effective strategies for its adoption in academic environments (Alias & Razak, 2023), and the strategies and role of microlearning in improving learning experiences and outcomes in the digital age (Alias & Razak, 2024). One of these studies explored the implementation of microlearning in e-learning contexts and its essential characteristics for effective use (Rahutomo et al., 2023).

Considering the existing gap and the potential of microlearning in basic education, this study aimed to systematically review the literature on its contributions. Although systematic reviews have already analyzed its use in other educational contexts, little is known about its specific application in basic education. Thus, this study seeks to synthesize the existing evidence and provide a comprehensive overview of how microlearning can be used to enhance teaching and learning at this educational level. The research questions guiding this review are as follows: (RQ1) What are the most commonly used DICTs with microlearning? (RQ2) What are the most relevant contemporary learning theories in the context of microlearning? (RQ3) What is the role of social technologies in the context of microlearning from a Science, Technology, Society, and Environment (STSE) perspective?

2. Methods

Systematic reviews have become increasingly important in the scientific community, providing a rigorous and transparent method for synthesizing evidence on a specific topic (Pullin & Stewart, 2006). In this type of investigation, the literature is searched comprehensively and exhaustively (Grant & Booth, 2009) through searches in scientific databases. Eligibility criteria must be used to select the studies of interest to respond to the objective established for the systematic review (Grant & Booth, 2009). The main advantage of systematic reviews is their ability to reduce bias and identify gaps in existing knowledge, thus providing a solid basis for decision-making in various fields. Although this research design is most commonly used to synthesize the results of studies with a quantitative

approach, it can also be adopted in syntheses of qualitative evidence (Dixon-Woods et al., 2005), as was considered in this study.

The conduct of this systematic review followed the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020 – see Supplementary Materials S1.pdf and S2.pdf) (Page et al., 2021); however, as this was not a health-related study, it was decided not to register a research protocol beforehand.

2.1. Databases and Search Strategy

This systematic review was conducted in four widely used and comprehensive databases to ensure complete coverage of the literature and relevant journals: Web of Science™ Core Collection, Scopus™, Educational Resources Information Center (ERIC), and IEEE Xplore® Digital Library. The first two were selected for their multidisciplinary nature and wide global use, while ERIC was chosen for its emphasis on education, and the latter was chosen because it is the main source of content focused on technology, including technologies applied to education, maintained by the Institute of Electrical and Electronics Engineers (IEEE).

After defining the research question, we selected the studies to make up the sample. This process was carried out on 22 May 2024, using the main descriptors “microlearning” related to the intervention context and “basic education” as the population of interest. Other synonymous and similar terms commonly used in the educational context and related to the English language were considered. The Boolean operator “OR” was used to combine similar terms, and the blocks were combined using the operator “AND” (Costa et al., 2024a; Terra et al., 2023), as can be seen in Table 1.

Table 1. The keywords included in the search strategy are organized into blocks.

Block	Descriptor		String
#1	Intervention	“microlearning”	“microlearning” OR “micro-learning” OR “small-size learning” OR “nano-learning” OR “learning on-the-go” OR “micro media learning” OR “micro-media learning” OR “compact learning” OR “quick learning” OR “snack learning” OR “short-form learning”
#2	Population of interest	“basic education”	“high school” OR “high-school” OR “k-12” OR “k12” OR “ktwelve” OR “k-twelve” OR “secondary school” OR “elementary school” OR “middle school” OR “upper school” OR “basic education”
#3	Search string		(#1) AND (#2)

The search looked for articles in the title, abstract, and keywords fields, which are part of the metadata, to obtain more precise results on the subject of study. Refinement filters were used in the search interfaces of the databases to limit the search to studies written in English, the lingua franca of international science (Hamel, 2007; Melitz, 2018), in addition to the fact that publications in English tend to have higher impact factors compared to other languages (Sangwal, 2013). In addition, studies whose main text was available in Portuguese were also considered.

2.2. Eligibility Criteria

The eligibility criteria were organized into two groups: inclusion and exclusion criteria. All inclusion criteria had to be met simultaneously for a study to be included. However, even if all the inclusion criteria were met, the study could be disregarded if it met at least one exclusion criterion.

The inclusion criteria were as follows:

- (i1) Original scientific articles or peer-reviewed conference papers.
- (i2) Articles published between 2015 and the date of data extraction in 2024.
- (i3) Studies whose main text was in English or Portuguese.
- (i4) Research was conducted on the basic education population to address microlearning.

The exclusion criteria were as follows:

- (e1) Duplicates (Costa et al., 2024a).
- (e2) Studies that are not fully available in the databases searched, and that cannot be accessed even after attempts to contact the authors (Pereira et al., 2023; Terra et al., 2023).
- (e3) Studies classified as opinion articles, commentaries, points of view, editorials or similar, dissertations, theses, reviews, preprints, editor's letters, books, book chapters, or similar productions (Álvarez-Gálvez et al., 2023).
- (e4) Research dealing with microlearning in diverse contexts or with specific populations, such as gifted students or those diagnosed with syndromes or disorders.
- (e5) Studies that were retracted (Pérez-Neri et al., 2022) up to the date of submission for publication of this systematic review; the verification of retraction was carried out through the Scite tool (<https://scite.ai/>, accessed on 11 October 2024), and any associated retraction records were verified (Munn et al., 2018).

2.3. Review Process

After extraction using the search strategy, the metadata of the identified studies were imported into Rayyan[®] software, available online (<https://www.rayyan.ai/>), and duplicate studies were automatically identified and eliminated (Ouzzani et al., 2016). This software is commonly used to conduct systematic reviews and stands out for its incorporation of artificial intelligence, learning from users' decisions to build a study prediction model during screening (Costa et al., 2024a). In addition, it allows us to remove studies that meet specific criteria, create labels for citations, extract relevant words, and use indispensable features to speed up the screening process (Ouzzani et al., 2016); because of these features, we chose to use Rayyan[®] software to screen and select studies by examining titles and abstracts.

In the screening stage, the first reviewer read the titles and abstracts of the articles to decide whether the articles would already be excluded or would go on to the next stage. Any doubts throughout the process were resolved by senior researchers (Costa et al., 2024a). Then, in the second stage, the full texts of the articles were read and revised. After completing this process, the selected articles were included in this systematic review. The flowchart for the selecting studies' process for this systematic review is illustrated in Figure 1 (Page et al., 2021).

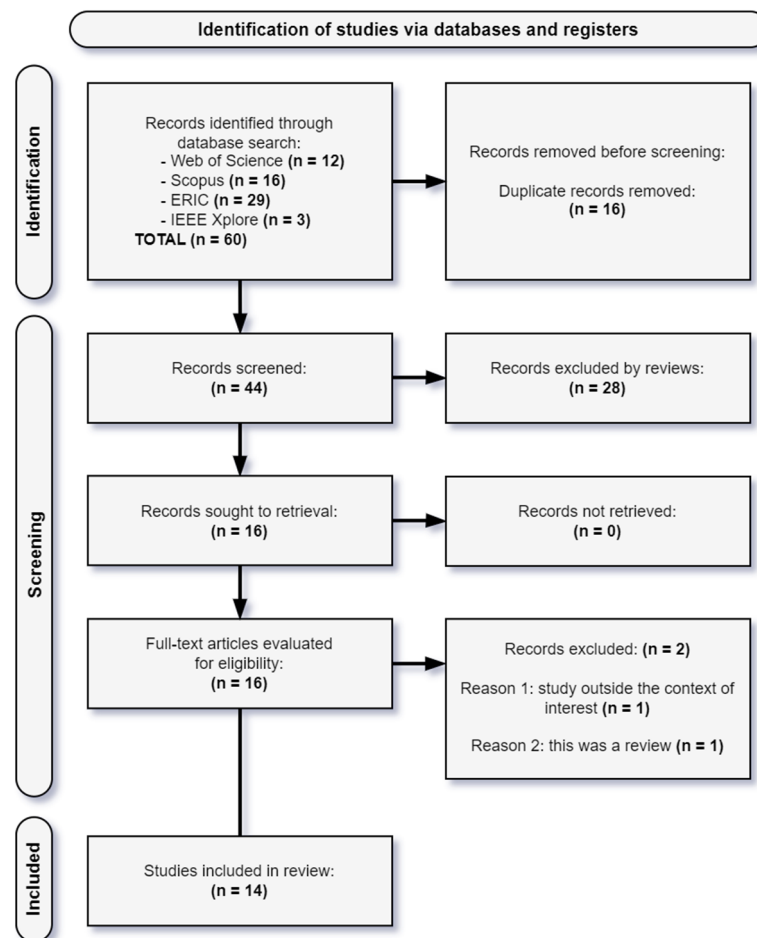


Figure 1. PRISMA 2020 flow diagram for identifying, screening, and including studies in this review.

