



Effect of Tablet-Based Learning on Mathematics Achievement of Students with Mild Intellectual Disabilities: A Review Article

Ehsan Elahi¹, Shabir Ahmad², Dr. M. Naeemullah³, Dr. Sajid Rehman⁴, Tahira Noor⁵

¹ Ph.D. Scholar (Education), Northern University, Nowshera, KPK, Pakistan.

² Ph.D. Scholar (Education), Northern University, Nowshera, KPK, Pakistan.

³ Dean, Faculty of Arts and Social Sciences, Northern University, Nowshera.

Email: naeemullah@northern.edu.pk

⁴ HOD, Department of Education, Northern University, Nowshera, KPK.

⁵ Ph.D. Scholar (Education), Northern University, Nowshera, KPK, Pakistan.

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Corresponding author:

Dr. M. Naeemullah

Email: naeemullah@northern.edu.pk

ABSTRACT

Students with mild intellectual disabilities (MID) often encounter persistent difficulties in learning mathematics because of limitations in cognitive processing, working memory, attention, and problem-solving skills. Recent advances in educational technology have introduced tablet-based learning as an innovative instructional approach that provides interactive, individualized, and visually supported mathematics instruction. This review article examines the available evidence regarding the effects of tablet-based learning on the mathematics achievement of students with mild intellectual disabilities. The objectives of the article were: (i) to review the existing literature on tablet-based learning for students with mild intellectual disabilities, (ii) to examine the effects of tablet-based learning on students' mathematics achievement, (iii) to identify the instructional features of tablet-based learning that contribute to improve mathematics performance, (iv) to explore the benefits and challenges associated with implementing tablet-based learning in mathematics instruction for students with mild intellectual disabilities. The review synthesizes findings from systematic reviews, meta-analyses, and empirical studies published during the past decade. The literature consistently indicates that tablet-based interventions improve students' mathematical performance by increasing engagement, motivation, conceptual understanding, and independent learning. Interactive applications, virtual manipulatives, multimedia instruction, and immediate feedback contribute to improved mathematics achievement across basic arithmetic, number sense, problem-solving, and functional mathematics skills. Despite these positive findings, challenges remain regarding teacher training, technology accessibility, and long-term implementation. The review concludes that tablet-based learning represents an effective instructional strategy for enhancing mathematics achievement among students with mild intellectual disabilities when integrated with evidence-based teaching practices. This review study is beneficial for students with Mild Intellectual disabilities, special education teachers, practitioners, general educational teachers, school administrators, educational leaders and experts, Educational Policymakers, Curriculum Developers and Educational Technology Companies, Researchers in Special Education and Educational Technology.

Introduction

Mathematics is an essential component of academic achievement and independent living. However, students with mild intellectual disabilities often experience substantial challenges in understanding mathematical concepts because of deficits in reasoning, memory, attention, and information processing. These learning characteristics frequently result in lower mathematics achievement than that of typically developing peers (Bouck & Long, 2023).

The integration of digital technology into classrooms has transformed instructional practices, particularly in special education. Tablet devices provide interactive multimedia environments that combine visual, auditory, and tactile learning experiences. Their portability, accessibility, and adaptive features make them suitable instructional tools for learners requiring individualized instruction. Recent research suggests that tablet-based learning enhances student engagement, increases instructional efficiency, and improves mathematics performance across various disability groups (Aspiranti & Larwin, 2021).

In recent years, technology-based interventions have gained traction as a means of addressing these challenges. Tablet computers, in particular, offer distinctive affordances for learners with ID: they reduce motor demands associated with writing, support sustained attention through guided touch points, and provide immediate visual feedback. Tablets also enable pacing that matches individual learner needs and can bolster motivation and engagement. This review synthesizes current evidence on the effect of tablet-based learning on mathematics achievement for students with mild intellectual disabilities. It examines effectiveness (acquisition, maintenance, and generalization), efficiency (time to criterion and error rates), and social validity, while identifying implications for practice and directions for future research.

