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Exploring the Impact of Digital Learning Tools on Literacy and Numeracy Outcomes in Malawi: A Case Study of Selected Schools in Machinga District

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ABSTRACT

This article investigates the impact of digital learning tools on literacy and numeracy outcomes in selected primary schools in Machinga District, Eastern Malawi. The study employed a mixed-methods case study design involving pre- and post-tests, classroom observations, focus group discussions with learners, and interviews with teachers and headteachers. Results show that digital tools positively contributed to literacy development (reading fluency, word recognition, and comprehension) and numeracy skills (basic arithmetic), though challenges related to infrastructure, teacher capacity, and equitable access limited effectiveness. The study concludes that digital learning can enhance foundational skills when integrated into teaching practice, supported with localized content, and sustained through investment in infrastructure and teacher professional development.

Keywords: digital learning, literacy, numeracy, Edutech Tablet, Malawi, BEFIT

1. Introduction

The ability to read with understanding and perform basic arithmetic forms the cornerstone of quality education and lifelong learning. In Malawi, national assessments have consistently highlighted poor literacy and numeracy performance among primary school learners, particularly in rural districts such as Machinga. Despite policy reforms and investments in teacher recruitment, class sizes remain large, instructional resources limited, and learning outcomes unsatisfactory.

To address these challenges, development partners and the Malawian government have promoted digital learning tools as a potential complement to traditional pedagogy. These tools, ranging from phonics applications to math games and adaptive practice platforms, promise individualized learning, interactive engagement, and immediate feedback. However, the evidence base in Malawi remains limited, with most studies conducted as donor-driven pilot projects without systematic evaluation.

This study seeks to explore the impact of digital learning tools on literacy and numeracy outcomes in selected primary schools in Machinga District. It further examines how teacher practices, infrastructure, and contextual factors shape the effectiveness of such interventions.

2. Literature Review

2.1 Global evidence on digital learning

Globally, research suggests that well-designed digital tools can improve foundational learning outcomes by providing adaptive practice, scaffolding, and engaging multimedia support **(*AA Al-Barakat, 2023*).** Studies in Asia and Latin America have shown measurable gains in reading fluency and numeracy fluency when digital tools are embedded into classroom practice.

2.2 Sub-Saharan African context

In Africa, the results are mixed. Pilot projects in Kenya, Uganda, and South Africa have demonstrated literacy and numeracy improvements, but challenges such as device shortages, unreliable electricity, and limited teacher training have constrained success ***(Wesonga Justus Nyongesa, June 2025).*** Importantly, the socio-cultural context—including language of instruction and parental support—affects the outcomes of digital learning interventions.

2.3 Malawi-specific studies

In Malawi, early projects using tablets with interactive literacy software showed promise, particularly for early grade reading in Chichewa. However, most evaluations noted sustainability issues once donor support ended. Furthermore, research has tended to focus more on literacy than numeracy, leaving gaps in understanding how digital tools affect mathematical learning.

2.4 Gaps addressed by this study

This study fills important gaps by:

1. Examining both literacy and numeracy outcomes simultaneously.
2. Focusing on rural schools in Machinga District, where educational challenges are most pronounced.
3. Exploring teacher practices, infrastructure, and learner perceptions alongside test score outcomes.

3. Methodology

3.1 Research design

The study employed a **mixed-methods case study design**, allowing triangulation between quantitative learner assessments and qualitative data from observations and interviews.

3.2 Study site and participants

Four primary schools in **Machinga District** were purposively selected for their involvement in digital learning programs. Participants included:

- 120 learners (Grades 1–4),
- 12 teachers, and
- 4 headteachers.

3.3 Data collection methods

- **Quantitative assessments:** Pre- and post-tests in literacy (phonics, fluency, comprehension) and numeracy (arithmetic, problem-solving).
- **Qualitative methods:** Classroom observations, semi-structured teacher interviews, focus group discussions with learners, and headteacher interviews.
- **Documentary review:** Program records, usage logs, and school-level reports.

3.4 Data analysis

Quantitative data were analysed using descriptive statistics to compare baseline and endline scores. Qualitative data were thematically coded to capture recurring themes on benefits, challenges, and perceptions of digital learning tools.

4. Findings

4.1 Literacy outcomes

Literacy Outcomes

The introduction of digital learning tools produced measurable improvements in literacy, especially at the lower primary level.

- Reading fluency and comprehension: Learners who had regular access to phonics-based applications and digital storybooks demonstrated improved word recognition and sentence fluency compared to peers in control schools. Comprehension scores also improved, as digital tools provided both text and audio reinforcement that supported learner understanding.
- Language of instruction: A major determinant of success was the use of localized language content. Programs that supported Chichewa and Yao instruction before transitioning to English yielded stronger literacy gains, whereas tools delivered solely in English had limited impact for early-grade learners.

