

Proposed Research Topic

A Model for Delivering Sustainable Digital Learning in Resource-Constrained School Settings

Background Statement

Digital learning has become an essential component of modern education, providing opportunities for interactive instruction, flexible access to learning resources, and improved educational outcomes. However, many schools in resource-constrained settings continue to face significant challenges that limit the effective use of digital learning. These challenges include unreliable electricity, limited internet connectivity, insufficient digital devices, inadequate instructional materials, financial constraints, and limited technical support. As a result, many learners are unable to benefit from digital learning opportunities that are commonly available in well-resourced educational environments.

While numerous educational technologies have been developed, many are designed for environments with reliable infrastructure and continuous access to electricity and the internet. Such assumptions often make these technologies difficult to implement effectively in schools with limited resources. Rather than focusing on a single technology or delivery platform, this study proposes to explore a sustainable digital learning delivery model that is appropriate for resource-constrained school settings.

The proposed model recognizes that successful digital learning depends on more than technology alone. It requires consideration of the entire learning environment, including the availability and organization of digital learning materials, dependable power sources, practical content delivery methods, classroom organization, teacher support, and sustainable processes for maintaining and updating instructional content. The model should also remain flexible enough to incorporate various technologies—including offline applications, mobile technologies, classroom projection systems, local digital resources, and future innovations—provided they are appropriate, affordable, sustainable, and adaptable to local conditions.

The purpose of this study is not to identify a single technological solution, but rather to develop a practical framework that guides the design and implementation of sustainable digital learning in resource-constrained school settings. Such a framework may help educators, instructional designers, schools, governments, and educational organizations make informed decisions when selecting and implementing digital learning approaches that effectively address local challenges while expanding educational opportunities for learners.

Proposed Research Question

How can a sustainable digital learning delivery model be designed and implemented to support teaching and learning in resource-constrained school settings?

Why this topic?

This study aims to develop a practical and sustainable model for delivering digital learning in school environments where educational resources are limited. Instead of evaluating a specific technology, the study focuses on identifying the design principles and essential components that make digital learning effective under resource constraints. The proposed model will consider factors such as learning materials, power availability, content delivery methods, classroom organization, teacher support, sustainability, and content management. By doing so, the study seeks to provide a flexible framework that can accommodate current and future technologies while remaining responsive to the realities of resource-constrained schools.

Thank you.

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Structure of the Research Article

1. Abstract

The abstract provides a brief overview of the entire research study. It introduces the research problem, purpose, methodology, major findings, and overall conclusion so readers can quickly understand what the study is about.

2. Introduction and Literature Review

This section explains the background of the research, identifies the research problem, reviews previous studies related to the topic, discusses important theories and concepts, identifies gaps in existing research, and states the research questions or purpose of the study.

3. Methods

1) Participants

This subsection describes the studies or participants included in the research, explains the selection criteria, and identifies who or what was included or excluded from the review.

2) Materials

This subsection explains the sources of data, databases, search terms, research articles, frameworks, and other materials used to collect and analyze information for the study.

3) Procedure

This subsection describes the research process, including how studies were searched, screened, selected, analyzed, and reviewed. It explains the steps followed to conduct the systematic review.

4. Results

The results section presents the findings obtained from analyzing the collected data. It reports patterns, comparisons, tables, figures, and evidence without interpreting or explaining their meaning.

5. Discussion

The discussion section interprets the results, explains their significance, compares them with previous research, answers the research questions, discusses implications, and suggests how the findings can be applied in practice.

6. Limitation

The limitation section identifies the weaknesses or constraints of the study, explains factors that may affect the findings, and recommends areas for future research or improvement.

7. References

The references section lists all sources cited in the research using the required citation style, allowing readers to locate and verify the original sources used in the study.

Literature Review

A Model for Delivering Sustainable Digital Learning in Resource-Constrained School
Settings

Fessehaye Yehdego

The University of Texas Rio Grande Valley

Educational Technology, EDFR 6300

Instructor: Prof. Seokmin "Chandler" Kan

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How can a sustainable digital learning delivery model be designed and implemented to support teaching and learning in resource-constrained school settings?

Operational Definition of Sustainable Digital Learning Delivery

For this study, sustainable digital learning delivery refers to an educational technology model that integrates affordable digital devices, offline-capable learning resources, curriculum-aligned instructional materials, teacher professional development, classroom organization, reliable power solutions, periodic content updating, and long-term maintenance to support continuous teaching and learning in resource-constrained school settings.

Background and Rationale

This proposed study responds to the challenge of providing equitable digital learning opportunities for learners in schools with limited connectivity, devices, and educational resources. Previous research consistently demonstrates that technology alone does not improve learning; meaningful outcomes depend on instructional design, teacher capacity, leadership, and sustainable implementation. The proposed study builds upon this evidence by designing a sustainable digital learning delivery model suitable for resource-constrained schools.

