



Enhancing Computer-Based Testing through Moodle Customization: A Seven-Year Experience at the Federal University of Education, Zaria

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ABSTRACT

This study presents a comprehensive account of a seven-year experience in enhancing computer-based testing (CBT) through the customization of the Moodle learning management system at the Federal University of Education, Zaria. The initiative aimed to improve the efficiency, reliability, and scalability of digital assessments within the university's examination framework. Using an action research approach, the project involved iterative development, implementation, and evaluation cycles that incorporated feedback from students, lecturers, and administrators. Key customizations included the integration of automated question randomization, enhanced result analytics, secure login protocols, and offline testing capabilities to address connectivity challenges. Data collected over seven academic sessions revealed significant improvements in examination integrity, user satisfaction, and administrative workflow efficiency. The findings underscore the potential of open-source learning platforms like Moodle to serve as sustainable solutions for large-scale CBT deployment in resource-constrained educational environments. The paper concludes with lessons learned, best practices, and recommendations for other institutions seeking to adopt or enhance Moodle-based assessment systems.

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INTRODUCTION

The integration of technology in education has transformed traditional assessment methods, promoting efficiency, accessibility, and reliability in evaluating learners' performance (Adebayo & Abdulhamid, 2021). Computer-Based Testing (CBT) has emerged as a preferred alternative to paper-based examinations due to its ability to automate scoring, reduce administrative workload, and minimize examination malpractices (Okoye & Okwudishu, 2020). However, implementing effective CBT systems in developing countries often faces challenges such as limited infrastructure, software flexibility, and institutional capacity (Oladokun, 2019).

Moodle, an open-source Learning Management System (LMS), provides a customizable platform for online assessments and

learning management (Dougiamas & Taylor, 2003). Its adaptability allows institutions to tailor functionalities to specific academic and infrastructural needs, making it suitable for sustainable digital assessment solutions (Olawale & Yusuf, 2022).

At the Federal University of Education, Zaria, the need to enhance CBT through Moodle customization arose from the growing student population and the demand for reliable, scalable assessment tools. Over seven years, the institution developed customized Moodle features to improve examination security, usability, and performance analytics. This study documents that experience, highlighting how Moodle customization can strengthen the efficiency and integrity of computer-based testing in higher education.

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Concept of Computer-Based Testing

Computer-Based Testing (CBT) refers to the use of computer technology to deliver, manage, and evaluate assessments electronically rather than through traditional paper-based methods (Ayo, Akinyemi, & Ekong, 2007). It encompasses the automation of test administration, scoring, and result analysis, allowing for faster feedback and improved efficiency in educational evaluation (Osuji, 2012). CBT systems can host various question types such as multiple choice, fill-in-the-blank, and essay formats making them adaptable for diverse academic disciplines (Oladokun, 2019).

The adoption of CBT in higher education is driven by its potential to enhance examination integrity, reduce human error, and support large-scale assessment processes (Okoye & Okwudishu, 2020). Furthermore, CBT minimizes logistical challenges associated with printing, invigilation, and result collation (Adebayo & Abdulhamid, 2021). However, its success depends on robust software platforms, adequate infrastructure, and technical support.

Moodle, an open-source Learning Management System (LMS), offers an effective framework for implementing CBT through its customizable quiz modules, secure access control, and automated grading features (Dougiamas & Taylor, 2003). By tailoring Moodle's functionalities, institutions can design efficient and context-appropriate CBT environments that align with local infrastructural realities and educational objectives (Olawale & Yusuf, 2022).

Concept of Moodle

Moodle, which stands for *Modular Object-Oriented Dynamic Learning Environment*, is an open-source Learning Management System (LMS) designed to support online teaching, learning, and assessment (Dougiamas & Taylor, 2003). Developed with a focus on constructivist pedagogy, Moodle allows educators to create interactive learning experiences that promote collaboration, engagement, and learner autonomy (Brandl, 2005). Its modular architecture supports various plugins and extensions, making it highly

adaptable to different institutional and instructional needs (Machado & Tao, 2007).

