



Enhancing conceptual understanding in elementary mathematics through technology integration and socially responsive teaching

Siti Rodiyah Hida^{1,*}, Thahira Wahyuni W.K.E. Kalani¹, Yuniar Marhamah S. Ibrahim¹, Melan Septiani Babay¹, Angsi Pakaya¹, Ivana Manorek¹, Chairil Anaz Yusuf¹, Irvin Novita Arifin¹, Isnanto¹

¹ Department of Basic Education, Postgraduate, Universitas Negeri Gorontalo, Gorontalo, North Sulawesi 96128, Indonesia.

* Correspondence: nadiyahida713@gmail.com

Received Date: December 15, 2025

Revised Date: January 5, 2026

Accepted Date: January 9, 2026

ABSTRACT

Background: Elementary education is shaped by social contexts and learning environments that influence students' academic development. Mathematics learning, particularly basic number operations, remains challenging due to abstract content and limited contextual instruction. Technology-based learning media offer an innovative approach to improving engagement, equity, and learning outcomes within diverse educational settings. **Methods:** This study adopted a qualitative case study approach to examine the integration of science and technology in elementary mathematics learning, particularly in teaching basic number operations. Data were collected through classroom observations and semi-structured interviews with the homeroom teacher to explore instructional strategies, learning dynamics, and the use of technology-based learning media. **Findings:** The findings indicate that students experienced significant difficulties in understanding basic number operations due to abstract content and limited interactive learning experiences. The integration of technology-based learning media, particularly interactive and visual digital tools, increased student engagement, motivation, and conceptual understanding of mathematics. Effective technology use, supported by appropriate infrastructure and teacher creativity, transformed mathematics learning into a more active, meaningful, and student-centered process. **Conclusion:** Based on these things, it can be concluded that teachers need to improve their competence in providing good pedagogy to students in the classroom. With the advancement of digitalization, it can be a solution and improve the learning process of students in mathematics subjects in elementary schools. **Novelty/Originality of this article:** This study offers original insight by situating technology-integrated mathematics learning within the social and educational environment of elementary classrooms, highlighting how teacher-driven digital pedagogy can address learning inequities and foster more inclusive, student-centered outcomes in line with interdisciplinary social-education perspectives.

KEYWORDS: basic number operations; digital pedagogy; elementary mathematics learning; technology-based learning media; student-centered learning.

1. Introduction

Education has a strategic role in shaping the quality of a nation's human resources. Through education, students are not only directed to acquire knowledge, but also equipped with the ability to think, behave, and act rationally in facing various life problems (Hu,

Cite this article:

Hida, S. R., Kalani, T. W. W. K. E. K., Ibrahim, Y. M. S., Babay, M. S., Pakaya, A., Manorek, I., Yusuf, C. A., Arifin, I. N., Isnanto. (2026). Enhancing conceptual understanding in elementary mathematics through technology integration and socially responsive teaching. *Asian Journal of Collaboration of Social Environment and Education*, 3(2), 118-134. <https://doi.org/10.61511/ajcsee.v3i2.2026.2538>

Copyright: © 2026 by the author. This article is distributed under the terms and conditions of the Creative Commons Attribution (CC BY) (<https://creativecommons.org/licenses/by/4.0/>) license.



2024). At the basic education level, the learning process becomes an important foundation for the intellectual development and character of students, because it is at this stage that basic values, learning habits, and initial mindset begin to be formed systematically. The success of learning in elementary school will greatly determine the readiness of students to follow the educational process at the next level.

One of the subjects that has an important role in basic education is mathematics. Mathematics not only serves as a tool for calculation, but also as a means to train logical, analytical, and systematic thinking skills. Through mathematics learning, students are invited to understand the relationships between concepts, solve problems, and develop accuracy and perseverance. Therefore, mastering mathematical concepts from an early age is an inevitability that cannot be ignored. However, in practice, learning mathematics often faces various challenges, especially in helping students understand abstract basic concepts.

Students' difficulties in understanding mathematics generally begin to be seen in the number operations material. Addition, subtraction, multiplication, and division are basic concepts that must be thoroughly mastered by elementary school students. If the understanding of this material has not been formed properly, then students will experience obstacles in learning the next mathematics material (Prabowo et al., 2022; Sukri et al., 2023). This condition not only has an impact on low learning outcomes, but can also affect students' attitudes and motivation towards overall mathematics learning.

In addition to the characteristics of the material, the learning approach used by teachers also has a great influence on the success of mathematics learning. Learning that is still teacher-centered and emphasizes memorization tends to provide less room for students to build an understanding of concepts independently. Students become passive and simply follow instructions without really understanding the process that is going on. Therefore, a more contextual, meaningful, and accommodating approach to learning is needed to accommodate students' different abilities and learning styles.

Along with the times, the learning process is faced with the demands of change that require adjustments in the way of teaching and learning. Today's student learning environment is increasingly influenced by social dynamics and the advancement of civilization that demands more complex thinking skills (Shutaleva, 2023). In this context, teachers are required to be more creative in designing learning so that the material presented can be well received by students. Learning is no longer enough if you only rely on textbooks, but needs to be supported by various sources and media that are able to help students understand concepts more completely.

Therefore, efforts to improve the quality of mathematics learning in elementary schools need to be carried out continuously through the development of learning strategies, methods, and media that are relevant to the needs of students. Appropriately designed learning is expected to help students build a strong understanding of math, foster confidence, and form a positive attitude towards the learning process. This introduction is the starting point for learning more about how mathematics learning can be developed adaptively and innovatively to address today's learning challenges.

