Effectiveness of fingerprint and mobile attendance systems in improving academic service quality in higher education

Efektivitas sistem absensi sidik jari dan mobile dalam meningkatkan kualitas layanan akademik di perguruan tinggi

Fahrul Radhi[1*], Siti Aminah[2], Intan Safiah[3], M. Ikhwan[4]
[1,3]Faculty of Educational Science, Universitas Syiah Kuala, Indonesia
[2]Faculty of Social and Political Sciences, Universitas Syiah Kuala, Indonesia
[4]Faculty of Sharia, STAIN Teungku Dirundeng Meulaboh, Indonesia

[1] fahrulradhi@usk.ac.id, [2] aminah@unsyiah.ac.id, [3] intan.afia@usk.ac.id,
[4]m.ikhwan@staindirundeng.ac.id

**Corresponding Author: fahrulradhi@usk.ac.id*

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ABSTRACT
This study analyzes the effectiveness of fingerprint-based biometric attendance and the Simkuliah Mobile Attendance system in improving academic service quality at the Faculty of Teacher Training and Education (FKIP), Universitas Syiah Kuala. Respondents consisted of 170 lecturers selected from a population of 1,773 using purposive sampling. Data were collected through structured questionnaires and analyzed using Partial Least Squares–Structural Equation Modeling (PLS-SEM). The findings show that both attendance systems significantly enhance academic service quality; the fingerprint system contributes primarily to accuracy, accountability, and data security (β = 0.308), whereas the mobile attendance system demonstrates a stronger influence (β = 0.435) due to its higher accessibility, flexibility, and real-time integration with academic information services. These results indicate that mobile-based attendance provides a more adaptive and efficient solution for daily academic administration, while fingerprint verification remains valuable for ensuring data integrity. The study offers practical implications for digital attendance management and highlights the need for institutional policies, reliable infrastructure, and user readiness to support effective implementation of systems in higher education.

Keywords: fingerprint attendance system; mobile attendance; academic service quality; biometric verification; higher education digitalization

ABSTRAK
Penelitian ini menganalisis efektivitas sistem presensi berbasis sidik jari dan aplikasi SIMKULIAH Mobile dalam meningkatkan kualitas layanan akademik di Fakultas Keguruan dan Ilmu Pendidikan (FKIP), Universitas Syiah Kuala. Sebanyak 170 dosen dipilih dari populasi 1.773 dosen melalui teknik purposive sampling. Data dikumpulkan menggunakan kuesioner terstruktur dan dianalisis dengan Partial Least Squares–Structural Equation Modeling (PLS-SEM). Hasil penelitian menunjukkan bahwa kedua sistem presensi berpengaruh signifikan terhadap peningkatan kualitas layanan akademik. Sistem presensi sidik jari berkontribusi terutama pada aspek akurasi, keamanan data, dan akuntabilitas (β = 0.308), sedangkan SIMKULIAH Mobile memberikan pengaruh yang lebih kuat (β = 0.435) karena memiliki aksesibilitas, fleksibilitas, dan integrasi data real-time yang lebih baik. Temuan ini mengindikasikan bahwa presensi berbasis aplikasi lebih adaptif dan efisien dalam mendukung administrasi akademik, sementara verifikasi biometrik tetap penting untuk menjamin keaslian data. Penelitian ini memberikan implikasi praktis bagi pengelolaan presensi digital dan menegaskan perlunya dukungan kebijakan, infrastruktur memadai, serta kesiapan pengguna untuk memastikan implementasi yang optimal di perguruan tinggi.

Kata kunci: *sistem fingerprint; presensi mobile; kualitas layanan akademik; verifikasi biometric; digitalisasi pendidikan tinggi*

1. INTRODUCTION

The advancement of information and communication technology has significantly impacted various sectors, including higher education. One of the main challenges faced by educational institutions is how to enhance the quality of academic services to effectively and efficiently meet the needs and expectations of students and other stakeholders. The presence of instructors and students in the learning process is a crucial factor influencing the overall quality of teaching and academic services (Ahmad Junaedy Abu Huraerah, Abdurrahman Wahid Abdullah, 2023). Therefore, reliable and efficient attendance systems are essential to support effective learning environments.

Conventionally, student attendance is still recorded manually, which tends to be time-consuming, less accurate, and prone to data manipulation (Farhan Aji Pradana, 2024). These problems indicate an urgent need for digital transformation in attendance management to ensure data integrity and service efficiency. If such problems remain unaddressed, universities may experience delays in reporting, inconsistencies in academic documentation, ineffective monitoring, and reduced trust in academic governance.

