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Technology Integration in Mathematics Education: Challenges and Opportunities for Enhancing Achievement at Junior Secondary School Level in Sri Lanka

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Abstract— *This study investigated the current state of educational technology integration in junior secondary science and mathematics education in Sri Lanka's Galle Division, focusing on challenges, opportunities, and strategies for improving student achievement. A mixed-methods approach was employed, combining structured questionnaires, open-ended interviews, and classroom observations. Data were collected from 70 students (Grades 6-9) and 16 mathematics teachers. The instruments included Likert-scale items, open-response questions, and observation checklists to assess perceptions, practices, and integration of educational technology. The results revealed limited use of educational technologies, with only 11% of students reporting smartboard use and 17% computer access. While 92% of students preferred technology-enhanced learning, 37% reported disinterest in mathematics. Teachers showed strong agreement on benefits (82-94%) but low implementation confidence (13%). A misconception prevailed, with both teachers and students perceiving technology mainly as physical tools rather than pedagogical approaches. This study highlights how educational technology is narrowly understood in developing contexts and underscores the importance of reframing it as a pedagogical approach rather than limited tools. By applying the TPACK framework, the study advances knowledge on bridging awareness, confidence, and practice gaps in mathematics education.*

Keywords— Educational Technology; Junior Secondary Education; Mathematics Teaching; TPACK Model; Teacher Professional Development.
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1. Introduction

Educational technology has emerged as a fundamental component of contemporary educational practice, encompassing diverse methodological approaches, pedagogical techniques, and technological tools that enhance the [1]. The global COVID-19 pandemic accelerated the adoption of digital educational modalities, with terms such as online learning, blended learning, and digital education gaining unprecedented prominence across educational institutions worldwide [2]. This technological shift has particularly highlighted the potential for educational technology to address longstanding challenges in mathematics education, a subject traditionally perceived as difficult and abstract by many students [3].

The National Council of Teachers of Mathematics (NCTM) has recognized the critical importance of integrating technology in mathematics education, emphasizing its potential to enhance instructional quality and student learning outcomes while promoting equity in mathematical education [4]. The nature of mathematics as a discipline requiring extensive practice rather than rote memorization makes it particularly suitable for technology-enhanced pedagogical approaches [5]. However, despite widespread recognition of technology's potential benefits, significant implementation challenges persist across educational contexts.

In Sri Lanka, as in many developing countries, mathematics achievement at the junior secondary level remains problematic. Statistical data indicate consistently low pass rates in mathematics and science subjects at the G.C.E. Ordinary Level examinations, reflecting systemic challenges in mathematical education [6]. The integration of educational technology presents a potential solution to these challenges; however, limited research exists that examines the specific context of Sri Lankan mathematics education and technology integration practices.

Educational technology, as defined by the Association for Educational Communications and Technology (AECT), encompasses "the ethical study and application of theory, research, and practices to advance knowledge, improve learning and performance, and empower learners through strategic design, management, implementation, and evaluation of learning experiences and environments using appropriate processes and resources" [7]. This definition emphasizes that educational technology extends beyond mere tools and equipment to include comprehensive theoretical and practical frameworks for enhancing education. In the Sri Lankan context, where resource constraints and infrastructure limitations are prevalent, this comprehensive understanding becomes particularly critical, as it shifts focus from expensive equipment acquisition to strategic pedagogical innovation that can work within existing constraints.

Research in technology-enhanced mathematics education has demonstrated positive correlations between the integration of appropriate technology and improved student outcomes [8]. Studies indicate that technology can enhance student motivation, engagement, and conceptual understanding while providing opportunities for interactive and personalized learning experiences [9]. However, Bray and Tangney's systematic review revealed significant gaps in research examining technology usage specifically within developing country contexts, particularly in South Asian educational systems [5].

The Technological Pedagogical Content Knowledge (TPACK) model, developed by Mishra and Koehler, provides a useful framework for understanding how to effectively integrate technology in education [10]. It highlights the importance of combining technological, teaching, and subject knowledge for meaningful use of educational technology. Recent reviews indicate that the TPACK model is relevant worldwide and can help guide teacher training in the effective use of technology [11]. In the context of Sri Lankan mathematics education, where teachers often face challenges related to inadequate training, limited technological literacy, and insufficient infrastructure, the TPACK framework offers a structured approach to understanding and addressing the multifaceted nature of technology integration barriers. Specifically, the framework helps identify whether challenges stem from lack of technological knowledge (TK), insufficient pedagogical strategies (PK), limited subject matter expertise (CK), or more critically, the inability to synthesize these knowledge domains. This diagnostic capability makes TPACK particularly valuable for developing targeted interventions in resource-constrained educational systems where professional development must be strategic and efficient.