Currently, the development of science and technology / *Ilmu Pengetahuan dan Teknologi* (IPTEK) in the digital era is currently taking place very rapidly and has a wide impact on various sectors of life, including the education sector. Advances in information technology, the internet, and artificial intelligence have driven the transformation of the learning paradigm from conventional learning to digital-based and interactive (Safitri, 2024; Ahmad et al., 2023). In the context of basic education, the development of science and technology requires teachers to be able to integrate technology as a means of supporting learning so that the teaching and learning process becomes more effective, efficient, and relevant to the characteristics of 21st century students. Mathematics as an abstract subject requires the support of technology-based learning media that is able to visualize symbolic concepts into a more concrete form and is easy to understand by elementary school students (Efendi et al., 2025; Dewi, 2023).

Mathematics learning in elementary schools is one of the fields that urgently needs the support of science and technology based innovation. Mathematics has abstract, systematic,

and hierarchical material characteristics, so it often causes difficulties for students, especially in the material of number counting operations such as addition, subtraction, multiplication, and division. These difficulties, if not handled appropriately, can have an impact on low learning motivation and student learning outcomes. Therefore, a learning approach is needed that is able to bridge abstract mathematics concepts into more concrete and easy to understand elementary school students.

One of the rapidly growing innovations is the use of learning websites and interactive digital media as a means of supporting mathematics learning. Technology-based media allows for the integration of text, images, animations, videos, and interactive exercises that can improve student motivation, engagement, and learning outcomes (Wati et al., 2024; Susilawati, 2023). Various studies have shown that the use of digital media and interactive multimedia is effective in improving students' understanding of number counting operations, such as addition, subtraction, multiplication, and division (Ratnasari et al., 2024; Apriani et al., 2025). The use of digital media is also in line with the demands of digital literacy in the Independent Curriculum, where students are encouraged to learn independently, reflectively, and meaningfully. Website-based learning media allows students to get hands-on feedback, iterate on material as needed, and learn at their own pace (Ulya et al., 2025; Marlis et al., 2025).

In addition, the use of digital applications and platforms such as Canva has been proven to be able to provide more interesting, visual, and contextual mathematics learning for elementary school students (Jannah et al., 2023; Rubiyanti & Novianti, 2025). However, the implementation of science and technology in mathematics learning in elementary schools is inseparable from various challenges. Limited infrastructure, internet access, and teachers' readiness and competence in managing technology-based learning are still major obstacles (Aliyyah et al., 2025; Rahmi et al., 2024). Therefore, increasing teachers' technological literacy through training and mentoring is an important factor so that the use of digital media can run optimally and have a positive impact on student learning outcomes (Ammalia et al., 2025; Sutinah & Suryaman, 2025).

Based on the results of observations and interviews, it was found that out of 32 grade VI students, as many as 24 students or 75% experienced obstacles in learning mathematics, especially in number calculation operation materials, while only 8 students or 25% showed good learning potential. This condition shows that there is a gap in understanding basic mathematical concepts that need to be addressed immediately through appropriate learning innovations (Iqbal et al., 2025; Pramudita, 2024). The homeroom teacher's efforts have been in the form of giving multiplication tables and distributing them in students' notebooks as a memory aid. However, this strategy has not yielded optimal results, especially for students who experience conceptual difficulties and lack of intensive mentoring.

Teachers' limited time due to busy activities outside school also affect the effectiveness of the learning process in the classroom (Sundari & Prihatin, 2025; Yuswatiningsih & Hariyono, 2025). Over time, homeroom teachers have tried to innovate learning by utilizing Canva's digital platform as a website-based learning medium. Canva's utilization, including interactive features and artificial intelligence (AI) support, has been shown to significantly increase students' interest, motivation, and understanding of math concepts (Pramono et al., 2025). Various studies have also shown that Canva-based learning media is effectively used in elementary school mathematics learning, especially in number counting operations (Sari et al., 2025; Taufiq et al., 2025).

Thus, the case study is relevant to examine in depth how teachers utilize science and technology as an integral part of mathematics learning strategies in the classroom. The use of science and technology is not only positioned as the use of digital media, but also as a pedagogical approach designed to help teachers present the concept of number counting operations in a more systematic, visual, and contextual manner. Through the use of Canva-based learning websites, teachers can organize interactive materials, exercises, and evaluations so that the learning process becomes more engaging, adaptive, and centered on student needs (Sutinah & Suryaman, 2025; Rubiyanti & Novianti, 2025). The use of science

and technology in mathematics learning allows teachers to play the role of facilitators who guide students in building understanding of concepts, not just conveying information.

Teachers can leverage digital features, such as animations, learning videos, interactive quizzes, and automated feedback to help students understand the gradual and meaningful process of addition, subtraction, multiplication, and division (Jannah et al., 2023; Pramono et al., 2025). With the support of digital media, teachers can also differentiate learning, provide reinforcement for students who experience difficulties, and enrichment for students who have better abilities (Taufiq et al., 2025). Thus, the use of science and technology-based learning websites has the potential to be a strategic solution for teachers in improving the quality of mathematics learning, closing the gap in learning outcomes, and creating active, meaningful, and sustainable learning in elementary schools.

2. Methods

This case study was carried out at Pohuwato Regency, with the aim of finding out in depth how to use science and technology (science and technology) in mathematics learning, especially in the material of number counting operations in class VI. This study uses a case study approach because it allows researchers to comprehensively understand the real conditions of learning, the role of teachers, and the dynamics of student learning processes in the context of a particular school environment. According to Yuswatiningsih & Hariyono (2025), a case study is a descriptive research that aims to conduct an intensive and in-depth investigation of individuals and social units by utilizing various important variables related to the development of the subject being studied. Therefore, this approach is considered appropriate to reveal in detail the practice of using science and technology carried out by homeroom teachers of grade VI.

Data collection in this case study was carried out through observation and interviews, which were designed to explore factual information about the mathematics learning process and teachers' strategies in utilizing learning technology. Observations were made to see firsthand learning activities in the classroom, teacher-student interaction, and the use of science and technology-based media during the teaching and learning process. Meanwhile, the interview was conducted directly with the homeroom teacher of grade VI as the main informant, in order to gain a deeper understanding of the background, pedagogical considerations, and obstacles faced in the implementation of technology-based learning in the classroom.