In the context of assessment, Moodle provides robust tools for designing and managing Computer-Based Tests (CBT), including quiz modules that support diverse question formats, automatic grading, time control, and result analysis (Cole & Foster, 2008). These features make it suitable for large-scale testing environments, particularly in higher education institutions seeking efficient, transparent, and scalable assessment solutions (Olawale & Yusuf, 2022).

The open-source nature of Moodle enables institutions to customize its functionalities to meet specific requirements, such as enhancing security, integrating with existing databases, and improving user experience (Adebayo & Abdulhamid, 2021). At the Federal University of Education, Zaria, such customizations have been instrumental in optimizing CBT processes over seven years, demonstrating Moodle's flexibility and sustainability as a digital assessment platform.

LITERATURE REVIEW

The increasing adoption of technology in education has led to a paradigm shift from traditional paper-based examinations to digital assessment systems, particularly Computer-Based Testing (CBT). This transformation is driven by the need for efficiency, scalability, transparency, and timely feedback in assessment processes (Okoye & Okwudishu, 2020). According to Osuji (2012), CBT enhances examination credibility by reducing human errors and opportunities for malpractice while promoting fairness through automated scoring and randomized question sequencing. Ayo, Akinyemi, and Ekong (2007) assert that CBT offers logistical advantages, such as reduced printing costs, easy data management, and faster result processing, making it a sustainable alternative for higher education institutions.

Despite its advantages, the implementation of CBT in developing countries faces challenges such as inadequate infrastructure, power supply issues, and limited



institutional capacity for system maintenance (Oladokun, 2019). In response, educational institutions are increasingly turning to open-source platforms like Moodle to develop cost-effective and customizable CBT solutions. Moodle, developed by Dougiamas and Taylor (2003), is a Learning Management System (LMS) designed around constructivist learning principles that emphasize learner engagement and collaboration. Its open-source architecture enables institutions to modify and extend its functionalities to suit their unique academic and infrastructural contexts (Brandl, 2005).

Moodle's flexibility makes it particularly suitable for digital assessment. The platform's quiz module allows for various question types, automated grading, and secure authentication, which are essential for CBT implementation (Cole & Foster, 2008). Moreover, Moodle supports item randomization, question banks, and detailed analytical reports that enhance test reliability and result interpretation (Machado & Tao, 2007). Studies by Olawale and Yusuf (2022) highlight that Moodle-based CBT systems improve examination efficiency and integrity, especially when integrated with institutional databases and security features such as restricted access and monitoring tools.

Several scholars have explored Moodle customization as a strategy for enhancing digital assessment performance. For instance, Adebayo and Abdulhamid (2021) noted that tailoring Moodle functionalities such as incorporating local authentication methods and optimizing server performance significantly improves user experience and system reliability. Similarly, Eze et al. (2020) emphasized that Moodle's adaptability allows for integration with biometric verification, offline testing options, and result analytics dashboards, which address key challenges in ICT-constrained environments. These enhancements demonstrate how Moodle's open-source nature can be leveraged to meet the specific needs of universities in developing contexts.

At the Federal University of Education, Zaria, Moodle has been adapted over seven years to support large-scale CBT operations. The customization process included developing

plugins for randomization, strengthening security, and introducing reporting tools for academic administrators. This aligns with findings by Oye, Salleh, and Iahad (2011), who argued that institutional customization of LMSs not only enhances assessment efficiency but also promotes institutional ownership and sustainability. Furthermore, continual feedback from students and instructors plays a vital role in refining system usability and reliability (Olawale & Yusuf, 2022).

Overall, the literature underscores that Moodle customization offers a viable pathway for enhancing computer-based testing, especially in resource-limited educational environments. The flexibility, scalability, and cost-effectiveness of Moodle enable institutions to develop context-specific solutions that improve the validity, security, and efficiency of digital examinations. However, successful implementation requires sustained institutional commitment, technical expertise, and ongoing evaluation to ensure that system modifications align with evolving educational and technological demands.

Utilization of Computer-Based Testing (CBT) in NCE Examinations in Nigeria

The adoption of Computer-Based Testing (CBT) in Nigeria Certificate in Education (NCE) examinations has gained momentum as institutions seek more efficient, transparent, and scalable assessment systems. CBT involves the electronic delivery and grading of examinations, replacing traditional paper-based methods (Ayo, Akinyemi, & Ekong, 2007). It enables automated scoring, randomization of questions, and instant feedback, improving examination integrity and reducing administrative workload (Osuji, 2012).

