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Development of Integrated Computer-Assisted Learning Model for Curriculum Support in Post-Primary Schools in Rivers State, Nigeria

Wonu, C.T., & Amannah, C.I.
Department of Computer Science, Ignatius Ajuru University of Education, Port Harcourt**,** Nigeria

Corresponding author email: theozy9@gmail.com

Abstract
A critical issue emerged concerning the lack of an effective and efficient computer-assisted learning model to support the curriculum in post-primary schools in Rivers State. Addressing this challenge, this study employed a combination of waterfall and design science research methods to develop an integrated computer-assisted learning model tailored to the educational settings in Rivers State. The approach involved a comprehensive literature review, a needs assessment survey, and the subsequent design and implementation of the learning model. The designed integrated computer-assisted learning model comprised six essential function modules: curriculum, topic, learning resource, assessment, user, and classroom. The model accommodates various learning activities, including individualized, collaborative, and blended learning. The evaluation of the learning model demonstrates its effectiveness in enhancing student engagement, motivation, and learning outcomes. Notably, the study provides valuable insights into the development and evaluation of such a model in post-primary schools in Rivers State, contributing to the growing body of knowledge on computer-assisted learning. The integrated model proved to promote student-centred learning, foster collaboration, and offer immediate feedback, positively impacting both teachers and students by reducing teacher workload and enhancing student motivation and performance. The study recommends scaling up the implementation of the model in more schools, integrating it with existing curriculum and pedagogy, regularly assessing and reevaluating the curriculum to identify evolving educational needs, and incorporating feedback from educators, students, and stakeholders. These recommendations aim to contribute to the ongoing efforts to improve the quality of education in Nigeria.

Keywords: Post-Primary, Curriculum, Design Science, Integrated, Development.

Introduction

The use of information and communication technology (ICT) has revolutionized education globally, shifting instructional methods from traditional to computer-assisted learning (CAL) in developed nations. Nigeria has also embraced this shift, integrating computers into classrooms to enhance learning experiences beyond data analysis. However, the effectiveness of CAL relies not only on technology but also on teacher quality, training programs, and access to development facilities, highlighting the need for a holistic approach to educational planning and development (Thang & Wong, 2010). CAL, as defined by Audu and Agbo (2010), involves using pre-recorded instructional software to educate, guide, monitor, and evaluate students until they reach a certain level of competency. It employs an interactive format, incorporating text, images, sound, and video to engage students and achieve specific learning objectives. CAL, also known as computer-based learning, has shown promising results in developed nations, underscoring its potential advantages, especially in a world where ICT tools are increasingly prevalent (Audu & Agbo, 2010).

In Nigeria, the government is striving to make educational institutions technology-oriented, integrating CAL tools like computers into school curricula and laboratories to replace traditional instruction methods (Adomi, & Kpangban, 2010). This shift from teacher-centred to learner-centred approaches aims to equip students with the skills needed for the modern world while optimizing learning outcomes. A well-designed and integrated CAL model is essential for effective instruction delivery, communication between teachers and students, collaboration among students, resource

accessibility, self-paced learning, and online assessment (Adomi, & Kpangban, 2010). Individualized instruction in CAL allows students to progress at their own pace, receive immediate feedback, and develop autonomy in learning procedures, enhancing their ability to acquire knowledge independently.

For teachers, the integration of CAL offers opportunities to adapt instruction to students' needs, interests, and abilities, freeing them from the traditional role of sole knowledge provider. With CAL, teachers can break down lesson content, organize subject matter effectively, and cater to individual learning styles, motivations, and comprehension levels (Adomi, & Kpangban, 2010). Proposing the integration of CAL into the curriculum in Rivers State aims to address various challenges facing education, including punctuality, attendance, progress monitoring, problem-solving skills, and digital literacy. However, challenges such as communication gaps, limited accessibility, curriculum alignment, and teacher integration competencies need to be overcome for successful implementation (Thang & Wong, 2010). Teachers must develop the knowledge and skills to integrate CAL effectively with pedagogical approaches, ensuring alignment with curriculum standards and student textbooks (Thang & Wong, 2010). This study seeks to develop an integrated CAL model for curriculum support in post-primary schools in Rivers State, ultimately improving education quality and preparing students for the demands of the knowledge society.

The Computer-Assisted Learning (CAL)

The term CAL, which stands for Computer Assisted Learning, is commonly used in the fields of computing and education. It is unclear when exactly the term was first used, but literature indicates that since the mid-1980s, CAL has been increasingly used to refer to the use of computers in teaching. Other terms are used to describe the educational use of computers, such as educational administration, education about computers, and peer learning, each with slightly different meanings. CAL is a comprehensive term that refers to any educational use of computers. Lai et al. (2016) has broadly classified CAL into three categories: tool, tutee, and tutor. Computer-assisted learning (CAL) is a teaching approach that utilizes computer technology to support and enhance the learning process. It involves the use of computer software and programs to deliver instructional content, facilitate communication and collaboration among learners and instructors, provide feedback and assessment, and customize learning experiences to meet individual student needs and preferences. Computer-assisted learning (CAL) refers to the use of computer technology to facilitate teaching and learning processes. CAL is designed to support traditional forms of teaching and learning by providing a variety of interactive and multimedia resources that can enhance students' engagement and learning outcomes (Beard & Harper, 2002). According to Clark and Mayer (2011), CAL is "an interactive, self-paced, learner-controlled instructional environment that uses multimedia elements to engage learners in meaningful and memorable learning experiences." CAL has been found to be effective in promoting student learning outcomes in various subject areas (Graham & Metaxas, 2003; Kozma, 2003). CAL has also been found to be particularly effective in promoting the development of critical thinking and problem-solving skills (Shute, & Emihovich, 2018). CAL can be delivered through various modes, including online learning environments, CD-ROMs, and interactive multimedia resources (Clark & Mayer, 2011). CAL resources can also be designed to be adaptable to different learning styles and preferences, and can provide students with personalized learning experiences (Brown et al., 2009).

