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MAKERERE UNIVERSITY BUSINESS SCHOOL

DEVELOPING A TECHNOLOGY-DRIVEN E-LEARNING SYSTEM TO BRIDGE

EDUCATIONAL GAPS IN WEST NILE REGION

BY

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A Project Proposal Submitted to the Faculty of Computing & Informatics of Makerere University
Business School in Partial Fulfilment for the Award of the Degree of Bachelor of Business
Computing of Makerere University

21st/November 2025

DECLARATION

We, the undersigned, declare that to the best of our knowledge, this proposal is our original work and has never been published or submitted for any award in any other institution.

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APPROVAL

This project proposal has been submitted with my approval as supervisor, and my signature is here appended:

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SECTION ONE

1. INTRODUCTION

1.1 Project Background

E-learning, or electronic learning, refers to the use of digital tools to access learning materials and study without always being in a physical classroom (Hermawan 2021; Mokhtar et al 2023). It involves using the internet to access educational resources, take part in online classes or lectures and conduct interactive activities (Cubillas et al 2023; Daher et al 2022; Justo et al 2022). The rise of technology has transformed how education is delivered globally, making learning more flexible, interactive, and accessible through e-learning systems (UNESCO 2023). These systems bring together digital platforms, artificial intelligence, and multimedia tools to offer learning experiences that are more personalised and engaging (Sakri et al 2025).

In Uganda, using e-learning has become an important way to reduce education inequalities, especially between towns and underserved rural regions (UNESCO 2021). The West Nile region however, districts such as Arua, Koboko, Yumbe, Moyo, Adjumani, Nebbi, Zombo, Maracha, and Pakwach, continues to fall behind the rest of the country in terms of digital inclusion (Monitor,2025, UNICEF, 2024; West Nile Secondary School survey, 2023). Although national education policies such as UPE and USE have made it easier for learners to go to school, those in West Nile still face significant challenges such as limited ICT infrastructure, inconsistent electricity supply, and minimal access to computers or internet-based learning environments (MoES, 2022; UBOS, 2023) and environmental challenges like flooding and poor roads worsen access (Parliamentary Watch, 2024).

During and after the COVID-19 pandemic, the government promoted digital learning through radio lessons, TV tutoring, and online platforms like the National E-learning portal. However, these efforts did not fully reach West Nile, where radio coverage is uneven, electricity is unreliable, and internet access is still very

limited. As a result, many students in the region were left without meaningful learning during school closures, which increased the inequalities that already existed (UNICEF,2023).

Inspired by these interventions, this project proposes developing a technology-driven e-learning system designed specifically for the West Nile. The proposed system will combine offline-capable digital platforms, mobile learning applications, and AI-assisted tutoring tools to improve teaching and learning. It will include local content in regional languages, solar-powered mini servers for places without electricity, and training modules to help teachers build ICT skills. The system's design focuses on accessibility, inclusivity, and sustainability, so that learners in remote areas can study even without internet.

1.2 Problem Statement

The West Nile region of Uganda still faces major education gaps compared to more developed parts of the country. Although educational policies like Uganda Primary Education (UPE) and Uganda Secondary Education (USE) have encouraged more learners to join school, the quality of learning in West Nile is still limited. Rural learners are the most affected, as many of them are left out of the digital changes that are shaping modern education.

While urban schools and universities in areas such as Kampala, Mukono, and Mbarara increasingly use e-learning platforms like Moodle and Google Classroom, the situation in rural West Nile districts is very different. Many schools operate without electricity, have no computers, and lack teachers trained in digital teaching. Only 12% of rural schools have access to reliable internet, and less than 25% have functional computer labs (Ministry of Education and Sports (MoES), 2022; UNICEF, 2023). This leaves many students depending only on chalkboard learning and rote memorization, making it hard for them to compete in today's knowledge-based global economy.

The problem is made worse by the shortage of skilled teachers and the lack of local digital learning materials. Around 45% of teachers do not have ICT skills (Uganda National Teachers' Union, 2023), which makes it hard for them to use technology into their lessons. This has resulted in disengaged learners, higher dropout rates (22% at secondary level), and weak performance in national assessments (UBOS, 2023).