Statement of the Problem

Mathematics is a fundamental subject that supports academic success, independent living, and future employment opportunities. However, students with mild intellectual disabilities often experience significant difficulties in learning mathematics due to limitations in cognitive functioning, working memory, attention, abstract reasoning, and problem-solving skills (Bouck & Long, 2023). These challenges frequently result in low mathematics achievement and reduced confidence in performing mathematical tasks.

The integration of educational technology, particularly tablet-based learning, has emerged as a promising instructional approach for supporting students with diverse learning needs. Tablets offer interactive multimedia content, immediate feedback, visual representations, and individualized learning experiences that may enhance students' understanding of mathematical concepts (Liu et al., 2024). Although numerous studies have investigated technology-assisted mathematics instruction, the available evidence is dispersed across different educational settings, participant groups, and intervention types.

There is a need to synthesize existing research to determine the effectiveness of tablet-based learning in improving mathematics achievement among students with mild intellectual disabilities. Such a review can provide educators, researchers, and policymakers with evidence-based guidance for integrating tablet technology into mathematics instruction and identifying directions for future research.

Objectives

1. To review the existing literature on tablet-based learning for students with mild intellectual disabilities.
2. To examine the effects of tablet-based learning on students' mathematics achievement.
3. To identify the instructional features of tablet-based learning that contribute to improved mathematics performance.
4. To explore the benefits and challenges associated with implementing tablet-based learning in mathematics instruction for students with mild intellectual disabilities.

Literature Review

Conceptual and Theoretical Foundations

Mathematics instruction for students with intellectual disabilities has been historically guided by principles of explicit, systematic, and multisensory teaching. The TouchMath technique, developed as a visually based method that places dots on numerals corresponding to their value, exemplifies this approach. Students touch and count these dots to perform arithmetic operations, integrating tactile, auditory, and visual learning channels. Research has consistently demonstrated that such multisensory approaches deepen conceptual understanding, accommodate diverse learning styles, and promote durable retention of mathematical skills (Kot & Yıkımsı, 2025).

Explicit instruction (EI) provides an additional theoretical foundation, emphasizing clear modeling, guided practice, independent practice, and systematic feedback. For learners with ID, who benefit from reduced cognitive load and predictable instructional sequences, EI has proven particularly effective. Schöld et al. (2024) demonstrated that tablet-based applications founded on EI principles produced significant and sustained improvements in arithmetic fact fluency for youth with mild ID.

Tablet-Based Learning in Special Education

Tablet-based learning refers to the use of touchscreen devices and educational applications to deliver instructional content. Unlike traditional instruction, tablets provide immediate corrective feedback, interactive exercises, animations, virtual manipulatives, and adaptive learning activities. These features allow teachers to individualize mathematics instruction according to students' learning needs. For students with mild intellectual disabilities, tablets reduce cognitive demands by presenting mathematical concepts in visually meaningful formats. Multimedia presentations improve attention and comprehension while allowing repeated practice without increasing learner frustration. Consequently, tablet-based instruction supports both academic achievement and learner motivation (Liu et al., 2024).

Technology Integration in Special Education

The integration of technology into mathematics instruction has been advocated by major professional organizations, including the National Council of Teachers of Mathematics (NCTM), which emphasizes technology as a tool for supporting conceptual learning and increasing student participation. Tablets, in particular, offer distinctive pedagogical advantages for students with ID: the touch-screen interface reduces fine motor demands associated with writing and numeral placement; immediate visual and auditory feedback supports self-correction and reinforcement; and interactive features sustain attention and motivation (Kot & Yıkıms, 2025).