2.4. Data Extraction

The full texts of the studies included in this systematic review were analyzed, and relevant data aligned with the research objective were extracted and synthesized. In this process, information on the characterization and design of the studies and the main highlights were taken into account, as summarized in a table (Erickson & Biedenweg, 2022).

2.5. Data Analysis

The content analysis technique (Bardin, 2016) was used to analyze the extracted data, structuring categories highlighting the main approaches to microlearning in the selected articles. This technique allows for flexibility in executing the stages as long as the process is straightforward and transparent, from the selection to the categorization and interpretation of the data (Câmara, 2013). The analysis followed a qualitative approach to answer the research questions, and in the quantitative and mixed studies, the quantitative synthesis was carried out first, quantifying the effect of each component, followed by the qualitative synthesis, identifying relevant characteristics (Costa et al., 2024a). In this way, the quantitative and qualitative data were transformed into categories/themes (Song et al., 2015). Therefore, we maintained the three main stages of content analysis: pre-analysis, exploration, and interpretation (Bardin, 2016).

In the pre-analysis phase, the sample corpus was constituted based on criteria such as homogeneity, completeness, relevance, objectivity, and representativeness, with the articles selected from international databases. The initial analysis involved reading the abstracts to check the relevance of inclusion in the research corpus. Following the rule of relevance (Bardin, 2016), articles with no direct relation to the topic were excluded.

In the exploration phase, the articles were read in full, pertinent notes were made, and the study was recorded in a spreadsheet containing the title, objectives, methods, primary results, and conclusions. The table allowed for the aggregation of papers with common characteristics in order to build categories. We opted for the categorical criterion, a content analysis technique, to transform the data into categories (Bardin, 2016). The recording units made it easier to understand the topic, and three categories were established and preliminarily defined: DICTs, Teaching–Learning Theory, and STSE.

In the last phase, the treatment and interpretation of the results condensed and highlighted the information in each category, highlighting convergent or innovative elements in the texts analyzed. This information was represented using diagrams, as described by (Melo et al., 2023).

2.6. Methodological Quality Assessment Approach

The quality of the included studies was assessed using two checklists. For qualitative studies, the Critical Appraisal Skills Program (CASP) was used for critical appraisal (Nadelson & Nadelson, 2014), while quantitative studies were assessed using the Downs and Black checklist (Downs & Black, 1998). The studies that adopted mixed methods were evaluated from both perspectives, with the qualitative results being analyzed using CASP and the quantitative results using the Downs and Black checklist.

The CASP checklist is widely used to assess the risk of bias in qualitative studies (Critical Appraisal Program Skills, 2018; Galdas et al., 2015; Long et al., 2020), considering three main questions in the assessment: “Are the results of the study valid?” (Section A), “What are the results?” (Section B) and “Will the results be useful locally?” (Section C) (Critical Appraisal Program Skills, 2018; Nadelson & Nadelson, 2014). In total, there are ten questions (Long et al., 2020; Nadelson & Nadelson, 2014), nine of which have objective answers classified as “yes” (2 points), “can’t say” (1 point) or “no” (0 points), with a maximum score of 18 (O’Dwyer et al., 2021). The last question is open-ended and requires a qualitative response (Critical Appraisal Program Skills, 2018). The overall quality of each assessed study is rated based on a three-star system: one star (0–6 points), two stars (7–12 points), and three stars (13–18 points) (O’Dwyer et al., 2021).

The Downs and Black checklist, comprising 27 items (Downs & Black, 1998), was adapted for this systematic review, as some items do not apply to the area in question. Thus, a reduced version was created with 10 selected items (items: 1–3, 7, 10–12, 16, 18, and 20). The quality score of each selected study was expressed as a percentage. Studies with a score $\geq 70\%$ were classified as being at “low risk of bias”, while those with a score $< 70\%$ were considered to be at “high risk of bias” (Downs & Black, 1998).

3. Results and Discussion

After analyzing the 14 articles included in this systematic review, it was observed that microlearning is presented from different practical perspectives and applied to various educational contexts and realities. The articles analyzed were organized in ascending order according to the year of publication, highlighting each study’s authorship, year, objective, results, and conclusion. The articles were identified with the letter “A”, followed by a numerical index reflecting their position in the database (Table 2).

Regarding the methodological approach, studies that used qualitative (four studies), quantitative (five studies), and mixed methods (five studies) were identified, showing a diversity of methods. Although the search included a ten-year time frame (2014–2024), it was only from 2018 onwards that the studies met all the eligibility criteria. When analyzing the objectives of the included studies, it became clear that the authors sought to investigate, analyze, evaluate, identify, promote, compare, and explore the use, implications, and

effectiveness of microlearning in basic education, with a focus on both student development and the role of teachers.

Table 2. Summary of the studies included in this systematic review ($n = 14$; time frame: 2018–2024).

ID	Author/Year	Summary of Objective	Results/Conclusion	Sample
A1	(Nikou & Economides, 2018)	Mobile microlearning for motivation and performance in science.	Improved motivation and performance.	108 high school students.
A2	(Surahman et al., 2019)	To evaluate the effect of hybrid training with microlearning on teacher performance.	Improved learning outcomes and interest in creating microlearning content.	31 teachers participating in a conference.
A3	(Epp & Phirangee, 2019)	Impact of a mobile tool on the vocabulary of English learners.	Effectiveness depends on the design of the learning activities.	47 high school students.
A4	(Dagiene et al., 2019)	Promoting creativity and computational thinking.	Effectiveness of microlearning for active learning.	87 elementary school students.
A5	(Allela et al., 2020)	Effectiveness of multimodal microlearning in teacher training.	Effective microlearning for teacher training.	130 teachers.
A6	(Birch & Lewis, 2020)	Microlearning and partnerships in distance learning during the pandemic.	Increased teacher confidence and effectiveness.	Almost 200 primary school teachers.
A7	(Zarshenas et al., 2020)	Comparing microlearning and gamification in controlling anxiety.	Both approaches are effective in controlling anxiety.	378 female secondary school students.
A8	(Alqarni, 2021)	Impact of microlearning on programming skills and motivation.	Microlearning improves skills and motivation.	78 secondary school students.
A9	(Almalki, 2021)	Microlearning for website design skills and motivation.	Effective design skills and motivation.	61 secondary school students.
A10	(Palti & Kima, 2022)	Promoting self-regulated learning and 21st-century skills.	Microlearning promotes SRL and 21st century skills.	23 elementary school students taking part in a conference.
A11	(Ma et al., 2023)	Impact of knowledge maps on online microlearning.	Improved engagement, knowledge structure, and performance.	42 teachers.
A12	(Gün Sahin & Kırmızıgül, 2023)	Effect of microlearning on conceptual and procedural knowledge in mathematics.	Contribution to conceptual and procedural knowledge development.	10 6th-grade students participating in a conference.
A13	(Herlambang, 2023)	Impact of social media on learning computer networks.	Positive impact on interests and learning outcomes.	80 vocational high school students.
A14	(Kohnke et al., 2024)	Effects of microlearning on professional digital competence.	Increased digital competence and integration of technology in teaching.	32 undergraduate students.

Note: SRL is short for Self-Regulation Learning skills.

The methodological designs employed in the different educational contexts reflect the variety of approaches in pedagogical research and the diversity of target populations. However, it was noted that not all the studies clearly specified the methods and instruments for collecting and analyzing data. It is noteworthy that the authors preferred the experimental design, which predominated in the studies that investigated the contributions of microlearning, with varied objectives and methods (Figure 2).