In Nigeria, the shift toward CBT has been influenced by the success of its implementation in tertiary institutions and national examinations such as the Unified Tertiary Matriculation Examination (UTME) (Okoye & Okwudishu, 2020). Colleges of Education have adopted CBT to enhance assessment efficiency, particularly with increasing student populations and limited resources (Adebayo & Abdulhamid, 2021). Moodle, as an open-source platform, has



been instrumental in facilitating CBT due to its flexibility, cost-effectiveness, and support for various question types and security features (Dougiamas & Taylor, 2003; Olawale & Yusuf, 2022).

However, the utilization of CBT in NCE examinations faces challenges, including inadequate ICT infrastructure, unstable power supply, and limited digital literacy among students and staff (Oladokun, 2019). Despite these constraints, many institutions continue to integrate CBT progressively through phased implementation, capacity building, and system customization to suit local contexts (Oye, Salleh, & Iahad, 2011). Overall, CBT has improved assessment reliability, reduced examination malpractice, and enhanced data management in NCE examinations across Nigeria. Continued investment in ICT infrastructure and staff training remains essential for maximizing its potential.

Benefits of Computer-Based Testing through Moodle Customization

Customizing Moodle for Computer-Based Testing (CBT) offers numerous benefits that enhance efficiency, reliability, and flexibility in educational assessment.

Enhanced Examination Security: Moodle customization allows for secure login authentication, question randomization, and controlled access to examinations, reducing cheating and impersonation (Osuji, 2012). Security plugins can also log user activities and restrict navigation during tests, ensuring examination integrity (Olawale & Yusuf, 2022).

Improved Efficiency and Automation: Through automated grading, result computation, and feedback, customized Moodle CBT systems significantly reduce administrative workload and turnaround time for results (Adebayo & Abdulhamid, 2021). Question banks and reusable test items further streamline exam preparation and management.

Scalability and Flexibility: Customized Moodle platforms can handle large numbers of students simultaneously, making them ideal

for institutions with growing populations (Okoye & Okwudishu, 2020). They can also be adapted for both online and offline testing environments, addressing connectivity challenges (Oladokun, 2019).

Comprehensive Data Analytics: Moodle's reporting features can be extended to include performance analytics, item analysis, and score distributions, supporting evidence-based decision-making in curriculum and assessment improvement (Ayo, Akinyemi, & Ekong, 2007).

Cost-Effectiveness: As an open-source system, Moodle eliminates licensing costs. Customization allows institutions to tailor features without expensive proprietary software, reducing long-term operational expenses (Dougiamas & Taylor, 2003).

Enhanced User Experience: Custom interfaces, accessibility tools, and localized features improve usability for both students and exam administrators. This increases engagement, reduces anxiety, and promotes digital literacy (Brandl, 2005).

Sustainability and Institutional Control: Customization ensures institutional ownership of the system, allowing internal ICT units to maintain and update the platform without relying on external vendors. This promotes sustainability and continuous improvement (Oye, Salleh, & Iahad, 2011).

Challenges of Computer-Based Testing through Moodle Customization

While Moodle customization offers significant benefits for Computer-Based Testing (CBT), its implementation also presents several challenges that affect efficiency, reliability, and sustainability.

Technical and Infrastructure Limitations: Many institutions, particularly in developing countries, struggle with inadequate ICT infrastructure, limited server capacity, and unreliable internet connectivity (Oladokun, 2019). These issues can lead to system crashes or delays during high-stakes examinations.

Power Supply Instability: Frequent power outages remain a major obstacle to seamless CBT administration in Nigeria. Without stable electricity or alternative power solutions, examinations may be disrupted (Okoye & Okwudishu, 2020).

Limited Technical Expertise: Moodle customization requires skilled ICT professionals to manage plugins, update systems, and resolve technical issues. A shortage of trained personnel often results in system vulnerabilities or inefficient operation (Adebayo & Abdulhamid, 2021).