Empirical Evidence on Effectiveness

A comprehensive meta-analysis synthesized 27 single-case experimental studies published between 2012 and 2022, examining tablet-mediated mathematics interventions for individuals with autism spectrum disorder and/or intellectual disability. Using the Tau-U effect size index, the analysis yielded an overall effect size of 0.98 (95% CI 0.92–1.00), indicating large improvements in mathematics performance. Importantly, no statistically significant moderators were identified, suggesting that tablet-mediated interventions produce robust effects across diverse learner profiles and mathematical content areas (Meta-analysis, 2024).

Comparative studies directly examining tablet versus paper-and-pencil implementations of TouchMath for teaching multiplication have yielded consistent findings. Kot and Yıkıms (2025) employed adaptive alternating treatments designs with four participants aged 14–15 diagnosed with intellectual disabilities. Both formats effectively supported acquisition, maintenance, and generalization; however, tablet-based delivery demonstrated superior efficiency for three of four participants, with reduced total teaching time and fewer errors. The exception, one participant who initially performed better with paper and pencil, ultimately shifted preference toward tablets following exposure, suggesting that familiarity effects may influence initial performance.

Randomized controlled trial evidence further supports the effectiveness of tablet-based interventions. Schöld et al. (2024) evaluated an explicit instruction-based arithmetic application with 30 youth with ID (aged 10–16) over 12 weeks. The intervention group showed significant improvements in arithmetic fact fluency compared to controls, with effects maintained six months post-intervention particularly for subtraction.

Social Validity and Engagement

Social validity data have been consistently positive across studies. Teacher responses indicated that Touch Math is an effective pedagogical tool for multiplication and applicable to other mathematical competencies. Student evaluations revealed positive attitudes toward mathematics, perceived success, and recognition of its importance. Researcher observations documented heightened motivation during tablet sessions, with students expressing explicit preferences for digital over paper-and-pencil formats (Kot & Yıkıms, 2025).

Effects of Tablet-Based Learning on Mathematics Achievement

Evidence from recent research consistently demonstrates that tablet-based learning positively affects mathematics achievement.

Liu et al. (2024) conducted a meta-analysis of 27 single-case experimental studies involving individuals with autism spectrum disorder and/or intellectual disability. The analysis reported a very large overall effect (Tau-U = 0.98), indicating substantial improvements in mathematics performance following tablet-mediated instruction. Improvements were observed across number recognition, addition, subtraction, multiplication, fractions, algebra, and problem-solving skills.

Similarly, Aspiranti and Larwin (2021) synthesized findings from 20 group-design studies involving 2,805 participants. Their meta-analysis found a moderate positive effect of tablet-based mathematics interventions on student achievement and highlighted that well-designed educational applications, sufficient instructional time, and appropriate implementation were associated with stronger outcomes.

Bouck and Long (2023) reviewed mathematics interventions for students with mild intellectual disabilities and concluded that technology-assisted instruction is among the promising evidence-based practices for improving mathematical learning, particularly when combined with systematic teacher instruction.

Gaps in the Literature

Despite promising evidence, the literature has notable limitations. Studies predominantly employ small-sample single-case designs, limiting external validity. The content focus remains narrow, with most investigations addressing basic multiplication and addition/subtraction, while multi-digit operations, division, word problems, and algebraic reasoning remain understudied. Longer-term maintenance and generalization data, while encouraging, require further investigation. Additionally, device-specific findings may not fully generalize to other technologies. These gaps underscore the need for continued research and systematic synthesis.

Method and Procedure

This study employed a systematic review methodology, synthesizing findings from peer-reviewed empirical studies investigating tablet-based mathematics interventions for students with mild intellectual disabilities. The review followed established guidelines for systematic literature reviews in special education, incorporating both quantitative (meta-analytic) and qualitative synthesis approaches.

A comprehensive literature search was conducted across multiple electronic databases, including: ERIC (Education Resources Information Center), PsycINFO, PubMed/Medline, Web of Science Google Scholar, Pro-Quest Dissertations and Theses.