Existing e-learning initiatives are poorly organised and mostly focused on urban areas, and many of them require strong internet and expensive devices that students in rural West Nile cannot afford. This makes it

hard for them to compete academically with learners in better resourced districts. Without a suitable and inclusive e-learning system, Uganda may widen the educational gap between regions, leaving learners in West Nile left behind from national development and digital transformation.

Therefore, there is an urgent need for a technology-driven e-learning system designed for low-connectivity and low-resource environments, one that can function offline, deliver localized content, and empower teachers with digital teaching skills. Such a system would not only improve access and quality but also promote equity, giving every Ugandan learner the opportunity to benefit from digital education regardless of their location or background.

1.3 Purpose of the Study

To design and develop a technology driven e-learning system that helps bridge educational gaps in the West Nile region.

1.4 Specific Objectives of the Study

- i. To understand how teaching and learning are currently being done in the West Nile Region, and to identify the key educational challenges learners and teachers are facing.
- ii. To review existing studies and information about e-learning systems, digital learning technologies and how they have been used to improve education in similar communities.
- iii. To design and develop a simple and user-friendly prototype of an e-learning system based on the needs identified.
- iv. To test the developed system, check how well it works, how easy it is to use, and whether it helps improve learning.

1.5 Study Scope

The project focuses on designing, developing, and implementing a technology driven e-learning system to improve access to quality education in West Nile region of Uganda, especially in rural and underserved communities. It brings together digital learning tools, localized content, and low-cost infrastructure to create an inclusive and sustainable learning model.

1.5.1 Geographical Scope

The project is limited to selected districts in the West Nile region including Terego, Nebbi, and Maracha, where access to digital learning is still low. It focuses on identifying the digital gaps in these schools and how a suitable e-learning platform can address them. Urban schools in Kampala and Mukono will also be included for comparison and cross-learning.

1.5.2 Subject Scope

This project is an information technology (IT) project that focuses on creating an easy-to-use e-learning system to improve education in the West Nile region, which is our case study. It involves understanding the needs of learners and teachers, designing and developing the online learning platform, adding learning materials, and making sure the system works well even in areas with weak internet. It also includes training users so they can use the system comfortably.

1.5.3 Time Scope

This project will run for about one year. The first months will be used to understand the needs of schools in West Nile. After that, the system will be designed and developed, followed by creating and adding learning content. The system will be tested in a few schools, improved based on feedback, and fully introduced to the whole region. The final months will be used to check how well the system is working and prepare the final report.

1.6 Significance of the project

The proposed technology-driven e-learning system has the potential to transform education in Uganda by reducing long-standing gaps between rural and urban learners. By using affordable digital technologies, the project aims to make education more inclusive, accessible, and interactive, supporting Uganda's goal of providing quality education for all, as outlined in the National Development Plan (NDP III) and Vision 2040.

It will give students in the West Nile region easy access to learning materials at anytime, helping them overcome challenges like few teachers, long distances to school and lack of textbooks. This allows learners to study at their own pace and improve their understanding.

It provides a simple and efficient way to share lessons, track the progress of the learner and manage large classes. The system supports teachers by reducing on the workload and enabling more interactive and flexible teaching.

It also introduces an affordable and scalable digital solution, helping schools address existing gaps, improve learning outcomes, and support Uganda's efforts to integrate ICT into education, especially in rural areas.

SECTION TWO

2. LITERATURE REVIEW

2.0 Introduction

This literature review looks at both global and local studies on using technology in education, with a focus on Uganda's specific social, economic, and infrastructural conditions. It examines successes, challenges, and lessons learned from similar initiatives in Sub-Saharan Africa, providing a basis for designing a technology-driven system that fits the local context.

