



The Development of an AppSheet-Based Digital Attendance System Using Integrated Technology to Support Student Discipline

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ABSTRACT

This study aims to design an AppSheet-based digital attendance application integrated with the Global Positioning System (GPS) and biometric features, and to evaluate the application's validity, practicality, and effectiveness. This study uses a research and development approach with the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model. Data were collected through interviews, questionnaires, observations, and document analysis. Participants were students of SMP Negeri 2 Satu Atap Sluke in Rembang, Central Java, Indonesia, using multilevel and simple random sampling. Data analysis used expert validation tests and product practicality tests. The statistical analysis used was nonparametric statistics because the number of samples was small and no immersion test was carried out, consisting of the Wilcoxon test and the Spearman correlation test. In addition, an N-Gain test was conducted. The results of the study showed that the developed instrument had very good validity (98%), so it could be used. The practicality test showed a score of 92%, indicating that this product is very practical to use. The effectiveness of this product was evaluated using three types of tests: the Wilcoxon test, Spearman's correlation, and the N-Gain. The Wilcoxon test showed that digital attendance significantly increased student attendance ($p = 0.001 < 0.05$), by 8 points compared to manual attendance. The Spearman's rho showed no significant difference in the use of this digital attendance system in improving student discipline, with a significance value of $0.176 > 0.05$. The N-Gain showed an average value of 0.04, indicating a low increase. It is recommended that the use of digital attendance to improve student discipline not be left solely to the device, but also receive support from various stakeholders, such as teachers, principals, parents, and the community.

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■ INTRODUCTION

Education is one of the key foundations of national development, with schools playing a vital role in maintaining educational quality and success. The principal, as the leading figure in the education system, is responsible for managing all educational components to achieve institutional goals. This position is highly strategic in ensuring the overall success of the learning environment (Lijun & Te, 2024). A tangible reflection of a principal's leadership is their ability to cultivate and uphold a culture of discipline among students (Nasution et al., 2025). Principals also guide the integration of educational technology that aligns with school needs and culture (Banoğlu et al., 2023).

One way a principal evaluates their effectiveness in managing students is by

implementing discipline (Seyfarth, 2002). The principal can be seen as an enforcer of discipline, as they shape the policies and implement them. The administration, as a means to enhance student discipline through development, created a digital attendance system (Belle, 2016). Consistent with Rebore (2011), computers and software applications can assist principals in maintaining accurate records in various school-related situations. In this study, the principal uses computer software, which is an attendance-related app for student discipline.

When it comes to managing discipline in schools, planning, monitoring, and evaluating student behavior is inextricably linked with compliance with school regulations. Attendance management platforms, which take the form of computerized systems for automatic attendance

monitoring and management analysis, are commonly used by organizations (Khoiriyah et al., 2018). These systems have been developed in parallel with the technology (from paper-based systems to barcodes, fingerprints, and other biometric systems) towards web- and smartphone-based applications that enable effective use in schools or organizations (Al-Husain et al., 2017).

Discipline is a key element in shaping student character and directly influences the success of the learning process. As formal educational institutions, schools are responsible for instilling discipline from an early age (Yunesa & Khaidir, 2019). One of the most visible indicators of discipline is students' punctuality and consistency in attending school (Rodriguez & Welsh, 2022). Digital attendance systems have become integral to school evaluation processes (Maulana et al., 2024). Student discipline is not merely a behavioral expectation but a crucial factor in academic achievement and character formation (Pabalik et al., 2023). Regular and timely attendance is one of the most measurable indicators of discipline (Kearney et al., 2019). The purpose of discipline is to guide students to act in accordance with established norms.

Discipline is the willingness to obey, submit to, and comply with rules and norms (Wirantasa, 2017). Student discipline at school includes arriving on time and wearing a school uniform (Ihsan, 2018). In the context of employees, discipline is adherence to work hours and the execution of duties (Hulu & Larosa, 2025). When applied to students at school, it can be interpreted as the completion of school assignments. In this study, student discipline was only monitored through school attendance.

There are significant issues with the attendance management in the traditional school system, which is inefficient, unreliable, and prone to manipulation (Bondugula et al., 2025). State Junior High School 2 Satu Atap Sluke in Rembang Regency, Indonesia, has similar troubles. Preliminary data from before the study, based on manual records, showed that the average student attendance was only 21 of 24 days (87.5%). Because the data was recorded manually, there was a possibility of inaccuracy due to recording errors.

Previous studies have demonstrated that digital attendance systems can enhance the accuracy and efficiency of attendance management. Rao (2022) developed the Atten Face system, a real-time attendance application that uses facial recognition technology to automatically record attendance via live camera snapshots, reducing manipulation and

improving accuracy. Similarly, the Roll Call system offers a modern, efficient approach to attendance management (Chukwude, 2023). Research by Aigbokhan et al. (2024) also supports the development of mobile-based attendance systems to improve accuracy and efficiency in educational institutions. Google Forms-based attendance methods are effective at increasing student discipline (Nasywa et al., 2025). In response, digital attendance systems tend to increase administrative efficiency and promote better discipline (Syahidi et al., 2025). Similarly, digital tools like EvoCard have been shown to help to effectively track and strengthen student attendance and discipline (Inayah & Maburi, 2024). A web-based attendance system has also been shown to improve efficiency and discipline (Mansor et al., 2022).

