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# A Systematic Literature Review of Technology-Supported Integers Instruction

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**Abstract**
Understanding integers is a fundamental component of mathematics learning; however, many students experience difficulties in mastering this concept. The integration of technology as a digital learning media offers potential opportunities to enhance students' conceptual understanding of integers. The objective of this study is to provide a comprehensive synthesis of empirical evidence on the integration of technology in integers learning. A systematic literature review was conducted using the PRISMA methodology to identify, screen, and evaluate relevant articles from the Scopus and ERIC databases. The review process, which employed inclusion criteria, yielded nine selected articles published between 2006 and 2024. The results indicate that research on technology integration in integer learning is dominated by studies conducted in Indonesia, followed by Turkey, Pakistan, and Greece, with the majority of participants coming from elementary and secondary education levels. These findings also indicate a prevalence of technologies with varying levels of interactivity, categorized as high, medium, and low. Furthermore, across all these studies, the integration of technology consistently demonstrated a positive impact on students' cognitive and affective outcomes, as well as on the overall learning process.
**Keywords:** Educational technology; integers; mathematics education; systematic literature review; technology-supported learning

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## INTRODUCTION

In the era of digitalization, the acceleration of technological transformation has created a new learning ecosystem that demands a paradigm shift in education, particularly in mathematics education (Mustafa, 2024). Various innovations, ranging from interactive simulations, animated videos, educational games, to augmented/virtual reality (AR/VR) and intelligent tutoring systems based on artificial intelligence, not only expand the representation of concepts but also allow personalization of learning pace according to individual needs (Muhaimin et al., 2025). Within the TPACK (Technological Pedagogical Content Knowledge) framework, the quality of mathematics learning now greatly depends on the synergy between content depth, pedagogical strategies, and the affordances of technology (Kholid et al., 2023). The principle of the Cognitive Theory of Multimedia Learning emphasizes the importance of aligning verbal and visual modalities to optimize cognitive processing (Mayer, 2024), while according to Cognitive Load Theory, non-intuitive interfaces can trigger a division of attention, thereby increasing unnecessary cognitive load and hindering learning efficiency (Ouwehand et al., 2025; Sweller, 2011), making this a primary concern in the current context of digital learning. Therefore, this context forms the foundation for re-examining the ways fundamental mathematical concepts are taught.

One of the fundamental concepts that plays a central role in the hierarchy of mathematical knowledge is the integers. As an important prerequisite for algebraic and advanced mathematical topics (Yu et al., 2024). Understanding integers supports mastery of the broader number system (Anton & Abrahamson, 2025) while also forming the foundation for formal reasoning at subsequent levels. Awareness of this urgency drives the introduction of integers as early as elementary school, so that students have sufficient time to build conceptual understanding before engaging with more complex material (Cetin, 2019). A deep understanding of integers encompasses not only procedural knowledge but also comprehension of why the procedures work. When students are able to represent and internalize the rules of positive and negative numbers in real-life contexts, they build a bridge between abstract concepts and concrete experiences (Anton & Abrahamson, 2025). According to Novita et al. (2025) The balance between conceptual and procedural knowledge will improve achievement and long-term retention.

In this regard, technology integration has the potential to act as a significant catalyst in integer learning. Dynamic visualization on digital number lines, educational games that replicate real-world scenarios, or adaptive feedback from intelligent tutoring systems can facilitate the transition from concrete to abstract understanding (Woods et al., 2018). Nevertheless, the success of such integration depends heavily on its alignment with TPACK principles and multimedia learning theories. If technology is used merely as a "feature-rich" tool without pedagogical grounding, it may increase students' cognitive load and hinder, rather than support, meaningful understanding.

Nevertheless, empirical evidence regarding the effectiveness of technology in integer learning still shows mixed results. Meta-analyses by Burns et al. (2025) confirmed a moderate positive effect of technology on mathematics learning outcomes, but also highlighted the wide variation of effect sizes across studies. Some research reported increased motivation and conceptual understanding through narrative-based educational games, while other studies found a surge in cognitive load when Augmented Reality (AR) interfaces were not designed according to the principles of segmentation and spatiotemporal contiguity. The phenomenon of "technology-rich but pedagogy-poor" illustrates the situation where sophisticated devices are used merely as digital projectors without transforming epistemologies of learning, in line with the warning of instrumental genesis theory that an artifact only becomes an educational instrument after meaningful appropriation by teachers and students (Aagaard et al., 2025).