The search period spanned from January 2012 to December 2025, capturing the emergence and proliferation of tablet-based educational interventions. Search terms included combinations of the following keywords: tablet, iPad, mobile device, touchscreen, mathematics, math, arithmetic, intellectual disability, intellectual disabilities, mild intellectual disability, Touch-Math, intervention, instruction, and single-case design.

The criteria to include the research studies in the review was (i) participants diagnosed with mild intellectual disability (or intellectual disability with specified mild severity), (ii) Intervention delivered via tablet or touchscreen device, (iii) mathematics achievement as a dependent variable, (iv) empirical research design (single-case experimental design, randomized controlled trial, quasi-experimental design, or group comparison), (v) Published in peer-reviewed journals or as doctoral dissertations, (vi) published in English or with English translation available.

The criteria for exclusion of the research studies in the review was; studies focusing on participants with severe/profound ID, autism without co-occurring ID, or other disabilities without ID, interventions delivered via desktop computers, smart boards, or non-tablet technologies, studies without quantitative outcome data, conference abstracts, book chapters, or opinion pieces without original data, studies with insufficient methodological detail to assess quality.

Mathematics Learning Difficulties among Students with Mild Intellectual Disabilities

Students with mild intellectual disabilities generally demonstrate slower acquisition of mathematical concepts than their peers. Common learning difficulties include; poor number sense and counting skills, difficulty performing arithmetic operations, limited working memory, problems solving mathematical word problems, difficulty transferring learned concepts to real-life situations, reduced attention span and slower processing speed.

Because of these challenges, researchers recommend explicit instruction, repeated practice, visual supports, and technology-assisted learning as effective instructional approaches (Bouck & Long, 2023).

Factors Contributing to Improve Achievement

Several features explain the effectiveness of tablet-based mathematics instruction like Interactive multimedia presentations increase student attention, Immediate feedback enables rapid correction of errors, Virtual manipulatives support understanding

of abstract concepts, Individualized instruction accommodates different learning rates, Gamification enhances motivation and persistence.

Touchscreen interaction improves accessibility for students with cognitive and motor challenges. These features create an engaging learning environment that promotes conceptual understanding while reducing mathematics anxiety (Liu et al., 2024).

Educational Implications

Teachers should integrate tablet-based activities into mathematics lessons rather than using tablets solely for practice exercises. Professional development is necessary to help educators select evidence-based applications, monitor student progress, and combine technology with explicit instruction. Schools should also ensure equitable access to devices, reliable technical support, and curricula aligned with educational standards.

Future research should include larger randomized controlled trials, investigate long-term learning outcomes, and examine the impact of emerging technologies such as adaptive learning systems and artificial intelligence on mathematics achievement among students with mild intellectual disabilities.

Mechanisms of Effectiveness

Several mechanisms may explain the effectiveness of tablet-based mathematics interventions for students with MID:

- **Reduced Cognitive Load:** The visual-kinesthetic affordances of tablets may reduce cognitive load by externalizing steps in operations and scaffolding working memory during counting and mapping. Direct touch on dot locations and dynamic dragging of results externalize cognitive operations, freeing working memory resources for mathematical reasoning.
- **Reduced Motor Demands.** The tablet interface reduces motor demands associated with writing and placing numerals, allowing students to focus on mathematical operations rather than physical execution. This is particularly beneficial for students with fine motor difficulties, which frequently co-occur with intellectual disabilities.
- **Immediate Feedback.** Tablet applications can provide immediate, non-judgmental feedback, supporting self-correction and reinforcing correct responses. This immediacy may be more effective than delayed feedback typical of paper-and-pencil instruction.
- **Sustained Attention:** Guided touch points and immediate visibility of dot paths support sustained attention, a domain in which students with ID often experience challenges. The interactive nature of tablet tasks may also reduce off-task behavior.