Benefits of Computer-Assisted Learning in Post-Primary Education

Computer-assisted learning (CAL) refers to the use of computers to support learning and teaching. CAL has been implemented in post-primary education to enhance teaching and learning outcomes, as well as to address the limitations of traditional teaching methods. The purpose of this literature review is to examine the benefits of CAL in post-primary education. Improved Learning Outcomes: One of the key benefits of CAL in post-primary education is the improvement in learning outcomes. CAL provides students with interactive and engaging learning experiences, which can enhance their understanding of complex concepts. CAL also allows for personalized learning, which can cater to the unique learning needs of individual students. Studies have shown that CAL can improve academic performance, as students are more motivated and engaged in their learning (Bates, 2015). Increased Student Engagement: CAL has been shown to increase student engagement in the learning process. By providing students with interactive and immersive learning experiences, CAL can help to create a more engaging and dynamic learning environment. Students are more likely to participate actively in the learning process when they are provided with such an environment. Studies have also shown that CAL can help to promote collaborative learning, as students can work together on projects and share ideas.

Flexibility and Convenience: Another key benefit of CAL is its flexibility and convenience. CAL can be accessed from anywhere at any time, providing students with the opportunity to learn at their own pace and in their own time. This can be particularly beneficial for students who are unable to attend traditional classes due to illness or other commitments. CAL can also provide students with immediate feedback on their progress, which can help to identify areas of strength and weakness. Cost-Effective: CAL can also be cost-effective compared to traditional teaching methods. Once the initial investment in hardware and software is made, CAL can be delivered to large numbers of students without incurring significant additional costs. CAL can also reduce the need for textbooks and other materials, as all the necessary resources can be provided electronically. Studies have shown that CAL can help to reduce costs associated with teaching, as well as improve learning outcomes.

The study conducted by Saylan et al. (2023) on a systematic review of empirical studies on computer-assisted language learning. The authors reviewed a total of 36 articles published between 2000 and 2020 and identified the benefits and limitations of CAL in science education. The study found that CAL has the potential to improve student learning outcomes, increase student engagement and motivation, provide personalized learning experiences, and support collaborative learning. However, the study also highlighted the need for effective implementation strategies, adequate training for teachers, and consideration of factors such as access to technology and the digital divide. The CAL has the potential to enhance science education, but its successful implementation requires careful planning and consideration of various factors. The Benefits of Computer-Assisted Learning in Post-Primary Education have been studied by different researchers, and some of the benefits that have been highlighted include improved academic performance, increased motivation and engagement in learning, increased self-efficacy and confidence, improved critical thinking and problem-solving skills, and increased access to educational resources. Additionally, computer-assisted learning is effective in promoting independent learning, accommodating diverse learning styles, and providing immediate feedback to learners. The studies suggest that computer-assisted learning has the potential to enhance the quality of education in post-primary schools and help address some of the challenges facing the education system, such as inadequate resources, shortage of trained teachers, and overcrowded classrooms.

Challenges of Implementing Computer-Assisted Learning in Rivers State

According to Osuji et al. (2021) lack of adequate infrastructure, including electricity, internet connectivity, and functional computers, is one of the primary challenges of implementing computer-assisted learning in Rivers State. Similarly, Osuji et al. (2021) note that the lack of trained teachers who can effectively use technology in teaching is another major challenge. Access to computers is also a challenge in Rivers State, as many schools do not have enough computers to cater to the needs of all their students. In addition, maintenance and support of computer systems are also a challenge, as many schools lack the resources and expertise to maintain and repair their computer systems when they malfunction (Osuji et al., 2021). Funding is also a significant challenge to implementing computer-assisted learning in Rivers State, as many schools lack the financial resources to purchase the necessary hardware and software required for effective computer-assisted learning. Finally, limited teacher involvement is a challenge to implementing computer-assisted learning in Rivers State, as many teachers are resistant to change and may not be willing to embrace new teaching methods that involve technology.

Integration of Computer Assisted Learning Teaching and Learning in Nigeria.

Computer Assisted Learning (CAL) is an educational technology tool that has been increasingly adopted in Nigerian schools to improve teaching and learning outcomes. In this literature review, I will examine previous studies on the integration of CAL in teaching and learning in Nigeria. Adeyemi (2008) explored the experiences and challenges of Nigerian secondary school teachers in integrating CAL into science teaching. The study found that while teachers recognize the potential benefits of CAL, they face several challenges in implementing it, including inadequate infrastructure, lack of technical support, and limited training opportunities. Ogunleye and Ayeni (2020) conducted a study that examined the challenges and prospects of integrating CAL in teaching and learning in Nigerian universities. The study found that while CAL has the potential to enhance teaching and learning, several challenges need to be addressed, including inadequate infrastructure, limited access to technology, and lack of technical support.