Despite the theoretical foundation and research support for educational technology in mathematics education, implementation challenges persist. Karunanayaka and Weerakoon identified teacher reluctance and inadequate technological literacy as significant barriers to the adoption of technology in Sri Lankan educational contexts [2]. Furthermore, research has highlighted the distinction between "educational technology" and "technology in education," emphasizing the need for a comprehensive understanding of pedagogical approaches rather than mere tool utilization [12]. This distinction is particularly salient in developing countries where the tendency to equate educational technology with hardware procurement often leads to underutilized equipment and missed pedagogical opportunities.

The percentage of students achieving satisfactory performance in mathematics at the junior secondary level in Sri Lanka remains concerning, with many students developing negative attitudes toward the subject. While educational technology presents potential solutions, limited research exists examining its current implementation status, effectiveness, and associated challenges within the Sri Lankan context. This research gap becomes especially problematic given the unique characteristics of the Sri Lankan education system, including its examination-oriented culture, multilingual teaching environment, urban-rural disparities in resource allocation, and the prevalence of private tuition as a parallel education system. Understanding how educational technology can function within, and potentially transform, these contextual realities requires empirical investigation grounded in local experiences.

This study aims to investigate the integration of educational technology in junior secondary mathematics education, with specific focus on the Galle Division. The research objectives are to: (1) examine current issues and challenges in mathematics achievement at the junior secondary level; (2) examine teachers' and students' knowledge and understanding of educational technology applications; (3) investigate teachers' perceptions regarding educational technology integration for mathematics instruction; (4) assess the current extent of educational technology utilization in mathematics classrooms; and (5) provide recommendations for enhancing educational technology integration to improve mathematics achievement. Through these objectives, this study seeks to contribute empirical evidence to the limited body of research on educational technology integration in South Asian mathematics education, while providing actionable insights for policymakers, school administrators, and teacher educators working to improve mathematics learning outcomes in resource-constrained contexts.

2. Method

This study employed a mixed-methods research approach, combining quantitative and qualitative data collection methods to provide comprehensive insights into educational technology integration in mathematics education. The mixed-methods design was selected to enable triangulation of findings, allowing quantitative results to be validated and enriched through qualitative insights, while providing a holistic understanding of the complex relationships between technology tools and classroom outcomes [13]. The research paradigm incorporated both descriptive and exploratory elements, utilizing questionnaire surveys, interviews, and classroom observations to gather comprehensive data about current practices, perceptions, and challenges in educational technology integration.

The study utilized random sampling methodology to select participants from schools within the Galle Division of Sri Lanka. The sample comprised: (1) Student participants: 70 students enrolled in grades 6, 7, 8, and 9, representing the junior secondary mathematics education level; and (2) Teacher participants: 16 qualified mathematics teachers currently teaching at the junior secondary level.

The sampling procedure ensured representation across different grade levels and school types within the division, providing diversity in perspectives and experiences related to mathematics education and technology integration.

Two separate structured questionnaires were designed, one for students and the other for teachers. Each instrument comprised several components, including sections on demographic and background information, closed-ended items measured on a Likert scale, and open-ended questions that provided respondents with the opportunity to elaborate on their views. Additionally, both questionnaires included items specifically designed to capture participants' awareness, usage, and perceptions of educational technology. Additionally, structured classroom observations were conducted to gather direct evidence of current teaching practices, technology utilization, and student-teacher interactions during mathematics instruction. Observation protocols focused on pedagogical approaches, technology integration instances, and student engagement indicators. Similarly, semi-structured interview elements were incorporated within the questionnaires to gather detailed qualitative insights regarding participants' experiences, challenges, and recommendations related to educational technology in mathematics education.

Statistical analysis was conducted using SPSS software, with descriptive statistics including frequencies, percentages, and cross-tabulations used to analyze response patterns. Data were presented through tables, charts, and graphs to facilitate interpretation. Qualitative responses from open-ended questions and observation notes were analyzed using descriptive analytical methods. Data coding procedures were implemented to identify recurring themes, patterns, and categories within participant responses. Thematic analysis facilitated the identification of key issues, perceptions, and recommendations that emerged from the participants' perspectives.

