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Effectiveness of Blended Learning in the Mathematics Curriculum on Self-Efficacy and Academic Motivation of Sixth-Grade Students

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A B S T R A C T

Purpose: The objective of this study was to examine the effectiveness of implementing blended learning in the mathematics curriculum on sixth-grade students' self-efficacy and academic motivation.

Methods and Materials: This applied research employed a quasi-experimental pretest–posttest design with a control group. The statistical population consisted of all sixth-grade elementary students in Kermanshah during the 2025–2026 academic year. A sample of 30 female students was selected through convenience sampling and randomly assigned to an experimental group (n = 15) and a control group (n = 15). The experimental group received eight sessions of blended learning in mathematics over one month, while the control group received traditional instruction. Data were collected using the Mathematics Self-Efficacy Questionnaire (4 items, 4-point Likert scale) and Harter's Academic Motivation Scale (33 items, 5-point Likert scale). Reliability coefficients using Cronbach's alpha were 0.90 and 0.91, respectively. Data were analyzed with SPSS-26 using descriptive statistics and multivariate analysis of covariance (MANCOVA).

Findings: Results of the multivariate analysis of covariance demonstrated a statistically significant difference between the experimental and control groups in posttest scores of self-efficacy and academic motivation after adjusting for pretest scores ($F = 23.145$, $p = 0.001$). Students in the experimental group showed significantly higher self-efficacy and academic motivation compared to the control group, indicating the positive impact of blended learning on both psychological variables.

Conclusion: Blended learning in the mathematics curriculum significantly enhances students' self-efficacy and academic motivation by providing flexible, interactive, and supportive learning environments. These findings highlight the potential of blended learning to improve affective and cognitive outcomes in elementary mathematics education.

Keywords: *Blended learning; Mathematics curriculum; Self-efficacy; Academic motivation; Elementary students*

1. Introduction

Mathematics education in contemporary schooling has undergone profound transformation as global shifts in pedagogy, technological innovation, and learning psychology have reshaped how mathematical understanding is constructed and assessed. As digital technologies become more widespread, educators increasingly seek instructional models that enhance students' cognitive engagement, perseverance, and motivational patterns in mathematics. One of the most influential developments in this regard is blended learning, an instructional approach that integrates face-to-face teaching with digital and independent learning opportunities to create more flexible, adaptive, and student-centered learning environments (Engelbrecht & Borba, 2024). The evolution of blended learning corresponds closely with a broader movement in mathematics education toward personalization, self-regulation, and digital competence as central pillars of effective learning.

Research across multiple educational systems has emphasized that students' mathematical achievement, self-efficacy, motivation, and emotional experiences are all significantly shaped by the quality and structure of the learning environment. For example, studies examining affective predictors of mathematics learning have identified reciprocal relationships among mathematics interest, mathematics anxiety, self-efficacy, and academic achievement (Du et al., 2022). These dynamics highlight the importance of creating mathematically rich environments that reduce anxiety, promote active engagement, and foster learners' confidence in their abilities. As self-efficacy is a key driver of students' persistence in problem-solving and their long-term performance trajectories, instructional approaches that enhance mathematical self-beliefs are essential for improving outcomes (Street et al., 2024).

Parallel to these psychological developments, tremendous expansion in educational technology has enabled the integration of digital platforms, adaptive systems, simulations, and multimedia content into mathematics classrooms. Recent work shows that digital technologies have become pivotal in human–technology interactions in mathematics learning, supporting visualization, symbolic reasoning, dynamic modeling, and collaborative problem-solving (Engelbrecht & Borba, 2024). At the same time, advanced AI-driven technologies have begun influencing conceptual research in pure mathematics and theoretical modeling, signaling a paradigm shift in how mathematical thinking is supported, analyzed, and extended (He, 2024). While these developments primarily affect advanced mathematics, they also shape school-level expectations for digital literacy and mathematics preparedness.

Blended learning stands at the intersection of these pedagogical and technological shifts, offering a hybrid instructional model that leverages both human interaction and digital affordances. In mathematics education, blended learning has been used to strengthen conceptual reasoning, provide interactive practice, increase student autonomy, and offer continuous feedback. Several empirical studies have shown that blended learning can significantly improve students' mathematical achievement and retention, often outperforming traditional teaching methods (Egara & Mosimege, 2024). Blended learning's promise lies in its potential to scaffold complex mathematical understanding through multiple representations, interactive digital tools, and personalized pacing, while maintaining the necessary guidance of classroom instruction.