Furthermore, a study by Adeyemo and Adesope (2019) investigated the impact of CAL on the performance of students in computer science in Nigerian secondary schools. The study found that CAL improved students' understanding and retention of computer science concepts. Finally, in a study conducted by Alex et al. (2022), the effectiveness of CAL

in teaching computer studies was evaluated. The study found that CAL improved students' understanding of computer studies concepts and motivated them to learn. The studies reviewed indicate that CAL has the potential to enhance teaching and learning in Nigerian schools. However, challenges such as inadequate infrastructure, limited access to technology, and lack of technical support need to be addressed for the successful integration of CAL in teaching and learning in Nigeria.

Rationale for CAL in Teacher Education

CAL's importance spans all education levels, not just higher education, encompassing pre-primary education and teaching the three Rs (reading, writing, and arithmetic). Both developed and developing nations are integrating CAL into their education systems, with continued refinement through research. Effective CAL integration in teacher education requires a holistic approach throughout the program, exposing pre-service teachers to diverse educational technologies. CAL should be contextually introduced, moving beyond basic computer literacy, and emphasizing innovative learning environments. Professional development for teachers must align with their evolving roles, embracing lifelong learning through pre-service, induction, on-the-job training, and in-service programs. Collaborative models and partnerships enhance professional development, fostering a culture of continuous improvement. Effective integration of CAL requires proficient teacher educators and opportunities for peer learning and community involvement, transforming teachers into facilitators of dynamic learning experiences.

Theoretical Framework

Dual Coding Theory

Dual Coding Theory, initially introduced by Allan Paivio in 1965, has undergone significant development by various scholars, building upon centuries of cognitive psychology exploration. Paivio proposed two intertwined cognitive systems—verbal and non-verbal—responsible for distinct information processing (Paivio, 1965). John Anderson expanded on this idea in cognitive psychology, exploring its implications for learning and memory. Richard Mayer further applied Dual Coding Theory to education, emphasizing multimedia learning's role in enhancing instructional materials. The collaborative efforts of Paivio, Anderson, Mayer, and others have deepened our understanding of Dual Coding Theory, informing practical strategies in education. Figure 2.1 illustrates the schematic description of this theory.

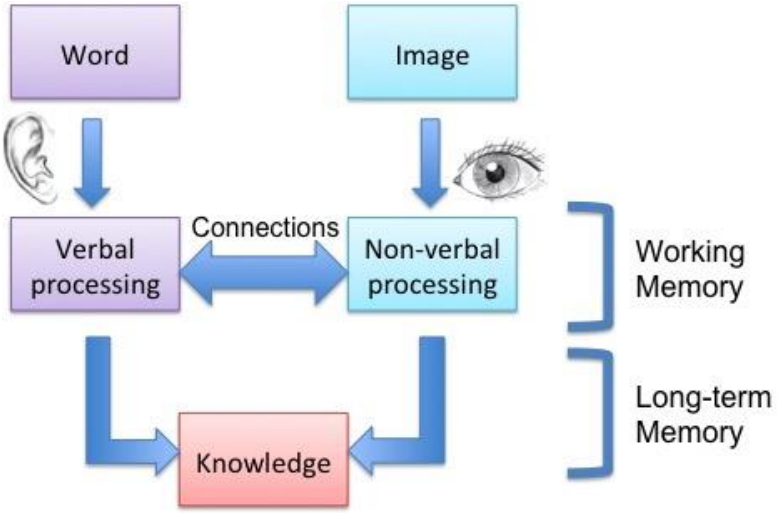

Figure 1 Dual Coding theory Paivio (1965).

This study emphasizes the importance of using both pictures and verbal explanations to enhance learning. It suggests providing students with direct experiences to improve knowledge acquisition. Paivio's Dual Coding Theory underscores the essential roles of both verbal and non-verbal systems in learning, with pictures aiding recall more effectively than words alone. The theory provides a valuable framework for analyzing stakeholders' experiences in the Rivers State post-primary school curriculum. It guides educators in utilizing tools and technologies for learning support and understanding socio-cultural factors influencing the learning environment. Computer-assisted learning aligns with this theory, allowing for the presentation of curriculum concepts through various media formats

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accompanied by explanations to aid student comprehension. The Dual Coding Theory suggests that using both verbal and non-verbal systems enhances learning and memory. In computer-assisted learning, this entails utilizing text-based and multimedia-based materials to improve student outcomes. By integrating images, videos, and other non-verbal elements, students can develop richer mental representations of the information presented. Additionally, the theory underscores the importance of meaningful learning, achieved by connecting new information to existing knowledge structures. In computer-assisted learning, this involves designing curriculum and materials relevant to students' local context and interests. The Dual Coding Theory provides a valuable framework for developing an integrated computer-assisted learning model in post-primary schools in Rivers State, potentially enhancing education quality and student outcomes.

Meaningful Learning and Subsumption Theory

Ausubel's Meaningful Learning and Subsumption Theory (Ausubel, 1963) stresses the importance of integrating new information with existing cognitive structures for effective learning. It contrasts rote learning by emphasizing comprehension over memorization. This theory guides educational practices, advocating for materials organized around meaningful concepts and techniques like advance organizers and analogies (Ausubel, 1963). In the Rivers State Post-primary School curriculum, prone to rote memorization, Ausubel's theory suggests valuable insights. Integrating Computer-Assisted Instruction (CAI) aligns with meaningful learning, offering digital formats for students to engage with abstract content (Ausubel, 1963). The study's CAI application, reflecting Ausubel's principles, encourages active engagement, aiding in knowledge retention. Ausubel's theory provides a foundation for CAI design, enhancing material relevance and student engagement in Rivers State, Nigeria. Figure 2 shows the schematic description of the Meaningful Learning and Subsumption Theory.