2.1. E-learning in Uganda

E-learning in Uganda has been steadily growing. Institutions like Makerere university, Kyambogo university, and UCU started using learning Management System (LMS) even before covid 19, but its adoption increased a lot during the lockdown (Nakabugo sieck,2020). The ministry of education also introduced the Uganda learning platforms and worked with telecom companies to provide subsidised data and access to educational websites (MoES, 2021). In remote areas like West Nile, NGOs such as UNICEF and learning Equality have supported digital learning using offline platforms like kolibri for learners with limited internet (UNICEF, 2021). These initiatives show that e-learning can help provide equitable access to education especially in underserved areas

2.2. Management of e-learning systems

Managing e-learning systems involves planning, delivering and monitoring online learning activities in an organised way. Schools and universities use platforms like Moodle, google classroom and zoom to share notes, give assignments, track progress, and communicate with learners (Nakabugo and sieck,2020). Good management of these systems makes sure that content is easy to access, teachers know how to use the platforms, and the learners get support when they need it. According to UNESCO (2020), effective management of e-learning also requires regular monitoring of learner engagement, digital literacy training, and proper organisation of online assessment.

2.3. Applications of e-learning systems in Uganda

E-Learning systems are used in schools to deliver lessons, share study materials, give assignments, and conduct quizzes through platforms like Moodle, google classroom, zoom and kolibri (Dhawan 2020). The systems also support online discussions and help teachers monitor learner progress. During and after COVID 19, many schools relied on the Uganda learning platform and kolibri to provide curriculum aligned content (NCDC,2021; UNICEF ,2021). Overall, e-Learning systems make learning more flexible and help ensure continuity, even when students cannot attend physical classes.

2.4. Designing an e-learning system

Designing an e-learning system begins with understanding what learners, teachers and the school environment need. According to UNESCO (2020), a good digital learning platform should be easy to use, accessible, and able to run even when internet connectivity is weak. The main features usually include uploading lessons, spaces for discussion, quizzes, progress tracking, and options that allow learners to access content offline. In Uganda especially in remote areas, design must consider challenges like weak internet, unstable electricity, and low digital skills (UCC,2022). Because of this, the system should be lightweight, easy to navigate and suitable for schools with limited resources.

2.5. Implementation of e-learning systems

Implementing an e-learning system involves several steps like training teachers, preparing digital learning materials, setting up the platform, and providing continuous technical support (MoES,2021). Schools also need to involve parents and learners, so that everyone understands how the system works and why it is important.

During covid 19, institutions that successfully introduced e-learning focused on ongoing teacher training, using simple and user-friendly platforms, and offering support learners (World bank, 2021). In rural areas, implementation may require solutions such as solar powered devices or offline servers like kolibri to overcome challenges related to electricity shortages and weak internet connectivity (UNICEF ,2021).

2.6. Importance of E-Learning Systems

E-learning systems provide flexibility by allowing learners to study any time and at their own pace (Dhawan, 2020). They improve access to quality learning materials, strengthen teacher-learner interaction and make

lesson more engaging through multimedia tools such as videos and interactive activities (UNESCO 2020). In Uganda, e-learning helps reduce the rural urban education gap by giving learners in remote areas like West Nile access to digital content they would otherwise not have (MoES, 2021). These systems also lower printing costs and support continuous learning during disruptions such as pandemics or school closures.

2.7. Challenges in designing and implementing E-learning Systems.

Even though e-learning has many advantages, several challenges still limit its successful adoption. Some of the major issues include limited internet connectivity, high data costs, unstable electricity, and low levels of digital literacy among teachers and learners (UCC,2022). Rural areas face even greater barriers such lack of appropriate devices like smart phones or laptops (NITA -U ,2021). Teachers may also find it difficult to adopt to new digital tools, which can negatively affect the quality of on-line teaching (MoES, 2021). On learner's, many experience distractions at home, low motivations, and difficulties accessing consistent academic or technical support (Dhawan, 2020)

2.8. Overcoming the Challenges.

To address these challenges, both government and institutions need to strengthen digital support systems. This includes expanding affordable internet access, digital skills training, and providing devices to students who lack them. (UNICEF,2021). Using offline platforms like Kolibri can also reduce reliance on internet connectivity, especially in remote areas (learning equality,2020). Schools in regions with unstable electricity can invest in solar powered solutions to ensure consistent access to digital learning tools (African Development Bank ,2020). Additionally continuous teacher training and the use of simple, user-friendly e-learning platforms can improve adoption and support better learning outcomes (MoES, 2021).

