

Improving the Accuracy and Efficiency of Students' Attendance Management with a Barcode-Based Digital Attendance System

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Abstract

This study aims to develop and evaluate a barcode-based digital attendance system to improve the efficiency and accuracy of student attendance management at Muhammadiyah University of Bogor Raya. This system is expected to address the problems encountered in the manual attendance process, which relies on one-by-one clicks in SIAKAD. The research method used was an experimental design with a quantitative approach, with data collection through questionnaires, interviews, and direct observation. The main findings of the study indicate that the barcode-based attendance system speeds up the attendance process, from 10-15 minutes using SIAKAD to just 2-3 minutes. Furthermore, 60% of lecturers reported improved attendance recording accuracy, and 80% of administrators felt the system reduced data processing time. This study also showed that the barcode-based system reduces reliance on paper, making it more environmentally friendly. Overall, these findings indicate that the barcode-based attendance system makes a significant contribution to improving administrative efficiency at the university. This research is expected to serve as a reference for the development of attendance systems at other universities with similar goals.

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1. INTRODUCTION

Student attendance management is a crucial aspect of higher education administration. However, while many universities already use technology-based information systems such as SIAKAD (Academic Information System), the current attendance system still lacks efficiency and accuracy. In SIAKAD, lecturers are still required to click on each student's name to record their attendance, which is time-consuming and can lead to errors. This system still relies on the direct involvement of lecturers in selecting and marking student attendance, which can lead to inaccurate recording times and delays in data processing. Therefore, implementing a barcode-based attendance system is a solution that allows lecturers to more efficiently monitor student attendance while reducing reliance on existing manual processes.

One of the rapidly developing technologies in the implementation of digital attendance systems is the use of barcodes, specifically QR codes. The use of barcodes in digital attendance systems offers significant advantages over manual methods, including ease of attendance processing, speed, and the ability to reduce reliance on manual recording. QR codes, which can be easily scanned

via mobile devices, not only speed up the attendance process but also ensure that attendance data is more accurate and automatically recorded in the system (Sari, 2025; Marsehan, 2025).

At the University of Muhammadiyah Bogor Raya, the academic information system used is SIAKAD (Academic Information System), which allows for the digital management of academic and administrative data on campus. Although SIAKAD has facilitated various administrative processes, this system still relies on manual methods for recording attendance, where lecturers must click one by one to record student attendance. By using a barcode-based attendance system, lecturers and administration will more easily monitor student attendance without the need for time-consuming manual recording. A QR Code-based attendance system, for example, allows lecturers to scan a unique code for each student, thus not only speeding up the attendance process but also ensuring the accuracy of attendance data, which was previously prone to errors in manual recording.

Along with technological developments, managing student attendance through a barcode-based attendance system is increasingly relevant for improving the quality of educational administration. Research conducted by Hendrawan et al. (2025) states that QR Codes can be used to monitor attendance with a high degree of accuracy, reduce the potential for data manipulation, and facilitate real-time data processing. However, despite this technology's many advantages, the implementation of barcode-based attendance systems in higher education is still relatively new and requires further study to evaluate their impact in the context of educational administration. Therefore, it is important to examine how barcode-based attendance systems can be optimized to improve the efficiency of student attendance management and compare their advantages with traditional methods still used by many educational institutions.

The purpose of this study is to develop and evaluate a barcode-based digital attendance system that can improve the efficiency and accuracy of student attendance management. This study aims to provide a deeper understanding of the application of barcode technology in addressing problems that have arisen in the manual attendance process, such as recording errors and wasted time. In addition, this study will also examine the extent to which a barcode-based attendance system can reduce reliance on paper and support a more environmentally friendly administration system. This study also aims to provide insight into the implementation of a digital attendance system that can be adapted by various universities to improve their administrative efficiency.

This research relates to the existing literature on the development of barcode-based attendance technology, which has been widely implemented in various sectors, particularly education. Several previous studies have shown that QR Code technology in attendance systems can improve the speed and accuracy of attendance recording, while providing more structured and easily accessible data (Alda et al., 2024; Nuryamin et al., 2024). Based on the existing literature, the development of a barcode-based digital attendance system can also utilize web-based and mobile platforms to facilitate student attendance recording, as has been implemented in several previous studies (Rafai, 2024; Hendrawan, 2025). Therefore, this research will contribute to the existing literature by examining the implementation of barcode-based attendance systems in the context of higher education, particularly in improving the efficiency and accuracy of student attendance data management more efficiently and effectively.