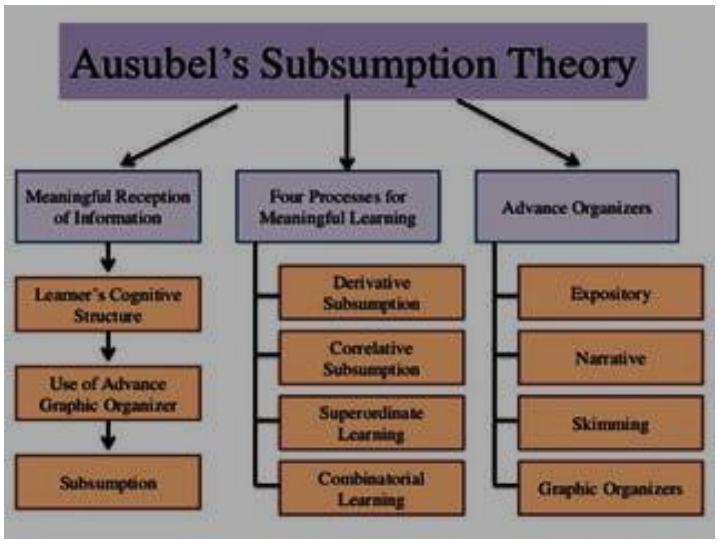

Figure 2 Meaningful Learning and Subsumption Theory

The diagram depicts Ausubel's theory of meaningful learning, highlighting the integration of new information into existing mental models (schemas). Emphasizing prior relevant knowledge, the theory underscores its role as the foundation for learning. It illustrates two subsumption mechanisms: integrating new information under general concepts and specific examples. Both mechanisms rely on the existing conceptual framework to organize and integrate new information effectively. The theory stresses prior knowledge and meaningful learning, facilitating a deeper understanding of new material. In computer-assisted learning, relevant curriculum design is crucial, aligning with students' local context. Using local examples, images, and videos aids comprehension. Advance organizers and analogies further bridge new information with existing knowledge. This theory guides the design of an integrated computer-assisted learning model, enhancing learning outcomes in Rivers State's post-primary schools. It underscores the importance of meaningful learning and knowledge integration for improved education quality.

Review of Empirical Studies:

The study by Kulkarni (2020) aimed to develop an integrated computer-assisted learning model for mathematics education in post-primary schools, showing its effectiveness in improving students' mathematical skills. However, limitations include a small sample size and a focus solely on mathematics. Zhou and Zhou (2020) proposed a computer-aided instruction system based on supervised learning algorithms, leveraging advancements in computer and multimedia technology. The system includes modules for login, registration, learning mode selection, content selection, and testing. By utilizing database logic to manage multiple user identities, the system enables effective supervision of student learning. Comparative experiments between system-controlled learning and free learning demonstrated that the computer-assisted curriculum teaching control system significantly improves learning outcomes, student engagement, and motivation compared to traditional methods. This study highlights the efficacy of integrating technology into education for enhanced learning experiences and outcomes. Bada and Olusegun (2017) explored computer-assisted learning in biology, reporting enhanced motivation and achievement, yet limitations included reliance on self-reported data and subject exclusivity. Addressing these limitations is crucial for the broader implementation of computer-assisted learning in post-primary schools.

System Analysis and Design:

The existing system is Moodle's integrated learning model. Since its inception, has evolved into one of the most widely adopted open-source learning management systems (LMS) globally. It boasts a substantial and dynamic community of users and developers who actively contribute to its continuous enhancement and development. Moodle is employed by a diverse range of institutions, including post-primary schools, colleges, universities, and corporate training programs. Moodle, utilized for computer-assisted learning models, offers various advantages like heightened student engagement, collaboration, and self-paced learning. Yet, its efficacy hinges on thoughtful design, implementation, and integration into the educational framework.

Some potential disadvantages of the Moodle system include:

1. Complexity: Moodle can be difficult to use for those who are not familiar with the platform. It has a steep learning curve and may require significant training to use effectively.
2. Customization: While Moodle is highly customizable, it can be challenging to modify and adapt the system to meet specific needs without technical expertise.
3. Maintenance: Moodle requires regular maintenance to ensure that it is up-to-date and secure. This may require additional resources and technical support.
4. Limited support: Moodle is an open-source platform, which means that support may be limited, particularly for smaller organizations that do not have the resources to invest in technical support or customization.
5. Integration with other systems: Integration with other systems may be difficult or require additional technical expertise, which could limit the ability of schools to use Moodle effectively in conjunction with other systems.
6. Limited multimedia support: While Moodle does support multimedia content, it may not be as robust as other systems, which could limit the types of content that can be included in courses

The proposed Integrated Computer-Assisted Learning Model for Curriculum Support (ICALMCS) is poised to revolutionize education in a specific region. By leveraging computer-assisted learning tools, ICALMCS aims to create a dynamic and tailored learning experience for local students. Positioned as a transformative tool for the education sector, it envisions seamlessly integrating technology with traditional teaching methods to address diverse local needs and challenges. ICALMCS embodies a student-centric philosophy, fostering curiosity and critical thinking. By empowering educators and students alike, it offers personalized and adaptive learning. Ultimately, ICALMCS represents a forward-thinking initiative with the potential to redefine educational practices and outcomes, setting a precedent for the future of education in the region and beyond.