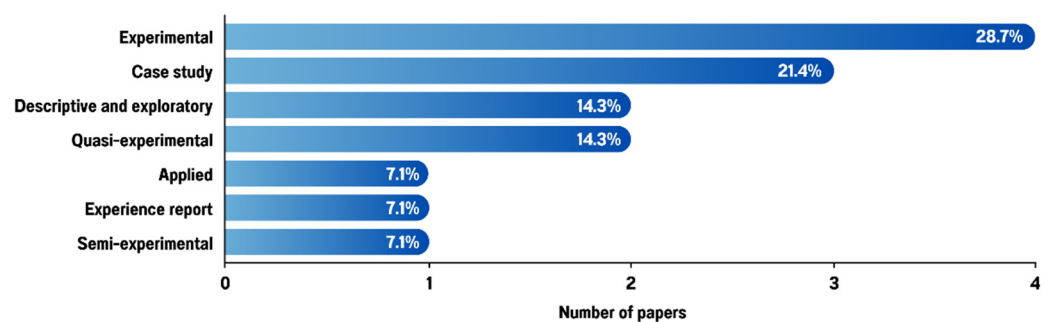


Figure 2. Methodological designs used in the studies included ($n = 14$).

The questionnaire was the most frequently used data collection instrument, appearing in 11 articles (78.6%). Pre- and post-tests were used in seven studies (50.0%). Observations and interviews were methods adopted in six studies (42.9%), while student feedback

was collected in three articles (21.4%). Less frequent instruments, such as system logs, WhatsApp group discussions, activity logs, and participant reflections, were used in only one study. It is worth noting that some studies used more than one data collection instrument, as shown in Figure 3.

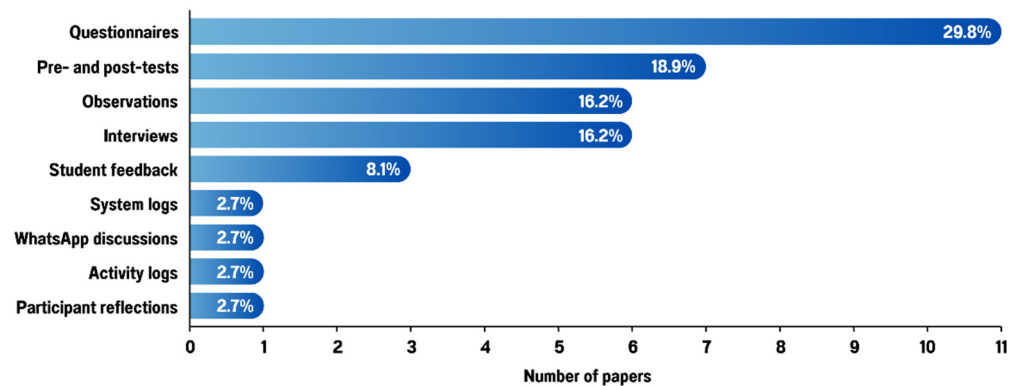


Figure 3. Data collection instruments used in the studies included ($n = 14$).

The data analyzed covered a wide range of samples, including primary and secondary school students, as well as teachers. Sample sizes ranged from small groups of a few participants to large groups with thousands of participants. Of the 14 studies included, the majority focused on students (10 studies), while the rest targeted teachers (four studies). The studies that looked at teachers analyzed various aspects of their work and training, varying in terms of location, number of participants, and specificity of subjects or positions.

The research was carried out in different regions of the world, with the highest concentration on the Asian continent (71.5%), followed by Europe (14.3%), North America (7.1%), and Africa (7.1%), as illustrated in Figure 4. This global panorama reveals a growing interest in microlearning in a variety of educational contexts, although the realities and needs of each region differ significantly. However, there are still a limited number of studies examining the effects of this practice on diverse populations, which makes it difficult to compare its application in different socio-economic contexts, highlighting the need for a broader evaluation of the effectiveness of microlearning in different contexts so that the conclusions can be more robust, comprehensive and generalizable.

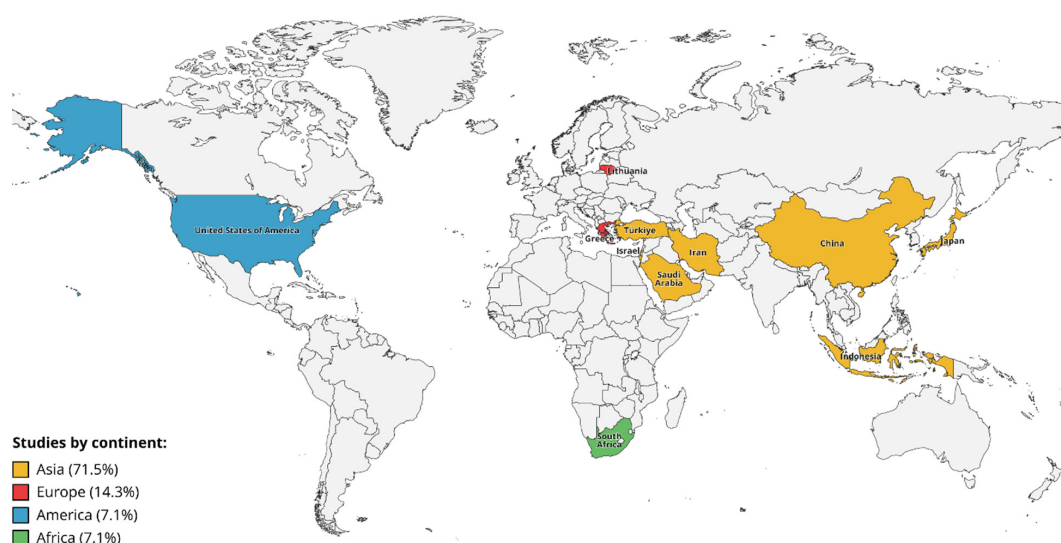


Figure 4. Studies on microlearning carried out by continent.

3.1. Content Analysis Results

The content analysis of the 14 articles that explored the use of digital technologies in education was conducted according to the guidelines (Bardin, 2016) for this technique. The categories, contexts, and recording units were carefully compared to identify similarities and differences, enabling a clearer understanding of how DICTs are being used in educational practice, as well as Teaching–Learning Theories and the social perspective of the STSE (Figure 5). The A4 paper has yet to be included in this diagram, as the authors of this study used an analog game, which does not fit into DICTs, indicated by the * symbol in the diagram.

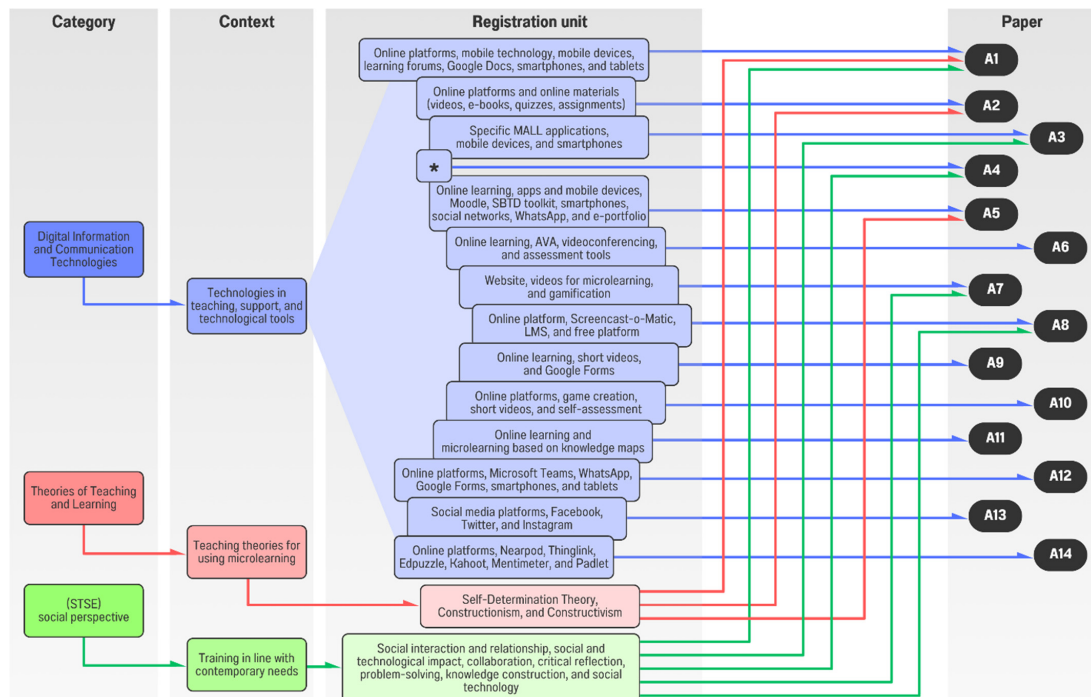


Figure 5. Analysis diagram of the categories, contexts, and recording units of the articles included.