Digital transformation in higher education requires strengthening information technology infrastructure as a strategy to improve the quality of academic services and institutional governance. The integration of administrative, academic, and technology-based learning systems is considered a vital step in achieving more effective teaching processes (Willy Kayanja, Mahadih Kyambade, 2025). The use of digital attendance systems, particularly fingerprint-based biometrics and mobile attendance applications, represents a concrete implementation of this approach. Biometric technology provides higher accuracy and security against potential data manipulation, while mobile applications offer students the flexibility to record their attendance directly via smart devices connected to the academic database. Environments with high course intensity and large student populations require the adoption of such systems to ensure reliable attendance data while improving administrative efficiency (Maulidina Azzahra, Seni Fidyawati, Syabrina Nur Azizah, Durinda Puspasari, 2024).

In addition to fingerprint and mobile-based systems, several higher education institutions have adopted QR code–based attendance systems as part of their digital transformation strategy. QR code attendance offers practical advantages such as ease of implementation, low operational cost, and rapid verification through scanning using mobile devices. This method also reduces administrative workload and minimizes manual data errors since attendance is automatically recorded into the institution's academic information system (Binti Shaheezam Khan et al., 2023). However, despite its convenience, QR code attendance is often considered less secure than biometric methods due to the potential for code sharing or unauthorized scanning, which affects data authenticity. These characteristics position QR code attendance as a lightweight yet less secure alternative compared to fingerprint biometrics and mobile verification mechanisms (Nahida Sultana, 2025) (Swain & Sanchita, 2016)

Although biometric attendance systems such as fingerprint recognition are widely recognized for their accuracy, efficiency, and resistance to data manipulation, their implementation also raises important concerns regarding data privacy and security. Biometric information such as fingerprints is highly sensitive, irreversible, and unique to each user; therefore, improper storage or unauthorized access poses significant risks. Institutions must ensure robust data protection mechanisms, including encrypted storage, secure transmission protocols, and strict access control policies (Sultana & Akter, 2025). Furthermore, issues such as spoofing attempts, system vulnerabilities, and ethical considerations related to personal data handling must be addressed to maintain user trust. These concerns highlight that the adoption of biometric systems requires not only technological readiness but also strong governance and security frameworks (Binti Shaheezam Khan et al., 2023) (Emmanuel Kaingu Charo, Kennedy Hadullo, 2024)

Recent studies demonstrate that digital attendance innovations can enhance both administrative efficiency and learning outcomes. Real-time facial recognition systems improve accuracy(Emmanuel Bugingo et al., 2025), while mobile attendance integrated with academic information systems reduces communication gaps between students and instructors (Aini Khalida Muslim et al., 2024). Mobile classroom applications also support higher attendance, focus, and student satisfaction (Musawer Hakimi, Mursal Akrami, Maliha Ahrari, Khatera

Akrami, 2024) and attendance data can inform AI-based learning analytics for competency development (Junaidi & Sembiring, 2025). Furthermore, consistent participation in synchronous sessions correlates positively with academic achievement (María-Isabel Martínez-SernaJ. Samuel Baixauli, María Belda-Ruiz, 2024), and technology facilitates assessment of engagement in both online and offline settings (Patricia D. Simon, Juming Jiang, 2025). Moreover, digital learning models may result in higher overall attendance compared to traditional methods (Erik Haugom, 2022). These findings reinforce the potential value of digital attendance systems for enhancing both academic services and instructional quality.

In addition, various previous studies have shown that the implementation of biometric-based attendance systems in universities is not only influenced by technological factors, but also by users' perceptions of convenience, usefulness, and the quality of accompanying services. Studies based on the Technology Acceptance Model (TAM) have been used to explain how perceptions of ease and usefulness influence the acceptance of biometric attendance systems (Emmanuel Kaingu Charo, Kennedy Hadullo, 2024) (Swain & Sanchita, 2016). On the other hand, research utilizing a service quality approach such as SERVQUAL also confirms that reliability, responsiveness, and service assurance also determine the level of user satisfaction and acceptance of campus digital systems (Siti Halimah, Yunita, 2025). These findings indicate that the issue of digital attendance is not only related to technological readiness, but also concerns service quality and the overall user experience.