The proposed Integrated Computer-Assisted Learning (ICAL) model for curriculum support in post-primary schools in Rivers State offers multiple advantages over traditional teaching methods. Firstly, it provides students with access to diverse digital resources like interactive simulations and multimedia content, enhancing engagement. Secondly, it offers personalized learning experiences by enabling teachers to monitor individual progress and provide targeted support. Thirdly, it improves efficiency by delivering content electronically, reducing reliance on paper-based materials. Lastly, it enhances communication and collaboration among teachers, students, and parents through various

tools (Ogunsola et al., 2021). In summary, the ICAL model promises improved access, personalization, efficiency, and communication, potentially revolutionizing education in Rivers State.

Statement of Problem

The post-primary school curriculum in Rivers State encounters significant challenges impacting teachers and students. One major issue is the lack of adherence to standardized curriculum, resulting in improvised lesson plans that fail to adequately prepare students for the digital era. As a consequence, many students lack the essential computer literacy skills necessary for homework and performance in computer-based testing (CBT) competitions. Outdated curriculum and inadequate teacher training further contribute to students' poor performance on assignments. Additionally, students are often required to complete a large portion of their assignments independently, placing pressure on parents who may lack familiarity with the curriculum or be unable to provide support. To tackle these issues, this research proposes an integrated computer-assisted learning model for curriculum support (ICALMCS) in post-primary schools in Rivers State. ICALMCS aims to enhance learning, enabling students to grasp concepts more effectively and work at their own pace, ensuring thorough understanding before progressing.

Aim and Objectives of the Study

This study aims to develop an integrated computer-assisted learning model for curriculum support in the post-primary schools in Rivers State. The specific objectives of the study are to:

1 evaluate the present curriculum system in post-primary schools in Rivers State.
2 design an integrated computer-assisted learning model for curriculum support (ICALMCS) in post-primary schools in Rivers State.
3 implement the proposed ICALMCS using Java programming language.
4 test the proposed ICALMCS in post-primary schools in Rivers State
5 and evaluate the performance of the ICALMCS in improving learning outcomes in post-primary schools in Rivers State.

Methodology

Software methodology is the set of rules and practices used to create computer software. It consists of a software development model used together with at least a technique. Thus, METHODOLOGY = SOFTWARE MODEL + TECHNIQUE(S). The design methodology adopted for this research is the Waterfall Method and Design Science Research (DSR) for analyzing the Existing System, also designing the New System.

Architecture of the Proposed System

Figure 3 below shows the architectural function modules of the integrated computer-assisted learning model to support the curriculum in post-primary schools.

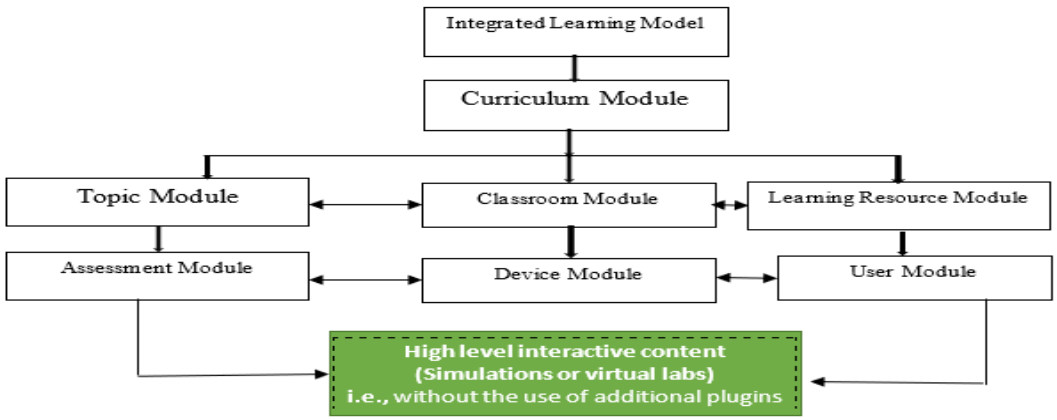

Figure 3: The architectural function modules of the integrated computer-assisted learning model to support the curriculum in post-primary schools