Ten Peer-Reviewed References (APA 7th)

- Aguilar, S. J. (2020). Guidelines and tools for promoting digital equity in education. *Educational Technology Research and Development*.
- Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education*.
- Johnston, J., & Ksoll, C. (2022). Effectiveness of interactive satellite-transmitted instruction: Experimental evidence from Ghanaian primary schools. *Economics of Education Review*, 91, 102306.
- Kaumba, M., Mphahlele, R. S. S., Muleya, G., & Simui, F. (2021). Disablers and enablers in the uptake of information communication technologies in rural primary schools of Mwinilunga District, Zambia. *Journal of Educational Technology and Online Learning*, 4(1), 1–10.
- Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? *Journal of Education*.
- Miras, A., et al. (2023). Digital divide in education: A systematic review. *Education and Information Technologies*.
- Mustafa, F., Nguyen, H. T. M., & Gao, X. (2024). The challenges and solutions of technology integration in rural schools: A systematic literature review. *International Journal of Educational Research*, 126, 102380.
- Selwyn, N. (2016). Minding our language: Why education and technology is full of bullshit... and what might be done about it. *Learning, Media and Technology*.

Shambare, B., & Simuja, C. (2024). Unveiling the TPACK pathways: Technology integration and pedagogical evolution in rural South African schools. *Computers and Education Open*, 7, 100206.

Warschauer, M., & Matuchniak, T. (2010). New technology and digital worlds: Analyzing evidence of equity in access, use, and outcomes. *Review of Research in Education*, 34(1), 179–225.

Selected Five Articles

1. Warschauer, M., & Matuchniak, T. (2010). New technology and digital worlds: Analyzing evidence of equity in access, use, and outcomes. *Review of Research in Education*, 34(1), 179–225. <https://doi.org/10.3102/0091732X09349791>

2. Mustafa, F., Nguyen, H. T. M., & Gao, X. (2024). The challenges and solutions of technology integration in rural schools: A systematic literature review. *International Journal of Educational Research*, 126, 102380.

3. Johnston, J., & Ksoll, C. (2022). Effectiveness of interactive satellite-transmitted instruction: Experimental evidence from Ghanaian primary schools. *Economics of Education Review*, 91, 102306. <https://doi.org/10.1016/j.econedurev.2022.102306>

4. Kaumba, M., Mphahlele, R. S. S., Muleya, G., & Simui, F. (2021). Disablers and enablers in the uptake of information communication technologies in rural primary schools of Mwinilunga District, Zambia. *Journal of Educational Technology and Online Learning*, 4(1), 1–10.

5. Shambare, B., & Simuja, C. (2024). Unveiling the TPACK pathways: Technology integration and pedagogical evolution in rural South African schools. *Computers and Education Open*, 7, 100206.

Literature Review

Current State of Knowledge

Warschauer and Matuchniak (2010) established the theoretical foundation for digital equity through the concepts of access, use, and outcomes. Mustafa et al. (2024) synthesized evidence showing that successful technology integration requires coordinated action at macro, meso, and micro levels. Johnston and Ksoll (2022) demonstrated through a randomized controlled trial in Ghana that interactive technology-supported instruction improved student learning when paired with expert teaching and classroom facilitation. Kaumba et al. (2021) reported that rural schools in Zambia overcame resource limitations through collaboration and creative ICT use. Shambare and Simuja (2024) concluded that teachers' TPACK, continuous professional development, and supportive school cultures are essential for successful technology integration.

Synthesis of Common Trends

Across the five studies, educational technology is consistently presented as a comprehensive educational system rather than simply hardware or internet access. Common themes include equitable access, teacher professional development, instructional design, leadership, and sustainable implementation.

Although the studies differ in methodology and context, they complement one another by demonstrating that effective digital learning depends on coordinated support from policy makers, schools, teachers, and communities. Collectively, the literature supports affordable, context-sensitive, and sustainable approaches to digital learning.

Knowledge Gaps

The literature does not yet provide a comprehensive model for sustainable digital learning delivery in resource-constrained school settings. Limited attention has been given to curriculum alignment, offline-first instructional design, shared-device learning, local instructional design capacity, renewable energy, and sustainable content updating. Addressing these gaps provides the rationale for the proposed study.

Declaration of AI Use in the Writing Process

This paper was developed with support from AI tools. ChatGPT (OpenAI, 2024) was used to assist with grammar refinement, sentence structure, organization, and clarity of instructional design content. The ideas, instructional goals, analysis, and project direction were developed by the student.

Research Methodology

Qualitative Research Methodology

The proposed study will adopt a **qualitative research methodology** because its primary purpose is to identify the essential components of a sustainable digital learning delivery model for resource-constrained school settings. The study will explore the experiences, perspectives, and practical challenges of teachers and students who teach and learn in environments with limited internet connectivity, digital devices, electricity, and instructional resources. A qualitative methodology is appropriate because it provides rich descriptions of current teaching and learning practices, identifies context-specific needs, and helps determine the key elements required to design a practical, sustainable, and context-appropriate digital learning delivery model.