Summary

The systematic review and meta-analysis of 27 single-case experimental studies examining tablet-based mathematics interventions for students with mild intellectual disabilities revealed a large overall effect size ($\text{Tau-U} = 0.98$, 95% CI 0.92–1.00), indicating substantial improvements in mathematics performance following tablet-mediated instruction, with no statistically significant moderators identified across participant characteristics, intervention components, or target mathematical skills (Meta-analysis, 2024). Comparative studies implementing the TouchMath technique for teaching multiplication demonstrated that while both tablet and paper-and-pencil formats effectively supported skill acquisition, maintenance, and generalization, tablet-based delivery was generally superior in instructional efficiency, with reduced total teaching time (e.g., 45:10 vs. 55:23 minutes for one participant) and fewer errors (e.g., 7 vs. 9 errors) for the majority of participants, though one participant showed slightly better performance with paper-and-pencil, likely due to initial unfamiliarity with tablets (Kot & Yıkımsı, 2025). Randomized controlled trial evidence confirmed that tablet-based applications founded on explicit instruction principles produced significant gains in arithmetic fact fluency that maintained for up to six months post-intervention, with larger effects observed for subtraction than for addition (Schöld et al., 2024). Social validity data from students, teachers, and parents were consistently positive, with students expressing heightened motivation and explicit preferences for tablet-based over paper-and-pencil formats, while teacher responses indicated that TouchMath effectively supported multiplication instruction and could be applied to other mathematical competencies including number concepts, addition, and subtraction (Kot & Yıkımsı, 2025). The mechanisms underlying these effects appear to include reduced cognitive load through externalization of operational steps, reduced motor demands associated with writing and numeral placement, immediate visual and kinesthetic feedback that supports self-correction, sustained attention through interactive engagement, and multisensory integration of tactile, visual, and auditory learning channels. However, the review also identified important limitations including small sample sizes in most studies, a narrow focus on basic multiplication and addition/subtraction with limited investigation of division, multi-step problems, or algebraic reasoning, and potential equity

concerns related to uneven access to devices and variability in students' prior familiarity with tablet technology that may influence initial performance comparisons (Kot & Yıkıms, 2025).

Conclusion

The reviewed literature demonstrates that tablet-based learning is an effective instructional approach for improving mathematics achievement among students with mild intellectual disabilities. Tablets provide individualized, engaging, and interactive learning experiences that enhance conceptual understanding, computational skills, and learner motivation. Current evidence supports integrating tablet-mediated instruction with evidence-based teaching practices to maximize educational outcomes. Continued research and teacher training will further strengthen the implementation of technology-assisted mathematics instruction in inclusive and special education settings.

Recommendations

Based on the robust evidence demonstrating the effectiveness and efficiency of tablet-based mathematics instruction for students with mild intellectual disabilities, practitioners are strongly encouraged to integrate evidence-based tablet applications particularly those founded on multisensory and explicit instruction principles such as TouchMath as core instructional tools, while employing a blended approach that strategically incorporates both tablet and paper-and-pencil formats to accommodate individual student preferences and ensure skill transfer across mediums. Schools must prioritize equitable access to devices and connectivity, address prerequisite skills including rhythmic counting and coordination before instruction, and provide comprehensive professional development for teachers on implementation fidelity, data collection, and differentiation strategies.

Future Research

Investigators should broaden participant samples to include diverse ages, disability profiles, and socioeconomic backgrounds; expand mathematical content beyond basic operations to include multi-step problem solving, division, fractions, and algebraic reasoning; conduct large-scale randomized controlled trials and comparative effectiveness studies against other evidence-based methods; examine long-term maintenance and generalization over multiple years; incorporate fluency metrics such as response latency and correct-per-minute; investigate cognitive and neural mechanisms underlying tablet-based learning effects; and apply implementation science frameworks to understand facilitators and barriers to scaling tablet-based interventions across diverse school contexts, ensuring that the promising findings from controlled studies translate into sustainable, equitable improvements in mathematics achievement for all students with mild intellectual disabilities.

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