The use of technology as a learning medium for integers holds great potential in helping students overcome conceptual barriers that often arise, such as errors in understanding operations of addition and subtraction with negative numbers. Although a number of previous studies have examined technology integration in mathematics learning, most of these works have focused on mathematics education in general without specifically addressing the topic of integers (Hanifah et al., 2025; A. Hidayat & Firmanti, 2024; Kholid et al., 2023; Tang et al., 2023). Yet, integers are one of the fundamental concepts that serve as prerequisites for mastering algebra and higher-order mathematical reasoning. Therefore, this study aims to conduct a systematic literature review on technology integration in integers learning within mathematics education. Specifically, this study seeks to describe journal articles on the topic and answer the following research questions: (1) what are the trends of research based on research location and participants?; (2) what technologies or digital media are used in studies of integers learning?; and (3) what are the positive impacts of technology use in integers learning?

## METHODS

This study uses a Systematic Literature Review (SLR) to answer the research questions. Gusenbauer and Gauster (2025) suggests that the initial stage in carrying out an SLR is to develop a protocol that clearly defines: (1) scoping for the objectives and targets of the analysis plan; (2) the inclusion and exclusion criteria of the studies; (3) how to identify the studies (searching); and (4) the analysis plan. To ensure that the protocol is properly implemented, this study uses the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach as proposed by Albhirat et al. (2024), which consists of four review stages, namely identification, screening, eligibility, and included (see Figure 1).

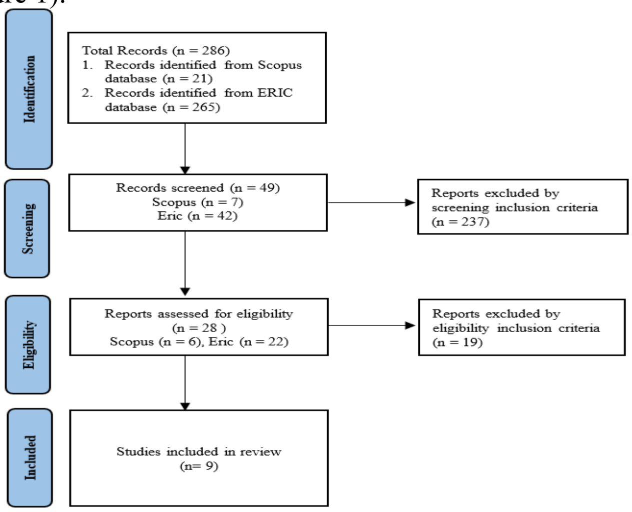

Figure 1. PRISMA Flowchart

### *Identification*

The identification stage in this study was carried out by determining the keywords used to search for the required research articles. The databases used in this study are Scopus and ERIC. The Scopus database is a comprehensive database in the academic field (Phuong et al., 2023), while ERIC consistently provides unique references for educational research that can complement other databases (Lam et al., 2024). The article search was conducted on 15 June 2025 using the following keywords: ((“Student” OR “Students”) AND (“Technology” OR “Digital Media Learning” OR “Digital Multimedia”) AND (“Mathematics Education” OR “Mathematics Learning”) AND (“Integers” OR “Integer”)). Using these keywords, a total of 114 articles were obtained, consisting of 21 articles from Scopus and 265 articles from the ERIC database.

### *Screening*

At this stage, the identified articles were further screened based on the inclusion criteria set out in Table 1 below. Based on the inclusion criteria in Table 1, a total of 7 articles from the Scopus database and 42 articles from the ERIC database met the requirements. Thus, there were 49 articles that fulfilled the inclusion criteria at the screening stage.

Table 1. Inclusion and Exclusion Criteria for Screening Stage

| Criteria | Inclusion | Exclusion |
|---|---|---|
| Type of publication | Journal article of conference proceeding | Others |
| Language | English | Others |
| Publication stage | Final | Article in press |
| Accessibility | Open access | Close access |
| Year | 2006 – 2024 | Outside from 2006 – 2024 |

### *Eligibility*

The eligibility stage was carried out by selecting the articles that had passed the screening stage based on the eligibility criteria shown in Table 2, which include the appropriateness of the abstract and title, field of study, and type of research. Based on the criteria in Table 2, six articles from the Scopus database and 22 articles from the ERIC database met the requirements. Thus, there were 28 articles that fulfilled the eligibility criteria.