Fig. 1. Interview with grade VI teacher

The interviews in this study use a semi-structured method, so that the researcher has flexible question guidelines and can develop according to the flow of discussion during the question and answer process. This approach allows researchers to explore teachers' experiences more openly, including teachers' views on students' abilities, the effectiveness of learning methods that have been applied, and the potential use of science and technology as math learning solutions. The results of the interviews showed that grade VI students had

an imbalance in learning potential, which had an impact on students' suboptimal understanding of the material on comprehensive number counting operations.

The imbalance of abilities was evident in the discussion and question and answer process in the classroom, where as many as 24 students or about 75% experienced difficulties in understanding the concepts of addition, subtraction, multiplication, and division while only 8 students or about 25% had the potential ability to understand the subject matter. So this requires special attention in overcoming problems that occur in grade VI students. The following is a diagram of the ability acquisition of grade VI students.

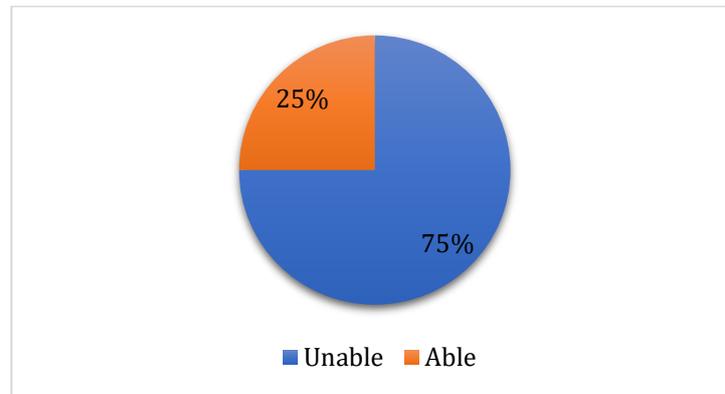


Fig. 2. Ability of grade VI students

Through the diagram, it appears that the ability in the classroom in mathematics subjects is dominated by students who lack the potential for broad understanding. Various improvement efforts that have been made by homeroom teachers in grade VI, such as repetition of materials and providing additional exercises, are still not able to achieve the expected learning targets. This condition encourages teachers to look for alternative solutions that are more innovative and adaptive to the needs of students, one of which is through the use of science and technology as supporting learning media. The use of science and technology in mathematics learning is seen as a strategic solution to overcome students' learning constraints, because technology allows for the presentation of materials that are more visual, interactive, and easy to understand.

In addition, in the 21st century era, learning activities are also supported by the availability of technological devices such as digital interactive boards (smartboard TV) used by teachers to display multimedia-based learning materials. The existence of this facility is an important supporting factor in the implementation of science and technology-based learning, as well as strengthening the role of teachers as facilitators who direct students to learn actively, meaningfully, and contextually in mathematics subjects. So teachers need to prioritize competence and skills in digitalization.

3. Results and Discussion

This study uses an interview method between homeroom teachers and researchers in obtaining information. The interviews in this study use a semi-structured method, so that the researcher has flexible question guidelines and can develop according to the flow of discussion during the question and answer process.

"In sixth-grade Mathematics, I strive to avoid monotony by minimizing lectures and encouraging student engagement through discussions and problem-solving. Lessons typically begin with a short video or relevant case study to provide students with context before moving on to the core material. Students are then divided into groups and given mini-project-based assignments, such as direct observations in the school environment on scales or comparisons. I also utilize Smartboard TVs to display presentations, simulations, and interactive assignments to make learning more visual and engaging. I believe that

the use of learning media is key to increasing student motivation and learning success, especially since they are already familiar with technology. Therefore, I use Canva's AI integration to transform abstract Mathematics material into interactive simulations, such as 'Tug of War' or a Numeracy Calculator on positive and negative number operations. Through these interactive and game-like media, students become more enthusiastic, dare to try, understand concepts more easily, and ultimately achieve better learning outcomes." (T.W.W.K.E, teacher)

3.1 Analysis and findings

Grade VI elementary school students occupy a very strategic position in the basic education system because it is the final stage of establishing the academic foundation and readiness for students' transition to secondary education. In this phase, students are not only required to master basic reading, writing, and numeracy skills, but are also expected to be able to understand concepts in a more in-depth, structured, and applicative manner. Mathematics as one of the core subjects plays an important role in shaping students' logical, systematic, and critical way of thinking. Therefore, mathematics learning in grade VI cannot be treated as a mere repetition of previous material, but as a process of maturing conceptual understanding that will be a long-term provision for students. However, the reality of learning math in many elementary schools, especially in areas far from urban centers, shows that students' understanding of basic math concepts such as number counting operations is still shallow.

Many students are able to memorize formulas or problem-solving steps, but have difficulty applying these concepts in different or more complex contexts. This condition shows that mathematics learning still tends to be oriented towards the end result, not on the thought process. As a result, students lack flexibility and cognitive confidence when faced with new problems, so math is often considered a difficult and daunting subject. At the same time, the development of science and technology has changed the way humans learn, communicate, and interpret information. Today's grade VI students are part of a generation that grew up in a digital environment, where visualization, interactivity, and speed of access to information are part of their daily lives. Synchronization between student characteristics and conventional learning methods has the potential to cause a widening learning gap. When math learning is delivered in an abstract and monotonous manner, students lose relevance and connection between the material being studied and the reality they are experiencing.

Mathematics learning in grade VI, shows that there are serious challenges in mastering the basic concept of number counting operations. Based on the results of observations and interviews, most students still have difficulty understanding the concepts of multiplication, addition, subtraction, and division as a whole. This phenomenon clearly reflects the gap in the quality of learning between regions, where teaching methods in areas far from urban centers often do not receive equivalent pedagogical techniques. As a result, students' confidence decreases drastically when faced with problem-solving problems, which then triggers a sense of inferiority and decreased motivation because they feel far behind the competency standards of other peers. This condition is in line with the views of Efendi et al. (2025) and Dewi (2023) who stated that a weak understanding of basic mathematical concepts is often influenced by the limitations of learning strategies and the lack of use of contextual media.