International research consistently demonstrates the value of blended learning for promoting meaningful mathematical learning. A context-based, technology-integrated blended model was shown to significantly enhance mathematical achievement while reducing mathematics anxiety by fostering meaningful engagement with mathematical ideas (Shishigu et al., 2024). Similarly, the use of blended learning aligned with the TPMK framework (Technological Pedagogical Mathematics Knowledge) has been recognized as an effective approach to enhancing mathematics teachers' competence and instructional design in technologically enriched contexts (Winarso & Udin, 2024). These findings indicate that blended learning is not merely a delivery mechanism but a comprehensive pedagogical strategy that reshapes classroom dynamics and promotes deeper mathematical reasoning.

Blended learning also aligns with broader educational transformations associated with the Fourth Industrial Revolution, which explicitly call for integrated, technology-enhanced, and student-centered pedagogies. In vocational and K–12 mathematics education alike, scholars argue for blended models that support 21st-century competencies such as collaboration, digital literacy, creativity, and problem-solving (Jalinus, 2021). As these competencies become more central to educational standards, blended learning emerges as a critical instructional framework capable of integrating traditional mathematical rigor with digital-age flexibility.

A notable aspect of blended learning's impact lies in its influence on teachers—their readiness, efficacy, and

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attitudes toward mathematics teaching. Studies show that teachers' preparedness for blended instruction is essential for successful implementation, and that professional development focused on blended learning improves teachers' sense of efficacy and instructional competence (Villanueva, 2022). In turn, teachers' motivational orientations and digital pedagogical skills directly influence students' engagement and mathematical achievement. The reciprocal nature of teacher–student relationships in online and blended environments has also been found to significantly shape students' academic motivation and engagement patterns (Akram & Li, 2024). These findings emphasize the interdependence of pedagogy, motivation, and digital learning conditions.

Alongside technological and pedagogical benefits, blended learning offers critical cognitive and affective advantages, particularly in fostering mathematics self-concept and self-efficacy. Systematic reviews have shown that interventions designed to strengthen mathematical self-efficacy and self-concept can significantly improve learning outcomes, engagement, and resilience in the face of mathematical challenges (Granello et al., 2025). Since blended learning environments provide autonomy, individualized pacing, interactive feedback, and multimodal representations, they naturally support the development of these affective dimensions. Students often feel more empowered when they can revisit digital content, explore simulations, and receive immediate feedback on tasks—features that help reduce performance anxiety and increase their sense of competence.

Classic philosophical perspectives on mathematics also offer insight into why blended learning may enhance deeper conceptual understanding. Bertrand Russell famously argued that mathematics is not only a tool for empirical reasoning but also a central component of metaphysics, logic, and human inquiry (Russell, 2025). This perspective underscores the role of mathematics as a discipline that extends beyond computations into realms of abstraction, creativity, and intellectual curiosity. Blended learning, by incorporating exploratory digital tools and conceptual visualizations, may help students experience mathematics in this richer and more intellectually expansive manner.

Empirical work conducted specifically in Iranian educational settings reinforces the global evidence supporting blended learning in mathematics. Studies comparing blended instruction with traditional or fully online formats have consistently found that blended learning improves mathematical achievement and student attitudes. For example, blended learning significantly enhanced achievement and improved the attitudes of elementary teachers toward mathematics instruction in a local context (Abadi Kobra, 2022). Similarly, research comparing the efficiency of blended mathematics courses with e-learning and face-to-face methods found that blended instruction produced superior outcomes for both male and female high school students (Abdollahzadeh, 2013). Another study demonstrated that blended learning leads to measurable progress in mathematical understanding and fosters positive attitudes among teachers, highlighting its importance in professional development (Kebria & Abedi, 2022). These studies provide strong contextual justification for implementing blended learning models within the Iranian mathematics curriculum.

