

 Research Article

Technology-Assisted Attendance Monitoring: A Case Study on QR Code System Usability and Performance

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Abstract

The increasing integration of digital technologies into academic administration has significantly improved operational efficiency, particularly in attendance monitoring. Traditional methods, such as manual sign-ins and biometric scanners, often have limitations, including time inefficiency, susceptibility to human error, and administrative burden. To address these issues, this study evaluated the usability and performance of the BISU-Bilar QR Code Generator and Contact Tracing System, which was repurposed for monitoring student attendance at Bohol Island State University–Bilar Campus. A mixed-methods research design was employed, combining quantitative data from structured surveys and qualitative insights from open-ended responses. The evaluation was guided by the ISO 25010 standard, focusing on key usability dimensions such as functional suitability, efficiency, reliability, and user satisfaction. Results from 106 respondents indicate that the system is generally functional, easy to learn, and effective in facilitating task completion. The highest-rated usability aspect was device compatibility, while system stability and security received the lowest scores, suggesting areas for technical improvement. Statistical analyses, including Principal Component Analysis (PCA) and Ordinary Least Squares (OLS) regression, revealed that system functionality and device compatibility significantly influence perceived efficiency. In contrast, system crashes and data security concerns negatively impact user experience. Visualized through a word cloud, qualitative feedback highlighted recurring themes such as the demand for real-time notifications, enhanced user interface design, and improved technical support. The study concludes that while the QR code-based system offers a practical and scalable solution for attendance tracking, targeted enhancements in system stability, cross-platform performance, and data protection are necessary to ensure reliability, boost user confidence, and promote long-term adoption within educational institutions.

Keywords: Attendance Monitoring, Digital Transformation, Educational Technology, Performance Assessment, QR Code System, Usability Evaluation

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1. INTRODUCTION

The rapid advancement of digital technologies has transformed various administrative processes, including attendance tracking. Traditional methods, such as manual sign-ins and biometric systems, are increasingly seen as inefficient, prone to human error, and often lacking data security. In response to these challenges, Quick Response (QR) code technology has emerged as a reliable, contactless alternative due to its ease of use, cost-effectiveness, and adaptability. QR code-based attendance systems streamline data collection, reduce administrative workload, and improve accuracy (Verma & Kaur, 2024).

In light of these developments—particularly accelerated by the COVID-19 pandemic—educational institutions have sought more flexible and scalable tools for managing attendance. Bohol Island State University – Bilar Campus (BISU-Bilar) is among those who responded to this need by implementing a QR-based application initially designed for contact tracing. This system has since been repurposed for

institutional attendance monitoring, addressing the demand for safe, efficient, and user-friendly digital solutions in face-to-face and hybrid learning environments.

This study is significant as it investigates the technical implementation of the BISU-Bilar QR Code Generator and Contact Tracing System and its usability and contextual effectiveness. While QR-based systems have widespread adoption, especially during and after the pandemic, many implementations lack formal usability assessments grounded in recognized standards. This research aims to fill that gap by conducting a structured evaluation of the BISU-Bilar system through the lens of usability—an essential yet often overlooked dimension in system adoption and sustainability.

1.1. Literature Review

The development and implementation of QR code-based attendance systems have gained significant traction across various academic institutions worldwide due to their efficiency, accuracy, and contactless nature (Agripa & Astillero, 2022; Amin et al., 2024; Benesa et al., 2024; Bhange et al., 2024; Ebin et al., 2022; Liew & Tan, 2021; Mangca, 2023). These systems address traditional challenges such as manual data entry, time consumption, and susceptibility to errors or proxy attendance (Manori et al., 2017; Mohammed & Zidan, 2023; Nuhi et al., 2020; Pati et al., 2023; Patel et al., 2019). The integration of QR technology has been shown to improve monitoring accuracy and streamline administrative workload (Pujastuti & Laksito, 2020; Rafila et al., 2020; Rahmawati et al., 2019; Rosmala et al., 2024). Furthermore, developments utilizing web and mobile frameworks, facial recognition, and cloud integration have elevated these systems' usability and scalability (Salleh, 2020; Shrivastava, 2024; Siew et al., 2023; Talip & Zulkifli, 2019; Wenny et al., 2022; Verma & Kaur, 2024). Beyond academic contexts, QR-based attendance systems also apply to broader sectors requiring secure and efficient tracking (Eyselein et al., 2025). The literature collectively underscores the growing demand for innovative, responsive, and tech-driven solutions in attendance management post-pandemic.