Table 2. Inclusion and Exclusion Criteria for Eligibility Stage

| Criteria | Inclusion | Exclusion |
|---|---|---|
| Article title and abstract | An appropriate title and abstract that complied with the study's requirements | Did not match requirements of study and were irrelevant |
| Field of study | Mathematics education | Others |
| Type of research | Original research | Review or others |

### *Included*

The final stage after eligibility is the included stage. At this stage, a more detailed examination of the article content was carried out to assess the relevance of the content or the appropriateness of the articles in relation to the research questions posed. Of the 28 articles that met the eligibility stage, 19 were excluded mainly due to irrelevance to the purpose of the SLR in answering the research questions. Thus, only nine articles were included for further analysis, with their identities presented in Table 3 below.

Table 3. List of Articles Included

| Authors | Article Title |
|---|---|
| Imania et al. (2021) | The development of interactive learning multimedia in teaching mathematics (integer number) to junior high school students |
| Suryanti et al. (2020) | Augmented Reality for Integer Learning: Investigating its potential on students' critical thinking |
| Rahmawati et al. (2024) | The implementation of Powtoon audiovisual media in learning mathematics on integer numbers |
| Cetin (2019) | Explaining the Concept and Operations of Integer in Primary School Mathematics Teaching: Opposite Model Sample |
| Aris et al. (2017) | Design Study: Integer Subtraction Operation Teaching Learning using Multimedia in Primary School |
| Wulandari and Damayanti (2018) | Scaffolding Based on Telolet Game in Teaching Integers |
| Şengül and Dereli (2013) | The Effect of Learning Integers Using Cartoons on 7th Grade Students' Attitude to Mathematics |

| | |
|---|---|
| Afzal et al. (2014) | The effect of Computer-Based Instructional Technique for the Learning of Elementary Level Mathematics Among High, Average, and Low Achievers |
| Panagiotakopoulos (2011) | Applying a Conceptual Mini Game for Supporting Simple Mathematical Calculation Skills: Students' Perceptions and Considerations |

***Data Extraction and Analysis***

The data extraction process from the selected articles involved the identification of key information, including the year of publication, the research location, the research participants, the type of technological device, and the impact of technology use in learning. The data obtained was subsequently compiled into an extraction table to facilitate the analysis process. Next, the data analysis was conducted using thematic analysis, particularly to answer research questions regarding technological devices and the impact of their use in integer learning. The thematic analysis steps employed in this study were adapted from Braun and Clarke (2019), as drawed in Figure 2 below. Moreover, a quantitative analysis was conducted on the numerical data, which included publication frequency in relation to research trends in location and research participants. The results of the analysis are presented in tables or diagrams to show the trend of the selected research.

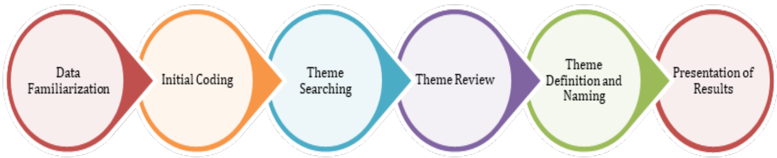


Figure 2. Thematics Analysis Stages

## RESULTS & DISCUSSION

***Results***

**Research Trends based on Research Location and Participants**

The distribution of publications based on research location and research participants from nine selected articles in the systematic literature review is presented below to provide an overview of the development and trends in research on the topics studied.

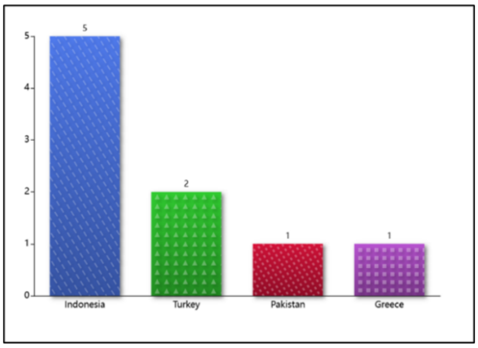


Figure 3. Distribution of Publication by Research Location (Source: Authors' Own Elaboration)