2.9. Conclusion

Overall, e-Learning systems have transformed Education by making learning more flexible, accessible, and engaging. In Uganda the introduction of platforms like Kolibri, Moodle and the Uganda Learning platform has supported thousands of learners especially in remote regions. Although challenges such as connectivity and digital literacy still exist, government support, partnerships and innovative design approaches continue to make e-learning more effective and inclusive. With the right strategies, digital learning can play a major role in bridging educational gaps in regions like West Nile.

SECTION THREE

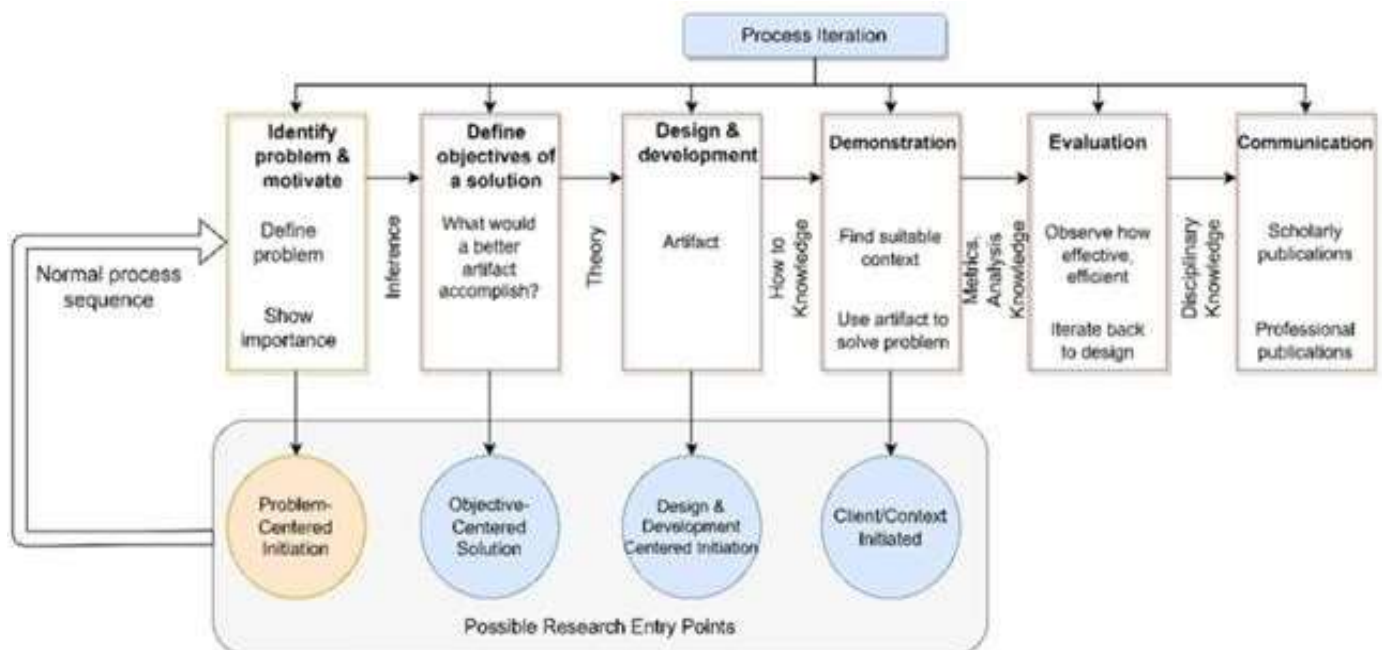
3. PROJECT RESEARCH METHODS

3.1 Research Design/Research Approach

This study uses the design science research methodology, it focuses on the design development and evaluation of artifacts that are supposed to solve the identified real-world problems (Hevner et al., 2004). In this research, our artifact will be a joint digital E-learning platform for learners in districts of Obongi, Zombo, Maracha, Pakwach among others.

3.2 DSR Process Model

Illustration of the design science research process diagram



Stage one: Problem Identification

In stage one, the study identifies and clearly defines the major learning challenges affecting students in the selected districts. This will be done through interviews, surveys and conversations with school administrators and students (Creswell, 2014). The data collected will guide the design of the digital learning platform

Stage Two: Definition of objectives for the solution

The study sets clear goals for the system. These include the following analysing the challenges that are already there in the rural schools, looking at relevant eLearning literature, and designing and developing the digital learning platform (Hevner et al., 2004)

Stage Three: Design and Development of the artifact

At this stage, the structure and features of the digital learning system are designed. A prototype will then be developed, having key features such as offline learning materials, video tutorials and ready to download question banks.