QR code-based attendance monitoring systems have become increasingly prevalent due to their affordability, operational efficiency, and ease of integration into existing infrastructure (Eyselein et al., 2025). These systems automate data capture, minimize human error, and enable real-time tracking. For instance, Mohammed and Zidan (2023) introduced an animated QR code method to enhance security and usability. Mangca (2023) developed a Laravel-based platform integrated with SMS notifications, demonstrating user interaction improvements. Similarly, Benesa, Tubice, and Tubice (2024) highlighted the benefits of automation and accuracy in attendance tracking.

In the broader institutional context, QR codes have been used beyond education. Agripa and Astillero (2022) implemented a QR code-based employee management system at Sorsogon State University. Siew et al. (2023) combined facial recognition with QR technology to address identity verification challenges in academic settings. Other scholars have validated the affordability and effectiveness of QR code systems in Philippine universities (Ebin et al., 2022) and demonstrated their adaptability across organizational domains (Pati et al., 2023).

Several researchers have emphasized the role of user-friendly interfaces and system integration in adoption success. Rafila, Darmanto, Kurniawan (2020), and Liew and Tan (2021) explored automated attendance workflows. Salleh (2020) and Rosmala et al. (2024) focused on web-based designs, while Wenny, Suhartono, and Parenting (2022) and Shrivastava (2024) addressed the efficiency and data-handling capacity of these systems. Nuhi et al. (2020) and Talip and Zulkifli (2019) explored mobile and large-scale use cases.

The post-pandemic era has driven further innovation. Amin et al. (2024) addressed health monitoring through QR technology, while Pujastuti and Laksito (2020) emphasized the need for usability testing. Scalability and security have also been explored by Bhange et al. (2024) and Manori et al. (2017). In the academic context, Rahmawati et al. (2019) and Patel et al. (2019) have confirmed the reliability of QR code systems in enhancing attendance processes.

Despite this vast body of work, a significant research gap persists. Most existing studies prioritize technical implementation or system integration—such as combining QR codes with facial recognition or messaging services—while overlooking formal usability evaluations. Few employ structured frameworks like ISO 25010, and qualitative user experiences remain underexplored, particularly in resource-constrained

educational settings. This highlights a pressing need for context-sensitive usability assessments incorporating quantitative metrics and qualitative user feedback.

1.2. Research Objectives

The increasing adoption of QR code-based attendance systems has highlighted a need for comprehensive usability assessments. While most previous research focuses on technical implementation and integration, little attention has been given to structured usability evaluations, especially in resource-constrained educational settings. This study aims to address this gap by evaluating the technical performance and user experience of the BISU-Bilar QR Code Generator and Contact Tracing System.

The study will assess the usability of the BISU-Bilar system using the ISO 25010 standards, focusing on dimensions such as efficiency, effectiveness, and user satisfaction. In addition, it will analyze qualitative feedback from users to identify recurring themes related to the system's usability and contextual effectiveness. The study will evaluate the system's performance in real-world academic use cases, particularly in resource-constrained environments. Finally, the study will provide recommendations for optimizing the deployment and sustainability of QR code-based attendance systems in educational institutions, focusing on usability improvements.

2. METHODS

This study employs a mixed-methods approach to evaluate the usability and performance of the BISU-Bilar QR Code Generator and Contact Tracing System, shown in Figure 1, repurposed for attendance monitoring post-pandemic. The methodology integrates quantitative and qualitative techniques, providing detailed information on the research design, participants, research instruments, procedures, and data analysis.