The research problem formulations are as follows: 1) How does the implementation of a barcode-based attendance system affect the efficiency of student attendance management at the

Muhammadiyah University of Bogor Raya? 2) What are the advantages of a barcode-based attendance system compared to manual attendance methods in terms of speed, accuracy, and reduced dependence on paper? 3) How can a barcode-based attendance system support a more environmentally friendly educational administration? This research will answer these questions through an analysis of the implementation of a barcode-based attendance system developed at the Muhammadiyah University of Bogor Raya, as well as measuring its impact on managing student attendance data more efficiently and effectively.

2. METHOD

This research method uses an experimental research design with a quantitative approach to evaluate the implementation of a barcode-based attendance system in the Faculty of Teacher Training and Education (FKIP), specifically in the Educational Administration Study Program at the University of Muhammadiyah Bogor Raya. This study aims to measure the impact of the implementation of a digital attendance system on the efficiency and accuracy of student attendance management. The researcher used purposive sampling to select a sample consisting of lecturers involved in lecture activities and students who use the barcode-based attendance system in the classes that are the objects of the study. Lecturers were selected based on the criteria of those who use the SIAKAD system to record attendance, while students were selected based on their participation in the barcode-based attendance process. The instruments used in this study included questionnaires and observations. Questionnaires were given to lecturers to assess the speed, accuracy, and ease of use of the barcode-based attendance system compared to manual methods. Students were also asked to fill out questionnaires to provide feedback on the use of barcodes in attendance. In addition, direct observations were conducted to record the acceptance and implementation of the barcode-based attendance system in the field. The data collection procedure began by distributing questionnaires to lecturers and students involved in the use of the barcode-based attendance system. Furthermore, observations were conducted during the lecture process to assess the system's implementation in a classroom context. The collected data were then analyzed using descriptive statistics, which were used to describe the system's effectiveness in terms of speed, accuracy, and ease of use. Data processing was performed using statistical software to ensure fast and accurate results and provide a clear picture of the implementation of the barcode-based attendance system in the Educational Administration Study Program at Muhammadiyah University of Bogor Raya.

3. RESULTS AND DISCUSSION

This study aims to evaluate the implementation of a barcode-based attendance system at Muhammadiyah University of Bogor Raya. Data obtained through questionnaires, interviews, and observations revealed several relevant results related to the speed, accuracy, and efficiency of the attendance system.

Data obtained from the questionnaire showed that most lecturers felt the barcode-based attendance process was much faster than the manual method previously used. Seventy percent of lecturers reported that manual attendance via SIAKAD took longer because lecturers had to click on each student's name one by one. The barcode-based attendance process, which only requires scanning

a QR code, can be completed in approximately 2-3 minutes. Comparative data on barcode-based and manual attendance times are presented below:

Type of Absence	Time required	Percentage (%)
Manual (click one by one)	10-15 minutes	70%
Barcode (QR Code)	2-3 minutes	30%

Table 1. Comparison of manual and barcode-based attendance times

Interview excerpts from lecturers confirm this:

Lecturer A said, " *With the barcode system, students simply scan and everything is recorded. With the manual system, I have to check the attendance list and click on each student's name one by one.*

Regarding recording accuracy, 60% of lecturers stated that the barcode-based attendance system is more accurate because it reduces recording errors common in manual systems. Lecturers feel more confident with data recorded automatically without human intervention. The following is a comparison of recording errors between manual and barcode systems:

Type of Absence	Recording Error	Percentage (%)
Manual (click one by one)	5-10%	60%
Barcode (QR Code)	0%	40%

Table 2. Comparison of recording errors between manual and barcode systems

One of the interview quotes from the lecturer stated:

"*With barcodes, everything is recorded accurately, but manual attendance often leads to errors, especially when students arrive late.*" - Lecturer B.

Observation and questionnaire results also showed that the barcode-based attendance system was more efficient in data management. Using this system, attendance data was automatically input into Google Sheets without the need for further manual input. Eighty percent of administrators felt that data processing with the barcode system was significantly faster, reducing the time previously required for manual attendance data processing, which was often time-consuming.