Regarding DICTs, online platforms and mobile devices have been widely adopted as central tools for implementing microlearning. In a study carried out in Greece [A1], mobile devices such as smartphones and tablets were used to access microlearning content, including short videos and quizzes with immediate feedback (Nikou & Economides, 2018). This pattern of using mobile platforms and devices was also repeated in other studies, [A2] in Indonesia and [A5] in Africa, which highlighted the use of apps and digital tools for disseminating educational content (Allela et al., 2020; Surahman et al., 2019). However, the effectiveness of these tools varied depending on the context; the study [A8] indicated that microlearning contributed significantly to the development of programming skills (Alqarni, 2021), and the study [A3] indicated that the mobile approach was not enough to promote deep interactions between students over time (Epp & Phirangee, 2019), showing that the superficiality of the use of technological resources can compromise learning retention.

Online platforms have also been highlighted as an efficient means of extending the reach of microlearning, especially in teacher-training contexts. In a study carried out in California [A6], the use of videoconferencing and tools such as Google Forms allowed educators to participate in short-term training during the COVID-19 pandemic, adapting to their schedules (Birch & Lewis, 2020). Similarly, the study [A5] found that using the Moodle platform and communities of practice in instant messaging tools such as WhatsApp effectively promoted collaboration between educators in different contexts (Allela et al.,

2020). In Indonesia, another study [A2] found that a blended microlearning training model significantly improved educators' learning outcomes and motivation with access to diverse content via an online platform (Surahman et al., 2019). The findings of this latest study highlight the importance of ongoing teacher training for the effective integration of these technologies, emphasizing that for DICTs to be effective, educators need to be trained and motivated to use them in their pedagogical practices. Similarly, a study carried out in China [A11] investigated the use of knowledge maps on an online platform with a microlearning system and concluded that immediate feedback, offered through quizzes and micro assessments, promoted an increase in participant engagement and a more apparent structuring of knowledge, and these factors resulted in a positive impact on educator performance (Ma et al., 2023). The flexibility provided by these platforms was a common point among the studies, allowing learning to occur asynchronously and adapted to the users' pace. In line with the other studies included in this systematic review that integrated DICTs into their research to support microlearning with teachers, the exploration of the microlearning experience in the continuing education of teachers in computing stands out, highlighting its relevance for professional development (Matos et al., 2022).

Finally, the adaptability and accessibility of microlearning have proven to be a central point in several studies, especially in contexts where access to technology is limited. In the study [A5], using smartphones and mobile platforms was essential to ensure teachers could access content in regions with limited technology infrastructure (Allela et al., 2020). Similarly, the study [A6] highlighted how short microlearning sessions allowed teachers to adapt to distance learning during the COVID-19 pandemic, easily integrating new teaching strategies into their pedagogical practices (Birch & Lewis, 2020). The COVID-19 pandemic, a global health crisis caused by the SARS-CoV-2 virus (Algahtani et al., 2021), occurred between 2019 and 2023 and disrupted traditional education systems worldwide, necessitating rapid adaptation to distance learning methods and digital tools.

In response to RQ1, studies show that when combined with digital technologies, microlearning can effectively improve learning, motivation, performance, and interaction in educational environments. It can also engage students and teachers and promote the development of digital competencies. Integrating immediate feedback and promoting collaborative learning is key to maximizing the benefits of this methodology. These technologies have been highlighted for their relevance in implementing microlearning methods (Figure 6).

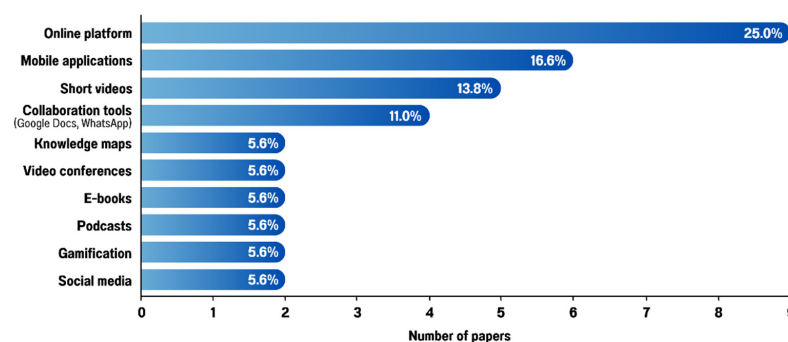


Figure 6. The most used DICTs in microlearning studies.

3.2. Learning Theories in Microlearning

Teaching theories guide pedagogical practice through concepts, principles, and strategies educational scholars develop to understand the teaching and learning process (Moreira, 1999). With regard to Teaching–Learning Theories, approaches such as Constructionism and Constructivism have emerged as important theoretical frameworks to support the use of microlearning. In several studies, such as [A1], [A5], and [A2], microlearning was

used to foster student autonomy and the active construction of knowledge, facilitating more personalized and dynamic learning (Allela et al., 2020; Nikou & Economides, 2018; Surahman et al., 2019). These studies have highlighted that microlearning, when well designed, can engage students by providing them with clear and accessible information that is appropriate to their level of knowledge and interest.

SDT explores how motivation influences human behavior and identifies basic psychological needs. The theory distinguishes between intrinsic motivation, which is internal and based on enjoyment of the activity, and extrinsic motivation, which is driven by external rewards. In the study [A1], SDT is applied to analyze student motivation in a mobile microlearning environment focused on homework assignments (Nikou & Economides, 2018). The research highlights that student motivation can be improved by meeting three fundamental psychological needs: autonomy, competence, and relatedness. The mobile microlearning approach (MBmLA) allows students to access learning units anytime and anywhere, promoting autonomy. In addition, interactive and timely feedback increases the perception of competence, while online collaboration between students strengthens the sense of relationship. SDT underpins the creation of a learning environment that supports these basic needs. Microlearning provides flexibility in accessing content and promotes self-direction and choice, which are essential for autonomy. Fast and interactive feedback helps students recognize their progress and develop their skills, increasing their perception of competence. Finally, social interaction and collaboration between students promote connection and mutual support, meeting the need for relationships. The application of SDT in mobile microlearning demonstrates how the theory can be adapted to modern educational contexts, using technology to facilitate learning. The research shows that satisfying the needs for autonomy, competence, and relatedness is associated with better learning outcomes and greater motivation, validating the theory and its relevance to current educational practices.

The research by (Dagiene et al., 2019), is based on the Constructionist Theory proposed by Seymour Papert, who argues that children learn best when they are actively involved in creating something meaningful such as projects or practical activities (Papert, 1980). Constructionist Theory is applied in the research by involving students in practical and creative activities that promote active learning. Students are encouraged to solve short tasks requiring creativity, allowing them to construct their knowledge by concretely interacting with computing concepts. In addition, group work and discussion between students are promoted, facilitating the exchange of ideas and the collective construction of knowledge. This practical and collaborative approach is central to applying constructionism, as students learn by doing and reflecting on their experiences.

In the study [A5], the authors used a socially mediated constructivist approach for teacher professional development (Allela et al., 2020). This approach emphasized collaborative learning, knowledge sharing in communities of practice, and microlearning to disseminate content in an interactive and participatory way. Constructivist Theory, supported by (Piaget, 1970) and (Vygotsky, 1980), underpinned the effectiveness of microlearning as a training strategy, guiding the structuring of the program and the evaluation of results. In practice, the theory manifested itself through active learning, where the participants built knowledge through experiences and reflections; collaboration, with group work and sharing of ideas; contextualization, linking learning to real situations and previous experiences; feedback and reflection, allowing for self-assessment and continuous adjustments; and flexibility, adapting the content to the learners' needs. These elements created a dynamic, student-centered learning environment where teachers and trainee educators applied new pedagogical strategies.

