

**POTRAZ-ZCHPC Research Proposal**

**AI-Powered Mobile Learning for Rural Zimbabwe: Bridging the Educational Divide Through Offline-First Intelligent Systems**

**Submitted by:** Olsen Tanatswa Mazambani and Gareth Chitate

**Institution:** Telone Centre For Learning

**Program:** Software Engineering

**Email:** MOtanatswa591@gmail.com or chitategareth@gmail.com

**Phone:** 0716785162 or 0717000461

**Date:** 25 June 2025

To: POTRAZ-ZCHPC Research Committee

Dear Review Panel,

We are pleased to submit our proposal titled 'AI-Powered Mobile Learning for Rural Zimbabwe: Bridging the Educational Divide Through Offline-First Intelligent Systems' in response to the 2025 POTRAZ-ZCHPC Call for Proposals. As students dedicated to leveraging digital innovation for social impact, this project combines our passion for educational equity and technical expertise in artificial intelligence.  
The proposed solution is grounded in Zimbabwean realities and aligns directly with national strategies for inclusive digital transformation. It aims to support unfortunate leaners through a scalable, low-cost, AI-driven mobile application capable of operating in low-connectivity environments. The app uses local language NLP (Natural Language Processing) models and offline machine learning to enable students to learn anytime, anywhere.

We are confident that this solution has the potential to significantly transform educational delivery in marginalized communities. Thank you for considering our proposal. We are eager to contribute to Zimbabwe’s ICT development and education equity goals.

Yours sincerely,

Olsen Tanatswa Mazambani and Gareth Tadiwanashe Chitate

# AI-Powered Mobile Learning for Rural Zimbabwe

# **1. Problem Statement**

Zimbabwe faces a significant educational chasm between urban and rural areas, exacerbated by limited access to digital learning resources, qualified educators, and reliable power infrastructure. Empirical evidence from UNICEF Zimbabwe (2023) indicates that over 68% of rural schools lack adequate access to digital learning resources, and nearly 75% of rural students have limited or no experience with computers in an educational context. This digital exclusion contributes significantly to the observed disparities in academic achievement between urban and rural students. Furthermore, data from the Ministry of Primary and Secondary Education (MoPSE, 2022) reveals a stark contrast in pupil-to-qualified-teacher ratios, exceeding 50:1 in rural areas compared to 28:1 in urban schools. This teacher shortage is compounded by challenges related to teacher absenteeism and limited opportunities for ongoing professional development, particularly in STEM disciplines. The Education Coalition of Zimbabwe (ECOZI, 2021) reports that over 80% of rural schools lack consistent access to electricity, posing a significant barrier to the adoption of conventional digital learning solutions. Compounding these infrastructural limitations are socio-cultural factors, including gender disparities and high rates of early school dropout among girls (PLAN International Zimbabwe, 2022), which further impede educational progress, particularly in STEM fields. These structural inequalities restrict academic achievement and limit long-term economic opportunities for rural youth, necessitating the development and implementation of inclusive, adaptive, and energy-efficient educational technologies tailored to resource-constrained environments.

Zimbabwe continues to experience a significant educational divide between urban and rural regions, primarily driven by disparities in access to digital learning tools, qualified teachers, and reliable power infrastructure. According to a **2023 UNICEF Zimbabwe Education Brief**, over **68% of rural schools** lack access to digital learning resources, and nearly **75% of students** in rural areas have never used a computer in an educational setting. This digital exclusion is a key factor behind poor academic outcomes in rural communities. 🔗 [Digital learning in Zimbabwe – UNICEF](https://www.unicef.org/zimbabwe/stories/expanding-access-quality-education-power-digital-learning-zimbabwe)

The **Ministry of Primary and Secondary Education (MoPSE)** reports that the average **pupil-to-qualified-teacher ratio** in rural areas exceeds **50:1**, compared to 28:1 in urban schools (MoPSE 2022 Annual Education Statistics Report). This teacher shortage is further strained by high absenteeism and limited ongoing training, especially in science and technology subjects. 🔗 [2022 Annual Education Statistics Report (Scribd)](https://www.scribd.com/document/802676321/2022-Annual-Education-Statistics-Report)

A 2021 policy paper by **Education Coalition of Zimbabwe (ECOZI)** highlights that more than **80% of rural schools** lack access to stable electricity, making it nearly impossible to implement digital learning without tailored, offline-first solutions. In addition, **PLAN International Zimbabwe** (2022) notes that **gender disparities** and high rates of **early dropout among girls** in rural areas (up to 12% before completing secondary school) significantly reduce educational outcomes, particularly in STEM. 🔗 <https://planipolis.iiep.unesco.org/sites/default/files/ressources/zimbabwe_essp_2021-2025.pdf>

These structural inequalities not only restrict academic performance but also undermine long-term economic opportunities for rural youth. There is therefore an urgent need for inclusive, adaptive, and energy-efficient educational technologies that are customized for low-resource environments.