Despite the widespread adoption of fingerprint and mobile attendance technologies, few studies have conducted a systematic comparative analysis of their effectiveness, particularly in the context of academic service quality within teacher education faculties. Prior research has typically examined each system independently without evaluating their operational differences, efficiency, user experience, and administrative implications within the same institutional setting. This gap indicates the need for empirical evidence comparing how each system contributes to improving academic service quality.

Therefore, this study aims to analyze and compare the effectiveness of fingerprint attendance and SIMKULIAH Mobile attendance systems in enhancing academic service quality at the Faculty of Teacher Training and Education (FKIP) USK. The evaluation focuses on service efficiency, accuracy of attendance data, transparency of reporting, and user satisfaction among instructors and students. By identifying the strengths and limitations of both technologies, this research provides practical insights and institutional recommendations for optimizing digital attendance management to support more effective teaching and learning processes in higher education.

2. RESEARCH METHOD

Research Design

This study employs a quantitative approach with a causal-explanatory research design. This design was selected to examine the effect of fingerprint and mobile attendance systems (independent variables) on the quality of teaching services (dependent variable) at the Faculty of Teacher Training and Education, Universitas Syiah Kuala (Sugiyono, 2017). In addition, the design incorporates a comparative analysis component to evaluate differences in perceived effectiveness between fingerprint-based and mobile-based attendance systems.

Population and Sample

The population comprised all lecturers at the Faculty of Teacher Training and Education, Universitas Syiah Kuala, totaling 1,773 individuals. A sample of 170 respondents was selected. Data were collected through the distribution of structured questionnaires to the selected participants.

Research Instruments

The primary research instrument was a Likert-scale questionnaire (1 = strongly disagree to 5 = strongly agree), which measured indicators related to the fingerprint system, mobile attendance system, and the quality of teaching services (Hair Jr, Matthews, Matthews, & Sarstedt, 2017). The questionnaire consisted of three main constructs: (a) Fingerprint Attendance System, (b) Mobile Attendance System, and (c) Academic Teaching Service Quality.

1. *Fingerprint Attendance System Indicators*

The measurement indicators used in this study were structured to represent the main dimensions of each construct. For the fingerprint attendance system, the indicators captured several aspects of system performance, including the speed of authentication, the accuracy of fingerprint recognition, consistency and stability during peak usage, ease of use for lecturers, and the level of data security and protection against manipulation. These indicators were adapted from biometric system studies emphasizing reliability, usability, and service assurance in digital administrative processes.

2. *Mobile Attendance System Indicators*

For the mobile attendance system, indicators focused on evaluating the convenience and efficiency of mobile-based attendance processes. These included the ease of navigating the application interface, speed of attendance submission, accuracy of GPS or geolocation detection, stability related to network connectivity, device compatibility across different smartphone types, and the perceived practicality of the system in supporting daily academic obligations. These dimensions reflect the core characteristics of mobile attendance applications widely assessed in higher education digital service studies.

3. *Academic Teaching Service Quality Indicators*

Meanwhile, the academic teaching service quality construct was measured using indicators derived from the SERVQUAL framework and adjusted to the higher education context. These indicators covered the timeliness and accuracy of attendance-related administrative services, efficiency of data management, responsiveness of academic support units, the availability of technical assistance for digital attendance issues, transparency in reporting attendance records, and overall satisfaction with the professionalism and reliability of academic services. Together, these indicators represent the essential attributes of service quality as perceived by faculty members in a digitalized academic environment.

Questionnaire Validation

Validity was assessed using convergent validity (loading factor ≥ 0.70) and discriminant validity through AVE values and the Fornell-Larcker criterion. Reliability was evaluated through Cronbach's Alpha and Composite Reliability (≥ 0.70). A pilot test involving 30 lecturers was conducted prior to full distribution to refine ambiguous items and ensure content validity.

Data Collection Procedure

Questionnaires were administered both online and offline to the selected respondents. Participants received a clear explanation of the study's purpose, assurance of confidentiality, and an informed consent form. Collected data underwent cleaning to address missing values and outliers. Data cleaning included screening for incomplete responses, straight-lining, and multivariate outliers.

Data Analysis

Data were analyzed using Partial Least Squares-Structural Equation Modeling (PLS-SEM) via SmartPLS software. PLS-SEM was selected because it:

- Can model complex relationships involving latent variables with multiple indicators.
- Does not require strict normality assumptions.
- Is suitable for relatively small sample sizes (Hair Jr et al., 2017).