From a pedagogical standpoint, blended learning is particularly effective because it operationalizes key principles of meaningful learning: learner engagement, concept formation, active participation, and contextual application. The integration of digital tools helps students visualize abstract mathematical concepts, while online learning spaces provide opportunities for reflection, practice, and scaffolding. Blended learning environments also support differentiated instruction, enabling teachers to accommodate diverse learning styles and provide targeted support (Chin et al., 2018). Furthermore, by combining synchronous and asynchronous activities, blended learning enhances students' time-management skills, independence, and cognitive flexibility—skills that are essential for long-term mathematical success.

In addition to cognitive benefits, blended learning addresses motivational challenges often encountered in mathematics classrooms. Research shows that academic motivation plays a critical role in determining students' engagement and persistence in online and blended learning environments (Akram & Li, 2024). The provision of interactive tasks, multimedia content, collaborative online discussions, and self-paced modules helps sustain students' interest and reduces the likelihood of disengagement. This is particularly important in mathematics, where negative emotions such as anxiety or frustration may hinder performance and long-term academic trajectories (Du et al., 2022). Blended learning's potential to mitigate such barriers makes it a powerful tool for enhancing students' motivational profiles.

At the same time, global research on blended learning in mathematics teacher education highlights the importance of developing teachers' digital literacy and pedagogical

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integration skills to ensure that blended models are implemented effectively. Studies emphasize that successful blended learning requires coherent instructional planning, alignment between digital and face-to-face components, and a supportive school infrastructure (Hodovaniuk et al., 2021). When these factors are present, blended learning can transform mathematics classrooms into dynamic, interactive, and student-centered spaces.

Despite the substantial evidence supporting blended learning, relatively few empirical studies have examined its effects on self-efficacy and academic motivation simultaneously among elementary school students. Given that self-efficacy and motivation are critical predictors of mathematical performance and long-term engagement, understanding how blended learning influences these variables—particularly in younger learners—remains a pressing research need. In addition, although several studies have explored mathematics achievement outcomes, fewer have investigated the affective and psychological benefits that blended learning may provide for sixth-grade students at a crucial developmental stage.

Therefore, the aim of this study is to examine the effectiveness of implementing blended learning in the mathematics curriculum on sixth-grade students' self-efficacy and academic motivation.

2. Methods and Materials

2.1. Study Design and Participants

The present study was applied in purpose and quasi-experimental in method, using a pretest–posttest design with a control group. The statistical population consisted of all sixth-grade elementary school students in Kermanshah during the 2025–2026 academic year. To determine the sample size, 30 sixth-grade female students were selected through convenience (purposeful) sampling based on the total population size and were randomly assigned to two groups: an experimental group (15 students) and a control group (15 students).

2.2. Measures

Mathematics Self-Efficacy Questionnaire: This questionnaire consists of 4 items. Scoring is based on a 4-point Likert scale (from "strongly disagree" to "strongly agree"). The validity and reliability of this instrument were reported in previous studies by Saeedi-Pour (2019), indicating a Cronbach's alpha of 0.74. The internal consistency coefficient of this scale was reported as 0.85 in the study by Middleton and Midgley (1997) and 0.79 in the study by Mohsen-Pour (2005). Additionally, a reliability coefficient of 0.87 was obtained in the research by Haji Hosseinlou et al. (2018). To determine construct validity, Lavasani, Khezri Azar, and Amani (2009) used confirmatory factor analysis via LISREL software and concluded that the indices demonstrated the significant and substantial contribution of each item in measuring the self-efficacy construct. In the present study, reliability was obtained at 0.90 using Cronbach's alpha.

Harter's Standard Academic Motivation Questionnaire: This questionnaire contains 33 items and aims to assess academic motivation among students. This instrument is a revised version of Harter's (1980, 1981) scale, designed as a measure of academic motivation. As originally developed, Harter's scale assessed academic motivation through bipolar questions in which one pole represented intrinsic motivation and the other extrinsic motivation, requiring respondents to choose only one motivational reason per item. Because in many academic contexts both intrinsic and extrinsic motives may coexist, Lepper et al. (2005) revised the scale into a more conventional format in which each item represents only one type of motivational reason (intrinsic or extrinsic). This questionnaire is rated on a Likert scale (never = 1; rarely = 2; sometimes = 3; often = 4; almost always = 5). Scores ranging from 33 to 66 indicate low academic motivation; scores between 66 and 99 indicate moderate academic motivation; and scores above 99 indicate very high academic motivation. The reliability of this questionnaire was reported as above 0.92 using Cronbach's alpha by Zohairi and Rajabi (2009). In the present study, reliability was obtained at 0.91 using Cronbach's alpha.