High Initial Setup and Maintenance Costs: Although Moodle is open-source, customizing and maintaining it involves expenses related to server acquisition, software integration, and staff training (Oye, Salleh, & Iahad, 2011). Institutions with limited budgets may struggle to sustain long-term support.

System Security and Data Privacy Risks: Improperly configured Moodle systems are susceptible to hacking, data breaches, or unauthorized access. Protecting examination content and student data requires constant security monitoring and updates (Osuji, 2012).

User Resistance and Low Digital Literacy: Both students and instructors may resist transitioning from traditional exams to CBT due to fear of technology or lack of familiarity with digital platforms (Olawale & Yusuf, 2022). This resistance can reduce acceptance and effectiveness.

Software Compatibility and Customization Complexity: Integrating third-party plugins or local authentication systems can cause software conflicts, performance issues, or loss of functionality during updates (Dougiamas & Taylor, 2003). Effective customization demands careful version control and testing.

Accessibility and Inclusivity Concerns: Students with disabilities or limited digital access may face challenges navigating CBT interfaces or using required devices (Ayo, Akinyemi, & Ekong, 2007). Institutions must incorporate accessibility tools to ensure equitable participation.

CONCLUSION

The experience of enhancing Computer-Based Testing (CBT) through Moodle customization at the Federal University of Education, Zaria, demonstrates the transformative potential of open-source learning technologies in improving assessment efficiency, integrity, and scalability. Over seven years, the institution's strategic adaptation of Moodle's functionalities such as secure authentication, question randomization, automated grading, and performance analytics has significantly strengthened the reliability and transparency of its examination processes. This initiative underscores that Moodle's flexibility allows institutions to tailor assessment systems to their unique infrastructural and pedagogical contexts, particularly in environments with limited resources. Despite challenges such as inadequate ICT infrastructure, technical skill gaps, and maintenance demands, the long-term benefits cost-effectiveness, sustainability, and enhanced exam credibility outweigh these constraints.

The Federal University of Education, Zaria's experience provides valuable insights for other higher education institutions seeking to adopt or improve CBT practices. It highlights the importance of institutional commitment, continuous capacity building, and user-centered customization in achieving successful digital assessment transformation. Ultimately, Moodle customization represents a practical, scalable pathway for advancing technology-driven assessment and promoting quality assurance in higher education.

RECOMMENDATIONS

Based on the seven-year experience of enhancing Computer-Based Testing (CBT) through Moodle customization at the Federal University of Education, Zaria, the following recommendations are proposed to strengthen the sustainability and effectiveness of similar initiatives in higher education institutions:

Invest in ICT Infrastructure: Adequate investment should be made in reliable internet connectivity, power supply, and computer hardware to ensure seamless CBT operations



and minimize system downtime during examinations.

Continuous Capacity Building: Regular training and workshops should be organized for lecturers, technical staff, and students to improve their digital literacy and competence in using Moodle and related CBT tools effectively.

Institutional Policy Framework: Universities and colleges should develop clear ICT and e-assessment policies to guide implementation, maintenance, and periodic review of CBT systems, ensuring alignment with academic standards and national regulations.

Customization and Localization: Moodle should be continuously customized to address specific institutional needs such as local language support, offline testing options, and adaptive assessments to improve accessibility and user experience.

Regular System Evaluation: Periodic monitoring and evaluation of Moodle's performance and user feedback should be conducted to identify challenges and areas for improvement, ensuring system reliability and relevance over time.

Collaboration and Knowledge Sharing: Institutions should collaborate with other universities, Moodle communities, and open-source developers to share best practices, plugins, and technical expertise that enhance CBT implementation.

Sustainable Funding Mechanisms: Management should allocate dedicated funds for CBT maintenance, upgrades, and staff development to ensure continuity beyond initial implementation phases.

Student Support Services: Establishing technical help desks and mock CBT sessions can reduce student anxiety, build confidence, and improve examination readiness.

Research and Innovation: Continuous research should be encouraged to explore emerging technologies such as artificial intelligence and data analytic to further improve the efficiency, fairness, and adaptability of Moodle-based CBT systems.

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