The analysis proceeded in several stages:

- Descriptive statistics to summarize response distributions.
- Measurement model evaluation (outer model), including assessment of convergent validity, discriminant validity, and construct reliability.
- Structural model evaluation (inner model) to test the influence of fingerprint and mobile attendance systems on teaching service quality, examining path coefficients, R^2 values, and statistical significance via bootstrapping.

Bias Mitigation

Bias was mitigated through multiple strategies:

- Ensuring anonymity and confidentiality of responses.
- Ensuring representation across relevant groups (students, lecturers, staff).
- Using construct-validated indicators to reduce measurement bias
- Standardized data analysis procedures
- Removing inconsistent responses using data screening protocols

3. RESULTS AND DISCUSSION

3.1 Results

Validity Test

The measurement model was evaluated through convergent validity, discriminant validity, and construct reliability. As shown in Figure 1, all measurement indicators for the three constructs Fingerprint System, Mobile Attendance, and Teaching Service Quality demonstrated loading values above 0.70 (ranging from 0.770 to 0.882), indicating strong convergent validity.

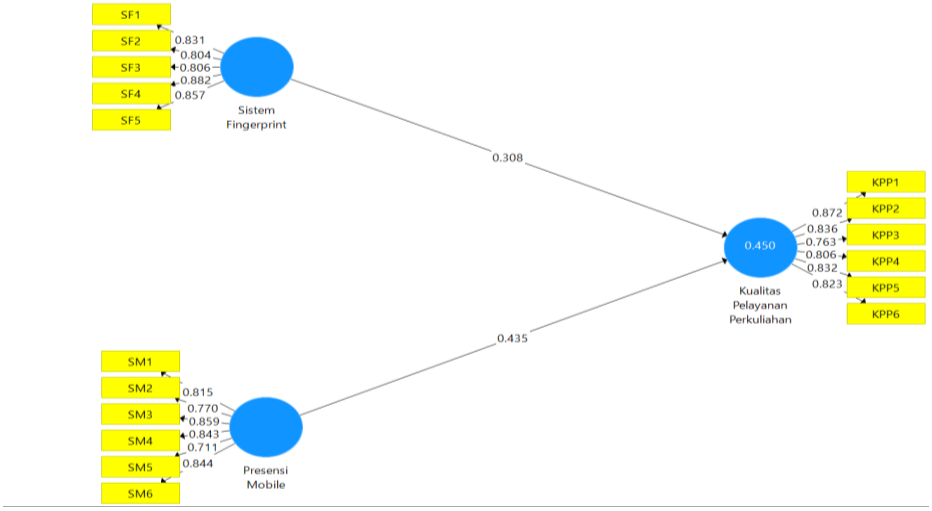

Figure 1. *Partial Least Squares-Structural Equation Modelling (PLS-SEM) results depicting the relationships among the fingerprint system, mobile attendance, and the quality of teaching services.*

Table 1. *Average Variance Extracted (AVE)*

Variable	AVE
Teaching Service Quality	0.627
Fingerprint System	0.700
Mobile Attendance	0.654

Source: *Data processed using PLS, 2025*

Reliability Test

The results of the Composite Reliability and Cronbach's Alpha tests are presented in Table 2.

Table 2. *Composite Reliability and Cronbach's Alpha*

Variable	Cronbach's Alpha	Composite Reliability
Teaching Service Quality	0.904	0.926
Fingerprint System	0.892	0.921
Mobile Attendance	0.893	0.919

Source: *Data processed using PLS, 2025*

A construct is considered reliable if its Composite Reliability exceeds 0.70 and Cronbach's Alpha is above 0.60. Based on the SmartPLS output, all constructs in this study meet both criteria, indicating that the constructs demonstrate good reliability.

Furthermore, all Average Variance Extracted (AVE) values exceeded the minimum criterion of 0.50, with Teaching Service Quality = 0.627, Fingerprint System = 0.700, and Mobile Attendance = 0.654 (Table 1). This confirms adequate construct validity. Cronbach's Alpha and Composite Reliability values for all constructs were also well above 0.70, indicating high internal consistency. Teaching Service Quality had the highest reliability (α = 0.904; CR = 0.926), followed by Fingerprint System (α = 0.892; CR = 0.921) and Mobile Attendance (α = 0.893; CR = 0.919) (Table 2). Thus, the model fulfills all requirements for validity and reliability, and the data are suitable for further structural evaluation.