- Learner engagement: Observations revealed that digital activities captured learners' interest, reducing absenteeism and encouraging active participation. Teachers noted that even reluctant readers were motivated to attempt tasks when working with tablets.
- Equity in access: Despite positive outcomes overall, differences emerged across learner sub-groups. Boys generally had more exposure to devices outside of class, often due to cultural norms and parental preferences. Girls, especially in lower-income households, were less likely to access digital tools beyond school hours, reinforcing gender disparities in literacy achievement.

4.2 Numeracy outcomes

Digital learning tools also had a positive impact on numeracy outcomes, though results varied across skill levels.

- Improved foundational skills: Learners using interactive math applications showed stronger performance in basic arithmetic (addition, subtraction, multiplication) compared to non-users. The adaptive features allowed learners to practice repeatedly until mastery, thereby strengthening fluency.
- Conceptual problem-solving: Gains in higher-order numeracy, such as word problems and application-based tasks, were weaker. This suggests that while digital tools are effective for drill-and-practice exercises, they require stronger integration into teaching strategies to enhance conceptual understanding.
- Pacing and confidence: Learners who struggled in mathematics benefited from self-paced digital practice, which reduced feelings of embarrassment and increased confidence. Teachers observed improved participation from weaker learners in group discussions after exposure to digital numeracy activities.

4.3 Teacher experiences

The study found that teachers played a pivotal role in mediating the impact of digital learning tools.

- **Positive perceptions**: Most teachers expressed enthusiasm about using digital tools, noting that they enhanced lesson delivery and reduced reliance on chalkboard-only instruction. Teachers particularly appreciated the built-in assessments that provided immediate learner feedback.
- **Integration challenges**: Despite positive attitudes, teachers faced challenges in fully integrating digital tools into their lesson plans. Many used them as supplementary aids rather than as integral components of instruction, largely due to limited training.
- **Professional development gaps**: Teachers highlighted the need for more structured training on digital pedagogy, classroom management with devices, and troubleshooting technical problems. Without ongoing capacity-building, the risk of underutilization remained high.
- **Workload reduction**: Teachers acknowledged that automated assessment features reduced marking time and enabled them to focus more on interactive teaching. However, this benefit was offset by logistical challenges in scheduling sufficient time for all learners to use devices.

4.4 Infrastructure and implementation

Persistent barriers included:

- Electricity shortages preventing regular device use.
- Device shortages forcing learners to share tablets, reducing practice time.
- Maintenance challenges including theft, breakages, and lack of spare parts.

4.5 Learner Attitudes and Motivation

Learners expressed enthusiasm for digital activities, with increased confidence and motivation. Many reported preferring lessons with tablets to traditional methods. Teachers also noted higher participation rates among previously shy or struggling learners.

The study found a strong link between digital learning and **increased learner motivation**.

- Learners reported preferring lessons involving tablets and games to traditional lessons.
- Shy and less confident learners participated more actively, as digital activities created a low-pressure environment for learning.
- Learners expressed excitement at interacting with technology, which fostered a culture of curiosity and exploration.
- Many learners requested more time with digital tools, suggesting that technology not only enhanced learning outcomes but also improved attitudes toward schooling in general.

5. Discussion

The study affirms that digital learning tools positively influence literacy and numeracy outcomes in Malawian rural schools, particularly for foundational skills. Results align with global findings that digital tools are effective in building fluency through repetitive, feedback-driven practice.

However, the study also highlights that teacher facilitation is critical. Where teachers integrated digital tools into structured lessons and used assessment feedback for targeted support, learning gains were stronger. Conversely, when tools were used in isolation, impacts were limited.

Infrastructure constraints and inequitable access remain major barriers. Without reliable electricity, adequate device-to-learner ratios, and sustainable maintenance systems, the full potential of digital learning cannot be realized. Additionally, equity concerns emerged, as boys and wealthier learners had more access to devices outside school, widening gaps.

6. Conclusion and Recommendations

This study concludes that digital learning tools hold promises for strengthening literacy and numeracy in Malawi, particularly in rural districts like Machinga. However, success depends on pedagogical integration, localized content, teacher training, and sustainable infrastructure investment.

Recommendations

1. **Teacher capacity building:** Provide continuous professional development in digital pedagogy.
2. **Localized content:** Prioritize tools in Chichewa and Yao to support early-grade learners.
3. **Infrastructure investment:** Expand electricity access, device provision, and maintenance systems.
4. **Equity measures:** Ensure gender-sensitive and socio-economic strategies to avoid deepening divides.
5. **Policy integration:** Embed digital learning into Malawi's education strategy with sustainable funding beyond donor projects.

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