To develop and implement solutions for the system and improve the efficiency and effectiveness of academic data management (including attendance data), a more data-driven system must be designed that consolidates information into a single application. Such a system would help in streamlining data processing and monitoring. Accordingly, setting up an Android-based digital attendance system is the appropriate solution for State Junior High School 2 Satu Atap Sluke because it enables real-time monitoring and checking of students' attendance.

AppSheet is a no-code platform designed for beginners, enabling them to create a data-driven application without programming knowledge. It connects easily to various data sources, including Google Sheets, Excel, and other cloud-based databases. AppSheet is especially good for educators who are not technical, with an intuitive user interface and the ability to customize to their specific needs.

There are certain limitations to biometric authentication, including those arising from proxies and remote recovery, as well as a lack of accuracy (Yusuf, 2020). There are several weaknesses in biometric systems, such as the potential for exploitation by malware. Hacked biometric data cannot be replaced, leaving users vulnerable to security threats (Yeovandi, 2025). GPS systems use geofencing to verify a person's presence at a specific location. GPS systems are a cheaper, more flexible, and more automated solution that replaces biometric attendance systems (Abdullah, 2025).

The novelty of this study lies in the investigation of the efficacy and feasibility of an AppSheet-based digital attendance system on student discipline. The unique approach to this investigation involves coupling two verification technologies, GPS and biometrics,

on the AppSheet platform. Previous studies were mostly conducted in large urban schools, whereas this study was conducted in small schools and rural areas.

This study aims to initiate the design and implementation of an AppSheet-based digital attendance system that tracks attendance via GPS and biometric verification to ensure student discipline at State Junior High School 2 Satu Atap Sluke. The system combines GPS to record attendance at the school location with biometric verification to verify student identity. Data produced by these technologies will be more accurate, valid, and reliable. Therefore, the research questions are: What is the design of the digital attendance application? What are the validity and practicality of the product? How effective is the digital attendance application at SMP Negeri 2 Sluke?

■ METHOD

Participants

The participants in this study consisted of three expert validators in the fields of information technology and student affairs. These expert participants validated the application design and provided input during the evaluation phase following implementation of the digital attendance application. Participants consisted of 15 students, five from grade VII, five from grade VIII, and five from grade IX, out of a total of 70 students at the school, selected with multilevel and simple random sampling. The study period was from January 2025 to May 2025. In Research and Development (R&D), initial trials may involve 3-6 subjects. Field trials may involve 6-12 subjects (Borg & Gall, 1984). This is very common because the purpose of R&D is not generalization but rather expert validation, product revision, and field trials. The limited-scale trial included five participants, while the large-scale trial involved 15 participants. According to Arikunto (2013), small-group trials typically consist of 4 to 14 respondents, whereas large-group trials range from 15 to 50 respondents.

Research Design and Procedures

The design of this study followed a research and development (R&D) approach using the ADDIE model comprising five stages: analysis, design, development, implementation, and evaluation. ADDIE encompasses: 1) the analysis stage (problem identification as the basis to determine suitable solutions); 2) the design stage (designing the product blueprint); 3) the development stage (producing the research product); 4) the implementation stage; and 5) the evaluation

stage (Sugiyono, 2015).

The stages of the ADDIE model used in this research are described below. The first stage, analysis, involved identifying issues related to student attendance through teacher interviews and document reviews to assess the school's readiness for implementing digital attendance. The indicators examined included the current attendance system, expectations for a digital system, available facilities, technical support, and user suggestions. The second part, design, involved building a product prototype on the AppSheet platform to address the identified problems. The third phase, development, consisted of configuring the digital attendance application to include integrated GPS and biometric verification features. The product was later validated by media experts to see if additional features would be beneficial. The fourth stage, implementation, involved testing the application with selected participants and eliciting feedback from three experts: an information technology expert, a media expert, and a student affairs expert. These experts were selected using their qualifications, which included a minimum of a bachelor's degree and at least 10 years of professional experience. The final step is evaluation, which was done after the product trials to evaluate their limitations and effects. All stages were continuously evaluated using expert validation results and student questionnaire responses.

Instruments

Data collection was a crucial component of this research, as the primary goal was to gather field data (Sugiyono, 2015). The techniques used included interviews, questionnaires, observations, and document analysis. This research instrument consists of measures of product validity, practicality, and effectiveness. The instrument for testing the product's validity and practicality was developed by the researchers themselves, with reference to the proposed theory.

Expert validation covers eight assessment parameters, namely: functionality to find out whether the application can record attendance with GPS and biometric verification, GPS accuracy to find out whether the system can detect user location accurately, data security to find out whether attendance data is stored securely and encrypted, user interface to find out whether the application display is easy to understand and use, system performance to find out whether the application runs smoothly without significant technical constraints, compatibility to find out

whether the application can be run on various devices (Android/iOS), data integration to find out whether attendance data can be exported and integrated with other systems, and biometric reliability to find out whether biometric verification works well without significant constraints.