In addition, the gap in learning quality is also influenced by geographical conditions and limited access to educational innovation, as conveyed by Safitri (2024) and Wati et al. (2024). Thus, the problems that occur do not only come from students' abilities, but also from learning systems and approaches that are not fully adaptive to their learning needs. This problem becomes even more evident when the available textbook media, even though it is equipped with tools such as multiplication tables, are not able to have a significant impact on students. Most students tend to get stuck in short-term memorization methods that are easy to forget when they have to apply concepts in more varied questions. Students

tend to memorize without understanding the meaning of the concepts underlying the number counting operation. This is strengthened by the findings of Pramudita (2024) and Apriani et al. (2025) which state that memorization-based mathematics learning has the potential to hinder students' critical thinking skills.

Static learning media are also less able to facilitate the visualization of abstract mathematical concepts, as conveyed by Ratnasari et al. (2024) and Susilawati (2023). Therefore, more interactive and flexible learning media is needed so that students can build a gradual and meaningful understanding of concepts. This condition shows how wide the gap in access to educational technology is at the elementary level, where students are still heavily dependent on static print learning resources, while the needs of the times demand more dynamic learning. The monotonous classroom atmosphere without the touch of innovative media ends up creating the stigma that math is a scary subject, so classroom interactions tend to be passive and boring. In an effort to overcome these problems, homeroom teachers of grade VI began to take advantage of the development of science and technology through the use of Canva's AI-based learning media.

Digitizing learning is one of the relevant approaches to bridge this gap. The use of digital technology in mathematics learning is not solely aimed at following trends, but as a pedagogical effort to strengthen the understanding of concepts through more concrete, visual, and interactive representations. Through digital media, symbolic mathematical concepts can be transformed into a more meaningful learning experience, so that students not only know "how" to solve problems, but also understand the "why" a concept works. In grade VI of elementary school, the need for digital-based mathematics learning becomes increasingly urgent because the material taught begins to demand high-level thinking skills. Number counting operations are no longer stand-alone, but integrated in problem-solving, reasoning, and decision-making. Without the right media support, students with heterogeneous abilities will find it difficult to follow learning optimally. Digitization of learning allows teachers to present materials with varying levels of complexity, so that they can accommodate different students' abilities and learning styles in one class.

The use of this technology is in line with the ideas of Ahmad et al., (2023) and Marlis et al., (2025) who emphasize the importance of integrating digital media in learning to improve the quality of the learning process. With the problems that occur among grade VI students, solutions are found that can overcome the challenges faced and optimize learning. To address this issue, teachers are starting to take advantage of technological advancements by using Canva's AI-based learning media. However, in the early stages of implementation, the use of Canva AI is still limited to presenting materials through LCD projectors, so learning interactions tend to be one-way. This condition shows that the utilization of science and technology depends not only on the availability of applications, but also on the support of learning devices and designs that allow for optimal active student engagement. A significant development occurred when schools began to use Smartboard TV as a means of supporting mathematics learning. This digital interactive board allows students to interact directly with Canva's AI-based learning media through touch and visual activities. This is in line with the findings of Iqbal et al. (2025) and Wati et al. (2024) who stated that interactive technology is able to increase the engagement and learning motivation of elementary school students.

With the Smartboard TV, mathematics learning is no longer passive, but encourages students to be directly involved in the process of promoting the concept of number counting operations. The integration of this device shows that the success of the use of science and technology is greatly influenced by the readiness of the infrastructure and the creativity of teachers in managing it. This condition then underwent significant changes after schools began to integrate the use of Smartboard TVs. This equipment comes as a solution to previous limitations, where touchscreen features allow games such as "tug-of-war numeracy" and "math sack competition" to be played directly by students in front of the class. With Smartboards, technology is no longer a spectacle, but a concrete gaming tool. Students can swipe, draw, and press numbers on the screen with their own hands, which directly increases their motivation and engagement. This transition from projector to *smartboard* proves that proper device support goes a long way in determining the extent to

which equitable and interactive digital access can truly be perceived by students in the classroom.



Fig. 3. Introduction of digital interactive board (Smartboard TV)

Through Canva AI, teachers can present the concepts of multiplication, addition, and subtraction in the form of images, animations, or videos that are easy for students to understand. This innovation is expected to help students who have difficulty understanding abstract material to make it more concrete and fun. The use of digital learning media such as Canva AI also provides students with the opportunity to learn independently and repeatedly. Students can access the material at any time, either at school or at home, giving them more time to practice and strengthen their understanding of math concepts. In addition, this digital media can adjust the difficulty level of the questions according to the abilities of each student, making learning more personalized and effective. The use of science and technology through Canva AI learning media is expected to make the atmosphere of learning mathematics more lively, interactive, and no longer boring. Students who previously struggled and lacked confidence are expected to become more motivated, active, and able to master basic mathematical concepts more effectively. This innovation is also the first step in creating learning that is adaptive to technological developments and student needs in the digital era.

Canva AI in grade VI marks an innovative step in mathematics learning. Teachers use Canva AI to design interactive web-based learning media that students can access, such as "numeracy tug-of-war" games and "numeracy sack racing races". This medium is designed to address students' boredom and difficulty in understanding mathematical concepts, especially a large number of operations. The use of website-based media allows students to learn independently and collaboratively. Educational games created through Canva AI not only boost motivation but also reinforce concept understanding through fun and contextual learning experiences. Through interactive media, students are encouraged to think critically, solve problems, and connect mathematical concepts with everyday life. Learning is no longer just about memorization, but emphasizes conceptual understanding and application.