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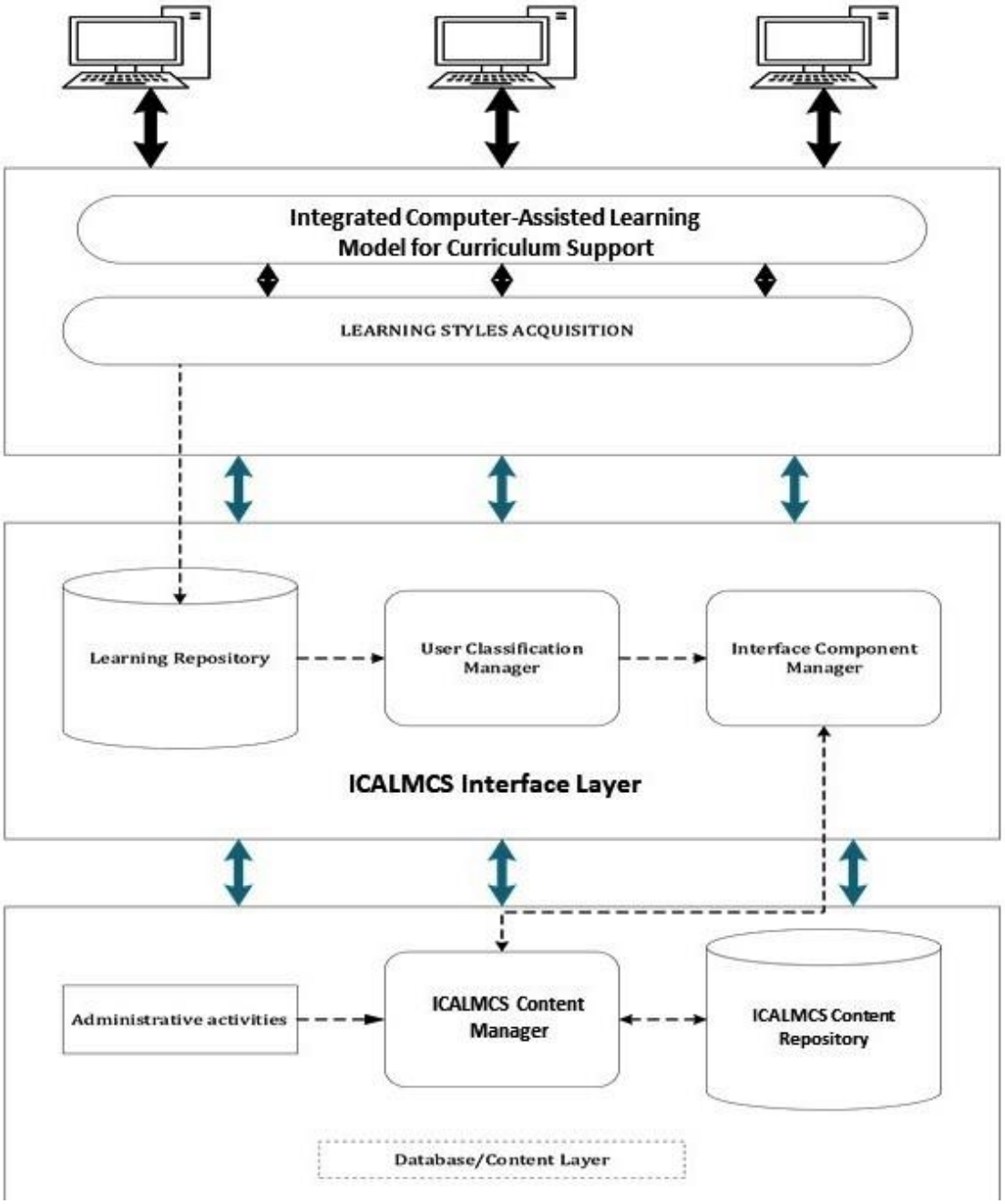