In response to RQ2, we observed that these three pedagogical theories provide a solid basis for microlearning, which creates effective learning environments that are motivating and adapted to the students' needs. They promote active and collaborative learning and enable the construction of knowledge in a contextualized and meaningful way.

3.3. STSE and the Social Perspective of Microlearning

Another important aspect highlighted in the studies was microlearning's social and technological impact in the educational context, especially concerning promoting collaboration and critical reflection. Studies such as [A5] and [A7], which investigated the use of microlearning for the development of teachers and adolescents, respectively, highlighted that this approach promoted group knowledge building and the development of collaborative skills (Allela et al., 2020; Zarshenas et al., 2020). However, the results of these studies also indicated the need for careful planning of microlearning activities to ensure that they encourage meaningful interactions between participants rather than just passively delivering content.

Although no work explicitly mentions the concept of the Science, Technology, Engineering, and Mathematics (STEM) education field, some of the studies evaluated incorporating elements that converge with its social perspectives (Costa et al., 2024b; Monarrez et al., 2024). These studies highlight the importance of aligning training with contemporary needs, such as social and technological impact, collaboration, inclusive education, critical reflection, problem-solving, and knowledge construction. This issue reflects the STSE-oriented approach to teaching, which seeks to establish connections between scientific and technological progress and its impact on society (Auler, 2007).

In response to RQ3, although [A1] does not explicitly mention the STSE approach, this research aligns with this perspective by exploring how DICTs impact education and society (Nikou & Economides, 2018). The study highlights the importance of social interaction and collaborative learning, promoting student connections, addressing collaboration issues, and building learning communities. In addition to improving school performance, technology strengthens social relationships, reflecting the principles of STSE. When using mobile devices, microlearning offers flexible and personalized access to content, promoting autonomy and collaborative activities, enriching the learning experience, and preparing students for the challenges of a technological and interconnected world.

Integrating social technologies from an STSE perspective through a mobile application can facilitate teaching, help overcome social barriers, and promote active learning (Epp & Phirangee, 2019), as observed in [A3]. These interactions, influenced by the social and educational context, promote meaningful, contextualized, and collaborative learning. However, the effectiveness of these technologies depends on how they are integrated and used in learning activities.

The study [A4] used microlearning to develop short tasks that teach computing concepts and encourage students to reflect on how these concepts relate to society and the environment by facilitating collaborative learning and knowledge-building (Dagiene et al., 2019). The tasks are formulated in an accessible format to stimulate discussions about the relevance of computing in social contexts, helping students see the practical application of what they learn. This approach helps students to develop critical thinking about technology and its role in society. In addition, when applied in a social context, microlearning increases student engagement and promotes a deeper understanding of computing concepts.

When approaching microlearning, integrating social technologies to promote mental health among adolescents, using the STSE perspective in the study [A7] that used short videos and gamification, facilitates access to knowledge and the interaction of female students with the content, demonstrating how technology can be used to address social

issues, such as anxiety, within a school context (Zarshenas et al., 2020) and engaging way. This approach improves the understanding of the content and promotes social interaction, reducing anxiety and strengthening mental health among adolescent girls, highlighting the importance of an interdisciplinary approach reflecting the interconnection between science, technology, and the participants' social environment. Social technologies play a key role in creating a learning environment that is accessible, dynamic, effective, and relevant to adolescents, allowing them to meaningfully connect with the content and promoting adolescent inclusion and active participation.

The study [A8] used microlearning to facilitate learning programming skills, providing short and accessible content that promotes student autonomy, motivation, interaction, and engagement, highlighting the interconnection between technology and education (Alqarni, 2021). By integrating social technologies, research promotes interaction and collaboration between students and teachers in the educational process. This integration connects students to knowledge in an interactive and accessible way, creating a learning environment that favors social interaction. The research reflects its impact on the formation of critical and aware citizens concerning the use of technology in society, as well as considering social and environmental needs, facilitating the construction of competencies relevant to the current context.

In line with STSE perspectives, social technologies are being used to develop Codecasts and Codelibras as teaching resources for programming in Massive Open Online Courses (MOOCs) (Oliveira, 2022). Podcasts combine audio and source code to explain programming concepts in a clear and engaging way, while Codelibras present source code entirely in Libras, allowing deaf students to access programming content in an inclusive and accessible way that meets the needs of different groups of students.

3.4. Methodological Quality Assessment

The results indicated a detailed assessment of the methodological quality of the studies included in this systematic review, using specific criteria for qualitative, quantitative, and mixed methods studies (Table 3). The application of CASP highlighted the predominance of qualitative studies with scores of three stars, indicating good quality; on the other hand, the adapted version of the Downs and Black checklist indicated that the quantitative assessment presented a low risk of bias, with scores of over 70%, except for one study, which obtained only 40%. Mixed-method studies were assessed from both qualitative and quantitative perspectives.

Table 3. Methodological quality assessment of the included studies ($n = 14$).

	Study (Year)	Conflict of Interest Was Reported?	Ethical Approval Was Reported?	Downs and Black Checklist												Total (0–10)	Score (%)
				Section A				Section B				Section C					
				01	02	03	07	10	11	12	16	18	20				
QUANTITATIVE (n = 5)																	
A1	(Nikou & Economides, 2018)	No	No	1	1	1	1	1	1	1	0	1	1	9/10	90%		
A7	(Zarshenas et al., 2020)	Yes	Yes	1	1	1	1	0	1	1	0	1	1	8/10	80%		
A8	(Alqarni, 2021)	No	No	1	1	1	0	1	1	1	0	1	1	8/10	80%		
A9	(Almalki, 2021)	No	No	1	1	1	1	1	?	?	0	1	1	7/10	70%		
A13	(Herlambang, 2023)	No	No	1	1	1	0	1	1	1	0	1	1	8/10	80%		
MIXED (n = 5) **																	
A2	(Surahman et al., 2019)	No	No	1	1	1	1	0	1	1	0	0	1	7/10	70%		
A3	(Epp & Phirangee, 2019)	Yes	No	1	1	1	1	1	1	?	0	1	1	8/10	80%		
A5	(Allela et al., 2020)	No	No	1	0	1	0	0	1	1	0	?	?	4/10	40%		
A10	(Palti & Kima, 2022)	No	Yes	1	1	1	0	1	1	1	0	0	1	7/10	70%		
A11	(Ma et al., 2023)	Yes	?	1	1	1	1	1	1	1	0	1	1	9/10	90%		

Table 3. Cont.

Study (Year)		Conflict of Interest Was Reported?	Ethical Approval Was Reported?	CASP Checklist												Total (0–10)	Score (Stars)
				Section A					Section B		Section C						
				01	02	03	04	05	06	07	08	09	10				
QUALITATIVE (n = 4)																	
A4	(Dagiene et al., 2019)	No	?	Yes	Yes	Yes	Yes	Yes	Yes	?	Yes	Yes	*	9/10	☆☆☆		
A6	(Birch & Lewis, 2020)	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	*	9/10	☆☆☆		
A12	(Cunha & Gurgel, 2016)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	*	10/10	☆☆☆		
A14	(Kohnke et al., 2024)	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	*	9/10	☆☆☆		
MIXED (n = 5) **																	
A2	(Surahman et al., 2019)	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	*	9/10	☆☆☆		
A3	(Epp & Phirangee, 2019)	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	*	9/10	☆☆☆		
A5	(Allela et al., 2020)	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	*	9/10	☆☆☆		
A10	(Palti & Kima, 2022)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	*	10/10	☆☆☆		
A11	(Ma et al., 2023)	Yes	?	Yes	Yes	Yes	Yes	Yes	Yes	?	Yes	Yes	*	9/10	☆☆☆		