2.3. Intervention

The blended learning intervention protocol (Agara & Mousi-Meij, 2024) was implemented over eight structured sessions, each integrating both face-to-face and online components to enhance conceptual understanding, self-efficacy, and academic motivation in mathematics. In Session 1, students reviewed prerequisite mathematical concepts (such as numerical operations, powers, and roots) and were introduced to the online learning environment, engaging in an in-class group review followed by watching a short instructional video and completing a five-item online quiz. Session 2 focused on introducing the new topic (e.g., quadratic equations), where conceptual teaching with real

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examples occurred in person, and students explored coefficient changes through interactive online exercises. Session 3 centered on guided practice in solving standard problems using methods such as factoring, the quadratic formula, and completing the square, combining teacher-led problem-solving in class with online self-assessment tasks providing immediate feedback. In Session 4, conceptual understanding was deepened through real-life problem-based activities, including group work on applied mathematical scenarios in person and viewing simulations or related videos online followed by analytical responses. Session 5 aimed to strengthen collaboration and social learning through group problem-solving tasks in class and discussion forums in the virtual space. Session 6 involved progress assessment and troubleshooting of common errors through a short written test with in-class error analysis and an online test with automated feedback. In Session 7, students applied mathematical concepts to a real or semi-research project, receiving guidance during face-to-face instruction and submitting a video or written report online. Finally, Session 8 provided a comprehensive review of key concepts alongside a final evaluation, combining a summary discussion and Q&A in person with an online final test and learner feedback form.

2.4. Data Analysis

Data analysis was performed using SPSS-26. In addition to descriptive statistical methods and statistical indicators such as mean and standard deviation, analysis of covariance (ANCOVA) was employed.

3. Findings and Results

As shown in Table 1, the posttest mean of self-efficacy in the experimental group (M = 14.27) is higher than the pretest mean of the experimental group. Likewise, the posttest mean of academic motivation in the experimental group (M = 16.55) is higher than the pretest mean of the experimental group (M = 11.12). In addition, the pretest mean of academic motivation in the control group (M = 9.14) is higher than its posttest mean (M = 9.03). Therefore, the pretest mean of academic motivation in the control group is lower than the pretest mean of the experimental group, and the posttest mean of academic motivation in the experimental group is higher than the posttest mean of the control group.

Table 1

Means and Standard Deviations of Pretest and Posttest Scores of Self-Efficacy in the Two Experimental and Control Groups

Variable	Group	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD
Self-efficacy	Experimental	15	11.23	3.47	14.74	3.35
	Control	15	11.01	3.12	11.78	3.14
Academic Motivation	Experimental	15	11.12	4.41	16.55	2.40
	Control	15	9.14	3.67	9.03	3.65

In this study, the underlying assumptions were that the sample selected through convenience sampling adequately represented the target population of sixth-grade students, that the participants in both the experimental and control groups had comparable baseline characteristics prior to the intervention, and that the instruments used—namely the Mathematics Self-Efficacy Questionnaire and Harter's Academic Motivation Scale—were valid and reliable measures for assessing the intended psychological constructs within this population. It was also assumed that external factors influencing self-efficacy and academic motivation remained relatively constant throughout the study period, that participants responded honestly to the questionnaire items, and that the implementation of the blended learning intervention was carried out consistently across all sessions. Additionally, the assumptions of analysis of covariance (ANCOVA), including normality of data distribution, homogeneity of variances, homogeneity of regression slopes, independence of observations, and linearity between covariates and dependent variables, were presumed to be met to ensure the accuracy and validity of the statistical conclusions.

Table 2

Results of Multivariate Analysis of Covariance for Examining the Difference in Posttest Scores of Self-Efficacy and Academic Motivation in the Experimental and Control Groups

Source	Sum of Squares	df	Mean Square	F	Sig.
Group	158.024	1	158.024	23.145	0.001
Pretest (Self-efficacy & Motivation)	48.574	1	48.574	6.954	0.014
Error	524.124	–	7.020	–	–
Total	13620	–	–	–	–

As presented in Table 2, after adjusting the pretest scores of self-efficacy and academic motivation, there is a significant difference between the two groups—experimental (blended learning in the mathematics curriculum) and control (traditional teaching method) ($F = 23.145$, $p = 0.001$). Therefore, the null hypothesis is rejected and the research hypothesis is confirmed. This indicates that the posttest means of self-efficacy and academic motivation are significantly higher in the experimental group than in the control group, suggesting that instruction through blended learning in the mathematics curriculum has a significant effect on the self-efficacy and academic motivation of sixth-grade elementary students.