Figure 3 shows the number of publications from nine analyzed articles based on research location. Indonesia is the country with the highest number of publications with five publications (i.e., Aris et al., 2017; Imania et al., 2021; Rahmawati et al., 2024; Suryanti et al., 2020; Wulandari & Damayanti, 2018). Turkey has two publications are Cetin (2019) and Şengül and Dereli (2013), while Pakistan is Afzal et al. (2014) and Greece is Panagiotakopoulos (2011) each contributed one publication

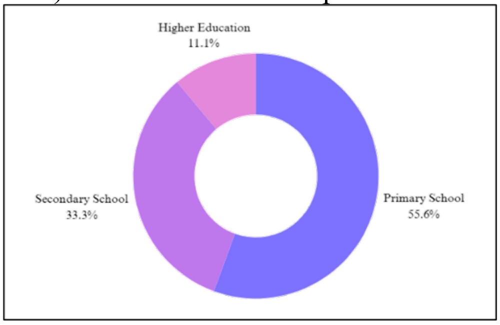


Figure 4. Distribution of Publication by Research Participants (Source: Authors' Own Elaboration)

Figure 4 shows the distribution of publications from nine analyzed articles based on research participants. Primary school students dominate with 55.6% of publications (Afzal et al., 2014; Aris et al., 2017; Cetin, 2019; Panagiotakopoulos, 2011; Şengül & Dereli, 2013). Secondary school participants account for 33.3% (Imania et al., 2021; Rahmawati et al., 2024; Suryanti et al., 2020). The remaining study involves higher education students, represented by Wulandari and Damayanti (2018). The large proportion of publications at the primary level shows that technology integration in integer learning is widely explored at this level.

**Types of Technology used for Integers Learning**

The types of technology in this SLR refer to the digital learning media used or developed in the studies as media for instructional learning. The digital learning technologies employed or developed in the nine analyzed articles are summarized in Table 4 below.

Table 4. Types of Technology used in Integers Learning from Articles Included

| Authors | Types of Technology |
|---|---|
| Imania et al. (2021) | Computer-based Interactive Multimedia |
| Suryanti et al. (2020) | Smartphone-based Augmented Reality (AR) |
| Rahmawati et al. (2024) | Powtoon |
| Cetin (2019) | Virtual Manipulative Model |
| Aris et al. (2017) | Video |
| Wulandari and Damayanti (2018) | Macromedia Flash 8 (Computer-based Educational Game) |
| Şengül and Dereli (2013) | Video Cartoons |
| Afzal et al. (2014) | Computer-Assisted Instruction (CAI) and Mathematics Learning Software |
| Panagiotakopoulos (2011) | Computer Educational Game with Microsoft VB 6.0 |

As shown in Table 4, the technologies used as learning media for integers in the nine reviewed articles are very diverse. Several computer-based technologies are still used, including computer-based interactives, computer-assisted instruction, and educational games developed using Microsoft Visual Basic (VB) and Macromedia Flash. Augmented reality (AR) technology, including virtual manipulatives, is also used to teach integers. AR allows students to visualize mathematical concepts more interactively. Additionally, visual learning media, such as Powtoon and videos, are used to provide a more varied learning experience. Thus, the analysis results show that learning integers can use a variety of technologies.

**The Impact of Technology as Digital Learning Media in Integer Learning**

The use of technology provides a different, dynamic, and personalized learning experience as a form of adaptation to the development of learning technology. Through technology as digital learning media, it is expected to provide positive impacts in cognitive, affective, or psychomotor aspects. In addition, learning integrated with technology becomes more meaningful and ultimately has a positive effect on students' learning goals. The results of the analysis of nine articles related to the positive impact of technology use in integer learning are summarized in Table 5.