3. Result and Discussion

3.1 Current Issues in Mathematics Achievement

The analysis of student interest in mathematics revealed concerning patterns that highlight fundamental challenges in mathematics education. As presented in Table 1, only 27% of students (combining "most interest" and "somewhat interest" categories) demonstrated positive attitudes toward mathematics, while 37% explicitly reported being "fed up with mathematics."

Table 1: Student Interest in Mathematics (n=70)

Response Category	Number of Students	Percentage
Most interest	9	13%
Somewhat interest	10	14%
Neither interest nor disinterest	20	29%
No interest	5	7%
Fed up with mathematics	26	37%

These findings indicate a significant crisis in student engagement with mathematics, with more than one-third of students expressing active frustration with the subject. The high percentage of students in the "neither interest nor disinterest" category (29%) suggests a concerning level of disengagement that could potentially develop into more negative attitudes without intervention. Further investigation revealed multiple interconnected factors contributing to poor mathematics achievement and negative student attitudes. Table 2 presents key findings regarding parental support, teaching methodology preferences, and technology integration interest.

Table 2: Factors Affecting Mathematics Learning (n=70)

Factor	Yes	Percentage	No	Percentage
Parental motivation for mathematics exercises at home	53	75%	17	25%
Student satisfaction with current teaching methods	23	33%	47	67%
Interest in technology-enhanced instruction	65	92%	5	8%

The data reveals a stark contrast between high parental supports (75%) and low student satisfaction with current teaching approaches (only 33%). This disconnect suggests that while home support exists, pedagogical methods employed in schools may be inadequate for engaging students effectively.

The qualitative analysis of student responses revealed several factors that contribute to difficulties in learning mathematics. A key concern highlighted by students was the lack of adequate pedagogical knowledge among some teachers, which hindered their ability to grasp mathematical concepts effectively. Challenges were particularly pronounced in the area of geometry, where limited teacher competency was reported in delivering instruction. Students also noted shortcomings in assessment practices, emphasizing that teachers often failed to mark exercises or provide constructive feedback to support learning. Furthermore, comparative concerns were raised regarding teaching quality, with many students expressing a preference for private tutoring over classroom instruction.

Finally, the predominance of monotonous, textbook-based teaching methods, with little methodological variation, was frequently cited as a barrier to engagement and understanding.

Despite widespread dissatisfaction with current teaching methods, 92% of students expressed strong interest in receiving instruction through technological tools. This finding suggests significant untapped potential for educational technology to address current engagement and achievement challenges in mathematics education.

3.2 Current Knowledge and Usage of Educational Technology

Limited Awareness and Utilization

The investigation of current educational technology usage revealed significant limitations in both awareness and implementation. Among student participants, only 11% (8 students) reported using smart boards in mathematics learning, while 17% (12 students) indicated rare computer usage by teachers. The majority of participants (72%) reported no technological tool usage in their mathematics classes.

Misconceptions about Educational Technology

A critical finding emerged regarding fundamental misconceptions about the nature and scope of educational technology. Both students and teachers demonstrated limited understanding of educational technology beyond basic physical tools. Participants consistently identified only tangible devices, such as calculators, Smartboards, computers, Whiteboards, and Charts and graphs.

This narrow conceptualization reflects several underlying factors that warrant deeper examination. First, the prevalent equipment-focused view of technology likely stems from how educational technology has been introduced and discussed in the Sri Lankan educational context, where policy initiatives and school-level discussions have historically emphasized hardware procurement and infrastructure development over pedagogical transformation. Second, the lack of exposure to comprehensive educational technology theory in teacher training programs means that educators themselves have not been equipped with frameworks to understand technology beyond its physical manifestations. Third, the examination-oriented nature of Sri Lankan education may contribute to viewing technology as supplementary tools rather than integral pedagogical approaches, since technology use is not explicitly assessed or required in standardized examinations. Finally, limited practical experience with diverse forms of educational technology such as learning management systems, adaptive learning software, or collaborative digital platforms means both teachers and students lack concrete reference points for conceptualizing technology's broader pedagogical applications.