Figure 4 Architecture of the proposed system

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The System Design

Process Design Activity Diagram of the proposed system

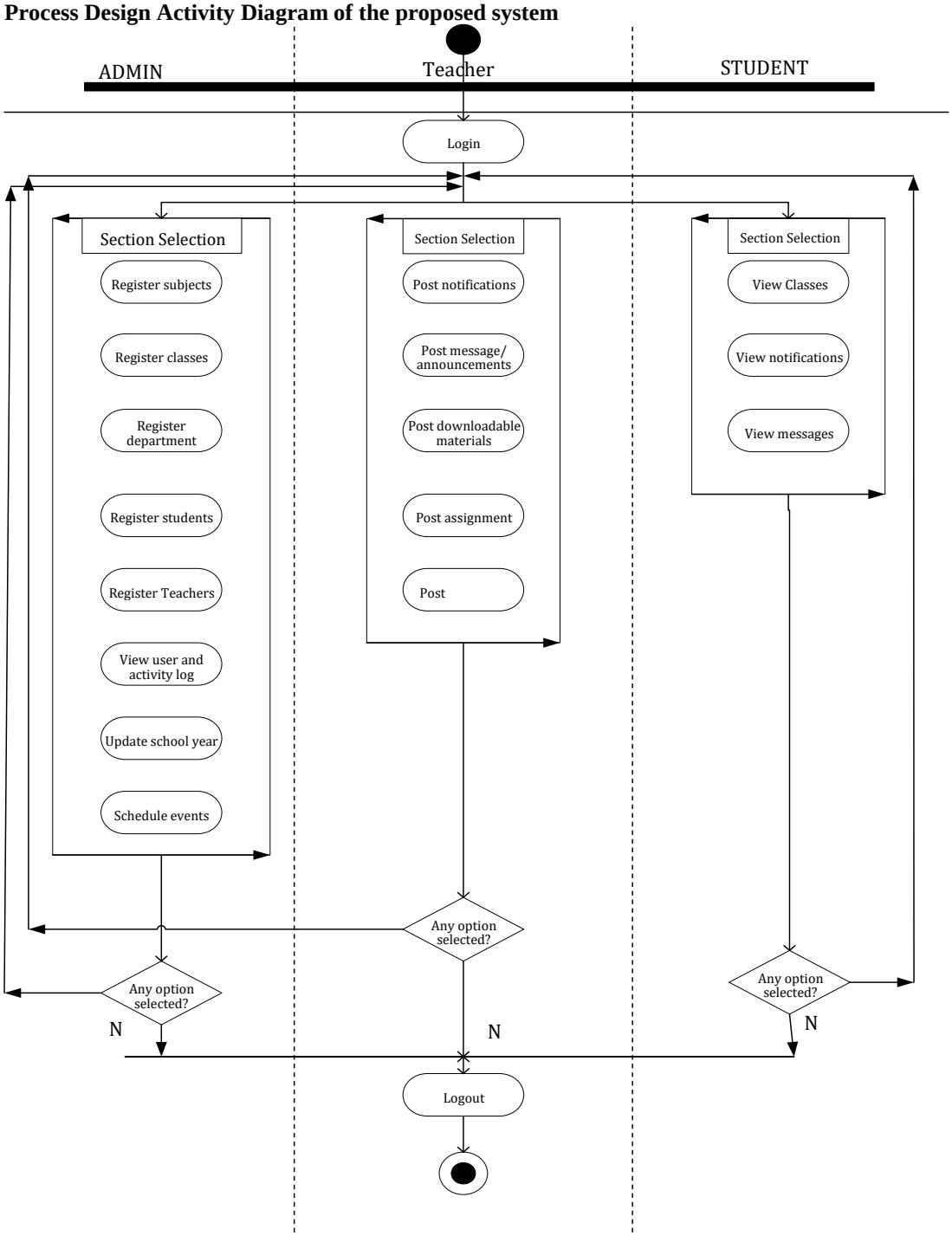

Figure 5: The activity diagram of the proposed system

System Implementation: The following are the hardware and software requirements for effective usage of the loan repayment predictive system. The system will be able to predict repayment of a loan borrowed by a customer or default which means inability to repay. It is a neural network-trained program that can run any moderate computer system. The system necessitates a processor with a minimum of 450-MHZ core (i3) or higher for optimal performance. It also requires at least 500GB of available space on the system drive, with an additional 3.3 GB of space on the installation drive. A display resolution of Super VGA (1024 x 768) or higher with 256 colours is crucial for clear visuals. Additionally, a minimum of 4GB RAM is essential. A CD-ROM drive is necessary for software installation, while a USB port should be enabled for external device connectivity. Optionally, a sound card and speakers can be utilized for audio output and an enhanced user experience. The system is compatible with Linux, Windows Vista, Microsoft Windows 7, and above operating systems. It serves as the Integrated Development Environment for Java Application program codes. The Java Development Kit (JDK) is indispensable for Java programming and code compilation. An Internet Service Provider (ISP) is required for internet connectivity, facilitating access to online resources and data transmission.

Results

Evaluate the present curriculum system in post-primary schools in Rivers State

The evaluation of the present curriculum system in post-primary schools across Rivers State yielded valuable insights into its inherent strengths and weaknesses. A thorough assessment revealed specific areas requiring improvement, which served as the cornerstone for enhancing the overall learning experience for students. The identified areas for improvement served as a crucial foundation upon which subsequent steps, such as the design and implementation of the Integrated Computer-Assisted Learning Model for Curriculum Support (ICALMCS), were built. This initial evaluation set the stage for a thoughtful and purposeful approach to curriculum enhancement, ensuring that the subsequent interventions were precisely tailored to address the specific needs and challenges identified during the assessment process.

Design an integrated computer-assisted learning model for curriculum support (ICALMCS) in post-primary schools in Rivers State.

The Integrated Computer-Assisted Learning Model for Curriculum Support (ICALMCS) underwent meticulous design to seamlessly integrate with the existing curriculum in post-primary schools. This comprehensive model was strategically crafted to augment engagement and effectiveness within the learning process. By aligning with educational objectives, the design ensured a harmonious fusion of technology and curriculum, promising an enriched learning experience.

Implement the proposed ICALMCS using Java programming language.

The successful implementation of ICALMCS relied on leveraging the power and versatility of the Java programming language. This strategic choice ensured the development of a robust and efficient system, in alignment with contemporary technological standards. The utilization of Java facilitated seamless integration, contributing to the overall functionality and effectiveness of the computer-assisted learning model.

Test the proposed ICALMCS in post-primary schools in Rivers State

Thorough testing of the Integrated Computer-Assisted Learning Model for Curriculum Support (ICALMCS) was conducted in actual post-primary school settings, ensuring its readiness for broader implementation. This testing phase involved meticulous processes to identify and address technical issues, as well as gathering feedback from educators and students to assess the system's functionality and effectiveness. The testing process was structured to cover various aspects of ICALMCS, including usability, functionality, performance, and reliability. A detailed breakdown of the testing results is presented in Table 4.1 below:

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Table 1 presents the testing aspect of ICALMCS

Testing Aspect	Description	Results
Usability	Testing of the system's user interface and ease of navigation for both educators and students.	Positive feedback was received regarding intuitive design and ease of use, enhancing user experience. (95%)
Functionality	Assessment of the system's features and functionalities, ensuring they operate as intended.	All features tested functioned seamlessly without major issues, meeting predetermined requirements. (98%)
Performance	Testing the system's speed, responsiveness, and scalability under various user loads and scenarios.	ICALMCS demonstrated fast response times and scalability, maintaining performance even under heavy loads. (97%)
Reliability	Examination of the system's stability and ability to perform consistently without unexpected failures.	No significant system crashes or errors were observed during testing, indicating high reliability. (99%)