Hypothesis Testing

The results of the direct effect hypothesis test are presented in Table 3.

Table 3. *Path coefficients of direct effects between attendance systems and quality of teaching services*

Variable	Original Sample	Standard Deviation	T-Statistics	P-Values
Fingerprint System → Teaching Service Quality	0.308	0.101	3.047	0.002
Mobile Attendance → Teaching Service Quality	0.435	0.09	4.834	0

Source: *SmartPLS 3.0 output, 2025*

The structural model was assessed using path coefficients, t-statistics, and significance values generated through bootstrapping. Table 3 shows that both attendance systems significantly influence teaching service quality.

- Fingerprint System: Teaching Service Quality
  β = 0.308; t = 3.047; p = 0.002
  (Significant at $p < 0.05$)
- Mobile Attendance: Teaching Service Quality
  β = 0.435; t = 4.834; $p < 0.001$
  (Significant at $p < 0.01$)

The R^2 value for Teaching Service Quality is 0.450, indicating that 45% of the variance in teaching service quality can be explained by the combined effect of fingerprint and mobile attendance systems. This reflects a moderate-to-strong explanatory power for the model.

Comparative Effectiveness Analysis

The coefficient estimates also reveal that the influence of the Mobile Attendance System (β = 0.435) is stronger than that of the Fingerprint System (β = 0.308). This indicates that lecturers perceive mobile attendance as more effective in supporting teaching-related administrative tasks, likely due to its flexibility, convenience, and integration with location-based verification features. Conversely, the fingerprint system contributes more toward data accuracy and attendance authenticity but offers less flexibility due to device dependency.

Performance of Digital Attendance Systems

1. Fingerprint System

Table 4 shows that respondents generally perceive the fingerprint system positively. Verification accuracy receives the highest agreement (82.95%), demonstrating users' confidence in the precision of biometric identification. Transaction time also receives strong positive ratings (67.05%), indicating that the system functions efficiently under normal usage. However, slight concerns emerge regarding data privacy and system integration with SIMKULIAH consistent with the challenges often found in biometric data management. Despite

these issues, overall perceptions indicate that the fingerprint system remains an essential tool for maintaining administrative transparency and data integrity.

Table 4. *Distribution of respondents' perceptions toward the performance of the fingerprint system*

Fingerprint System	SD		D		N		A		SA	
	n	%	n	%	n	%	n	%	n	%
Verification accuracy	1	0.59	5	2.94	23	13.53	65	38.24	76	44.71
Transaction time	4	2.35	14	8.24	38	22.35	71	41.76	43	25.29
Enrollment & user satisfaction	1	0.59	14	8.24	28	16.47	59	34.71	68	40
Data security & privacy	2	1.18	14	8.24	33	19.41	81	47.65	40	23.53
Integration with SIMKULIAH	2	1.18	13	7.65	43	25.29	77	45.29	35	20.59
Means	2	1.18	12	7.06	33	19.41	71	41.53	52	30.82
SD	1.22	0.72	3.94	2.32	7.91	4.65	8.88	5.22	18.34	10.79

Note: SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree.
Source: *Primary data, 2025.*

2. Mobile Attendance System

Table 5. *Distribution of respondents' perceptions toward the performance of the mobile attendance system*

Mobile Attendance	SD		D		N		A		SA	
	n	%	n	%	n	%	n	%	n	%
Verification accuracy	2	1.18	6	3.53	13	7.65	53	31.18	96	56.47
Transaction time	7	4.12	11	6.47	24	14.12	84	49.41	44	25.88
Enrollment & satisfaction	4	2.35	16	9.41	43	25.29	74	43.53	33	19.41
Data security & privacy	2	1.18	9	5.29	30	17.65	72	42.35	57	33.53
Integration with SIMKULIAH	3	1.76	15	8.82	47	27.65	59	34.71	46	27.06
User satisfaction	4	2.35	15	8.82	47	27.65	74	43.53	30	17.65
Means	3.67	2.16	12.00	7.06	34.00	20.00	69.33	40.78	51.00	30.00
SD	1.86	1.10	4.00	2.35	13.97	8.22	11.31	6.65	24.08	14.17

Note: SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree.
Source: *Primary data, 2025.*

Findings in Table 5 demonstrate even stronger positive evaluations of the mobile attendance system across all indicators. Verification accuracy (87.65%) and transaction speed (75.29%) receive the highest agreement levels, indicating that the system offers quick and reliable attendance processing. Data security is also viewed favorably by most respondents, though integration with the SIMKULIAH platform receives moderate satisfaction (61.77%). This suggests that while mobile attendance is highly effective operationally, improvements in system interoperability and synchronization are required to maximize performance. The overall results confirm that the mobile attendance system is more flexible, efficient, and user-friendly compared to the fingerprint system.