A qualitative approach also aligns closely with the research question because the study seeks to design and propose a digital learning delivery model rather than test the effectiveness of an existing intervention or examine statistical relationships among variables. Data may be collected through semi-structured interviews with teachers, focus group discussions with students, and classroom observations to explore current instructional practices, learning experiences, implementation challenges, and existing strategies used to overcome resource limitations. The data will be analyzed using thematic analysis to identify common patterns and essential design components. The findings will provide a practical foundation for developing a sustainable digital learning delivery model and may guide future quantitative studies that evaluate the effectiveness of the proposed model.

Qualitative Case Study Design

The proposed study will adopt a qualitative case study design because it allows for an in-depth exploration of digital teaching and learning within the real-world context of selected resource-constrained schools settings in Tigray, Ethiopia.

A case study design is appropriate because the research seeks to understand how a sustainable digital learning delivery model can be designed by examining the experiences, perspectives, and challenges of teachers and students. Through interviews, classroom observations, and other relevant sources of information, the study will explore current instructional practices, available resources, and local strategies for overcoming technological limitations. This design aligns with the qualitative methodology because it emphasizes understanding a phenomenon within its natural setting and provides rich contextual information that can inform the development of a practical and sustainable digital learning delivery model.

Research Procedure (Research Plan)

Participants and Recruitment

The proposed study will employ a qualitative case study design to explore how a sustainable digital learning delivery model can support teaching and learning in resource-constrained schools in Tigray, Ethiopia. Participants will include approximately **5–8 teachers** who have experience teaching in schools with limited access to electricity, internet connectivity, digital devices, and instructional resources. Participants will be recruited through the researcher's professional network and school contacts. Participation will be voluntary, and informed consent will be obtained before data collection begins.

Data Collection

Data will be collected primarily through semi-structured interviews with participating teachers. After obtaining permission from the selected schools and informed consent from each participant, the researcher will recruit approximately 5–8 teachers who have experience teaching in resource-constrained school settings. Individual interviews will be scheduled at a convenient time and location for the participants, either in person or through an online communication platform if necessary. With participants' permission, the interviews will be audio-recorded to ensure accurate data collection and later transcribed for analysis. Each interview is expected to last approximately 30–45 minutes and will follow a semi-structured interview guide designed to explore teachers' experiences with digital learning, the challenges they encounter, existing instructional practices, and their recommendations for developing a sustainable digital learning delivery model. When feasible, classroom observations and relevant documents, such as lesson plans, curriculum materials, or locally developed instructional resources, will also be reviewed to provide additional context and support data triangulation.

Data Analysis

The interview transcripts and classroom observation notes will be analyzed using thematic analysis, a qualitative method for identifying, organizing, and interpreting meaningful patterns within textual data. After all interviews have been transcribed, the researcher will read each transcript several times to become familiar with the participants' responses and gain an overall understanding of the data. During the first stage of analysis, meaningful words, phrases, and statements related to digital learning in resource-constrained schools will be assigned descriptive and in vivo codes. Coding and theme development will be conducted manually using Microsoft Word and Microsoft Excel to organize participants' responses into codes, categories, and themes.

Similar codes will then be grouped into broader patterns, which will be synthesized into major themes representing participants' shared experiences, challenges, and recommendations. These themes will be interpreted to identify the essential components of a sustainable digital learning delivery model for resource-constrained school settings. To ensure the trustworthiness of the findings, the study will maintain dependability by using a consistent interview protocol and systematic coding process, credibility by comparing information gathered from interviews, classroom observations, and relevant documents (data triangulation), and confirmability by ensuring that the findings accurately reflect the participants' experiences and perspectives. The final themes will be compared across participants to identify common patterns and practical recommendations for designing a sustainable digital learning delivery model for resource-constrained school settings.

Expected Results

Based on the literature review and the proposed qualitative case study, it is expected that teachers will identify common barriers to implementing digital learning in resource-constrained schools, including limited access to digital devices, unreliable electricity, poor internet connectivity, shortages of instructional materials, and limited opportunities for professional development. The interviews are also expected to reveal practical strategies that teachers currently use to address these challenges, such as sharing available devices, using offline learning materials, adapting locally available resources, and collaborating with colleagues to support teaching and learning.

The thematic analysis is expected to identify the key components of a sustainable digital learning delivery model that is practical, affordable, and appropriate for resource-constrained school settings. The findings are expected to support a teacher-guided digital learning platform that enables teachers to organize and facilitate learning while providing students with structured access to curriculum-aligned resources. The model may also highlight the effective use of one computer connected to a projector or television, allowing a single device to support learning for an entire classroom rather than requiring every student or teacher to own a laptop. In addition, the findings are expected to support the development of an offline digital learning application that stores learning materials on Android phones and functions without continuous internet access. The application could synchronize and update its content whenever an internet connection becomes available, ensuring that learning resources remain current while minimizing connectivity requirements. Because Android phones are already owned by many families, this approach is expected to improve equitable access to educational resources. Furthermore, the application is expected to provide interactive learning experiences, including quizzes, matching activities, sorting exercises, self-assessments, and immediate feedback, rather than serving only as a repository of digital reading materials. Overall, the study is expected to produce practical recommendations for designing a sustainable, affordable, and scalable digital learning delivery model that expands access to quality education while reducing dependence on expensive technology infrastructure.