Table 5. The Impact of Technology from Articles Included

| Authors | Impact |
|---|---|
| Imania et al. (2021) | 1. Enhancing the effectiveness and efficiency of learning<br>2. Reducing external learning barriers<br>3. Facilitating students' understanding and improving absorption |
| Suryanti et al. (2020) | 1. Increasing student engagement in learning<br>2. Improving understanding and thinking skills<br>3. Providing interactive and concrete learning experiences<br>4. Helping visualization of abstract concepts<br>5. Enhancing students' motivation and attention |
| Rahmawati et al. (2024) | 1. Improving learning effectiveness<br>2. Simplifying students' understanding |
| Cetin (2019) | 1. Improving students' understanding of integer operations and the meaning of integers<br>2. Overcoming misconceptions regarding the symbol. "−"<br>3. Facilitating knowledge transfer toward advanced concepts and becoming a solution for the limitations of directional models |
| Aris et al. (2017) | 1. Enhancing students' conceptual understanding of integer operations (subtraction)<br>2. Supporting abstract understanding through concrete visualization<br>3. Improving interaction, discussion, and collaboration among students |
| Wulandari and Damayanti (2018) | 1. Overcoming students' difficulties in performing integer operations<br>2. Simplifying abstract concepts; increasing students' enthusiasm in solving mathematics problems |
| Şengül and Dereli (2013) | 1. Developing positive attitudes toward mathematics<br>2. Enhancing students' interest in learning mathematics |
| Afzal et al. (2014) | Improving students' achievement or learning outcomes on integer concepts |
| Panagiotakopoulos (2011) | 1. Enhancing students' computational skills; increasing students' motivation<br>2. Fostering positive perceptions toward mathematics learning |

Based on Table 5, the use of technology has a positive impact on the learning process and outcomes of students. Several articles show that technology helps in the effectiveness and efficiency of learning, reduces learning barriers, and helps students in deeply understanding the concept of integers through more concrete visualizations. The use of technology encourages students to be more active in learning, increasing their motivation and interest in learning. In addition, in terms of learning outcomes, the use of technology also has an impact on improving learning outcomes, computational skills, and the formation of positive attitudes and perceptions towards learning.

***Discussion***

**Research Trends based on Year of Publication, Research Location, and Participants**

Regarding the location of the research, the analysis showed that most of the research was conducted in Indonesia, based on the nine selected articles. This shows that

Indonesia is the country where most research on technology integration in integer learning was conducted. In Indonesia, the focus on integrating technology in mathematics learning, including the concept of integers, is based on the potential to improve students' learning outcomes, as well as to address educational challenges in the global era (Mutohar & Hughes, 2013). In addition, after the COVID-19 pandemic, research trends in Indonesia also shifted toward online learning, including the use of technology and digital platforms (Nasution, 2022). The integration of technology in learning showed positive impacts in the form of improving students' problem-solving skills and understanding (Hidayat & Firmanti, 2024). On a general level, teachers' beliefs also received positive impacts from technology integration in learning (Hidayat et al., 2024). This was also the case in other countries as research locations, including Turkey, Pakistan, and Greece.

The next research trend discussed in this study was observed from the research participants. The large proportion of publications at the primary level shows that technology integration in integer learning is widely explored at this level. This is consistent with findings that primary school teachers increasingly integrate technology in teaching mathematics, albeit with varied pedagogical approaches (Kadluba et al., 2025). This also confirms that learning technology can indeed be integrated into early education (Sun & Hoelscher, 2023), starting with primary school. Moreover, student development at the primary level is critical in laying the foundations of early mathematics; thus, research at that stage is very important. Primary school students can build an intuitive understanding of integers through technology and real-life examples (Anton & Abrahamson, 2025; Cengiz et al., 2019). This strengthens the argument that the potential of technology in integer learning is highly important to produce broader educational outcomes for primary school students.

In addition to primary school students, research on technology integration in learning integers is also widely carried out at the secondary school level. The choice of secondary school participants is based on several factors. The concept of integers in the curricula of several countries, such as Indonesia and Turkey, is studied at the secondary school level. Hence, the consideration of technology use in integer learning is very important. (Zhao Ma et al., 2024) stated that the integration of technology aligns with learning objectives, thus making learning easier. On the other hand, this is also related to the implication that when students become users of technology, their understanding and engagement increase significantly (Migallón et al., 2025). Meanwhile, in higher education, the integers concept is rarely a major focus. Bozkurt and Sharma (2020) stated that higher education representation in studies specifically related to integers is still limited. This is because the mathematics curriculum in higher education focuses on advanced mathematical concepts, so research in technology integration tends to target advanced mathematical areas (Fardian et al., 2025).

**Types of Technology used for Integers Learning**

In mathematics learning, digital media have become very important, especially since the Covid-19 pandemic (Mulenga & Marbán, 2020). As a general characteristic, learning through technology integration provides different experiences that may increase students' achievement and engagement in mathematics activities. This is confirmed by Clements et al. (2025), who stated that integrating media technology into learning creates different learning experiences that can enhance students' mathematics achievement. On the other hand, the integration of technology in mathematics can also shift the goal of learning mathematics, not only producing correct answers but also focusing on deep conceptual understanding and problem-solving (Radović, 2024).