Stage Four: Demonstration

The prototype will be showed in the schools picked at random through case studies or simulation workshops. These demonstrations aim to show how the prototype can be applied in reality to support students and learners, teachers and administrators.

Stage Five: Evaluation

Once the prototype is developed, it will be carefully evaluated through checking how users interact with the system, checking to see how the system works and checking how secure it is. This stage involves getting feedback from learners, teachers and administrators to make sure that the system meets both functional and operational requirements.

Example: A pilot rollout in selected schools and surveys, will help in determining if the platform successfully creates an impact on the student's overall education journey.

Stage Six: Communication

This stage involves recording the development process, seeing how things have come out, and giving the findings to both academic and the other relevant stakeholders. This ensures that the project's contributions are clearly explained in simple language and that lessons learned can inform future deployments in similar educational environments.

3.3. Target Population and Sample

The study targets stakeholders directly affected by or involved in the education process. These include students, teachers and school administrators, district education officers and school management committee members. Each group brings their idea on the causes of academic failure, making them available contributors to both identifying the problem and designing the solution.

3.4 Sampling Techniques

This study will use a combination of stratified sampling and purposive sampling to ensure both representativeness and depth in participant selection (Creswell, 2014).

3.4.1 Stratified sampling

Stratified sampling will be used to divide the selected population in order starting with the districts and then onto the schools and students. This approach makes sure that all the groups are looked at, included and all units are compared (Yin, 2017).

District Stratification: The districts in West Nile (Yumbe, Pakwach, Terego) have different locations, economy and education backgrounds. Two districts will be chosen randomly out of three districts and the studies will be based on the results that we shall get from both to represent the whole area.

School Stratification: With the districts selected, schools will be divided further into two which is the government and private category. Two schools will be picked from one, one private and another government

giving a total of four schools. Students will be randomly selected from all classes so that it caters for all of the students in the region.

3.4.2 Purposive Sampling

While stratified sampling ensures breadth, purposive sampling will be applied to identified key informants who possess critical knowledge relevant to the study objectives (Creswell, 2014)

These include:

3.4.4.1 Teachers who handle core subjects in the sampled classes.

3.4.4.2 Head teachers and school administrators who oversee school operations

3.4.4.3 District Education Officers (DEOs) with oversight of education policy and implementation in the respective districts

3.4.4.4 Parents and guardians of selected students to provide insight into home-based learning challenges.

3.5 Sources of Project Data

Primary Data:

Primary data will be collected from the people involved through field-based research in the chosen rural districts by using the following sources and methods:

Structured question papers will be given to students to find out the challenges in learning, access to materials, and digital exposure.

Semi-structured interviews will be done with subject teachers to understand teaching strategies, syllabus and performance challenges.

Interviews will be conducted with DEOs to obtain data on policy enforcement, district level performance metrics, and intervention gaps.

Secondary Data

Secondary data will be got from records that are already there and government sources. The information helps us understand where they are coming from, check the facts in the chosen districts and compare with the information that we shall get from the primary data.

Uganda National Examinations Board (UNEB) Reports, viewed through UNEB's official website and district education offices.

School Records, Official performance records, teacher deployment lists, and student attendance logs will be requested directly from the selected school's administrators.

Ministry of Education and Sports Documents, Policy reports, and statistical abstracts will be sourced from the Ministry's online portal and public libraries.

3.5. Data Collection Techniques

3.5.1. Surveys: why this technique, it's because it will help to gather quantifiable data from students, teachers, and administrators. Structured questionnaires will be used to capture information on ICT access, rate of e-learning use, the digital skills, and challenges faced. For example, a survey may ask students how regularly they use computers and ask whether they do have internet access at home. Surveys are useful because they collect measurable data from many respondents quickly.