The product practicality test covers four aspects with 13 questions: ease of use, time and energy efficiency, reliability and accuracy, and technical support and readiness. The ease-of-use aspect includes the login process, the availability of guides, and the application's usability. Aspects of time and energy efficiency include the speed of use, the attendance process, and the speed of result recapitulation. The reliability and accuracy aspects aim to show the attendance location relative to the school location, apply only to each student's identity, and ensure attendance results are accurate and reliable. The technical support and readiness aspects show that the school provides facility support, provides quick assistance in the event of disruptions, and provides training before using the application.

Data Analysis

Data analysis consisted of several methods: expert validation using a four-point scale (1 = very poor to 4 = very good) and product practicality testing using a four-point scale (1 = very impractical to 4 = very practical). To assess the effectiveness of the digital attendance application, nonparametric statistics were used, namely the Wilcoxon test and Spearman's rank correlation. This non-parametric statistic was applied because the number of respondents was small and no prerequisite tests were carried out. The N-Gain test measures the effectiveness of digital

attendance by comparing pretest (before implementation) and posttest discipline scores.

RESULT AND DISCUSSION

The Design of The Digital Attendance Application

According to the ADDIE model, the research steps consist of analysis, design, development, implementation, and evaluation. Analyze stage. All teachers mentioned that student attendance is still recorded manually. This is corroborated by observation records and documentation. Attendance is recorded on paper. This manual attendance system is difficult to use, as teachers admitted it required significant time and effort. They hope that there will also be a change in attendance patterns as technology replaces traditional attendance.

Design stage

The initial stage involves building the system and designing its structure, the database, teacher and subject data, student names, and attendance data. Next, it builds the application flowchart, including logging in, entering attendance, and recording attendance. The application workflow involves (1) students logging into the application and selecting their student number, which automatically returns the name and class. Then, a photo is taken, and a sign that they have been there, and (2) attendance is automatically reported to the system, and a report is created. The next step is to create a storyboard that visually represents the application's interface exactly as it will appear on a smartphone. Next, we decide which technologies and features to integrate into our device (e.g., AppSheet and GPS) before we design that functionality.

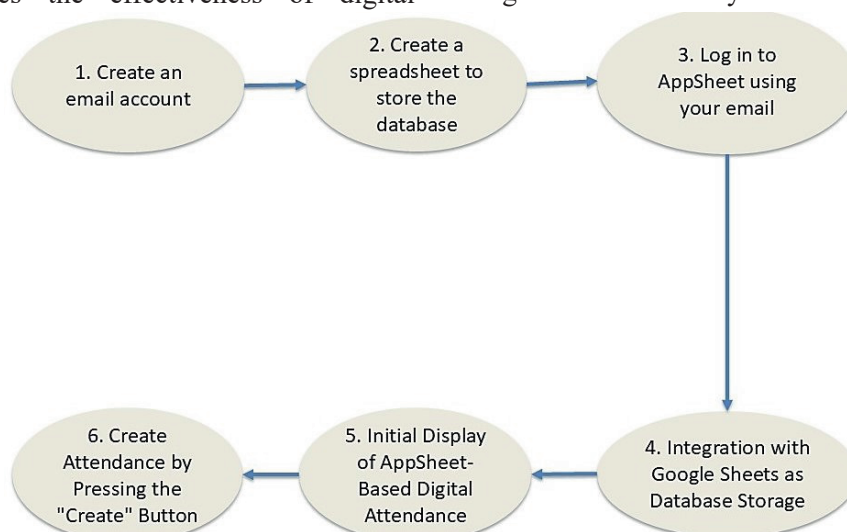


Figure 1. AppSheet-Based digital attendance design

The subsequent stage involves developing a storyboard, which serves as a visual outline of the application's interface as it will appear on a smartphone. After that, the technologies and features to be integrated, specifically AppSheet and GPS, are determined for implementation on the device. The key features of the application include: (1) a student data section containing the student identification number, name, and class; (2) a daily attendance system with options for present, excused absence, sick leave, and rejected (late) attendance; and (3) an automatic reporting interface that generates attendance summaries accessible to principals, teachers, homeroom teachers, and parents. The final step in this

stage is the evaluation process, which includes designing an expert validation instrument to assess the feasibility of the developed product. The storyboard design is illustrated in Figure 1.

The Validity and The Practicality of The Product

Development stage

After we have set up (developed) an account on Google Mail, which runs Google Sheets, create a Google Mail data file and an attendance sheet. Then it involves creating an AppSheet application with the data file and attendance sheet through the "create," "presensi", and student list buttons (Figure 2).

Figure 2. AppSheet initial design

Then the application developed on Appsheet was tested, which employs GPS (location) and biometric (signature) verifications. For example, the first page of attendance is a '+' sign to start attendance. The next page will list the attendance data entry page, where a date and time set to "today" appear and are not

editable. An additional student's registration number, status, photo, location, and signature are also shown. For instance, when clicking the student registration number, either their name and class are included automatically, or the word "description" is shown when a student is absent or sick. See Figure 3.

Figure 3. Display of name, class, and description

Students complete the attendance form as shown in Figure 4. This page includes the date, time, student ID number, name, class, status, location photo, and signature you filled in

earlier.

By now, two kinds of testing have been performed: product validity and product practicality. The validity test was conducted by

Figure 4. Attendance form display

three information technology specialists using a four-point Likert scale, with 1 indicating “very poor” and 4 indicating “excellent.” This validity test is conducted before the product trial is implemented with students.