The variety of learning technologies used in integer learning across the nine articles indicates alternative tools that can be adopted to create meaningful learning. However, as Radović (2024) highlights, their use must be aligned with the paradigm shift towards meaningful learning for students. Furthermore, the choice of digital learning technology should be tailored to activities designed by teachers so that student engagement becomes effective in constructing their understanding. Thus, the selection or development of digital media or technologies must align with the interactivity level and intended learning objectives.

Media interactivity refers to the level of active involvement of users with digital learning media in the learning process. Clark and Mayer (2016) stated that digital learning media have three interactivity levels: (1) low interactivity, by watching or listening; (2) medium interactivity, involving activities directly provided by the media, such as navigation and answering simple questions; and (3) high interactivity, involving object manipulation, simulation, and interactive features. Based on these three levels, the technologies in the nine reviewed articles can be categorized as shown in Figure 5. High-interactive digital media enhance student engagement through real-time interaction and feedback (e.g., AR and virtual tools). Medium interactivity provides limited feedback, while low interactivity merely presents information in a linear manner without feedback. Therefore, the higher the level of interactivity, the greater the opportunity for students to build understanding, including concepts related to integers, through more active learning experiences.

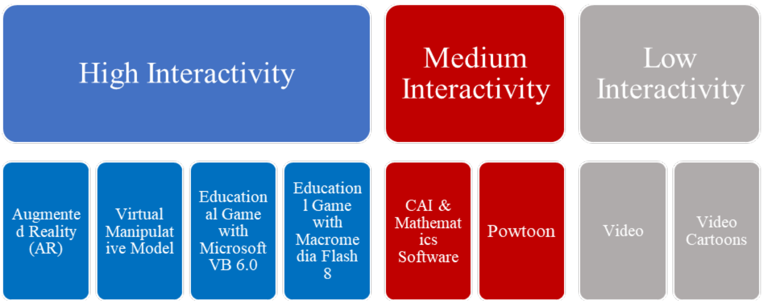

Figure 5. Classification of Digital Learning Media in Articles Included by Interactivity (Source: Authors' Own Elaboration)

The integration of digital learning technologies in integrated learning provides opportunities for students to construct understanding. Digital media can create a dynamic context that encourages a deeper understanding of mathematical concepts and provides opportunities not only for students but also for teachers to conduct better learning assessments (Cirneanu & Moldoveanu, 2024). Thus, the variety of digital learning media in integrated learning identified in the nine articles can serve as alternatives for teachers in classroom practice, allowing them to select media that match the needs and capabilities of both teachers and students, as well as the intended learning objectives.

**The Impact of Technology as Digital Learning Media in Integrated Learning**

The use of technology as digital learning media in integrated learning demonstrates positive impacts on cognitive and affective domains. The analysis of nine articles shows that seven studies indicated that integrating digital learning media into integrated learning had a positive impact on the cognitive domain (Afzal et al., 2014; Aris et al., 2017; Cetin, 2019; Imania et al., 2021; Rahmawati et al., 2024; Suryanti et al., 2020; Wulandari & Damayanti, 2018). This indicates that most of the studies reviewed place cognitive outcomes as the dominant impact. In the cognitive domain, technology integration positively influenced students' understanding of integers, particularly integer operations, by helping them comprehend abstract integer concepts, overcoming misconceptions such as the "−" symbol, and addressing difficulties in learning integer operations. In addition, cognitive benefits included improved computational skills. Using digital tools in integers learning helps students build mental models for understanding integers (Sukiyanto et al., 2023). The digital learning environment created through technology integration forms a dynamic learning context. The digital learning environments in classrooms encourage students' comprehension of complex mathematical concepts, such as integers (Cirneanu & Moldoveanu, 2024). Furthermore, they emphasized that technology integrated into learning supports teachers in carrying out more accurate assessments.

Moreover, technology-based learning allows students to actively engage in manipulation, visualization, and feedback, which facilitates the construction of mental models that lead to deeper understanding. The abstract nature of integer concepts can be visualized or represented through digital tools, giving students a clearer picture of these concepts. The technological tools integrated into integer learning and interactive learning environments enable students to visualize abstract mathematical concepts, such as subtraction and addition of integers (Cirneanu & Moldoveanu, 2024; Clements et al., 2025). On the other hand, technology-based learning supports students in learning according to their abilities, which is known as personalized learning (Maheshwari & Farooqui, 2024). Therefore, learning can provide equal opportunities for all students based on individual capabilities, positively influencing their cognitive development.