4. Discussion and Conclusion

The findings of this study demonstrated that the implementation of blended learning within the mathematics curriculum had a significant positive effect on sixth-grade students' self-efficacy and academic motivation. After controlling for pretest scores, the posttest means for both variables were substantially higher in the experimental group than in the control group, indicating that blended learning created a more supportive, engaging, and cognitively stimulating environment compared to traditional face-to-face instruction. These results align with a broad body of international research that positions blended learning as a powerful pedagogical model capable of enhancing both cognitive and affective learning outcomes in mathematics education. The present study's findings support earlier work emphasizing that self-efficacy, motivation, and mathematics performance are interrelated constructs that respond strongly to changes in instructional design and learning environments (Du et al., 2022). By integrating digital tools, interactive content, and flexible pacing, blended learning appears to effectively strengthen learners' beliefs in their abilities as well as their sustained interest in mathematics.

The improvement in students' self-efficacy observed in this study is consistent with evidence showing that blended learning environments promote greater autonomy and mastery experiences, which are foundational to self-efficacy development. Research on mathematical self-efficacy highlights the importance of meaningful engagement, feedback, and opportunities for incremental success in building students' confidence in their mathematical capabilities (Street et al., 2024). In the present study, the combination of face-to-face sessions with online components—such as interactive exercises, immediate digital feedback, and multimedia explanations—likely offered students repeated successful experiences and reinforced their sense of competence. These findings resonate with results from systematic reviews indicating that pedagogical interventions incorporating technology can significantly enhance students' mathematics self-concept and self-efficacy across different educational systems (Granello et al., 2025). Flexible access to online content may have further reduced anxiety and increased students' willingness to revisit challenging concepts, supporting the formation of stronger self-efficacy beliefs.

Moreover, the results related to academic motivation demonstrate that blended learning not only elevates students' confidence but also sustains their interest and engagement in learning mathematics. Research has shown that teacher–student relationships, interactive learning environments, and opportunities for autonomy significantly influence students' academic motivation in digital and blended contexts (Akram & Li, 2024). The online components used in this study—such as self-paced exercises and discussions—likely supported students' intrinsic motivation by allowing them to explore mathematical ideas independently. At the same time, classroom discussions and collaborative tasks may have strengthened extrinsic motivation through social interaction and teacher feedback. These patterns align closely with the argument that blended learning is most effective when it provides a balanced integration of independent digital learning and guided face-to-face instruction, ensuring that learners remain engaged without becoming overwhelmed (Shishigu et al., 2024).

The findings of this study also correspond with the growing body of research showing that blended learning enhances mathematics achievement and cognitive engagement across a range of educational settings. Studies conducted in secondary and primary schools consistently report improvements in achievement, retention, and conceptual understanding when blended learning approaches are implemented effectively (Egara & Mosimege, 2024). The multi-modal instructional features of blended learning—such as visual simulations, dynamic modeling tools, and conceptual representations—play a crucial role in supporting deeper mathematical reasoning. This perspective is further reinforced by research highlighting the transformative impact of digital technologies on mathematics education, particularly in promoting exploration, inquiry, and conceptual understanding (Engelbrecht & Borba, 2024). In the present study, these affordances were likely influential in helping students connect abstract ideas to visual and experiential representations, contributing to the observed improvements in motivation and perceived competence.

Furthermore, international studies have emphasized that effective blended learning requires high-quality instructional planning, integration of digital resources, and alignment with pedagogical goals (Winarso & Udin, 2024). The structured intervention protocol used in this study—which combined conceptual teaching, interactive practice, collaborative problem-solving, and digital reinforcement—mirrors the characteristics of successful blended learning designs documented in the literature. Similar findings in vocational and teacher education contexts underscore the importance of curricular coherence, technological scaffolding, and opportunities for inquiry-based learning within blended frameworks (Jalinus, 2021). The positive outcomes observed here suggest that when blended learning is carefully designed and consistently implemented, it has the potential to address persistent motivational and self-efficacy challenges commonly observed in mathematics classrooms.