The assessment parameters, which include eight criteria for measuring the instrument's validity, are explained in the research methods section. Based on the instrument validity test using this formula, the result was 98% (see Supplementary File). According to Akbar in Saputri et al. (2023), if the R&D instrument validity test falls within the range of 85.01%- 100%, the instrument is considered valid and can be used without revision.

In addition to completing a questionnaire for validity testing, the experts also provided feedback on the application being developed. The following is some of the expert feedback. The first expert supported a variety of devices, but she argued that it was important to include an account called admin. Another device, however, to create an admin account, you would need to have access to the user management system, and you need to include an email that will act as an attendance administrator on a different device. It must be added or an access link copied on top of it for easier integration. Secondly, a QR code can be used with an ID card to improve the efficiency and effectiveness of the attendance process, so it is proposed to be embedded in the student's ID card. Rather, a solution might be to convert a spreadsheet that holds all students' information into a single QR code. Schools could have given QR scanner-esque devices, ensuring that it does not make it difficult to get to school, and students cannot go to school using cell phones. Third, to separate data by

class and prevent mixing across classes, implement a class-based filter. One technique the IT teacher may use is to set the data for each class using the short-filter feature, thereby organizing and analyzing the attendance data more effectively. Meanwhile, the second IT expert found that the evaluation result was, first, to adjust the attendance description in the “Presence Rejected” column. This would involve changing the "presence rejected" column to "late" or another appropriate description option for a more accurate and comprehensive picture in the multilevel logic system. It was so that the information displayed more closely aligns with what was actually taken for given conditions and serves to increase accuracy and precision in the picture of attendance.

The second expert required that the main or front page could be transformed into an aesthetic, intuitive, and working design to enhance the user experience. Improved layout, a variety of visual elements, and the presentation of information were also featured. The aim was to improve user engagement and impression management.

The third expert proposed improving the user interface to make it easier for students to navigate and adding features for notifications and reminders about the attendance schedule. Secondly, the IT practitioner said that photos should be taken directly using the application's selfie feature, not by selecting a photo from the gallery. Also, to discourage students from using photos or images for jokes or other unnecessary reasons, the photos or images should be hidden by opening the view menu, selecting the absent option, then selecting the main image, and finally selecting the none option.

How effective is the digital attendance application?

Implementation Stage

The next step was to implement the product by testing it in real settings. Users of this application are students in levels VII, VIII, and IX. This application has been used for the last three months.

At this stage, a practical test of the product was conducted. The product's practicality test was conducted after expert validity testing confirmed the product was valid and testable. The practical aspects of the product have been explained in the methods section. The trial was conducted on 15 students. The practicality test results for the processed product were 92%. According to Nurhusain &

Hadi (2021), if $P > 90\%$, the product is very good and very practical to use.

Evaluation stage

The last stage was that of evaluation. This application was evaluated for performance using the Wilcoxon test, Spearman's correlation, and the N-Gain test. This evaluation involved 15 students.

Based on the data in Table 1, student attendance when recorded using digital attendance has increased. The average increase in digital presence compared to manual presence is 8 points.

Based on the Wilcoxon test results, a Z-value of -3.427 was obtained with an Asymp. Sig. (2-tailed) value of 0.001. Because the

Table 1. Results of the wilcoxon test

		N	Mean Rank	Sum of Ranks
Digital Attendance - Manual Attendance	Negative Ranks	0a	.00	.00
	Positive Ranks	15b	8.00	120.00
	Ties	0c		
	Total	15		

significance value is less than 0.05 ($0.001 < 0.05$), it indicates a statistically significant increase in student attendance with manual attendance compared to digital attendance. In accordance with the developed application, student discipline in this study was measured solely by students' punctuality in attending

school. Data were obtained by reviewing student attendance lists for the past three months. To determine the correlation between digital attendance use and student discipline, a nonparametric Spearman's Rho analysis was used. The result of Spearman's rho correlation analysis is summarized in Table 2.

Table 2. Result of the spearman rho correlation

		Digital Attendance	Discipline
Digital Attendance	Correlation Coefficient	1.000	.369
	Sig. (2-tail)	.	.176
	N	15	15
Discipline	Correlation Coefficient	.369	1.000
	Sig. (2-tail)	.176	.
	N	15	15

The results indicate that digital attendance is not a significant predictor of discipline since the sig. 2-tailed $0.176 > 0.05$, and it might be that other factors are the

stronger predictors of discipline outcomes.

A comparison of the pre-test results using manual attendance and the post-test results using digital attendance is shown in Figure 5.

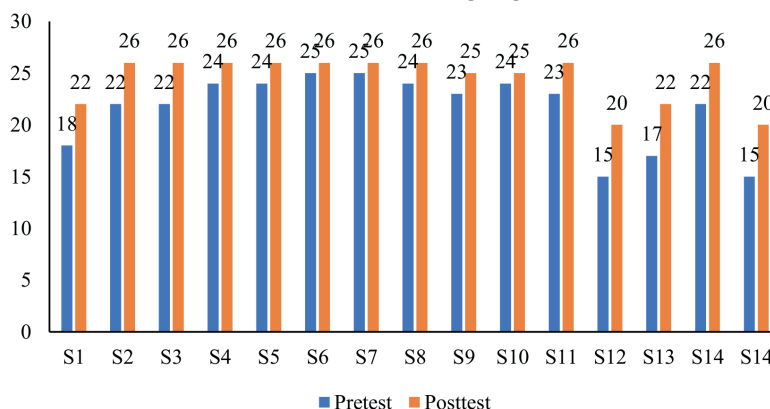


Figure 5. The result of pre-test and post-test

The results of the N-Gain test were collected from 15 students who took pre- and post-tests and are presented as follows. The lowest N-Gain score was 0.01, and the highest was 0.06, or an average N-Gain of 0.04, see

Figure 6. N-Gain scores <0.0 are considered low (Harianja, 2024). This result indicates that the improvement in student attendance discipline resulting from the implementation of the digital attendance system is limited.