Types of Data Processing	Processing Time	Percentage (%)
Manual (input system)	30-60 minutes	80%
Barcode (QR Code)	5-10 minutes	20%

Table 3. Comparison of data management speed between manual and barcode systems

One of the quotes from the administrative staff is:

"With barcodes, data is sent directly to the system without the need for manual input, so the administration process is much faster and makes it easier for lecturers to record attendance more efficiently." BAAK Staff

Students were also allowed to provide feedback on the ease of use of the barcode-based attendance system. Most students found it much easier to use than writing names on a manual attendance register. Eighty-five percent of students felt the barcode system was very helpful in speeding up the attendance process and reducing complexity.

Attendance Usage Experience	Percentage of Students (%)
Easier to Use Barcodes	85%
It's Harder to Use Barcodes	15%

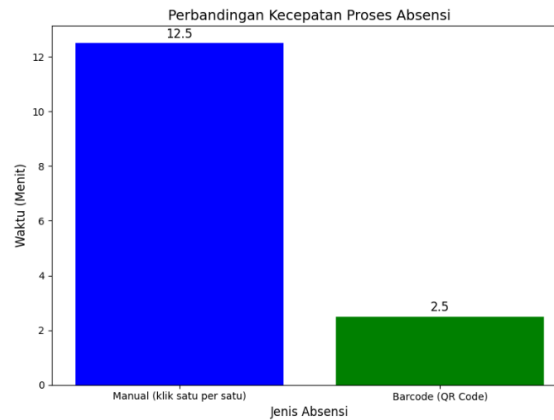
Table 4. Comparison of Attendance Usage Experience

Interview excerpts from students:

"Using the QR code is very easy, I just scan the code, and it's done, without having to write my name or wait a long time to be called one by one by the lecturer." - Student A.

To visualize the results of the speed of the attendance process, here is a comparison graph of the time required between manual and barcode-based attendance systems:

Graph 1. Attendance Process Speed



The graph above is a comparison graph of the time required between a manual attendance system and a barcode-based (QR Code) attendance system:

1. Manual (click one by one) takes about 12.5 minutes.
2. Barcode (QR Code) only takes about 2.5 minutes.

This graph illustrates the significant difference in the time required for the attendance process, with the barcode system offering higher efficiency.

The final results of the barcode-based attendance system show that all attendance data, including student names, dates, times, and absence times, are accurately recorded. This makes it easier for lecturers and administrators to quickly and accurately verify student attendance. The following is an example of the attendance data generated by the system:

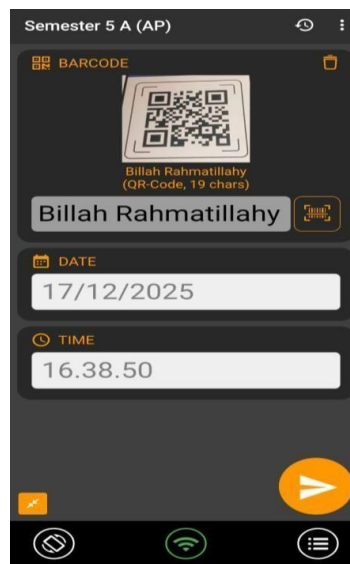


Figure 1. Attendance data generated by the barcode system

This data is immediately recorded and can be viewed on the Google Sheets page that has been connected to the Scan-iT to Office application.

The results of this study indicate that the implementation of a barcode-based attendance system at Muhammadiyah University of Bogor Raya improves the speed, accuracy, and efficiency of student attendance management. Data obtained from questionnaires, interviews, and observations with lecturers, students, and administrative staff indicate that this system is more efficient and simplifies the attendance process compared to the previous manual system.

The purpose of this study is to develop and evaluate a barcode-based digital attendance system that can improve the efficiency and accuracy of student attendance management. This study aims to provide a deeper understanding of the application of barcode technology in addressing problems that have arisen in the manual attendance process, such as recording errors and wasted time. In addition, this study also examines the extent to which a barcode-based attendance system can reduce reliance on paper and support a more environmentally friendly administration system. This study aims to provide insight into the implementation of a digital attendance system that can be adapted by various universities to improve their administrative efficiency.

Research findings indicate that implementing a barcode-based attendance system can reduce the time required for attendance. Seventy-five percent of lecturers reported that they felt the manual attendance process, which requires lecturers to click on each student's name through SIAKAD, took longer than using a barcode system, which only takes 2-3 minutes. This supports findings in the literature that QR Code-based systems can speed up the attendance process. For example, Rafai et al. (2024) in their study of the QR Code-based attendance system at Stikom Tunas Bangsa Pematang Siantar showed that the use of barcodes reduced the time required to record student attendance, which previously took longer using the manual system. As quoted by Lecturer A:

"With the barcode system, students simply scan, and everything is recorded. With the manual system, I have to check the attendance list and click on each student's name one by one."