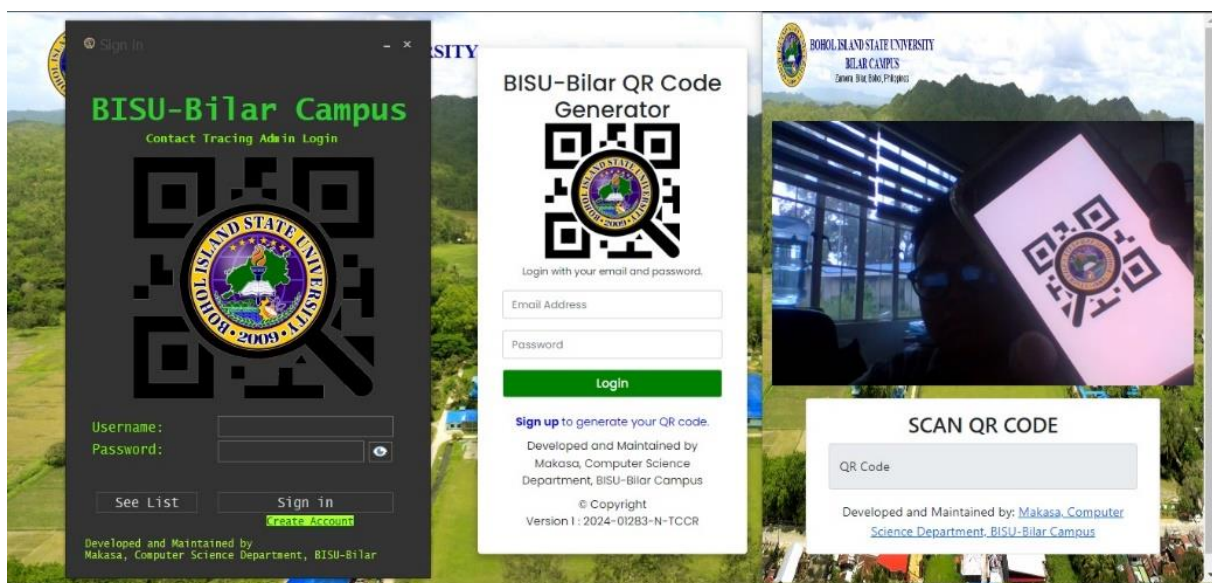


Figure 1. BISU-Bilar QR Code Generator and Contact Tracing System

2.1. Research Design

The study adopts a case study design within a mixed-methods framework, combining controlled usability testing with structured survey research and open-ended qualitative feedback. This design incorporates pre-test and post-test evaluations to measure system performance and user satisfaction over time. The quantitative component measures key performance indicators such as task completion times, error rates, and Likert-scale survey responses. In contrast, the qualitative component gathers in-depth user insights through open-ended questionnaires. Detailed documentation of the test scenarios, software

configurations, and measurement protocols is maintained to allow other researchers to repeat the experiments with precision.

2.2. Participants

Participants were purposively selected from the BISU-Bilar Campus community, including students who regularly engage with attendance monitoring systems. This diverse sample was chosen to represent various technical proficiencies and user experiences. All participants provided informed consent under the Data Privacy Act of 2012 (Republic Act No. 10173), with assurances that their data would be securely stored and used solely for academic research purposes. The sample size was determined based on campus demographics, ensuring the study yielded statistically valid and generalizable insights.

2.3. Research Instruments

The primary research instruments include a structured survey based on the ISO 25010 quality model, a detailed usability testing protocol, and an open-ended questionnaire. The survey employs a 5-point Likert scale (where one indicates “Strongly Disagree” and five indicates “Strongly Agree”) to evaluate multiple dimensions of the system, including functional suitability, performance efficiency, compatibility, usability, reliability, and security. Additionally, participants are invited to provide qualitative feedback through an open-ended question to capture improvement suggestions. Before collecting full-scale data, these instruments were pilot-tested to ensure clarity, reliability, and validity. (See Table 1 for the complete list of survey questions.)