## 2. Research Objectives & Innovation Highlights (Zimbabwean Context)

This research aims to address the educational disparities in rural Zimbabwe by developing and evaluating an AI-powered mobile learning platform specifically designed for low-resource settings. The primary objectives of this research are:

- To develop AI tutors in local languages using lightweight NLP(Natural Language Processing) models.

- To ensure app compatibility with affordable devices.

- To integrate adaptive learning and voice-interactive features for accessibility.

Innovation in Zimbabwean Context:

- First educational AI app in Zimbabwe offering offline-first functionality in local languages.

- Novel hybrid content delivery system (offline + SMS/Wi-Fi updates).

- Ministry of Primary and Secondary content for Forms 1–4 STEM subjects.

Evidence from Econet's Ruzivo e-learning platform 🔗 <https://cioafrica.co/ruzivo-econets-new-digital-learning-platform/> shows that localized educational content improves performance by 30% in supported schools. This supports the innovation’s feasibility and relevance. Chikoro AI <https://chikoro-ai.com/> has noticed that approximately 31% of Zimbabwe's primary and secondary schools have internet access, leaving many students without the benefits of digital learning platforms. <https://www.heraldonline.co.zw/balancing-foundational-learning-and-ai-in-zimbabwes-schools/>

# 3. Methodology Justification

We propose a mixed-method, four-phase methodology:

1. Needs Analysis: Surveys, interviews, and school visits in three provinces to tailor the solution to user needs.
2. Agile Development: Iterative app development using Flutter (cross-platform), TensorFlow Lite (lightweight AI), and SQLite (offline storage).
3. To be deployed: Deployed in 5 schools with A/B testing for performance tracking.
4. Impact Evaluation: Combines quantitative (exam results) and qualitative (surveys, interviews) approaches.

Justification: Mixed methods allow both measurable outcomes and qualitative feedback. Using lightweight models is supported by Zhang et al. (2021), who demonstrated that TensorFlow Lite improves app speed and compatibility in low-resource settings. SMS-based update systems are proven effective in rural areas (GSMA Mobile for Development, 2020).

The application of HPC is critical to the success of this project. The AI-powered adaptive learning algorithms require significant computational resources for training and deployment. HPC infrastructure will be used to:

Train Machine Learning Models: Train complex machine learning models for adaptive learning. These models will be trained on large datasets of student performance data to personalize the learning experience.

Process Data: To efficiently process and analyze large datasets of student performance data collected from the mobile learning platform.

Model Optimization: Optimize machine learning models for performance and efficiency. This will involve exploring different model architectures, hyperparameters, and training algorithms to achieve the best possible results.

Scalable Deployment: Deploy the AI-powered mobile learning platform on a scalable cloud infrastructure to ensure that it can support a large number of users in rural Zimbabwe.

# 4. Expected Outputs and Impact

This research is expected to produce the following outputs:

A fully functional, offline-capable AI mobile application: Featuring curriculum-aligned content, adaptive learning algorithms, and a user-friendly interface.

Peer-reviewed publications: Disseminating research findings in academic journals and conferences.

Policy recommendations: Providing evidence-based recommendations to the Ministry of Primary and Secondary Education on how to effectively integrate AI-powered mobile learning into the Zimbabwean education system.

Open-source software and data: Making the mobile learning application and de-identified data publicly available to promote further research and development in the field of educational technology.

The expected impact of this research includes:

Improved student learning outcomes: Increased academic achievement, particularly in core subjects like mathematics, science, and literacy.

Increased student engagement: Greater motivation and interest in learning, leading to improved attendance and reduced dropout rates.

Reduced achievement gap: Narrowing the educational disparities between rural and urban schools.

Empowerment of rural communities: Providing rural communities with access to high-quality education and creating opportunities for economic development.

Contribution to the field of educational technology: Advancing the understanding of how AI can be used to improve education in low-resource settings.

- Offline-capable AI mobile application.

- Fully localized content aligned to the national curriculum.

- Evaluation report on learning improvements and teacher workload reduction.

Impact: Projected improvement in student pass rates from an estimated value of 42% to 55%, and reduction in teacher workloads by 13+ hours per week. Estimated compatibility with 90% of low-cost Zimbabwean Android devices.