Technology integration in integer learning also produces positive effects in the affective domain. Technology as a learning medium not only facilitates knowledge construction but also stimulates motivation. These findings align with previous studies (Cujba & Pifarré, 2024; Ersozlu, 2024), which reported that technology-assisted instructional design enhances both mathematics achievement and students' positive attitudes. Technology also makes learning more dynamic through visualization, providing comfort (Liburd & Jen, 2021). The presence of instant feedback and personalized learning contributes to greater engagement and self-confidence, especially for students with lower initial motivation (Kulik & Fletcher, 2016). Higher motivation and positive attitudes toward learning further enhance students' cognitive abilities. Student engagement with technology positively influences learning motivation, which, in turn, affects cognitive development (Li & Zhu, 2023). Motivated students are more likely to put forth effort and engage in cognitive processes, leading to stronger cognitive growth.

In addition to cognitive and affective domains, technology integration in instruction learning positively impacts instructional implementation. The positive effects include increased effectiveness and efficiency of learning and improvement in interaction, discussion, and student collaboration. Saha et al. (2024) pointed out that effectiveness in education refers to the success of achieving instructional goals, while some experts (Ulkhaq et al., 2024) states that efficiency refers to how results are achieved using available resources. The positive impacts of technology on effectiveness and efficiency are attributable to its ability to visualize abstract integer concepts (Cirneanu & Moldoveanu, 2024) and provide interactive, real-time feedback (Zhang et al., 2024). Furthermore, technology enables teachers to deliver instruction in a more structured, interactive, and repeatable manner, thus increasing the efficiency of learning (Rigopouli et al., 2025).

The use of technology as digital learning media in integrated learning also enhances interaction, discussion, and collaboration among students. Technology allows real-time feedback and fosters peer discussion, including promoting active participation in large classes (Giberti et al., 2025). This improvement is not solely due to technology itself but also to the teacher's role. Segal and Biton (2024) emphasized that technology supports collaboration between teachers and students. Additionally, teachers who maximize the use of technology can strengthen pedagogical relationships and implement learner-centered instruction, which increases students' engagement with mathematics (Attard & Holmes, 2020). Therefore, technology use in integers learning provides opportunities for interaction, discussion, and collaboration under varying classroom learning conditions.

The integration of technology into integers learning has a positive impact on students' cognitive and affective domains. This aligns with the cognitive theory of multimedia learning, which emphasizes that learning becomes effective through the integration of words and images, thereby facilitating dual processing. Mayer (2024) states that the cognitive theory of multimedia learning plays a role in explaining how visual representations reinforce conceptual understanding through the optimization of visual-spatial processing. Thus, in integer learning, the integration of technology as a learning medium helps students understand abstract mathematical concepts while simultaneously increasing student engagement and interest in learning.

On the other hand, the effectiveness of using learning technology is based on the ability to manage students' cognitive load during the learning process. Thammabut and Wonganu (2024) state that instructional design using digital technology can reduce extraneous load through the structured presentation of concepts, thereby allowing students to effectively utilize their cognitive resources in understanding the material. Furthermore, the gradual presentation of material and teacher guidance can help students manage intrinsic load, which is one aspect of students' cognitive load (Faber et al., 2024). Therefore, learning about integers using technology as a digital learning medium not only enhances conceptual understanding but also provides a learning experience that does not overburden students cognitively.

## CONCLUSION

Mastery of integers concept is a fundamental component of mathematics learning. This systematic literature review highlights the growing role of technology as digital learning media in supporting students' understanding of integers. These findings indicate that various forms of technology with varying levels of interactivity have been integrated into mathematics education, particularly at the primary and secondary levels. Overall, the integration of technology in integer learning contributes positively to students' cognitive development, especially in conceptual understanding, as well as to the affective domain by increasing motivation, engagement, and positive attitudes toward mathematics. Furthermore, technology-supported learning enriches the learning process by creating a more effective, interactive, and collaborative classroom environment.

Despite these positive findings, this review has limitations due to the relatively small number of studies and the use of only two academic databases. Therefore, future research could utilize more than two databases to explore a wider range of digital technologies and investigate their long-term impact on students' conceptual understanding of integers in various educational contexts.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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