Table 1. Survey Questions for Evaluating the BISU-Bilar QR Code System

Dimension	Survey Item	Response Scale
Functional Suitability	The software provides all the functionalities I need for my tasks.	1 – 5
	The software produces accurate and correct results.	1 – 5
	The software helps me complete tasks efficiently.	1 – 5
Performance Efficiency	The software responds quickly to my actions.	1 – 5
	The software runs smoothly without significant delays.	1 – 5
Compatibility	The software works well on my device(s) and operating system.	1 – 5
	I have not encountered significant compatibility issues with other tools or platforms.	1 – 5
Usability	The user interface is intuitive and easy to navigate.	1 – 5
	I can learn to use the software with minimal effort.	1 – 5
	The software provides helpful instructions or support when needed.	1 – 5
Reliability	The software runs consistently without frequent crashes or errors.	1 – 5
	The software is stable when performing essential tasks.	1 – 5
Security	My data is protected and secured in this software.	1 – 5
	I feel safe using this software without concerns about data breaches.	1 – 5
Open-Ended Feedback	What improvements or additional features would you like to see in the software to enhance your experience?	Open response

2.4. Procedures

The study was conducted on a system actively utilized in classroom settings for over a year since its implementation following the 2022 pandemic. As the system has been integrated into daily class activities from 2023 to the present, this research focused on gathering user feedback. Participants consistently using the BISU-Bilar QR Code system for attendance monitoring were invited to complete a structured survey assessing its usability, efficiency, and effectiveness. Additionally, an open-ended questionnaire was administered to capture qualitative insights regarding their experiences and potential areas for improvement. The data collection was systematically conducted to ensure reliability and facilitate future research replication.

2.5. Data Analysis

Quantitative data collected from the usability tests and structured surveys were analyzed using descriptive statistics, including means, standard deviations, and frequency distributions, to assess the system's performance relative to ISO 25010 benchmarks. In parallel, qualitative responses from the open-ended questionnaires were subjected to thematic analysis to identify recurring themes and insights. Additionally, a word cloud was generated to represent the frequency of key terms mentioned by participants visually. This integrated approach to data analysis ensures that the findings are robust, comprehensive, and reproducible.

3. RESULTS AND DISCUSSION

The increasing demand for efficient and user-friendly attendance monitoring systems in educational institutions underscores the importance of developing cost-effective technological solutions. This study evaluated the usability and performance of a QR code-based attendance monitoring system, aiming to address inefficiencies in traditional attendance tracking methods. The system was assessed through a structured survey, with results indicating favorable user perceptions regarding functionality, accuracy, and ease of use.

As summarized in Table 1, user ratings across various usability attributes ranged from 3.77 to 4.08 (out of 5). The highest-rated item was "The software works well on my device(s) and operating system" (mean = 4.08), suggesting strong device compatibility. Conversely, "The software runs consistently without frequent crashes or errors" received the lowest mean score (3.77), indicating some concerns about system stability.

Overall, users reported that the system facilitates task efficiency (mean = 4.06), produces accurate results (mean = 4.05), and is intuitive to learn (mean = 4.06). These findings suggest the system performs reliably for routine use but could benefit from improvements in stability and compatibility with third-party tools (mean = 3.87).