Notes: Downs and Black checklist—Section A assessment the reporting: 01 (is the hypothesis/aim/objective of the study clearly described?), 02 (Are the main outcomes to be measured clearly described in the introduction or methods section?), 03 (Are the characteristics of the participants included in the study clearly described?), 07 (Does the study provide estimates of the random variability in the data for the main outcomes?), and 10 (Are 95% confidence intervals and/or p-values reported for the main results, except when $p < 0.001$?); Section B assessment the external validity: 11 (Was the sample representative of the entire population from which they were recruited?) and 12 (Was the sample containing the participants selected in such a way that it was representative in relation to the entire population from which they were recruited?); and Section C assessment the internal validity: 16 (If any of the results of the study were based on ‘data dredging’, was reported transparently?), 18 (Were the statistical tests used to assess the main outcomes appropriate?), and 20 (Were the main outcome measures used accurate, i.e., valid and reliable?). Questions 04, 05, 06, 08, 09, 13, 14, 15, 17, 19, and all of Section D were unsuitable for Social Sciences and Humanities studies; so, they were disregarded in this evaluation. CASP is the acronym for Critical Appraisal Skills Programme Qualitative Research Checklist—Section A assesses whether the results of the study are valid: 01 (Was there a clear statement of the aims of the research?), 02 (Is a qualitative methodology appropriate?), 03 (Was the research design appropriate to address the aims of the research?), 04 (Was the recruitment strategy appropriate to the aims of the research?), and 05 (Were the data collected in a way that addressed the research issue?); Section B assesses the results: 06 (Has the relationship between researcher and participants been adequately considered?) and 07 (Have ethical issues been taken into consideration?); and Section C assesses whether the results will be useful: 08 (Was the data analysis sufficiently rigorous?), and 09 (is there a clear statement of findings?). Qualitative studies were classified as low (one star: 0–3 points), medium (two stars: 4–7 points), and high quality (three stars: 8–10 points). The symbol ‘?’ indicates uncertainty or indeterminable. * Question 10 of the CASP (What is the value of the research?) was answered. ** Mixed-method studies were evaluated from both perspectives: Downs and Black and CASP.

3.5. Limitations of Microlearning in Basic Education

This study has some limitations that are worth highlighting. Firstly, although the terms are interrelated, much remains to be explored. This research was restricted to articles published in the last ten years and with language delimitation, which may have left out older studies that could offer relevant information. There is also the possibility of publication bias, in which investigations with positive results are more likely to be published than those with negative results. This review’s approach covered only some of the dimensions of microlearning in basic education, which could limit a comprehensive understanding of the topic. Finally, the perspectives on the concepts of STEM should be addressed in all studies, which suggests a more complete and comprehensive exploration should be conducted in future research.

4. Conclusions

This study demonstrates that microlearning, integrated with digital technologies such as online platforms, mobile applications, and short videos, is relevant in improving motivation, performance, and interaction in the educational environment. It also contributes to the development of digital skills and collaborative learning. Underpinned by contemporary theories such as SDT, Constructionism, and Constructivism, microlearning promotes active, contextualized, and meaningful learning adapted to the students’ needs.

From an STSE perspective, social technologies extend these benefits by fostering social interactions, autonomy, and critical reflection on the use of technologies and their social and environmental impacts, making learning more accessible, inclusive, and relevant to citizen education. The studies analyzed also highlighted the central role of this approach in personalizing teaching, increasing engagement and understanding of content, as well as stimulating critical thinking. By dividing content into short modules, microlearning facilitates knowledge retention and connects concepts to everyday situations, consolidating itself as an effective strategy in line with the demands of the contemporary educational context of digital technologies and mobile devices.

As a future perspective, there is a need for research in Brazil that explores the potential of microlearning through digital platforms and social networks, evaluating their ability to personalize learning, increase student engagement, and make learning more meaningful. Trends such as content segmentation, the use of mobile technologies, and gamified strategies should be further explored based on contemporary theories that support their application. In addition, it is essential to consider the social and ethical impacts of technology in education to develop accessible, inclusive, and innovative practices. These initiatives are indispensable for improving the quality of teaching, preparing students for the challenges of a digital and globalized world, and meeting the demands of a constantly evolving education driven by digital technologies.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/educsci15030302/s1>, Supplementary File S1: The PRISMA 2020 checklist for this systematic review; Supplementary File S2: The PRISMA 2020 for this systematic review' abstract checklist.

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Abbreviations

The following abbreviations are used in this manuscript:

COVID-19	Coronavirus Disease 2019
CASP	Critical Appraisal Skills Program

DICTs	Digital Information and Communication Technologies
ERIC	Educational Resources Information Center
IEEE	Institute of Electrical and Electronics Engineers
IFTM	Instituto Federal do Triângulo Mineiro
IF Goiano	Instituto Federal Goiano
LMS	Learning Management System
MOOCs	Massive Open Online Courses
MBmLA	Mobile microlearning approach
MALL	Mobile-Assisted Language Learning
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RQ1	Research Question 1
RQ2	Research Question 2
RQ3	Research Question 3
SBTD	School-Based Teacher Development
STEM	Science, Technology, Engineering, and Mathematics
STSE	Science, Technology, Society, and Environment
SDT	Self-Determination Theory
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
SDGs	Sustainable Development Goals
VLE	Virtual Learning Environment

References

- Algahtani, F. D., Hassan, S.-N., Alsaif, B., & Zrieq, R. (2021). Assessment of the quality of life during COVID-19 pandemic: A cross-sectional survey from the Kingdom of Saudi Arabia. *International Journal of Environmental Research and Public Health*, 18(3), 847. [\[CrossRef\]](#)
- Alias, N. F., & Razak, R. A. (2023). Exploring the pedagogical aspects of microlearning in educational settings: A systematic literature review. *Malaysian Journal of Learning and Instruction*, 20(2), 267–294. [\[CrossRef\]](#)
- Alias, N. F., & Razak, R. A. (2024). Revolutionizing learning in the digital age: A systematic literature review of microlearning strategies. *Interactive Learning Environments*, 1–21. [\[CrossRef\]](#)
- Allela, M. A., Ogange, B. O., Junaid, M. I., & Charles, P. B. (2020). Effectiveness of multimodal microlearning for in-service teacher training. *Journal of Learning for Development*, 7(3), 384–398. [\[CrossRef\]](#)
- Almalki, M. E. M. (2021). Designing a micro-learning-based learning environment and its impact on website designing skills and achievement motivation among secondary school students. *International Journal of Computer Science and Network Security*, 21(12), 335–343. [\[CrossRef\]](#)
- Alqarni, A. S. (2021). The effect of microlearning on programing skill enhancements and learning motivation among the secondary school students. *International Journal of Computer Science and Network Security*, 21(10), 168–176. [\[CrossRef\]](#)
- Auler, D. (2007). Enfoque ciência-tecnologia-sociedade: Pressupostos para o contexto brasileiro. *Ciência & Ensino*, 1, 1.
- Álvarez-Gálvez, J., Ortega-Martín, E., Carretero-Bravo, J., Pérez-Muñoz, C., Suárez-Lledó, V., & Ramos-Fiol, B. (2023). Social determinants of multimorbidity patterns: A systematic review. *Frontiers in Public Health*, 11, 1081518. [\[CrossRef\]](#)
- Bardin, L. (2016). *Content analysis* (3rd ed., Vol. 70). Edições.
- Birch, R., & Lewis, K. (2020). Building partnerships to support teachers with distance learning during the COVID-19 pandemic: Cohorts, confidence, and microteaching. *Issues in Teacher Education*, 29, 149–157.
- Câmara, R. H. (2013). Content analysis: From theory to practice in social research applied to organizations. *Gerais: Revista Interinstitucional de Psicologia*, 6(2), 179–191.
- Chilton, H., & McCracken, W. (2017). New technology, changing pedagogies? Exploring the concept of remote teaching placement supervision. *Higher Education Pedagogies*, 2(1), 116–130. [\[CrossRef\]](#)
- Chomunorwa, S., Mashonganyika, E., & Marevesa, A. (2023). Digital transformation and post-COVID-19 education in South Africa: A review of literature. *South African Computer Journal*, 35(1), 91–100. [\[CrossRef\]](#)
- Choudhary, H., & Pandita, D. (2024). Maximizing learning outcomes in the digital age: The role of microlearning for Gen Z. *Development and Learning in Organizations: An International Journal*, 38(3), 15–18. [\[CrossRef\]](#)
- Costa, W. P., Fernandes, M. S. V., Memon, A. R., Noll, P. R. E. S., Sousa, M. M., & Noll, M. (2024a). Factors influencing the work of researchers in Scientific Initiation: A systematic review protocol. *PLoS ONE*, 19(1), e0297186. [\[CrossRef\]](#) [\[PubMed\]](#)