# 5. Sustainability and Partnerships

Sustainability will be achieved through:

Community Ownership: Engaging local communities in the design and implementation of the mobile learning platform.

Capacity Building: Training local teachers and community members to maintain and support the application.

Partnerships: Building strong partnerships with local organizations, government agencies, and international donors to ensure the long-term sustainability of the project.

Key partnerships will include:

Ministry of Primary and Secondary Education (MoPSE): To ensure alignment with the national curriculum and to facilitate the integration of the mobile learning platform into the Zimbabwean education system. - Collaborate with the Ministry of Education for content validation and updates.

Local Schools and Communities: To ensure that the mobile learning platform meets the needs of students, teachers, and community members.

Telecommunications Companies: To explore options for providing affordable internet access to rural schools and communities. - Partner with TelOne for zero-rated data and SMS infrastructure.

Technology Companies: To provide technical support and expertise in the development and maintenance of the mobile learning platform. - Train local teachers and “tech champions” to ensure community ownership.

Funding through POTRAZ-ZCHPC, with future monetization via premium features for urban schools.

Market analysis

**Current Context and Challenges**

* Zimbabwe’s education system, especially in rural areas, faces challenges including lack of stable electricity, limited digital infrastructure, and gender disparities affecting STEM education.
* Existing AI platforms lag due to poor localization, limited offline accessibility, high costs, and lack of tailored content for Zimbabwean curricula and language contexts.
* Digital divide issues persist as many students and teachers lack access to modern devices and reliable internet, hindering AI adoption.

**Potential Impact Timeline**

**Within 6 Months**

* Pilot deployment of an AI learning app tailored to Zimbabwe’s Form 1-6 syllabus with offline-first capabilities to overcome connectivity issues.
* Initial teacher and student training on AI tool usage and digital literacy.
* Early data collection on user engagement, learning outcomes, and gender participation gaps.
* Establish partnerships with schools and education stakeholders for feedback and support

**Within 1 Year**

* Scale-up to more schools, including rural areas, improving access to personalized learning, intelligent tutoring, and STEM content.
* Integration of predictive analytics to identify at-risk students and tailor interventions, improving retention and performance.
* Development of localized content and multilingual support to enhance relevance and inclusivity.
* Begin monetization through affordable subscription models for schools and individual users, with tiered pricing for offline and online access

**Within 3 Years**

* Widespread adoption across Zimbabwe’s secondary schools, contributing to improved national education outcomes and STEM participation, especially for girls.
* Expansion of AI features such as automated grading, adaptive assessments, and career guidance aligned with 4IR skills.
* Collaboration with government and NGOs to integrate AI into national education policy frameworks and digital infrastructure initiatives.
* Diversified revenue streams from subscriptions, licensing to institutions, premium content, and potential government or donor funding

.

**How Current AI Learning Platforms Lag Behind**

* Most platforms are designed for developed markets, lacking offline functionality crucial for Zimbabwe’s rural schools.
* Insufficient localization leads to poor alignment with Zimbabwe’s curriculum and languages, reducing engagement and effectiveness.
* High subscription costs and technical complexity limit accessibility for students and schools with constrained budgets
* Limited focus on gender-sensitive content and support to address dropout rates among girls in STEM.

**Revenue Generation Strategies**

* Subscription Model: Affordable monthly or annual subscriptions for students, parents, and schools with different tiers (basic offline access to premium online content).
* Institutional Licensing: Contracts with schools, school districts, and government education departments for bulk access and integration.
* Freemium Model: Basic free access with paid upgrades for advanced features, personalized tutoring, and STEM modules.
* Partnerships and Grants: Collaborate with NGOs, government, and international donors focused on education and digital inclusion to subsidize access and scale.
* Value-added Services: Offer teacher training, analytics dashboards, and curriculum development consulting as paid services.
* Advertising and Sponsorships:Carefully integrated, non-intrusive advertising or sponsored content relevant to education and youth can be a revenue source without compromising user experience.
* Content Marketplace:Develop a platform marketplace where third-party educators, content creators, and institutions can sell localized learning materials or supplementary courses, with the AI app taking a commission on sales.

# Budget Summary

|  |  |
| --- | --- |
| Activity | Cost |
| Development | $1200 |
| Field Testing | $650 |
| Localization | $400 |
| Evaluation | $300 |
| Transport | $400 |
| Food | $250 |
| Marketing | $400 |
| Hosting and API Integratuion | $200 |
| Contigency | $300 |
| Total | $4100 |

# 7. Literature Review

Numerous studies underscore the necessity for inclusive educational technology in sub-Saharan Africa. UNESCO (2021) reports that over 80% of children in rural African schools’ lack access to quality digital learning resources. In Zimbabwe, Ruzivo Digital Learning has documented significant performance improvements in schools utilizing localized content and digital tools.