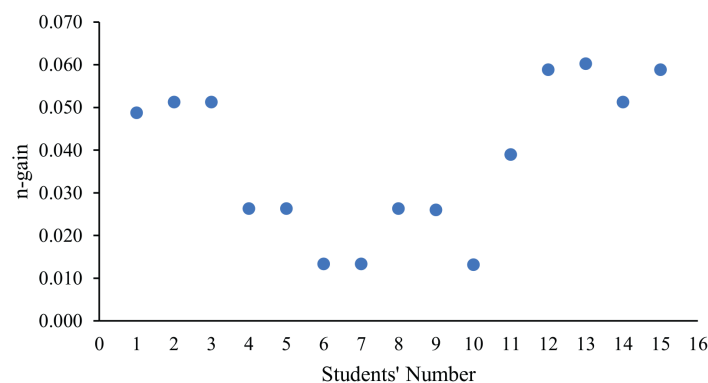


Figure 6. N-Gain result

This low improvement must be approached with discretion. These are preliminary findings given the small sample size, the lack of a control group, and non-significant regression results; therefore, we consider the relationship between digital attendance and student discipline to be potentially positive. To confirm these findings, more rigorous, larger-scale designs are necessary, including experimental studies, and more detailed analyses are required.

This paper advances the existing literature by using a no-code platform (AppSheet) that integrates GPS and biometric verification, enabling schools to implement these technologies easily and inexpensively. Comparative studies with Rizki and Setiawan (2024), Zulhidayati et al. (2024), and Ariyanti (2021) have similarities and differences. Although all studies are based on AppSheet and GPS-based verification, here we have set different goals: to develop, implement, and assess a digital attendance technology in a particular classroom setting.

The results indicate that the digital attendance system does not substantially affect student discipline. Teachers and principals cannot improve student discipline without involving parents. Improving student discipline requires collaboration between the school community and parents, especially in rural areas (Aulia & Ismail, 2025). Improving student discipline cannot rely solely on technology; more importantly, it is the students themselves and their environment. According to Noviekayati and Sandi (2025), student discipline is influenced by internal and external factors. Internal factors include character, motivation, and self-awareness. External

factors include the role of parents, teachers, and principals, as well as the community.

This indicates that despite digital attendance improving monitoring and accountability, it does not, in itself, substantially improve student discipline. Supportive policies, supervision, parental support, and learner motivation are likely to play a more salient role. Integration of digital attendance with broader behavioral and management approaches may lead to meaningful improvements in student discipline. Similarly, the findings of this study also show that the AppSheet-based digital attendance system offers significant practical benefits in managing student attendance.

Although the study results showed no significant effect of digital attendance on student discipline, the motivation from teachers and principals to ensure students arrive on time and comply with school regulations has gradually improved student discipline. It is hoped that this positive trend can be maintained to foster a culture of school discipline. These findings differ from those of previous studies (Smith, 2024).

Automatic notifications and real-time reporting tools help intervene for missing or late students at an early stage by generating alerts. These results, however, should be interpreted with caution because the statistical analysis did not yield a significant result. A positive trend, rather than conclusive evidence of effectiveness, is present, and more research with larger samples and stronger comparative research designs is required. Even though most students have smartphones to use the app, the system's effectiveness ultimately depends on the extent to which the school is

technologically prepared and connected to the internet.

Lack of internet access still makes it difficult for staff to use the system effectively, which is why technical training sessions are required to use it properly. This work focuses on designing an AppSheet digital attendance system that includes GPS and biometric verification tools to address attendance management and recording. Manual systems are cumbersome and susceptible to tampering, whereas GPS enables real-time, on-campus student verification, reducing attendance errors. Biometric checks, such as selfies or digital signatures, allow attendance data to better reflect a student, ensuring a more accurate representation of information and making the data more valid and reliable. The AppSheet application can automatically record attendance using QR codes and GPS, and it provides an integrated database of student information (registration number, name, class, attendance history).

The system offers user-friendly access, multi-device capability (smartphone, tablet, computer), and data security as its top priority. Google Sheets student data is restricted to authorized administrators and teachers, and only they can access or modify it. The AppSheet-based digital attendance system offers integrated, secure, and easy-to-use solutions that can be leveraged to better student discipline management. Aside from attendance capture, it also produces analytical reports that enable data-driven decision-making.

Expert review applied eight factors: ability to function, GPS precision, data safety, user interface, system performance, compatibility, data integration, and biometric accuracy. The validation from three experts yielded an average rating of 98%, indicating the product is “valid.” The practicality test, including ease of use, efficiency, reliability, and technical preparedness, provided a score of 1,384.62 out of 1,500 (92.31%), rated as “very good.” This outcome indicates that the product satisfies quality criteria in content, design, and features.