In this case, the use of web-based learning media through Canva AI also encourages the application of active and collaborative learning. Activities such as counting games and interactive quizzes require students to think critically, collaborate, and solve problems contextually. This is in line with the views of Ulya et al. (2025) and Pramono et al. (2025) who emphasize the importance of students' active involvement in meaningful learning. These findings show that the use of science and technology designed pedagogically is able to create a more enjoyable learning atmosphere and is relevant to the needs of students in

the digital era. The games "tug-of-war numeracy" and "numeracy sack racing competition" are concrete examples of deep learning apps/websites.



Fig. 4. Implementation of digitalization interactive board (Smartboard TV)

The use of science and technology in mathematics learning also has an impact on the psychological aspect of students, especially in building confidence and positive attitudes towards mathematics. When students are exposed to interactive learning media that are visually and contextually designed, they no longer feel intimidated by abstract symbols, numbers, and counting operations. Students must analyze problems, collaborate, and make decisions quickly, allowing high-level thinking skills to develop. Students become more active, enthusiastic, and confident in facing math challenges. Thus, mathematics learning is not only oriented towards cognitive achievement, but also plays a role in shaping students' mental and emotional readiness to face more complex learning challenges. A tech-friendly learning environment can reduce math anxiety and encourage students to dare to try, make mistakes, and learn from the process.

In terms of teacher professionalism, the integration of science and technology in mathematics learning is a means of reflection and sustainable competency development. Teachers are required to continue to adapt to technological developments, update learning strategies, and check the effectiveness of the media used. This process indirectly encourages a culture of lifelong learning for teachers, where innovation does not stop at one particular medium or application. The use of Canva AI is an example of how teachers can develop their pedagogical creativity by combining technology, teaching materials, and student characteristics in one whole learning unit. This feature is especially helpful for students who need more time to understand the material. Teachers also benefit from the ease and flexibility of Canva AI's design. Teachers can customize materials to meet the needs of the classroom, update content, and integrate various digital learning resources. This shows that the right integration of technology is able to revive students' interest in learning, transforming the classroom atmosphere that was originally rigid into a learning laboratory that is active, fun, and relevant to the needs of today's digital generation.

The sustainability of the use of science and technology in mathematics learning also needs to be supported by systematic and long-term oriented planning (AlAli et al., 2023; Gamage et al., 2022). Technology integration should not be incidental or just follow trends, but should be part of school learning planning and development. With the support of school policies, teacher capacity building, and continuous evaluation, science-based learning innovations can evolve into consistent and widespread good practices. In this context, the experience shows that the use of technology designed pedagogically can be a catalyst for change towards mathematics learning that is more inclusive, adaptive, and relevant to the demands of the digital era.

3.2 Implications

This study shows that the success of the use of science and technology in mathematics learning is greatly influenced by the readiness of school facilities and infrastructure. The availability of supporting devices such as Smartboard TVs and adequate access to technology are important factors in optimizing the use of Canva's AI-based media. Wati et al. (2024) and Ahmad et al. (2023) emphasized that without adequate infrastructure support, technology-based learning innovations have the potential to not run optimally. Therefore, the use of science and technology needs to be systematically planned in order to have a real impact on the quality of learning. In addition to infrastructure, teacher competence and digital literacy play a key role in the successful integration of science and technology. Teachers are required not only to be able to operate technology, but also to integrate it into effective learning strategies. Aliyyah et al. (2025) and Rahmi et al. (2024) emphasized the importance of teacher training and mentoring so that technology is used pedagogically, not just as a presentation tool. By improving teacher competence, science and technology-based mathematics learning can be directed to develop understanding of concepts, not just attract students' attention.

Collaboration between schools, parents, and local governments is essential to address the digital divide. From an evaluation perspective, the use of interactive media makes it easier for teachers to monitor students' progress in real-time. Teachers can provide hands-on feedback and adjust learning strategies according to students' needs. The long-term benefit of leveraging Canva AI is the creation of an adaptive, creative, and collaborative learning culture in elementary schools. Students not only master math but also acquire digital skills and critical thinking skills needed in today's era. The integration of science and technology in mathematics learning can be a model for other schools in developing technology-based learning innovations. With an in-depth approach and interactive media, learning mathematics becomes more relevant, engaging, and meaningful for students.

The role of teachers in this context is very central. Teachers no longer only function as conveyors of information, but as designers of learning experiences that are able to integrate technology with the purpose of learning mathematics. The use of digital platforms such as Canva AI, for example, opens up space for teachers to develop learning media that are creative, contextual, and in accordance with the characteristics of students. Through visual design, animations, and educational games, teachers can transform the atmosphere of learning mathematics that was previously rigid into a more lively and participatory atmosphere. Digitization of learning also provides opportunities for more personalized and adaptive learning (Rizvi et al., 2025; Strielkowski et al., 2025). Students can learn at their own pace, repeat ununderstood material, and get feedback in person. This is especially important for grade VI students who have potential imbalances, where some students need special time and approaches to understand math concepts. With the support of technology, teachers can facilitate a variety of learning needs without sacrificing the achievement of overall learning goals.

In addition to the cognitive aspect, digital-based mathematics learning also has an impact on the affective aspect of students. Direct interaction with interactive digital media can increase students' motivation to learn, curiosity, and confidence. When students feel actively involved in learning, they are more willing to try, are not afraid to make mistakes, and are more open to the learning process. This condition is very important to reduce the math anxiety that elementary school students often experience. The integration of mathematics and the digitization of learning in grade VI also contributes to the development of 21st century skills. Students not only learn to count, but also learn to think critically, solve problems, collaborate, and use technology responsibly. Mathematics learning integrated with technology helps students understand that mathematics is not just a school subject, but a useful thinking tool in everyday life and various fields of science.

In the long term, the implementation of this strategy is expected to be able to eliminate the gap in the quality of learning between regions by making the learning model a reference for other schools in Pohuwato Regency. The use of interactive media as an adaptive solution

to the limitations of the learning environment proves that teachers' creativity supported by technology can create great changes (Mhlongo et al., 2023; Moltudal et al., 2022). This will gradually build a healthier education ecosystem and contribute to a sustainable learning environment, where a culture of reflection, adaptability to technology, and alignment with student needs is the main foundation in producing a digitally proficient and digitally competent generation.