This narrow conceptualization contradicts Collier's comprehensive definition of educational technology, which encompasses not only electronic equipment but also "the design and evaluation of curriculum and learning experiences and the problems of implementing and renovating them" [14]. The limited awareness suggests inadequate professional development and training regarding the theoretical foundations and practical applications of educational technology.

Teacher Knowledge Assessment

Teacher participants demonstrated similar limitations in understanding educational technology's comprehensive scope. When asked about integration possibilities, all teacher responses focused exclusively on physical tools and equipment. This finding indicates systemic gaps in teacher preparation and professional development regarding educational technology theory and practice.

The limited awareness among educators is particularly concerning given their role in implementing technology-enhanced pedagogical approaches. Without comprehensive understanding of educational technology principles, effective integration remains unlikely regardless of available resources or equipment.

3.3 Teacher Perceptions of Educational Technology Integration

Positive Attitudes toward Technology Benefits

Despite limited implementation experience, mathematics teachers demonstrated overwhelmingly positive perceptions regarding educational technology's potential benefits. Table 3 presents comprehensive data on teacher attitudes across multiple dimensions of educational technology integration.

Table 3: Teacher Perceptions of Educational Technology in Mathematics Education (n=16)

Statement	Agree/Strongly Agree	Percentage
Educational technologies engage learners' attention and motivate them	13	82%
Educational technologies improve learners' test and exam results	15	94%
Educational technology stimulates learners' curiosity	12	75%
Educational technologies encourage learners to develop problem-solving strategies	10	63%
Educational technologies improve teachers' efficiency	14	88%
Educational technology provides better teaching approaches and understanding	12	75%
Educational technology supports cooperative learning	8	50%
Technology-assisted instruction is more effective than traditional methods	11	69%
Increases academic achievement	12	75%

Promotes student collaboration	13	82%
Makes classroom management more successful	12	75%
Promotes development of communication skills	13	82%
Enhances professional development	14	88%

The data indicates strong teacher recognition of educational technology's potential benefits, with particularly high agreement levels regarding improved test results (94%), enhanced teacher efficiency (88%), and professional development opportunities (88%).

Implementation Challenges and Barriers

The findings highlight two major challenges that hinder the effective integration of educational technology. First, only 13% of teachers (2 out of 16) expressed confidence in their ability to successfully implement technology in their classrooms, indicating a sharp disparity between the perceived benefits of technology and teachers' self-efficacy in applying it.

This dramatic confidence gap, where 82-94% of teachers recognize technology's benefits but only 13% feel capable of implementing it, reveals multiple interconnected barriers operating at individual, institutional, and systemic levels. At the individual level, teachers' lack of confidence may stem from limited personal experience with technology in their own education, minimal hands-on training opportunities, fear of technical failures in front of students, and uncertainty about how to troubleshoot problems when they arise. Institutionally, schools may lack technical support staff, provide insufficient time for teachers to experiment and prepare technology-enhanced lessons, offer no mentoring or peer collaboration opportunities for technology integration, and maintain evaluation systems that do not reward innovative pedagogical approaches. Systemically, teacher education programs have not adequately prepared graduates with integrated technological pedagogical knowledge, professional development initiatives remain sporadic and tool-focused rather than pedagogically comprehensive, and resource allocation patterns prioritize equipment purchase over sustained capacity building. This multi-layered analysis helps explain why positive attitudes alone are insufficient to drive implementation and underscores the need for systemic interventions that address confidence barriers at all levels simultaneously.

Second, workload concerns emerged as a significant barrier, with just 26% of teachers agreeing that educational technology would help reduce their workload. This suggests apprehensions about increased complexity and additional time demands associated with technology use. Collectively, these findings reveal that although teachers acknowledge the potential advantages of educational technology, they often lack the confidence, skills, and institutional support required for effective implementation. The resulting gap between positive perceptions and actual capacity constitutes a critical obstacle to technology integration in mathematics education.

3.4. Discussion

3.4.1 Systemic Challenges in Mathematics Education

The research findings reveal interconnected systemic challenges that contribute to poor mathematics achievement at the junior secondary level. The high percentage of students expressing frustration with mathematics (37%) combined with widespread dissatisfaction with teaching methods (67%) indicates fundamental problems in pedagogical approaches and curriculum delivery.

The relationship between high parental support (75%) and low student engagement suggests that current educational approaches fail to capitalize on available home-based support systems. This finding aligns with international research indicating that parental involvement alone is insufficient without effective school-based pedagogical practices [15].