The Wilcoxon result mentions that the average increase in digital presence compared to manual presence is 8 points. This finding is consistent with previous studies (Haugom, 2022; Antunes et al., 2020), which found that digital technology enhances attendance and engagement in education (Lu & Cutumisu, 2022) and, ultimately, leads to better educational outcomes (Diab-Bahman et al., 2022). However, the simple linear regression analysis showed that digital attendance did not have a significant effect on student discipline at

the 95% confidence level. The effect was positive (but weak) with a regression coefficient of 0.33 and a p-value of 0.176 (>0.05).

The Spearman Rho test indicates no significant correlation between digital application use and student discipline; this may suggest that other factors have a greater impact. This result supports the findings of Diab-Bahman et al. (2022): improvements in attendance do not always lead to improvements in student discipline and achievement. However, the superiority test reveals greater efficiency and effectiveness with digital attendance than with manual attendance. Be wary of relying on these data as strong, conclusive proof of improvement.

Findings align with prior studies on web-based attendance and temperature monitoring systems (Mansor et al., 2022) and digital learning technologies (Haugom, 2022)—both of which showed that technology increases participation, efficiency, and monitoring. While Mansor's research analyzed web-based systems that aggregate health data, this study developed a GPS- and biometric-verification application on AppSheet to track attendance in real time at a junior high school. Pramesti & Febrianto (2024) also found that AppSheet-based attendance systems enhance the efficiency of teacher attendance in elementary schools. These studies, taken together, support the idea that digital systems improve accuracy, efficiency, and decision-making for attendance management. Prior studies also support the concept that biometric identification reduces such manipulation and enhances accuracy (Njoki, 2014; Rao, 2022). Studies by Aigbokhan et al. (2024) and Chukwude (2023) highlight the effectiveness of mobile and automated attendance systems in improving data accuracy and discipline management.

This research has certain limitations. The small sample size and the single-school setting of the present study limit the generalizability of the results. The short implementation duration may not have anticipated long-term behavioral variations. However, technical challenges such as unreliable internet connections or inconsistent device availability might also have limited the data's reliability. It also did not take into account other variables such as school policy, teacher leadership, and parent involvement. The lack of correlation between digital presence and student discipline suggests that multiple factors influence discipline outcomes. Additional confirmation of these outcomes would require ongoing multivariate analyses, larger sample sizes, longer follow-up periods, and more cross-cohort data collection.

Setting up a digital attendance system would be an attractive and leading solution for improving discipline among school students, driving digital transformation, and enhancing the quality of education.

■ CONCLUSION

In this study, an AppSheet-based digital attendance system with GPS and biometric verification is shown to improve student attendance. However, this application has not improved students' discipline. Digital applications are tools that cannot, on their own, improve student discipline without additional support. The role of teachers, principals, parental support, and the student environment are factors that can influence the formation of student discipline. Collaboration among various educational stakeholders in student discipline is necessary.

■ DECLARATION OF GENERATIVE AI IN THE WRITING PROCESS

During the writing of this manuscript, the authors employed Google Translate to assist with language refinement. The authors have reviewed and edited the content generated by this tool and assume full responsibility for the content of the published article.

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■ REFERENCES

- Abdullah, S. B. (2025). Applications in determining whether a point located by the Global Positioning System (GPS) lies inside a polygon using the Ray casting algorithm Amidst Digital Transformation in Saudi Arabia. *Journal of health and social behaviour*.
- Aigbokhan, E. E., Adigun, J. O., Lawal, O. N., Okikiola, F. M., Onadokun, I. O., & Oladiboye, E. O. (2024). Mobile attendance system using gps and facial authentication. *Anchor University Journal of Science and Technology*, 4(2), 132–145. <https://doi.org/10.4314/aujst.v4i2.3>
- Alsaadi, I. M. (2021). Study on the most popular behavioral biometrics, advantages, disadvantages, and recent applications: A review. *Int. J. Sci. Technol. Res*, 10(1), 15–22. <https://doi.org/10.13140/RG.2.2.28802.09926>
- Al-Husain, Prastian, A. H. A., & Ramadhan, A. (2017). *Perancangan sistem absensi online menggunakan android guna mempercepat proses kehadiran karyawan pada pt. Sintech berkah abadi. Technomedia Journal (TMJ)*, (2), 116–127. <https://doi.org/10.5281/zenodo.1250308>
- Antunes, F. R., Pina-Oliveira, A. A., Apostolico, M. R., & Puggina, A. C. G. (2020). Motivation of classroom attendance students for the use of digital technologies in online courses. *Revista Gaucha de Enfermagem*, 41, 1–12. <https://doi.org/10.1590/1983-1447.2020.20190289>
- Arikunto, S. (2013). *Prosedur Penelitian: Suatu Pendekatan Praktik* (15th ed.). Rineka Cipta.
- Ariyanti, G. (2021). *Perancangan Sistem Absensi Siswa Menggunakan Aplikasi Appsheet pada MDTA Attawakkal* [Design of Student Attendance System Using Appsheet Application at MDTA Attawakkal]. *Jurnal Teknik Informatika Unika St. Thomas (JTIUST)*, 6 (2), 367–372. <https://doi.org/10.54367/jtiust.v6i2.1553>
- Aulia, S. P., & Ismail, I. (2025). Teachers' role in shaping student discipline in the digital era: a case study of sd 105438 paya lombang. *Journal of General Education and Humanities*, 4(3), 1263–1276. <https://doi.org/10.58421/gehu.v4i3.650>
- Banoğlu, K., Vanderlinde, R., Çetin, M., & Aesaert, K. (2023). Role of school principals' technology leadership practices in building a learning organization culture in public k-12 schools. *Journal of School Leadership*, 33(1), 66–91. <https://doi.org/10.1177 / 10526846221134010>
- Belle, L. J. (2016). The role of principals in maintaining effective discipline among learners in selected Mauritian state secondary schools: An education management model. *University of South Africa (South Africa) ProQuest Dissertations & Theses*, 2016. 32054515. <https://www.proquest.com/openview/50318f7a9187e65d7045dfcc07b6add7/1?pq-origsite=gscholar&cbl=2026366&diss=y>
- Bondugula, V., Thummanapelli, S., Yadagiri, S., & Kumari, A. (2025). Advancements in student attendance management: A facial recognition-based system. *AIP Conference Proceedings*, 3297(1),