From a pedagogical perspective, using Canva AI provides an opportunity for teachers to develop more personalized and adaptive learning (Hariyanto et al., 2025). Teachers can provide feedback directly, adjust the difficulty level of the material, and facilitate the diverse learning needs of students. Overall, the use of Canva AI as a mathematics learning medium shows great potential in improving the quality of learning. The innovations carried out by teachers reflect the strategic role of educators as agents of change in facing the challenges of 21st century learning. With the right science and technology support, mathematics learning can be developed to be more inclusive, interactive, and meaningful, as well as good practices that can be replicated in other elementary schools

However, the digitization of mathematics learning cannot be separated from the challenges that come with it. Limited facilities and infrastructure, internet access, and teacher readiness are still obstacles in many elementary schools. Therefore, the use of technology needs to be planned realistically and contextually, adjusted to school conditions and student characteristics. Digitalization is not the final goal, but a means to improve the quality of learning. Math learning should be geared towards strengthening conceptual understanding, not replacing the role of teachers or eliminating direct interaction in the classroom. Technology needs to be positioned as a supporting tool that enriches the learning experience, while teachers remain the main director, facilitator, and companion in the learning process. With this approach, mathematics learning can take place in a balanced manner between the use of technology and the strengthening of pedagogical interactions.

The importance of understanding mathematics and digitization of learning in grade VI is also related to efforts to reduce the gap in education quality between regions. When technology is used appropriately, schools in resource-constrained areas can develop innovative and relevant learning. This shows that the quality of learning is not solely determined by geographical location, but by the creativity of teachers and the support of the education system in facilitating the use of science and technology. Overall, grade VI elementary schools require a broader, more in-depth, and adaptive approach to learning mathematics to technological developments. Strengthening the understanding of mathematical concepts through the digitization of learning is a strategic step to prepare students to face the challenges of continuing education and life in the digital era. Mathematics learning that is integrated with technology not only improves learning outcomes, but also forms a positive attitude towards learning, strengthens thinking skills, and fosters students' confidence as lifelong learners.

4. Conclusion

Based on the case study of science and technology in mathematics subjects with learning media created through Canva AI, it can be concluded that the integration of technology in mathematics learning has a significant positive impact. Canva's use of AI-based media can present material in a way that is more interactive, visual, and easy for elementary school students to understand. Canva's features, which are easy to access and use on computers and mobile devices, also make it easy for teachers and students to learn. From a learning outcomes perspective, Canva's use of AI-based learning media has proven to be effective in improving students' math performance.

Teachers can take advantage of Canva's various features, such as templates, animations, and illustrations, to create materials that meet students' needs and often abstract the characteristics of math content. In addition, schools need to provide training and guidance for teachers to be more proficient in designing and developing digital learning media using Canva AI. This training is important to ensure that teachers can harness Canva's

full potential, as well as adapt the medium to students' developmental levels and learning needs. In addition, collaboration between teachers in sharing experiences and creating learning media can also improve the overall quality of education.

Therefore, to support the sustainability and effectiveness of the use of Canva AI, schools and education offices are expected to provide adequate technology infrastructure, such as stable internet access and adequate digital devices in the classroom. Periodic evaluations of Canva's media use also need to be conducted to assess their impact on student learning outcomes and motivation, as well as to identify barriers to future improvement.

The use of science and technology through Canva AI can continue to be developed as an adaptive and relevant innovation in mathematics education. Thus, the development of digital-based mathematics learning in grade VI elementary schools is not just a methodological innovation, but an urgent pedagogical need. Through careful planning, the use of appropriate technology, and the active role of teachers as agents of change, mathematics learning can be a strategic means in creating a generation that excels in numeracy and is digitally competent.

Acknowledgments

The authors express deepest gratitude to grade VI teachers and all students who have participated actively and cooperatively in the implementation of the research. Openness and cooperation are important factors in the smooth collection of data and the implementation of digital media-based learning. All parties who have assisted directly or indirectly in the completion of this research have also made a meaningful contribution to the quality and success of the research.

Authors Contributions

Conceptualization, S.R.H.; Methodology, S.R.H.; Investigation, S.R.H.; Data Curation, S.R.H.; Formal Analysis, S.R.H.; Writing – Original Draft, S.R.H.; Writing – Review & Editing, S.R.H.; Visualization, S.R.H.; Validation, S.R.H. and T.W.K.; Resources, T.W.K.; Development of Instructional Solution using Canva AI, T.W.K.. All authors have read and agreed to the published version of the manuscript.

Funding

This research did not receive external funding.

Ethics Review Board Statement

Not available.

Informed Consent Statement

Not available.

Data Availability Statement

Not available.

Conflict of Interest

The authors state that there is no conflict of interest.

Declaration of Use of Generative AI

During the preparation of writing this work, the author uses google scholar, google book and semantic scholar to obtain references to journals and books. Then google translate and microsoft word review translation as a tool in converting Indonesian into English as well as AI intelligence assistance in the form of gemini and perplexity in reviewing narratives and synonyms of words and sentences in producing a synthesis of the series of sentences needed.