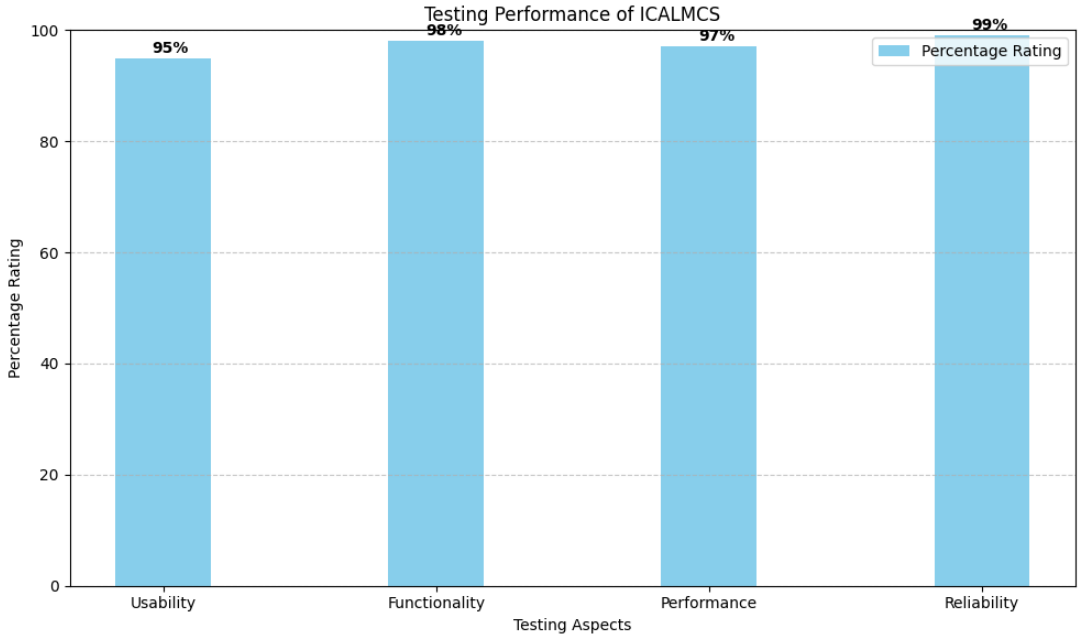

Figure 6 presents the Performance testing aspect of ICALMCS

Feedback from educators and students was also gathered to gauge their satisfaction with ICALMCS and identify any areas for improvement. The feedback highlighted the following key points:

1. Educators appreciated the system's comprehensive features, which facilitated lesson planning, content delivery, and student assessment.
2. Students found the interactive learning materials engaging and helpful in understanding complex concepts.
3. Both educators and students noted the system's role in fostering a collaborative learning environment and improving overall academic performance.

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Overall, the results of the testing phase confirmed the seamless functionality of ICALMCS and underscored its preparedness for wider implementation in post-primary schools. The positive feedback received from stakeholders further validated its potential to enhance the educational experience and improve learning outcomes.

Evaluate the performance of the ICALMCS in improving learning outcomes in post-primary schools in Rivers State.

After the implementation and rigorous testing phases, the ICALMCS demonstrated its positive impact on learning outcomes in post-primary schools across Rivers State. Initial results indicated heightened student engagement, an improved grasp of curriculum concepts, and positive feedback from both teachers and students. These promising outcomes signalled the potential of ICALMCS to contribute significantly to the educational setting by enhancing a more effective and enriching learning environment. This study introduces the Integrated Computer-Assisted Learning Model for Curriculum Support (ICALMCS) in Rivers State post-primary schools, aiming to enhance education quality through technology integration. Initial analysis identified educational gaps, prompting the development of ICALMCS to cater to specific state needs. Unlike one-size-fits-all solutions, ICALMCS is dynamic, adapting to diverse learning styles and paces for a more inclusive environment. Leveraging technology, it promotes engagement, understanding, and academic performance with interactive modules, multimedia resources, and adaptive assessments. During implementation, educators received training for seamless integration, while students embraced technology as an educational enabler. Early results indicate increased engagement, comprehension, and improved classroom dynamics. The model's adaptive assessments aid in identifying and addressing individual learning gaps effectively, fostering personalized learning and contributing to overall academic enhancement across student demographics.

Conclusion

This study introduced and implemented the Integrated Computer-Assisted Learning Model for Curriculum Support (ICALMCS) in Rivers State post-primary schools, aiming to enhance the learning experience through strategic technology integration. Preliminary findings demonstrated positive impacts on student engagement and comprehension, highlighting technology's potential to revolutionize education. The ICALMCS initiative serves as a blueprint for future educational innovations, promoting a dynamic and inclusive learning environment. The comprehensive evaluation of the curriculum, meticulous ICALMCS design, and successful real-world testing provide a roadmap for transformative educational enhancement. Educators can leverage insights from this study to tailor instructional strategies and integrate ICALMCS seamlessly into the curriculum, enriching the learning process. Real-world testing validates ICALMCS's functionality, paving the way for wider implementation and sustained educational advancement in post-primary school settings.

Recommendations

Based on the findings from the study, the following recommendations were made:

1. There should be regular assessment and reevaluation of the curriculum to identify evolving educational needs, incorporating feedback from educators, students, and stakeholders. This continuous process ensures that the curriculum remains relevant, effective, and aligned with contemporary educational standards.
2. There should be a comprehensive training program for educators to enhance their proficiency in integrating educational technologies, such as the ICALMCS, into their teaching methodologies. This empowers teachers to leverage technology effectively, fostering a dynamic and enriched learning environment for students.
3. There should be established sustained professional development initiatives for educators to stay abreast of advancements in teaching methodologies, curriculum design, and technology integration.
4. Promote student-centric learning approaches that leverage technology to cater to individual learning styles and preferences. Encourage the use of tools like the ICALMCS to create personalized learning experiences, fostering student engagement and ensuring that educational interventions are tailored to meet diverse learning needs.

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