- Costa, W. P., Melo, A. F., Venâncio, P. E. M., São Bernardo, M. A., Noll, P. R. E. S., & Noll, M. (2024b). Students' research experience, self-perceptions, and scientific productivity in undergraduate research programs: A case study of a Brazilian Midwest Institute. *Innovations in Education and Teaching International*, 1–16. [CrossRef]
- Critical Appraisal Programm Skills. (2018). *CASP qualitative checklist*. Available online: <https://casp-uk.net/checklists-archive/casp-qualitative-studies-checklist-fillable.pdf> (accessed on 20 December 2024).
- Cruz, E. P. F., Gomes, G. R. R., & Azevedo Filho, E. T. (2022). Microlearning as a new techno-pedagogical approach: A review. *Research, Society and Development*, 11(6), e47611629548. [CrossRef]
- Cunha, R., & Gurgel, R. (2016, October 24–27). *Práticas de inclusão digital na educação de jovens e adultos: Minicurso de introdução à informática. Proceedings of the XXII Workshop de Informática na Escola (WIE 2016)* (pp. 417–426), Uberlândia, Brazil. [CrossRef]
- Dagiene, V., Futschek, G., & Stupuriene, G. (2019). Creativity in solving short tasks for learning computational thinking. *Constructivist Foundations*, 14(3), 382–396.
- De Gagne, J. C., Park, H. K., Hall, K., Woodward, A., Yamane, S., & Kim, S. S. (2019). Microlearning in health professions education: Scoping review. *JMIR Medical Education*, 5(2), e13997. [CrossRef] [PubMed]
- Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, 125(6), 627–668. [CrossRef] [PubMed]
- Dixon-Woods, M., Agarwal, S., Jones, D., Young, B., & Sutton, A. (2005). Synthesising qualitative and quantitative evidence: A review of possible methods. *Journal of Health Services Research & Policy*, 10(1), 45–53. [CrossRef]
- Díaz-García, V., Montero-Navarro, A., Rodríguez-Sánchez, J.-L., & Gallego-Losada, R. (2022). Digitalization and digital transformation in higher education: A bibliometric analysis. *Frontiers in Psychology*, 13, 1081595. [CrossRef] [PubMed]
- Downs, S. H., & Black, N. (1998). The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. *Journal of Epidemiology & Community Health*, 52(6), 377–384. [CrossRef]
- Epp, C. D., & Phirangee, K. (2019). Exploring mobile tool integration: Design activities carefully or students may not learn. *Contemporary Educational Psychology*, 59, 101791. [CrossRef]
- Erickson, B. D., & Biedenweg, K. (2022). Distrust within protected area and natural resource management: A systematic review protocol. *PLoS ONE*, 17(3), e0265353. [CrossRef]
- Filatro, A., & Cavalcanti, C. C. (2022). *Metodologias inov-ativas na educação presencial, a distância e corporativa* (2nd ed.). Saraiva Uni.
- Galdas, P., Darwin, Z., Fell, J., Kidd, L., Bower, P., Blickem, C., McPherson, K., Hunt, K., Gilbody, S., & Richardson, G. (2015). A systematic review and metaethnography to identify how effective, cost-effective, accessible and acceptable self-management support interventions are for men with long-term conditions (SELF-MAN). *Health and Social Care Delivery Research*, 3, 34. [CrossRef] [PubMed]
- González-Salamanca, J. C., Agudelo, O. L., & Salinas, J. (2020). Key competences, education for sustainable development and strategies for the development of 21st Century skills. A systematic literature review. *Sustainability*, 12(24), 10366. [CrossRef]
- Grant, M. J., & Booth, A. (2009). A typology of reviews: An analysis of 14 review types and associated methodologies. *Health Information & Libraries Journal*, 26(2), 91–108. [CrossRef]
- Gün Sahin, Z., & Kırmızıgül, H. G. (2023). Teaching mathematics through micro-learning in the context of conceptual and procedural knowledge. *International Journal of Psychology and Educational Studies*, 10(1), 241–260. [CrossRef]
- Gylfason, T. (2001). Natural resources, education, and economic development. *European Economic Review*, 45(4–6), 847–859. [CrossRef]
- Hamel, R. E. (2007). The dominance of English in the international scientific periodical literature and the future of language use in science. *AILA Review*, 20, 53–71. [CrossRef]
- Herlambang, A. D. (2023, December 8–9). *Social media platforms utilization influence on the vocational high school students' learning interests and learning outcomes in computer network subjects*. 2023 Eighth International Conference on Informatics and Computing (ICIC) (pp. 1–7), Malang, Indonesia. [CrossRef]
- Hug, T. (2005, May 6–8). *Micro learning and narration exploring possibilities of utilization of narrations and storytelling for the designing of "micro units" and didactical micro-learning arrangements*. Web.Mit.Edu MiT4: The Work of Stories, Proceedings of the Fourth Media in Transition Conference, Cambridge, MA, USA.
- Kabilan, M. K., Annamalai, N., & Chuah, K.-M. (2023). Practices, purposes and challenges in integrating gamification using technology: A mixed-methods study on university academics. *Education and Information Technologies*, 28(11), 14249–14281. [CrossRef] [PubMed]
- Kaushik, M. K., & Verma, D. (2019). Determinants of digital learning acceptance behavior. *Journal of Applied Research in Higher Education*, 12(4), 659–672. [CrossRef]
- Ko, M., Choi, S., Yatani, K., & Lee, U. (2016, May 7–12). *Lock n' LoL: Group-based limiting assistance app to mitigate smartphone distractions in group activities*. 2016 CHI Conference on Human Factors in Computing Systems (pp. 998–1010), San Jose, USA. [CrossRef]
- Kohnke, L., Fong, D., Zou, D., & Jiang, M. (2024). Creating the conditions for professional digital competence through microlearning. *Educational Technology & Society*, 27(1), 183–197. [CrossRef]