Open Access

©2026. Author(s). This article is licensed under the Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution, and reproduction in any media or format, as long as you give appropriate credit to the original author and the source, provide a link to the Creative Commons license, and indicate whether changes have been made. Images or other third-party material in this article are included under the Creative Commons license of the article, unless otherwise stated in the material credit line. If the material is not covered by the Creative Commons license of the article and your intended use is not permitted by law or exceeds the permitted use, you must obtain permission directly from the copyright holder. To view a copy of this license, visit: <http://creativecommons.org/licenses/by/4.0/>

References

- Ahmad, S. N., Syahrir, M., Pasanda, O. S. R., Mustika, W., Zaman, N., Adhimastra, I. K., & Darsim, S. K. H. (2023). *Applied Science and Technology*. Break Media.
- AlAli, R., Alsoud, K., & Athamneh, F. (2023). Towards a sustainable future: evaluating the ability of STEM-based teaching in achieving Sustainable Development Goals in learning. *Sustainability*, 15(16), 12542. <https://doi.org/10.3390/su151612542>
- Aliyyah, R. R., Inesia, I., Ningrum, K. S., & Mumtazah, D. (2025). Digital literacy assistance for elementary school teachers. *Qardhul Hasan: Community Service Media*, 11(2), 297-305. <https://doi.org/10.30997/qh.v11i2.15572>
- Ammalia, A., Azizah, A. L., Al Wasim, A., Khoiri, A., Mutmainah, K., & Khanifa, N. K. (2025). Optimizing Technology Literacy and Student Creativity through the Teaching Campus Program at SD IT Ibnu Abbas Lampung. *Collaboration: Journal of Community Service*, 5(4), 523-532. <https://doi.org/10.56359/kolaborasi.v5i4.541>
- Apriani, N. K. R., Ermiana, I., & Nurmawanti, I. (2025). Development of Giant Snake Learning Media and Ladder for Calculating Operating Materials for Grade IV Students of SDN 32 Ampenan. *Scientific Journal of the Education Profession*, 10(2), 1435-1444. <https://doi.org/10.29303/jipp.v10i2.3336>
- Dewi, M. S. A. (2023). *Buku Ajar Pembelajaran Matematika SD untuk Mahasiswa PGSD*. Nilacakra.
- Efendi, R., Inayah, S., Mardhotillah, B., Sholeh, R. N., & Kulimbang, E. (2025). *Mathematics Learning and Learning*. Ume Publishing.
- Gamage, K. A., Ekanayake, S. Y., & Dehideniya, S. C. (2022). Embedding sustainability in learning and teaching: Lessons learned and moving forward—Approaches in STEM higher education programmes. *Education Sciences*, 12(3), 225. <https://doi.org/10.3390/educsci12030225>
- Hariyanto, Kristianingsih, F. X. D., & Maharani, R. (2025). Artificial intelligence in adaptive education: a systematic review of techniques for personalized learning. *Discover Education*, 4(1), 458. <https://doi.org/10.1007/s44217-025-00908-6>
- Hu, Y. H. (2024). Improving ethical dilemma learning: Featuring thinking aloud pair problem solving (TAPPS) and AI-assisted virtual learning companion. *Education and information technologies*, 29(17), 22969-22990. <https://doi.org/10.1007/s10639-024-12754-4>
- Iqbal, M., Sutriyani, W., & Zumrotun, E. (2025). Development of Tens (P4) Smart Board Learning Media in Mathematics Subjects. *Journal of Mathematics Education Al-Irsyad*, 4(2), 366-380. <https://doi.org/10.58917/ijme.v4i2.345>
- Jannah, F. N. M., Nuroso, H., Mudzanatun, M., & Isnuryantono, E. (2023). The use of the Canva app in maths learning media in elementary schools. *Journal of Basic Education*, 11(1), 138-146. <https://doi.org/10.20961/jpd.v11i1.72716>
- Marlis, M. I., Khatimah, H., Dahlan, S., Arfiani, F., Yuanata, A., Maghfirah, S. N., ... & Amadyah, N. (2025). *Media Ajar Digital*. Idebuku.
- Mhlongo, S., Mbatha, K., Ramatsetse, B., & Dlamini, R. (2023). Challenges, opportunities, and prospects of adopting and using smart digital technologies in learning environments: An iterative review. *Heliyon*, 9(6). <https://doi.org/10.1016/j.heliyon.2023.e16348>