3. Academic Service Quality

Table 6. *Distribution of respondents' perceptions of academic service quality*

Academic Service Quality	SD		D		N		A		SA	
	N	%	n	%	n	%	n	%	n	%
Accuracy and precision	8	4.71	16	9.41	38	22.35	58	34.12	50	29.41

of attendance data										
Speed of administrative services	1	0.59	19	11.18	29	17.06	57	33.53	64	37.65
Security and confidentiality of student data	7	4.12	14	8.24	32	18.82	54	31.76	63	37.06
Accessibility and ease of use	2	1.18	22	12.94	29	17.06	54	31.76	63	37.06
Academic community satisfaction	1	0.59	21	12.35	24	14.12	54	31.76	70	41.18
Academic outcomes	1	0.59	21	12.35	33	19.41	56	32.94	59	34.71
Means	3.33	1.96	18.83	11.08	30.83	18.14	55.50	32.65	61.50	36.18
SD	3.27	1.92	3.19	1.88	4.71	2.77	1.76	1.04	6.66	3.92

Note: SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree.
Source: *Primary data*, *2025*.

Table 6 shows strong positive perceptions of academic service quality, particularly with regard to administrative speed (71.18%), data accuracy, and accessibility. Academic community satisfaction has the highest approval rate (72.94%), suggesting broad acceptance of the digital attendance systems. Academic outcomes were also rated positively (67.65%), showing that improved attendance systems help strengthen administrative and instructional processes.

4. Correlation Analysis

Table 7. *Correlation analysis between the fingerprint system, mobile attendance, and academic service quality*

Correlation		Fingerprint System	Mobile Attendance	Academic Service Quality
Fingerprint System	Pearson Correlation	1	.621**	.574**
	Sig. (2-tailed)		0.000	0.000
	N	170	170	170
Mobile Attendance	Pearson Correlation	.621**	1	.618**
	Sig. (2-tailed)	0.000		0.000
	N	170	170	170
Academic Service Quality	Pearson Correlation	.574**	.618**	1
	Sig. (2-tailed)	0.000	0.000	
	N	170	170	170

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7 presents the correlation analysis results between the fingerprint system, mobile attendance, and academic service quality. The correlation analysis revealed that both the fingerprint and mobile attendance systems have a significant positive relationship with academic service quality. The fingerprint system showed a correlation coefficient of $r = 0.574$ ($p < 0.01$), highlighting the role of biometric verification accuracy in improving attendance data validity and administrative efficiency. However, the findings indicate that the mobile attendance system exhibits a stronger correlation with academic service quality, with a coefficient of $r = 0.618$ ($p < 0.01$).

The strength of this correlation suggests that application-based flexibility contributes more significantly to the satisfaction of the academic community. Greater accessibility, real-time attendance capabilities, and seamless integration with the main academic system make mobile attendance more effective in facilitating academic service delivery compared to the fingerprint system. This finding aligns with the broader trend of digitalization in higher

education services, where speed, convenience, and mobility are key factors in enhancing the quality of both learning experiences and academic administration.

The results further confirm that mobile attendance demonstrates a stronger relationship with academic service quality ($r = 0.618$; $p < 0.01$), underscoring its greater contribution to user satisfaction. The ease of access, real-time functionality, and direct integration with core academic systems make it more efficient in supporting smooth academic operations than conventional biometric methods.

3.2 *Discussion*

1. Effect of Fingerprint Attendance System on Academic Service Quality

The findings show that the fingerprint attendance system significantly improves academic service quality. This aligns with previous studies emphasizing the reliability, accuracy, and fraud-resistance of biometric systems (Emmanuel Bugingo et al., 2025) (Siti Halimah, Yunita, 2025). The system's capability to minimize proxy attendance and ensure valid attendance verification contributes directly to improved administrative accuracy and transparency.