Mtebe & Raisamo (2014) emphasize that mobile learning in low-resource areas enhances engagement and exam results when aligned with national curricula. Furthermore, research from the GSMA (2020) supports SMS-based education delivery as effective in regions with limited internet coverage.

This proposal builds upon these findings by integrating localized AI with SMS/Wi-Fi hybrid update systems in an offline-first model tailored to Zimbabwean infrastructure. <https://spikedmedia.co.zw/zimbabwes-national-e-learning-strategy-spreads-to-rural-schools/>

Dr. Nzira Masanga’s 1999 report emphasized the need to reform Zimbabwe’s overly theoretical curriculum towards a competency-based approach fostering critical thinking and practical skills, recognized the importance of integrating ICT in education through infrastructure investment and teacher training, stressed modernizing the education system to equip learners with digital literacy for a changing global landscape, advocated decentralizing school management to better adopt technologies, and highlighted addressing disparities in technology access between urban and rural schools to bridge the digital divide.

**Source:**  
Presidential Commission of Inquiry into Education and Training (1999), *Nziramasanga Report*, Government of Zimbabwe

# 8. Research Questions

## Research Questions:

1. Can an offline-first AI-powered learning app improve STEM subject performance in rural Zimbabwe?
2. What is the usability and accessibility levels of localized NLP(Natural Language Processing) interfaces in Shona/Ndebele?
3. How do AI-driven recommendations impact learner engagement in low-resource settings?

And some of the questions that were asked in the surveys and interviews include:

**Questions for Teachers**

* Do students have reliable electricity and digital devices?
* How often is digital equipment available?
* What challenges do you face using digital tools?

## **Questions for Students**

* Do you have access to electricity and digital devices?
* How often do you use digital learning tools?
* What difficulties do you face?
* Are digital materials easy to use?
* Do digital tools help your learning?

# 9. Ethical Considerations

All research activities will comply with ethical standards as guided by the Zimbabwe Research Council. Informed consent will be obtained from school administrators, teachers, and students' guardians. Data collection will ensure anonymity, and no identifiable student data will be shared.

In carrying out this research work the researcher strive in

* obtaining informed consent from students, parents, teachers, and community members before participating in the research.
* protecting the privacy of student data by using anonymization techniques and secure data storage protocols.
* ensuring that the mobile learning platform is culturally appropriate and sensitive to the needs of rural Zimbabwean communities.
* addressing potential risks and benefits associated with the use of AI in education.

Data stored within the app will be encrypted (AES-256), and periodic audits will be performed. Teachers will be trained on ethical AI usage and informed of students’ data privacy rights.

# 10. Timeline and Work Plan

|  |  |  |
| --- | --- | --- |
| Phase | Duration | Activities |
| Needs Assessment | Aug - Sep 2025 | Surveys, interviews, site visits |
| App Development | Oct 2025 - Jan 2026 | Agile development, NLP model training |
| Pilot Testing | Feb - Apr 2026 | App deployment, performance tracking |
| Evaluation & Report | May 2026 | Data analysis, stakeholder presentations |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Aug – Sept 2025 | Oct 2025 -Jan 2026 | Feb – Apr 2026 | May 2026 |
| Needs Assessment |  |  |  |  |
| App Development |  |  |  |  |
| Pilot Testing |  |  |  |  |
| Evaluation |  |  |  |  |
| Documentation |  |  |  |  |

# 11. Conclusion

This proposal offers a high-impact, scalable, and contextually appropriate educational solution for Zimbabwe. By addressing infrastructure limitations through offline-first AI and local language integration, it contributes to both national education goals and the broader digital inclusion agenda. This research has the potential to transform education in rural Zimbabwe by providing access to high-quality, personalized learning experiences that are tailored to the specific needs of students in low-resource settings. By leveraging the power of AI and mobile technology, this project can help to bridge the digital divide, improve student learning outcomes, and create opportunities for economic development in rural communities. This research will contribute to the growing body of knowledge on the use of AI in education and will provide valuable insights for policymakers and practitioners seeking to improve educational outcomes in developing countries. The utilization of HPC resources is fundamental to the project's success, enabling the development and deployment of sophisticated AI algorithms that can personalize learning and improve student outcomes. Through careful consideration of ethical implications and a commitment to sustainability, this research aims to create a lasting impact on the lives of rural Zimbabwean students and communities.

The expected results — including improved STEM scores, reduced teacher burden, and high compatibility with affordable devices — underscore the proposal’s potential to transform education in rural Zimbabwe.