Within the specific context of the Sri Lankan education system, these challenges are amplified by several structural factors. The highly competitive examination system, where students' entire educational trajectories depend heavily on performance in national examinations, creates intense pressure that often leads to rote learning and memorization rather than conceptual understanding. This examination culture is further complicated by the widespread reliance on private tutoring, which has become a parallel education system where many students report receiving more effective instruction than in their regular schools. The prevalence of large class sizes often exceeding 40-50 students per classroom in government schools severely limits teachers' ability to provide individualized attention, implement interactive pedagogical approaches, or effectively integrate technology even when equipment is available. Additionally, the multilingual nature of mathematics education in Sri Lanka, where instruction may occur in Sinhala, Tamil, or English depending on the school medium, creates unique challenges in developing and disseminating technology-enhanced resources that are linguistically and culturally appropriate. Resource disparities between urban and rural schools, well-established and under-resourced institutions, and different provincial educational zones further compound these challenges, creating an uneven landscape for technology integration initiatives.

3.4.2 Educational Technology as a Potential Solution

The overwhelming student interest in technology-enhanced instruction (92%) presents a significant opportunity for addressing engagement challenges. This finding supports research indicating that appropriately implemented educational technology can enhance motivation and learning outcomes in mathematics education [16].

However, the current minimal usage of educational technology tools (11% smart board usage, 17% computer access) indicates substantial gaps between student interest and institutional capacity for technology integration. This disparity suggests that infrastructure limitations and implementation challenges prevent realization of technology's potential benefits.

In the Sri Lankan context, several additional factors constrain technology utilization beyond simple infrastructure availability. Frequent power interruptions, particularly in rural and semi-urban areas, make consistent technology use unpredictable and unreliable, discouraging teachers from planning technology-dependent lessons. Internet connectivity remains limited and expensive, restricting access to cloud-based resources, online learning platforms, and digital content repositories that could enhance mathematics instruction. The lack of technical support personnel in most schools means teachers must troubleshoot technical problems themselves, consuming valuable instructional time and increasing anxiety about technology use. Furthermore, national curriculum guidelines and textbooks have not been systematically updated to incorporate technology integration guidance, leaving teachers without clear direction on how to align technology use with mandated learning outcomes. Assessment practices remain traditional, with no incorporation of technology-based evaluation methods, thereby implicitly signaling that technology use is supplementary rather than essential. These contextual realities suggest that infrastructure provision alone cannot solve the technology integration challenge; comprehensive systemic reforms addressing curriculum, assessment, support systems, and teacher capacity development are equally necessary.

3.4.3 Teacher Development Needs

The paradox between teacher recognition of technology benefits (82-94% agreement rates) and implementation confidence (13%) highlights critical professional development needs. Teachers appear to understand educational technology's theoretical value but lack practical skills and confidence for classroom integration.

This finding supports the need for comprehensive teacher development programs that go beyond basic technology training to include pedagogical integration strategies. The TPACK model's emphasis on combining technological, pedagogical, and content knowledge appears particularly relevant for addressing these identified gaps [8].

Effective teacher development for technology integration in the Sri Lankan mathematics education context requires carefully designed interventions that address multiple dimensions simultaneously. First, training programs must move beyond demonstrating how individual tools function to focus on pedagogical strategies for integrating technology into specific mathematical concepts and lesson sequences. Teachers need opportunities to observe expert demonstrations, practice technology integration in low-stakes environments, receive constructive feedback, and gradually build implementation confidence. Second, professional development should be sustained and iterative rather than one-off workshop sessions, allowing teachers to implement strategies, reflect on outcomes, troubleshoot challenges, and refine their approaches with ongoing support. Third, peer learning communities and mentoring systems can provide crucial emotional and practical support, helping teachers overcome isolation and share successful strategies adapted to local constraints. Fourth, pre-service teacher education programs must be fundamentally restructured to ensure new teachers enter the profession with integrated TPACK competencies rather than requiring remedial training later. Finally, professional development initiatives should explicitly address teachers' workload concerns and time management strategies, demonstrating how technology can eventually reduce preparation time and enhance efficiency rather than simply adding more responsibilities.