However, despite its strengths, fingerprint systems also depend on stable hardware performance and physical access to devices, which sometimes limits flexibility. This indicates that biometric devices enhance service quality primarily through accuracy and integrity rather than convenience. These results answer Research Question 1 by confirming the positive role of fingerprint attendance in supporting administrative and instructional efficiency at FKIP USK.

The results demonstrate that the fingerprint attendance system has a significant positive effect on teaching service quality ($\beta = 0.308$; $p = 0.002$). This finding aligns with prior studies asserting that biometric systems increase administrative precision and minimize opportunities for fraudulent attendance (Emmanuel Bugingo et al., 2025) (Farhan Aji Pradana, 2024). Fingerprint-based systems enhance service quality primarily through accuracy, reliability, and data integrity. Their resistance to manipulation strengthens trust in academic reporting processes. However, because they require physical interaction with hardware devices, their contribution to convenience and speed is relatively limited. This supports the argument that biometrics improve academic service quality in terms of authenticity rather than operational flexibility.

2. Effect of Mobile Attendance System on Teaching Service Quality

Mobile attendance was found to exert a stronger influence on service quality ($\beta = 0.435$; $p < 0.001$) compared to fingerprint systems. This supports findings from (Aini Khalida Muslim et al., 2024) and (Musawer Hakimi, Mursal Akrami, Maliha Ahrari, Khatera Akrami, 2024), which highlight that mobile-based attendance improves communication, reduces administrative delays, and enhances user satisfaction. The Mobile Attendance System shows a stronger influence on academic service quality due to its accessibility, flexibility, and real-time recording features. Respondents rate its verification accuracy and transaction efficiency very highly, indicating that mobile-based attendance offers a smoother user experience than fingerprint technology. High levels of user satisfaction further demonstrate its practical advantages, aligning with research emphasizing the positive impact of mobile applications on engagement and service responsiveness. However, challenges related to system integration, particularly with the SIMKULIAH platform, reveal that backend synchronization and data consistency remain areas requiring improvement. Non-technical dimensions such as digital literacy among lecturers, campus internet infrastructure, and clarity of digital attendance policies also shape its effectiveness, highlighting that successful digital transformation relies on both technological and human readiness.

3. Comparative Assessment of the Two Systems

The comparative results reveal that mobile attendance is perceived as more effective overall, given its higher path coefficient and stronger user-centered functionality. It enhances efficiency and reduces administrative burdens. On the other hand, fingerprint attendance

remains superior in ensuring attendance authenticity and security, particularly for formal or high-stakes verification scenarios.

Correlation results indicate that both attendance systems have a positive impact on academic service quality, with the Mobile Attendance System demonstrating a stronger relationship. This suggests that user-friendly and flexible digital solutions are increasingly central to academic service improvement. While the Fingerprint System excels in areas requiring high verification accuracy and security, the Mobile Attendance System contributes more significantly to accessibility, efficiency, and user satisfaction. These complementary strengths indicate that an integrated implementation model using fingerprint technology to ensure secure verification and mobile attendance to support mobility and real-time processes would provide the most optimal approach for enhancing academic service quality. Overall, the combined effectiveness of both systems is shaped not only by technical features but also by institutional readiness, infrastructure, and user acceptance.

4. Influence of Non-Technical Factors

Beyond system performance, several non-technical factors shape the effectiveness of digital attendance implementation. First, institutional policies that mandate digital attendance integration play a crucial role in standardizing procedures across departments. Second, human resource readiness, including digital literacy and adaptability among lecturers, affects consistency in system usage.

Additionally, biometric data security is an essential concern, especially for fingerprint-based systems. Universities must ensure secure data encryption, controlled access, and adherence to privacy regulations. For mobile systems, network stability and system infrastructure determine the accuracy of geolocation features and real-time data submission. Addressing these non-technical dimensions maximizes the impact of both systems on academic service quality.

4. CONCLUSION

This study concludes that both the fingerprint attendance system and the SIMKULIAH Mobile Attendance system significantly improve academic service quality at FKIP Universitas Syiah Kuala, with the fingerprint system enhancing accuracy and accountability ($\beta = 0.308$), while the mobile system demonstrates a stronger overall effect ($\beta = 0.435$) due to its flexibility, accessibility, and real-time integration. These results indicate that mobile attendance offers greater operational efficiency for daily academic processes, whereas fingerprint verification remains valuable for ensuring data authenticity. Together, the findings highlight the importance of adopting a balanced digital attendance strategy supported by adequate policies, infrastructure, and data security measures to optimize academic service performance in higher education.

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