- Moltudal, S. H., Krumsvik, R. J., & Høydal, K. L. (2022, February). Adaptive learning technology in primary education: Implications for professional teacher knowledge and classroom management. In *Frontiers in Education* (Vol. 7, p. 830536). Frontiers Media SA. <https://doi.org/10.3389/educ.2022.830536>
- Prabowo, A., Suryadi, D., Dasari, D., Juandi, D., & Junaedi, I. (2022). Learning obstacles in the making of lesson plans by prospective mathematics teacher students. *Education Research International*, 2022(1), 2896860. <https://doi.org/10.1155/2022/2896860>
- Pramono, NCR, Azhari, IM, & Rahmadietha, R.A. (2025). Utilization of AI Technology in Mathematics Teaching Modules: Improving Understanding of Number Multiplication Concepts in Grade IV Elementary Schools. *Karimah Tauhid*, 4(9), 6825-6844. <https://doi.org/10.30997/karimahtauhid.v4i9.20750>
- Pramudita, AP (2024). Development of Materials for the Addition and Subtraction of Papinjur Game Media for Elementary School Class I. *Journal of Elementary School Teacher Education Research*, 12(5). <https://ejournal.unesa.ac.id/index.php/jurnal-penelitian-pgsd/article/view/60783>
- Rahmi, R., Hamdunah, H., & Fitri, D. Y. (2024). Training on the Making of Interactive Learning Media in the Era of the Independent Curriculum of Teachers of SMPN 31 Padang. *Damhil: Journal of Community Service*, 3(2), 55-65. <https://doi.org/10.37905/damhil.v3i2.28561>
- Ratnasari, N. M.M., Wiarta, I. W., & Sujana, I. W. (2024). Android-assisted numeracy-based literacy-based interactive multimedia for class IV distribution materials. *Indonesian Student Research Journal*, 4(1), 81-94. <https://doi.org/10.36663/jpmi.v4i1.673>
- Rizvi, I., Bose, C., & Tripathi, N. (2025). Transforming Education: Adaptive Learning, AI, and Online Platforms for Personalization. In *Technology for Societal Transformation: Exploring the Intersection of Information Technology and Societal Development* (pp. 45-62). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-96-1721-0_4
- Rubiyanti, D., & Novianti, N. (2025). Improve Understanding of Math Concepts through Canva-Based Interactive Media for Elementary School Students. *JADIKA: Journal of Elementary School Teacher Education*, 1(2), 44-51. <https://jurnal.lppmamanah.org/index.php/jadika/article/view/35>
- Safitri, S. (2024). A study on the impact of science and technology developments on education. *Journal of Educational and Social Science Innovation*, 2(2), 20-31. <https://ejournal.uniramalang.ac.id/jipsos/article/view/4321>
- Sari, N. K., Naba, D. M., & Arifendi, R. F. (2025). Fragmented Learning Innovation: Development and effectiveness of Canva-based interactive teaching modules for elementary school students. *SJME (Journal of Supreme Mathematics Education)*, 9(2), 265-275. <https://doi.org/10.35706/sjme.v9i2.203>
- Shutaleva, A. (2023). Ecological culture and critical thinking: building of a sustainable future. *Sustainability*, 15(18), 13492. <https://doi.org/10.3390/su151813492>
- Strielkowski, W., Grebennikova, V., Lisovskiy, A., Rakhimova, G., & Vasileva, T. (2025). AI-driven adaptive learning for sustainable educational transformation. *Sustainable Development*, 33(2), 1921-1947. <https://doi.org/10.1002/sd.3221>
- Sukri, S., Prabawanto, S., & Usdiyana, D. (2023). Analyzing students' learning obstacles on distance material in three dimensional. *Jurnal Penelitian Pendidikan IPA*, 9(4), 1672-1678. <https://doi.org/10.29303/jppipa.v9i4.2774>
- Sundari, I. P., & Prihatin, Y. (2025). Analyze the learning needs of maths in elementary schools through the use of Canva's AI media on multiplication materials. *BADA'A: Scientific Journal of Basic Education*, 7(2), 102-109. <https://doi.org/10.37216/badaa.v7i2.2348>
- Susilawati, W. (2023). *Innovative Mathematics Learning Based on Mathematics Software Applications*. Gunung Djati State Islamic University, Bandung.
- Sutinah, T., & Suryaman, M. (2025). Using Canva App as a Learning Media in Elementary School to Improve the Quality of Learning. *Journal of Tahsinia*, 6(9), 1390-1402. <https://doi.org/10.57171/jpqe9b21>

- Taufiq, I., Adrias, A., Fitrawati, F., & Fitria, Y. (2025). Canva's Media Effectiveness in Improving Primary School Math Motivation and Learning Outcomes 2022–2025: A Systematic Literature Review. *Educational Catalysts: Journal of Education and Mathematics*, 2(4), 114-124. <https://doi.org/10.62383/katalis.v2i4.2653>
- Ulya, N., Suhailah, S. E., Putri, V. J., & Revita, R. (2025). The Role of Digital Learning Media in Mathematics Learning in the Era of Independent Learning: A Review of the Systematic Literature. *Algebra: Journal of Education, Mathematics and Earth*, 1(2), 126-136. <https://doi.org/10.62383/aljabar.v1i2.536>
- Wati, D. C., Judijanto, L., Apriyanto, A., Sepriano, S., & Maryana, M. (2024). *Media & Technology Learning Mathematics*. PT. Sonpedia Publishing Indonesia.
- Yuswatiningsih, E., & Hariyono. (2025). *Buku Ajar Metode Penelitian Untuk Mahasiswa*. Samudra Biru.

Biographies of Authors

Siti Rodiyah Hida, Department of Basic Education, Postgraduate, Universitas Negeri Gorontalo, Gorontalo, North Sulawesi 96128, Indonesia.

- Email: nadiahida713@gmail.com
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: <https://scholar.google.com/citations?user=F9NfMrQAAAAJ&hl=id>

Thahira Wahyuni W.K.E. Kalani, Department of Basic Education, Postgraduate, Universitas Negeri Gorontalo, Gorontalo, North Sulawesi 96128, Indonesia.

- Email: thahirakalani30@gmail.com
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A

Yuniar Marhamah S. Ibrahim, Department of Basic Education, Postgraduate, Universitas Negeri Gorontalo, Gorontalo, North Sulawesi 96128, Indonesia.

- Email: yuniarmarhamahibrahim@gmail.com
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: <https://mahasiswa.ung.ac.id/151421008/home>

Melan Septiani Babay, Department of Basic Education, Postgraduate, Universitas Negeri Gorontalo, Gorontalo, North Sulawesi 96128, Indonesia.

- Version: melanbabay12@gmail.com
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: <https://mahasiswa.ung.ac.id/151420169/home>

Angsi Pakaya, Department of Basic Education, Postgraduate, Universitas Negeri Gorontalo, Gorontalo, North Sulawesi 96128, Indonesia.

- Email: angsipakaya9@gmail.com
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A

Ivana Manorek, Department of Basic Education, Postgraduate, Universitas Negeri Gorontalo, Gorontalo, North Sulawesi 96128, Indonesia.

- Email: imanorek67@gmail.com
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A

Chairil Anaz Yusuf, Department of Basic Education, Postgraduate, Universitas Negeri Gorontalo, Gorontalo, North Sulawesi 96128, Indonesia.

- Email: anazysf28@gmail.com
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: <https://mahasiswa.ung.ac.id/151421101/home>

Irvin Novita Arifin, Department of Basic Education, Postgraduate, Universitas Negeri Gorontalo, Gorontalo, North Sulawesi 96128, Indonesia.

- Email: irvinovitaarifin@ung.ac.id
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: 57211065743
- Homepage: <https://ung.ac.id/formasi/people/198011012009122001>

Isnanto, Department of Basic Education, Postgraduate, Universitas Negeri Gorontalo, Gorontalo, North Sulawesi 96128, Indonesia.

- Email: isnanto@ung.ac.id
- ORCID: 0000-0003-0637-1139
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: <https://ung.ac.id/formasi/people/198007102006041002>