3.4.4 Conceptual Understanding Gaps

The limited awareness of educational technology's comprehensive scope among both teachers and students represents a fundamental barrier to effective integration. The focus on physical tools rather than pedagogical approaches suggests inadequate exposure to educational technology theory and practice.

This misconception aligns with Lane's distinction between "educational technology" and "technology in education," emphasizing the need for comprehensive understanding of technology's pedagogical applications rather than mere tool utilization [14].

The conceptual gap extends beyond individual misunderstanding to reflect systemic issues in how educational technology is framed within national educational discourse and policy. Government initiatives focused on computer laboratory establishment and smartboard procurement, while valuable, have inadvertently reinforced equipment-centered definitions of educational technology. Educational technology is rarely discussed in terms of learning design principles, constructivist pedagogical approaches, differentiated instruction strategies, formative assessment practices, or collaborative learning frameworks—all of which could be enhanced through technological and non-technological means. This narrow framing limits imagination about what educational technology integration might accomplish and constrains the types of solutions educators consider viable. Addressing this conceptual gap requires fundamental shifts in educational policy language, teacher education curriculum design, school leadership training, and public discourse about the role of technology in education. Educational technology must be repositioned as a comprehensive approach to enhancing learning through strategic design, implementation, and evaluation of pedagogical experiences, with various tools and resources serving this broader purpose rather than defining the field itself.

3.4.5 Practical Implications for Educational Stakeholders

The findings of this study present several important implications for different stakeholders in the education system.

For Educational Policy Makers: A key priority for policy makers is systematic investment in technological infrastructure. However, such investment alone is insufficient without parallel initiatives that strengthen teacher development and pedagogical support systems. Policy frameworks and training guidelines should also move beyond viewing educational technology merely as physical tools, instead adopting a more comprehensive definition that includes pedagogical theories and practices. Furthermore, professional development for teachers must be prioritized, with adequate funding and sustained policy support to bridge the gap between technology awareness and actual classroom implementation. Specific policy interventions might include establishing minimum technology integration competency standards for teacher certification, creating dedicated budget lines for ongoing professional development rather than one-time training, developing national digital content repositories with mathematically and culturally appropriate resources, and implementing incentive systems that reward innovative pedagogical practices.

For School Administration: School leaders are central to ensuring effective integration of technology in teaching and learning. This requires holistic planning that incorporates teacher training, pedagogical support, and ongoing technical assistance. Importantly, given the strong student interest in technology-enhanced learning, administrators should actively integrate student perspectives into planning and decision-making processes. Additionally, robust monitoring and assessment mechanisms are necessary to evaluate the effectiveness of technology integration initiatives and ensure that they contribute to improved learning outcomes. School leaders must cultivate school cultures that view technology experimentation as valuable professional growth rather than risky deviation from established practices, provide protected time for collaborative planning and peer learning, secure adequate technical support through hiring or partnerships, and advocate for their schools' technology needs with provincial and national authorities.

For Teacher Education Programs: Teacher preparation programs must explicitly integrate the principles of the Technological Pedagogical Content Knowledge (TPACK) framework, ensuring that pre-service teachers understand the interrelated dimensions of technology, pedagogy, and subject content. Training should emphasize practical, hands-on experiences with technology integration rather than limiting instruction to theoretical concepts. To sustain long-term competency development, mentoring and structured support systems should also be established to build teacher confidence and foster continuous professional growth in technology integration. Specific curricular reforms might include requiring pre-service teachers to design, implement, and evaluate technology-enhanced mathematics lessons during practicum experiences, exposing them to diverse educational technology tools and approaches through required coursework, facilitating partnerships with schools successfully implementing technology integration so student teachers can observe and learn from expert practice, and assessing TPACK competencies explicitly in teacher certification evaluations.

3.4.6. Recommendations for Practice

Based on these implications, the following recommendations can be drawn for immediate, medium-term, and long-term courses for action.

Immediate Measures: In-service professional development should be augmented in order to provide comprehensive training on technology integration, according to the TPACK model. These programs should incorporate theoretical foundations along with classroom application strategies. Concurrently, systematic campaigns of awareness are required to broaden teachers' and students' understanding of educational technology beyond basic tools, emphasizing its pedagogical applications. Pilot programmes should also be launched to demonstrate successful models of technology integration, offering concrete examples that can inspire broader utilization across schools. Immediate actions should prioritize low-cost, high-impact interventions such as facilitating peer observation opportunities where teachers can see colleagues successfully integrating technology, creating teacher learning communities focused on sharing technology integration strategies, developing quick-reference guides and video tutorials for common technology integration challenges, and recognizing and celebrating early adopters to build momentum and normalize technology use.