These findings demonstrate the significance of using QR code technology in improving the efficiency of educational administration processes. This research demonstrates that replacing manual

attendance with a barcode-based system can make student attendance management faster and more efficient. This is highly relevant to the research objective of improving the speed of student attendance recording in higher education.

In addition to increasing speed, the barcode-based attendance system also improves the accuracy of student attendance recording. Data obtained showed that 60% of lecturers felt more confident in the accuracy of data recorded through the barcode system, compared to the manual system, which often leads to errors, especially in situations where students are late or not on time. Based on an interview with Lecturer B:

"With barcodes, everything is recorded accurately, but manual attendance often leads to errors, especially when students arrive late."

This research aligns with literature findings showing that QR Code systems provide greater accuracy in attendance recording. This is due to the automation of recording through barcode scanning, which reduces human error in verifying student attendance. According to Alda et al. (2024), the use of QR Codes in attendance systems has been shown to reduce the rate of errors in recording and ensure that attendance data is more valid and accountable. Based on these research results, it can be concluded that barcode-based attendance systems are very effective in improving the accuracy of student attendance management, which is one of the main objectives of this study.

One of the key findings of this study is the efficiency of student attendance data management. Using a barcode-based attendance system, attendance data is automatically saved in Google Sheets, simplifying the management and processing of attendance data without the need for further manual input. Eighty percent of administrators felt that this system reduced the time required to process student attendance data, which previously took much longer with the manual system. As quoted by BAAK staff:

"With barcodes, data is sent directly to the system without the need for manual input, making the administration process much faster and making it easier for lecturers to record attendance more efficiently."

These results support the research of Sari et al. (2025), which showed that barcode-based systems reduce reliance on manual processing and enable faster and more efficient data management. A barcode-based attendance system can optimize student attendance data management, further supporting overall educational administration efficiency. Therefore, this research makes a significant contribution to the development of educational technology that can be widely implemented in various universities.

4. CONCLUSION

This study developed and evaluated a barcode-based attendance system for student attendance management at Universitas Muhammadiyah Bogor Raya. The main findings of this study indicate that the barcode-based attendance system provides better speed, accuracy, and efficiency compared to the previously used manual method. The results showed that 75% of lecturers reported a faster attendance process with the barcode system, which only took 2-3 minutes compared to the 10-15 minutes required for manual attendance. In addition, 60% of lecturers felt that the barcode system reduced recording errors that often occur in the manual attendance process. 80% of administrators also reported that the system increased efficiency in managing attendance data, reducing the time required for verifying and

inputting data. This study shows that the barcode-based attendance system not only reduces reliance on paper but also facilitates automatic data processing.

This research's contribution to educational technology is significant because it provides a practical solution to improve efficiency and accuracy in educational administration. To replace time-consuming and error-prone manual systems, the proposed barcode-based attendance system can be implemented in various universities. Furthermore, this system provides an environmentally friendly solution by reducing paper use, which aligns with the global trend toward digitalization and sustainability.

While the results of this study demonstrate the significant potential of implementing a barcode-based attendance system, several areas warrant further investigation in future research. First, the issue of technological accessibility for students who lack adequate devices to scan QR codes is a concern. Further research could explore solutions to address the reliance on mobile devices, such as developing web-based applications accessible through devices other than smartphones.

Second, although this system improves speed and accuracy, technical issues, such as QR code scanning failures, remain a barrier to implementing barcode-based attendance systems. Further research could develop a more robust system with improved scan quality and the ability to address these technical issues.

Third, future research could examine the impact of digital attendance systems on other aspects of educational administration, such as more efficient academic data management and the integration of attendance systems with other academic platforms (such as SIAKAD). This would help assess the long-term impact of attendance technology use on overall higher education administration.

Finally, while this study focused on efficiency and accuracy, it's important to explore the user experience of both lecturers and students using this system. Further research could use qualitative methods to delve deeper into user experiences with barcode-based attendance systems, as well as potential barriers that may arise during daily use.

Thus, this research opens up opportunities for further exploration in the development of a more efficient and environmentally friendly digital attendance system in the future.

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