- Langreiter, C., & Bolka, A. (2005, June 23–24). *Snips & spaces: Managing microlearning*. To Appear in Proceedings of the Microlearning Conference 2005, Innsbruck, Austria.
- Lin, T.-Y., Yang, C.-C., & Huang, B.-R. (2023). Going beyond language learning: A microlearning instructional design to promote EFL learners' collaboration competency. *International Journal of Emerging Technologies in Learning (IJET)*, 18(12), 224–251. [\[CrossRef\]](#)
- Long, H. A., French, D. P., & Brooks, J. M. (2020). Optimising the value of the Critical Appraisal Skills Programme (CASP) tool for quality appraisal in qualitative evidence synthesis. *Research Methods in Medicine & Health Sciences*, 1(1), 31–42. [\[CrossRef\]](#)
- Ma, N., Zhao, F., Zhou, P.-Q., He, J.-J., & Du, L. (2023). Knowledge map-based online micro-learning: Impacts on learning engagement, knowledge structure, and learning performance of in-service teachers. *Interactive Learning Environments*, 31(5), 2751–2766. [\[CrossRef\]](#)
- Martin, S., Diaz, G., Sancristobal, E., Gil, R., Castro, M., & Peire, J. (2011). New technology trends in education: Seven years of forecasts and convergence. *Computers & Education*, 57(3), 1893–1906. [\[CrossRef\]](#)
- Matos, E. S., Coutinho, C. B., Zabot, D., Tavares, G. O., Santos, J. M. O., Azevedo, L., & Serra, C. S. C. (2022, July 31–August 5). *Experiência de microlearning na formação continuada de professores em computação*. Proceedings of the XXX Workshop Sobre Educação em Computação (WEI 2022) (pp. 109–120), Niterói, Brazil. [\[CrossRef\]](#)
- Melitz, J. (2018). English as a lingua franca: Facts, benefits and costs. *The World Economy*, 41(7), 1750–1774. [\[CrossRef\]](#)
- Melo, A. F., Costa, W. P., Rodrigues, R. R., Nunes, L. A. C. B., Noll, P. R. E. S., & Noll, M. (2023). Panorama of undergraduate research in Brazil: Profile, scientific production, and perceptions. *Publications*, 11(2), 30. [\[CrossRef\]](#)
- Mohammed, G. S., Wakil, K., & Nawroly, S. S. (2018). The effectiveness of microlearning to improve students' learning ability. *International Journal of Educational Research Review*, 3(3), 32–38. [\[CrossRef\]](#)
- Monarrez, A., Frederick, A., Morales, D. X., Echegoyen, L. E., & Wagler, A. (2024). Hispanic/Latinx STEM majors applying to graduate school: The role of family, peers, and undergraduate research programs in facilitating community cultural wealth. *Journal of Latinos and Education*, 23(1), 205–219. [\[CrossRef\]](#)
- Moreira, M. A. (1999). *Teorias de aprendizagem*. Editora Pedagógica e Universitária.
- Munn, Z., Stern, C., Aromataris, E., Lockwood, C., & Jordan, Z. (2018). What kind of systematic review should I conduct? A proposed typology and guidance for systematic reviewers in the medical and health sciences. *BMC Medical Research Methodology*, 18(1), 1–9. [\[CrossRef\]](#) [\[PubMed\]](#)
- Nadelson, S., & Nadelson, L. S. (2014). Evidence-based practice article reviews using CASP tools: A method for teaching EBP. *Worldviews on Evidence-Based Nursing*, 11(5), 344–346. [\[CrossRef\]](#)
- Nasution, A. K. P. (2022). Education technology research trends in Indonesia during the COVID-19 pandemic. *Asia Pacific Journal of Educators and Education*, 36(2), 65–76. [\[CrossRef\]](#)
- Nikou, S. A., & Economides, A. A. (2018). Mobile-based micro-learning and assessment: Impact on learning performance and motivation of high school students. *Journal of Computer Assisted Learning*, 34(3), 269–278. [\[CrossRef\]](#)
- O'Dwyer, C., Tarzia, L., Fernbacher, S., & Hegarty, K. (2021). Health professionals' experiences of providing trauma-informed care in acute psychiatric inpatient settings: A scoping review. *Trauma, Violence, & Abuse*, 22(5), 1057–1067. [\[CrossRef\]](#)
- Oliveira, M. G. (2022, April 24–29). *Codecasts e codelibras para o ensino de programação em Moocs*. Extended Proceedings of the II Simpósio Brasileiro de Educação em Computação (EDUCOMP Estendido 2022) (pp. 01–02), Feira de Santana, Brazil. [\[CrossRef\]](#)
- Orakcı, Ş. (2021). Exploring the relationships between cognitive flexibility, learner autonomy, and reflective thinking. *Thinking Skills and Creativity*, 41, 100838. [\[CrossRef\]](#)
- Ouzzani, M., Hammady, H., Fedorowicz, Z., & Elmagarmid, A. (2016). Rayyan—A web and mobile app for systematic reviews. *Systematic Reviews*, 5(1), 1–10. [\[CrossRef\]](#) [\[PubMed\]](#)
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., . . . Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372(71), 1–9. [\[CrossRef\]](#)
- Palti, A., & Kima, R. B. R. (2022, June 19–23). *Self-regulated learning with task-centered microlearning*. Proceedings of the 16th International Conference of the Learning Sciences-ICLS 2022 (pp. 1954–1955), Nashville, TN, USA. Available online: <https://repository.isls.org/handle/1/9000> (accessed on 24 August 2024).
- Papert, S. A. (1980). *Mindstorms: Children, computers, and powerful ideas*. Basic Books.
- Pereira, N. G., Silva, R. M. F., Oliveira, I. F. R., Fernandes, M. S. V., Costa, W. P., Vitta, A., Noll, P. R. E. S., & Noll, M. (2023). Administrative professionals' quality of life in educational institutions: A systematic review protocol. *BMJ Open*, 13(8), e074119. [\[CrossRef\]](#) [\[PubMed\]](#)
- Pérez-Neri, I., Pineda, C., Flores-Guerrero, J. L., Estêvão, M. D., Vasanthan, L. T., Lorente, S., García-González, R., Devulapalli, V., Weerasekara, I., Aguiar, D. R., Barros-Sevillano, S., Le, L. K.-D., & Sandoval, H. (2022). Adherence to literature search reporting guidelines in leading rheumatology journals' systematic reviews: Umbrella review protocol. *Rheumatology International*, 42(12), 2135–2140. [\[CrossRef\]](#)

- Piaget, J. (1970). *The science of education and the psychology of the child*. Orion Press.
- Pullin, A. S., & Stewart, G. B. (2006). Guidelines for systematic review in conservation and environmental management. *Conservation Biology*, 20(6), 1647–1656. [CrossRef] [PubMed]
- Rahutomo, R., Hiererra, S. E., Arifin, Y., Suprayogi, M. N., & Pardamean, B. (2023, August 24–25). *Fundamental components of microlearning for sustainable quality education: A systematic literature review*. 2023 International Conference on Information Management and Technology (ICIMTech) (pp. 684–689), Malang, Indonesia. [CrossRef]
- Rios, D. L. S., Gomes, A. S., Alves, F. O. M., Pereira, A. J., & Queiros, L. M. (2023). Applicability of microlearning for mobile devices. *Renote*, 20(2), 269–279. [CrossRef]
- Ruesch, J. M., & Sarvary, M. A. (2024). Structure and flexibility: Systemic and explicit assignment extensions foster an inclusive learning environment. *Frontiers in Education*, 9, 1324506. [CrossRef]
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68–78. [CrossRef] [PubMed]
- Sangwal, K. (2013). Some citation-related characteristics of scientific journals published in individual countries. *Scientometrics*, 97(3), 719–741. [CrossRef] [PubMed]
- Song, T., Ding, Y., Sun, Y., He, Y.-N., Qi, D., Wu, Y., Wu, B., Lang, L., Yu, K., Zhao, X., Zhu, L., Wang, S., & Yu, X.-S. (2015). A population-based study on health-related quality of life among urban community residents in Shenyang, Northeast of China. *BMC Public Health*, 15(1), 921. [CrossRef]
- Sozmen, E. Y. (2022). Perspective on pros and cons of microlearning in health education. *Essays in Biochemistry*, 66(1), 39–44. [CrossRef] [PubMed]
- Surahman, E., Sulthoni, Ulfa, S., Husna, A., Slamet, T. I., Qolbi, M. S., Setiawan, A. B., At Thaariq, Z. Z., & Diana, R. C. (2019, October 4–5). *The effect of blended training model to improving learning outcomes: A case in micro learning object training*. 2019 5th International Conference on Education and Technology (ICET) (pp. 33–38), Malang, Indonesia. [CrossRef]
- Tan, L., Balakrishnan, N., & Varma, N. (2022). Teaching ST concepts during a pandemic: Modes for engaging learners. *Asia Pacific Journal of Educators and Education*, 37(1), 157–179. [CrossRef]
- Terra, L. F., Costa, W. P., Silva, R. M. F., Rezende, L. M. T., Noll, M., & Noll, P. R. E. S. (2023). Interventions towards barriers to the practice of physical activity in adolescence: A systematic review protocol. *PLoS ONE*, 18(7), e0287868. [CrossRef] [PubMed]
- United Nations. (2024). *United Nations transforming our world: The 2030 agenda for sustainable development*. Available online: <https://sdgs.un.org/2030agenda> (accessed on 12 May 2024).
- Vygotsky, L. S. (1980). *Mind in society: Development of higher psychological processes* (M. Cole, V. Jolm-Steiner, S. Scribner, & E. Souberman, Eds.). Harvard University Press. [CrossRef]
- Zarshenas, L., Saranjam, E., Mehrabi, M., & Setoodeh, G. (2020). Microlearning and gamification in anxiety management among girl adolescents in Iran: An interventional study. *Pakistan Journal of Medical & Health Sciences*, 14(1), 422–450.
- Zavodna, M., Mrazova, M., Poruba, J., Javorcik, T., Guncaga, J., Havlaskova, T., Tran, D., & Kostolanyova, K. (2024). Microlearning: Innovative digital learning for various educational contexts and groups. *European Conference on E-Learning*, 23(1), 442–450. [CrossRef]

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