Medium-term Initiatives: Upgrading technology infrastructure remains a priority, but it must be linked with pedagogical requirements and teacher capacities to effective utilization. Curriculum frameworks, especially in mathematics, should be revised to explicitly include expectations and guidelines for technology integration. Furthermore, evaluation systems should be developed to measure both the effectiveness of integration and its impact on student learning outcomes. Medium-term strategies should include establishing school-level technology integration coordinators who provide ongoing support, developing comprehensive digital resource libraries aligned with the national mathematics curriculum, implementing formative assessment mechanisms to track technology integration progress and student learning impacts, and creating pathways for advanced professional certification in educational technology integration that provide career advancement opportunities for teachers.

Long-term Strategic Goals: At a systemic level, educational reforms should embed technology integration as a fundamental element of mathematics education, rather than as an optional enhancement. Teacher education programs should be restructured to ensure that new graduates enter the profession with strong competencies in educational technology integration. Finally, sustained investment in research and development is essential to track progress, identify challenges, and explore new opportunities for advancing technology integration in the education system. Long-term transformation requires fundamental shifts in how mathematics teaching and learning are conceptualized, moving from transmission models toward constructivist, inquiry-based approaches where technology serves as an enabler of deeper mathematical thinking, collaboration, and creativity. This vision necessitates sustained political will, adequate resource allocation, continuous research and evaluation, and willingness to learn from both successes and failures over an extended implementation period.

3.4.7 Limitations and Future Research Directions

This study was conducted in the Galle Division of Sri Lanka, which may limit the generalizability of findings to other contexts. Although the sample size is suitable for exploratory purposes, it could be expanded for broader analysis. In addition, the cross-sectional design offers only a snapshot of current practices, without capturing long-term outcomes or implementation processes.

Future research should address these limitations through longitudinal studies that track the sustained impact of technology integration on mathematics learning. Comparative studies across regions and cultures would help distinguish universal principles from context-specific factors. Experimental or quasi-experimental interventions could further clarify causal links between technology use and student achievement. Action research involving teachers and schools would simultaneously enhance practice and generate practical knowledge. In addition, exploring the role of technology within STEAM education could broaden its relevance and application.

4. Conclusion

This study investigated educational technology integration in junior secondary mathematics education in Sri Lanka's Galle Division, revealing critical insights into the challenges and opportunities for improving mathematics learning outcomes. The research identified a significant crisis in student mathematical engagement, with 37% expressing frustration with mathematics and only 27% demonstrating positive interest, despite 75% receiving parental support and 92% expressing interest in technology-enhanced instruction.

The investigation revealed fundamental conceptual gaps, with both teachers and students narrowly perceiving educational technology as physical tools rather than comprehensive pedagogical approaches. While teachers demonstrated strong recognition of technology's potential benefits (82-94% agreement), only 13% expressed implementation confidence, highlighting a critical capacity gap that prevents translating awareness into practice. Current technology utilization remains minimal (11% smartboard usage, 17% computer access), representing a substantial disconnect between potential and reality.

This study contributes empirically to the limited literature on educational technology integration in South Asian mathematics education, specifically addressing gaps identified in prior systematic reviews. By applying the TPACK framework to analyze the multifaceted barriers to technology integration in developing country contexts, the research advances theoretical understanding of how technological, pedagogical, and content knowledge must interact within specific institutional and cultural constraints. The findings demonstrate that technology integration challenges extend beyond infrastructure limitations to encompass conceptual understanding gaps, professional development deficiencies, and systemic factors embedded in examination-oriented educational cultures.

The research highlights that effective educational technology integration in resource-constrained contexts requires comprehensive systemic interventions addressing infrastructure, professional development, curriculum design, assessment practices, and conceptual frameworks simultaneously. Student enthusiasm for technology-enhanced learning, combined with teacher recognition of its potential, provides a foundation for transformation if supported by strategic, sustained, and contextually appropriate implementation efforts. Ultimately, success depends not on technology provision alone, but on cultivating educators' capacity to leverage diverse pedagogical approaches technological and otherwise to enhance mathematical understanding, engagement, and achievement.

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