The results also align with philosophical and theoretical perspectives on mathematics, which argue that mathematics is not merely procedural or computational but deeply conceptual, creative, and exploratory. Russell's classical argument that mathematics forms part of human logic and metaphysical reasoning (Russell, 2025) resonates with the immersive learning experiences made possible through blended environments. Digital tools enhance students' abilities to explore patterns, structures, and conceptual relationships, thereby engaging them in more authentic mathematical inquiry. The interactive elements of blended learning support this vision by enabling learners to manipulate variables, investigate relationships, and visualize abstract phenomena, fostering deeper mathematical curiosity and sustained engagement.

In addition to international evidence, the findings of this study are strongly supported by prior research conducted in Iran, which consistently shows that blended learning outperforms both traditional and fully online methods in mathematics education. For example, blended learning has been demonstrated to significantly improve mathematical achievement and positively influence teachers' attitudes (Abadi Kobra, 2022). Another study comparing blended learning with e-learning and traditional formats found that blended instruction led to improved outcomes for both male and female students in early high school mathematics (Abdollahzadeh, 2013). Additionally, evidence shows that blended learning enhances mathematics teachers' performance, instructional attitudes, and the effectiveness of their pedagogical practices (Kebria & Abedi, 2022). These findings support the conclusion that blended learning is well-suited to Iranian educational contexts, where there is an increasing need for student-centered, technologically enriched instruction.

From a psychological perspective, blended learning appears to support both elements of motivation theorized to influence mathematics learning: intrinsic motivation—through autonomy, creativity, and relevance—and extrinsic motivation—through feedback, achievement reinforcement, and structured guidance. Research shows that when online learning engagement is strengthened through meaningful teacher–student interaction, academic motivation increases significantly (Akram & Li, 2024). In the present study, the combination of accessible digital materials and supportive classroom teaching likely activated these motivational pathways, contributing to the significant gains observed in the experimental group. These improvements are also consistent with evidence that meaningful technology integration can reduce mathematics anxiety and promote more positive attitudes toward learning (Shishigu et al., 2024). Blended approaches appear especially promising because they buffer students against the cognitive overload and emotional pressures sometimes experienced in purely traditional or fully online environments.

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Taken together, the results of this study contribute to the expanding literature that positions blended learning as a highly effective instructional model for enhancing both affective and cognitive dimensions of mathematics learning. The alignment of these results with international, regional, and theoretical perspectives strengthens the validity of the findings and underscores the importance of blended instructional models in contemporary education. As mathematics education continues to evolve within increasingly digital and hybrid learning ecosystems, blended learning offers a flexible, robust, and evidence-based approach for improving students' confidence, engagement, persistence, and understanding.

This study was limited by its relatively small sample size of 30 students, which restricts the generalizability of the findings. The use of convenience sampling may introduce selection bias, and the participants were drawn exclusively from one grade level and one city, limiting broader applicability. Additionally, the intervention lasted only one month, which constrains the ability to assess long-term effects on motivation and self-efficacy. Finally, the study relied on self-report questionnaires, which may be influenced by social desirability and response biases.

Future research should employ larger and more diverse samples from multiple schools and regions to enhance generalizability. Longer-term longitudinal designs would help clarify how sustained blended learning influences motivation, self-efficacy, and mathematical proficiency over time. Future studies may also explore additional outcomes such as problem-solving ability, classroom engagement, digital literacy, and mathematics anxiety. Experimental designs that compare different types of blended models could identify which combinations of face-to-face and online components are most effective.

Teachers should integrate blended learning strategically by combining conceptual instruction with meaningful digital activities that provide feedback and allow self-paced exploration. Schools should invest in teacher training to build digital pedagogical skills and ensure consistent implementation. Additionally, instructional designers should incorporate multimedia, simulations, and collaborative tasks to maximize engagement and address diverse learning needs. Blended learning environments should also include mechanisms for continuous support and interaction to sustain student motivation and confidence in mathematics.

Authors' Contributions

Authors equally contributed to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

All procedures performed in studies involving human participants were under the ethical standards of the institutional and, or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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