

Innovation Article

eNur: development of a digital laboratory management system with equipment loan features for nursing students

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Background: The laboratory is essential in nursing education, where students develop practical skills using laboratory equipment. However, manual laboratory management often leads to issues such as inefficiencies in equipment borrowing, returns, and practicum scheduling, affecting the learning process's smoothness.

Purpose: This study aims to develop and test a digital laboratory management system with equipment lending features.

Methods: This study uses Research and Development, which consists of four stages: Analysis Phase, application testing, Expert Validity, and Application Testing.

Results: An eNur application, a web-based application using a computer with features for borrowing laboratory equipment and scheduling lab skills, has been created. Students can borrow lab equipment independently via smartphone. The results of the trial conducted on students found that this application system is more effective than manual.

Conclusion: This application can improve the effectiveness and efficiency of laboratory management, especially in terms of borrowing, returning equipment and scheduling lab skill practicums. This application is user-friendly with an intuitive display and can be accessed anytime via computer or smartphone.

INTRODUCTION

The laboratory is one of the most critical facilities in nursing education, where students can apply the theories they have learned to real-world practice.¹ Therefore, good laboratory management is crucial to support practical learning activities.^{2,3} However, many laboratories still manage various processes such as administration, equipment borrowing, and scheduling manually, which risks causing errors in records, disorganized data, and difficulties in accessing information quickly. Laboratory management information systems can be an effective solution to overcome these issues.^{4,5}

Previous research shows that integrating laboratory information systems can improve administrative efficiency and students' learning experiences. In line with other studies, it was also found that a well-implemented laboratory information system positively impacts students' academic achievement. Meanwhile, other studies have revealed that laboratory information systems play an essential role in improving coordination and data management in the laboratory, which impacts the quality of learning.^{6–8}

Although several studies have shown the benefits of implementing information systems in laboratories, there is still a gap in research on optimizing managerial features such as equipment borrowing and scheduling for greater efficiency.³ Previous studies noted that while laboratory information systems can improve data management, some features related to ease of access and user comfort for students are still limited.⁹ Furthermore, their study stated that while the gradual implementation of systems can improve management, there is not enough focus on

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enhancing students' understanding of laboratory equipment.²⁰⁻²³

In addition, such a system could streamline communication students and laboratory between staff, reduce administrative burdens, and allow for a more organized and efficient use of laboratory resources. Integrating features like equipment loan and scheduling could help eliminate overlaps and optimize the use of available equipment, reducing wait times and improving the laboratory experience. As educational institutions continue to embrace digital transformation, such systems will likely become a standard in ensuring better management practices and improved learning outcomes.¹⁰ To address these gaps; this study aims to develop a comprehensive laboratory management system that focuses on enhancing both administrative processes and the students' understanding of laboratory tools and equipment.

METHOD

The method used in this study is the ADDIE model approach to the analysis, development, expert validity, and application testing.^{11–13}

Stage 1 Analysis Phase

This phase identifies the needs and issues in the laboratory, including analyzing the manual management of equipment borrowing and scheduling. A preliminary study was conducted through interviews and observations to determine the requirements for developing an information system.

Stage 2 Application Development

This stage includes designing a digital information system that includes features such as inventory management, equipment lending, equipment feasibility, and scheduling of practice sessions. The design is arranged into a specific and measurable framework (storyboard). The information system is developed based on the completed design and then tested by experts before implementation.

Stage 3 Expert Validity

The expert validation test in this study used the Aiken V Index. The data collection technique was carried out by distributing questionnaires with twenty-one questions and then revising the use, if any, with expert advice. The application system was tested for its effectiveness in tangibles, empathy or ease of use, responsiveness, reliability, and accuracy before the application was used by students.