060012. <https://doi.org/10.1063/5.0294678>
- Borg, W. R., & Gall, M. D. (1984). Educational research: An introduction. *British journal of educational studies*, 32(3). <https://doi.org/10.2307/3121583>.
- Chukwude, O. M. (2023). Development of face recognition-based attendance system. *SLU Journal of Science and Technology*, 6(1 & 2), 214–224. <https://doi.org/10.56471/slujst.v6i.362>
- Diab-Bahman, R., Al-Enzi, A., Sharafeddine, W., & Aftimos, S. (2022). The effect of attendance on student performance: implications of using virtual learning on overall performance. *Journal of Applied Research in Higher Education*, 14(3), 1175–1192. <https://doi.org/10.1108/JAR-HE-04-2021-0135>
- Harianja, M. R., Yusup, M., & Siahaan, S. M. (2024). Uji N-Gain pada efektivitas penggunaan game dengan strategi SGQ untuk meningkatkan berpikir komputasi dalam literasi energi [N-Gain test on the effectiveness of using games with SGQ strategy to improve computational thinking in energy literacy]. *Jurnal Intelektualita: Keislaman, Sosial dan Sains*, 13(2), 303–310. <https://doi.org/10.19109/intelektualita.v13i2.25168>.
- Haugom, E. (2022). The effect of changing from campus-based to digital teaching on student attendance: A case study of Norwegian business students. *Heliyon*, 8(11), 1–5. <https://doi.org/10.1016/j.heliyon.2022.e11307>
- Hulu, B. M., & Larosa, Y. M. (2025). Analysis of the implementation of online attendance on civil servant discipline. *Research Horizon*, 5(5), 1881–1892. <https://doi.org/10.54518/rh.5.5.2025.786>.
- Ihsan, M. Z. (2018). Peran konsep diri terhadap kedisiplinan siswa [The role of self-concept in student discipline]. *NALAR: Jurnal Peradaban dan Pemikiran Islam*, 2(1), 1–11. DOI: <https://doi.org/10.23971/njppi.v2i1.915>.
- Inayah, S., & Maburi, A. H. (2024). Real-Time attendance and discipline monitoring through evocard. *Proceedings of International Conference on Education, Society and Humanity*, 02(02), 586–592. <https://ejournal.unuja.ac.id/index.php/icesh/article/view/10130/3796>
- Kearney, C. A., González, C., Graczyk, P. A., & Fornander, M. J. (2019). Reconciling contemporary approaches to school attendance and school absenteeism: Toward promotion and nimble response, global policy review and implementation, and future adaptability (Part 1). *Frontiers in Psychology*, 10, 2222. <https://doi.org/10.3389/fpsyg.2019.02605>.
- Khoiriyah, N. L., Marisa, F., & Wijaya, I. D. (2018). Rancang bangun sistem presensi online berbasis granted validitas data [design and construction of an online attendance system based on granted data validity]. *JIMP-Jurnal Informatika Merdeka Pasuruan*, 3(1), 53–61. <https://doi.org/10.37438/jimp.v3i1.89>
- Lijun, W., & Te, H. C. (2024). The role of primary school principals and administrators in promoting student achievement, teacher effectiveness, and a positive school culture. *Journal of Roi Kaensarn Academi*, 9(8), 727–739. <https://so02.tci-thaijo.org/index.php/JRK-SA/article/view/272236>
- Lu, C., & Cutumisu, M. (2022). Online engagement and performance on formative assessments mediate the relationship between attendance and course performance. *International Journal of Educational Technology in Higher Education*, 19(1), 1–23. <https://doi.org/10.1186/s41239-021-00307-5>
- Mansor, N. S., Awang, H., Ndanusa, A. B., Idris, R., & Shahatha Al-Mashhadani, A. F. (2022). Design and development of attendance and temperature recording system: a smart companion for the current vle implementation in Malaysian schools. *Proceedings 2022*, 82, 111., 1–9. <https://doi.org/10.3390/proceedings2022082111>
- Maulana, R. M., Sudur, M., Wilantara, R. A., As'ari, A. F., & Suparto, A. A. (2024). Implementation and impact of digital absence in education. *Journal of Research, Review and Educational Innovation*, 2(3), 147–154. <https://doi.org/10.47668/jrrei.v2i3.1605>
- Nasution, W. A., Siahaan, A., & Hasibuan, B. (2025). Principal's leadership in forming student discipline. *Jurnal Kependidikan Islam*, 6(1), 111–122. <https://doi.org/10.54150>
- Nasywa, D. A., Syabani, R. A., & Malikhah, N. (2025). The effectiveness of google form-based digital attendance in improving student discipline in educational settings. *INTEGRATIA: Journal of Education, Human Development, and Community Engagement*, 3(1), 52–60. <https://doi.org/10.71155/integratia.vXiX.X>.
- Njoki, W. S. (2014). *Biometrics class attendance management system*. University of Nairobi.
- Noviekayati, I. G. A. A. & Sandi, F. F.