3.5.2. Interviews: This is best of them all because it will target key stakeholders such as headteachers, ICT coordinators, or distinct education officers. For example, talking to headteachers helps reveal the real challenges schools face. Many of them mention issues like unstable electricity, computers that no longer

work, and the struggle of fitting digital lessons into an already tight timetable. These interviews give firsthand insights and help explain why some schools still find it hard to fully adopt e-learning.

3.6 System Analysis & Design Approach

This project will follow an object-oriented analysis and design approach combined with a prototyping method to ensure that the e-learning system is developed in a structured and user centred way. OOAD is suitable for this project because it allows the system to be broken down into clear components such as users, lessons, assessments, content modules and communication features. By analysing the system in terms of objects, attributes and interactions, it becomes easier to design a solution that is flexible, easy to update, and capable of meeting the unique needs of schools in the West Nile region.

Alongside OOAD, the project will use a prototyping approach where early versions of the system will be created and shown to potential users such as teachers and students. These prototypes will help the researcher gather feedback on the system layout, features, and usability before developing the final version. Using prototyping reduces development mistakes because users can identify what works and what needs improvement early in the process. This approach also ensures that the final e-learning system is simple, accessible, and aligned with the real learning challenges experienced in low resource school environments.

3.7. Design Techniques

The design techniques to be used include Use Case Diagrams and Entity Relationship Diagrams (ERDs). These will be used to model functionality and data structures.

Use Case Diagrams: These will be defining the system's functional requirements by showing the system interactions between users (actors) and system functionalities (use cases). This technique provides a clear overview of how users such as students, teachers, and administrators will interact with different features of the system, such as accessing learning materials, tracking performance, or uploading resources.

Entity Relation Diagrams (ERDs): These will be used in modelling the database structure of the system. ERDs help in identifying different data entities (e.g., users, courses, and performance records), their attributes, and relationships. This ensures optimal data storage, retrieval, and integrity across the system. Using ERDs helps in avoiding data redundancy and ensures scalability of the system in future implementations.

Together, these techniques will provide a functional and structural blueprint of the system.

3.7.1. Technology Stack Selection

The technology stack was carefully selected to balance performance, cost-effectiveness, and sustainability:

Category	Minimum system requirements
Frontend Development	HTML5, CSS, Bootstrap, JavaScript (React.js), Progressive Web App (PWA)
Backend Development	Node.js, Express.js, Redis, MongoDB
Integration Components	RESTful APIs, Web Sockets, JSON Web Tokens (JWT)

3.8 Anticipated Project Constraints

- i. Technology adoption: most of the users don't know how to use digital tools and not used to using such systems may refuse to use the system which could slow down the process or make it hard building the system.
- ii. Resource Limitations: lack of people, money and resources may affect both the development and successful implementation of the system.
- iii. Stakeholder Engagement: the effectiveness of the project depends on the contribution made by the stakeholders. Any delays in in the activities such as data collection can affect the implementation of the system.

3.9 Ethical Considerations

- i. **Informed Consent:** permission will be got from the participants before participation in surveys and interviews. They'll also be informed about the project objectives in getting data from them and for what purpose the data will be used for.
- ii. **Data Privacy:** Unknown datasets kept on password-protected servers; GDPR-compliance for EU collaborators.
- iii. **Inclusivity:** Platform tested with visually impaired students using JAWS screen readers. Gender-balanced content (e.g., STEM examples featuring female role models).

4. APPENDICIES

Project Budget

Item	Description	Unit Cost	Quantity	Total
Transport while in field	Moving to West Nile schools to collect data	350000	3 trips	1,050,000
Printing and photocopying	Questionnaires, interview guides, consent forms, reports	1000 per page	250 pages	250,000
Internet/ data bundles	Research, online tools, system development	130,000	3 months	390,000
Stationery	Pens, paper, notebooks, files for fieldwork	Full amount	1	120,000

Software and tools	Hosting, domain development tools, cloud space, testing	Full amount	1	1,800,000
Refreshments	Soda/Water for students and teachers during interviews	5000 per person	25 people	150,000
Prototype development costs	Server setup, UI design, coding, testing, offline features	Full amount	1	3,300,000
Contingency	Unexpected costs			1,000,000
				8,060,000

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