Stage 4 Application Testing

The study was conducted in the Faculty of Health Sciences laboratory, Muhammadiyah University of Purwokerto. The population used in this study were students of the Nursing Study Program. The sample used was 63 students, with the criteria of 5th-semester students who have and can operate smartphones and are willing to be respondents. Application testing was carried out by using a questionnaire to measure the level of tangibles, ease of use, responsiveness, reliability, and accuracy.

Ethical Considerations

Ethical approval for the research was obtained from the Faculty of Health Sciences Ethics Committee of Muhammadiyah University of Purwokerto on October 22, 2024, with approval number No.KEPK/UMP/46/X/2024.

RESULTS

Result of Analysis Phase

Based on the needs analysis results obtained through interviews, the main problems in the management laboratory were identified, namely the manual process of borrowing tools and scheduling practicums, which caused difficulties in recording, slow data access, and unclear understanding of tools for students.

Result of Application Development

The digital laboratory management system application, eNur, has been successfully developed. This system is designed with key features such as equipment lending, inventory management, and scheduling of practical sessions. The main menu will appear when the user accesses the website (Figure 1). The user must register and log in using the username and password created (Figure 2). After logging in, students will get information about the laboratory equipment loan menu (Figure 3). and users will get information related to the laboratory usage schedule menu (Figure 4), and users can access the equipment features in the laboratory, and admins can access the goods inventory feature (Figure 5). This application can be visited at https://enur.ump.ac.id.

Result of Trial

The trial results show that this application is more effective than the manual system. The trial includes the tool borrowing and returning system, scheduling practical skills, and system effectiveness. The test results show that the use of this application is more effective in terms of usability, speed, suitability, ease, accuracy, and trust. The data in the application is also more complete than the data in the manual. In addition, this application has proven to be faster in facilitating the borrowing of laboratory equipment and scheduling laboratory use than the manual system. This system can be accessed via smartphone or computer.

DISCUSSION

This study successfully developed a digital laboratory management information system, eNur, designed to enhance administrative efficiency and facilitate students borrowing equipment and scheduling practical sessions. The trial conducted with 63 students showed that this application is useful, with most respondents rating it as excellent in ease of use and time efficiency. Expert validation using the Aiken index also indicated very high results, signifying that the system is relevant and valid for use. The findings align with previous studies that

demonstrate the effectiveness of laboratory information systems in improving efficiency and the quality of learning.¹⁰ Integrating laboratory information systems could improve administration and student learning experiences. Additionally, previous studies highlighted that laboratory information systems are essential for enhancing data coordination and learning management. $^{10,14-16}$



This research strengthens the literature by incorporating equipment borrowing and scheduling features tailored specifically to the needs of nursing laboratories.¹⁷ eNur is also highly relevant to local needs in nursing education in Indonesia. The system addresses the demand for digitalized laboratory services, emphasizing that digital management is crucial to improving efficiency and effectiveness in learning.18,19 This study significantly contributes to advancing the management of nursing education laboratories, particularly by providing easy and fast digital access for students; the system's tangible contributions are evident from the positive user responses.8 Students reported that eNur helped them organize practical schedules more transparently, while students found it easier to understand and use laboratory equipment. These findings support the study, which stated that information systems positively impact students' academic performance.20-25

eNur key strengths include web-based accessibility, integrated equipment borrowing, inventory management, and automated practical scheduling. These features are designed to improve time efficiency and accessibility, which users highly appreciate. However, the study has some limitations, such as the relatively small sample size, limiting the generalizability of the findings. Moreover, the research only assessed the system's short-term effectiveness without providing data on its long-term impact on laboratory management. External factors, such as network stability, were also not thoroughly analyzed.

CONCLUSIONS AND RECOMMENDATION

This study successfully developed and validated eNur, a digital laboratory management system that enhances administrative efficiency and streamlines equipment borrowing and scheduling. The system is proven relevant, feasible, and innovative for nursing education laboratories. Future research should involve larger samples and longer-term evaluations to assess its impact further. Adding features like data analysis and automatic reporting and exploring broader adoption in healthcare education institutions can enhance its benefits.

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