Table 1. Descriptive Statistics of User Perceptions on the QR Code-Based Attendance Monitoring System

Survey Item	Count	Mean	Std. Dev.	Min	25%	50%	75%	Max
The software provides all the functionalities I need for my tasks.	106	4.02	0.87	1.00	3.25	4.00	5.00	5.00
The software produces accurate and correct results.	106	4.05	0.84	1.00	4.00	4.00	5.00	5.00
The software helps me complete tasks efficiently.	106	4.06	0.85	0.00	4.00	4.00	5.00	5.00
The software responds quickly to my actions.	106	4.07	0.78	2.00	4.00	4.00	5.00	5.00
The software runs smoothly without significant delays.	106	3.89	0.81	2.00	3.00	4.00	4.00	5.00
The software works well on my device(s) and operating system.	106	4.08	0.81	2.00	4.00	4.00	5.00	5.00
I have not encountered significant compatibility issues with other tools or platforms.	106	3.87	0.86	1.00	3.00	4.00	4.00	5.00

underscoring the significant role of robust performance and reliable compatibility in enhancing task efficiency.

Table 2. Regression Analysis Results for System Efficiency Predictors

Predictor	Coef.	Std. Err.	t	p-value	95% CI
The software provides all the functionalities I need for my tasks.	0.451	0.087	5.189	0.000	[0.278, 0.623]
The software produces accurate and correct results.	0.079	0.084	0.937	0.351	[-0.089, 0.247]
The software works well on my device(s) and operating system.	0.467	0.113	4.127	0.000	[0.242, 0.692]
The software runs consistently without frequent crashes or errors.	-0.253	0.128	-1.977	0.051	[-0.507, 0.001]
My data is protected and secured in this software.	-0.350	0.132	-2.651	0.009	[-0.611, -0.088]

The results of this study align with the Technology Acceptance Model (TAM), which emphasizes perceived usefulness and ease of use as key drivers of technology adoption. High user ratings in efficiency and intuitiveness suggest that these factors contributed positively to the system's acceptance. However, concerns over crashes and data security indicate that perceived risk—a known barrier in TAM extensions—may moderate user trust and sustained use.

Compared to previous studies on attendance technologies, this system demonstrates superior performance in ease of deployment, cost-efficiency, and user satisfaction. Integrating QR code scanning offers a streamlined, contactless solution that aligns with post-pandemic educational needs and sustainability goals.

The findings further reinforce existing literature suggesting that low-complexity, high-impact technologies can significantly improve administrative tasks in educational settings. The positive feedback on functionality and ease of use supports the view that user-centric design contributes to successful technology adoption.

This study proves that a QR code-based attendance system can enhance operational efficiency, accuracy, and user satisfaction in academic environments. While the system is broadly effective, targeted improvements in system stability and data security are needed to maximize its reliability. Integrating findings with TAM and broader literature highlights the potential for scalable, sustainable attendance solutions in education.

5. CONCLUSION

This study examined the usability and performance of a QR code-based attendance monitoring system, demonstrating its effectiveness in facilitating accurate and efficient attendance tracking in educational settings. The findings reveal that users generally perceive the system as functional, intuitive, and responsive, aligning with the principles of user-centered design and the Technology Acceptance Model.

Despite its strengths, the system exhibits areas that require enhancement—particularly regarding stability, security, and interface design. Addressing these issues is essential to improve user trust, ensure reliable performance, and support broader adoption.

Future research should prioritize strengthening data security protocols to safeguard sensitive information and prevent breaches. Improving the interface to offer a more seamless and accessible user experience is also recommended. Additionally, integrating machine learning techniques for real-time error detection and correction could significantly enhance the system's adaptability and accuracy. Expanding usability evaluations to include larger, more diverse user groups will offer deeper insights into varying user needs and expectations, thereby guiding more inclusive system improvements.

Overall, the results affirm the potential of QR code-based technologies as scalable, sustainable solutions for educational administration, particularly in streamlining routine processes like attendance monitoring.

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Research Ethics. This study was conducted following ethical guidelines, ensuring compliance with the Data Privacy Act of 2012 (Republic Act No. 10173) to protect the confidentiality and rights of survey participants. Ethical approval was obtained from the appropriate institutional review board before the data collection process commenced.

Data Availability Statement. The data used in this study are available upon reasonable request. Due to privacy concerns, sensitive participant information has been anonymized to ensure confidentiality.

Conflicts of Interest. The author declares no conflicts of interest related to this study.

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