- (2025). Factors determining student discipline: a systematic literature review. *International Journal of Research and Innovation in Social Science (IJRISS)*, 9(11). <https://doi.org/10.47772/IJRISS.2025.91100216>
- Nurhusain, M. & Hadi, A. (2021). *Desain pembelajaran statistika terapan berbasis kasus berkualitas baik (valid, praktis, dan efektif) untuk mahasiswa pendidikan matematika* [good quality (valid, practical, and effective) case-based applied statistics learning design for mathematics education students], *Indonesian Journal of Educational Science (IJES)*, 3(2), pp. 105–119. <https://doi.org/10.31605/ijes.v3i2.951>.
- Pabalik, L., Mediatati, N., & Nusarastraya, Y. H. (2023). The relationship between learning discipline and learning achievement students in civics subjects. *JMKSP (Jurnal Manajemen, Kepemimpinan, Dan Supervisi Pendidikan)*, 8(1), 351–364. <https://doi.org/10.31851/jmksp.v8i1.11938>
- Pramesti, S., & Febrianto, P. T. (2024). *Implementasi sistem absensi digital untuk meningkatkan efisiensi pencatatan kehadiran guru di sekolah dasar* [implementation of a digital attendance system to improve the efficiency of teacher attendance recording in elementary schools]. *JATI (Jurnal Mahasiswa Teknik Informatika)*, 8(2), 2429–2434. <https://doi.org/10.36040/jati.v8i2.9521>
- Rao, A. (2022). AttenFace: A real-time attendance system using face recognition. *IEEE 6th Conference on Information and Communication Technology (CICT)*, 1–5. <http://arxiv.org/abs/2211.07582>
- Rebore, R. W. (2011). *The essentials of human resources administration in education*. Pearson Higher Ed.
- Rizki, A. M., & Setiawan, D. L. (2024). *Penerapan sistem informasi kehadiran siswa menggunakan aplikasi appsheet berbasis android* [implementation of student attendance information system using android-based appsheet application]. *(JATI) Jurnal Mahasiswa Teknik Informatika*, 8(5), 10704–10712. <https://doi.org/10.36040/jati.v8i5.11102>
- Rodriguez, L. A., & Welsh, R. O. (2022). The dimensions of school discipline: toward a comprehensive framework for measuring discipline patterns and outcomes in schools. *AERA Open*, 8, 1–23. <https://doi.org/10.1177/23328584221083669>
- Saputri, D.; Mellisa; Hidayati, N.; Fauziah, N. (2023). *Lembar validasi: instrumen yang digunakan untuk menilai produk yang dikembangkan pada penelitian pengembangan bidang pendidikan* [validation sheet: an instrument used to assess products developed in educational development research]. *Biology and Education Journal*, 3(2) tahun 2023: 133–151. <https://journal.uir.ac.id/index.php/baej/article/view/15347>.
- Seyfarth, J. T. (2002). *Human resources management for effective schools*. Allyn & Bacon/Longman Publishing, a Pearson Education Company, 1760 Gould Street, Needham Heights, MA 02494. <http://www.abacon.com>.
- Smith, J. (2024). Attendance school: a qualitative study exploring principals' strategies for enhancing attendance. trident university international. *ProQuest Dissertations & Theses*, 2024. 31558862. <https://www.proquest.com/openview/f48f28e7400e105db9094ee5afffb482/1?pq-origsite=gscholar&cbl=18750&diss=y>
- Sugiyono. (2015). *Metode penelitian kuantitatif kualitatif dan R&D*. In CV. Alfabeta, Bandung.
- Syahidi, F., Subasman, I., Aspandi, A., & Khotimah, M. D. (2025). Enhancing efficiency in student attendance recording through implementation of a digital presence system: a field study in elementary schools. *EDUKASIA Jurnal Pendidikan dan Pembelajaran*, 6(2), 1339–1352. <https://doi.org/10.62775/edukasia.v6i2.1772>
- Wirantasa, U. (2017). *Pengaruh kedisiplinan siswa terhadap prestasi belajar matematika* [The influence of student discipline on mathematics learning achievement]. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 7(1). <http://dx.doi.org/10.30998/formatif.v7i1.1272>.
- Yunesa, V., & Khaidir, A. (2019). Factors influencing students' discipline character building. *Advances in Social Science, Education and Humanities Research, Volume 178*, 271–275. <http://creativecommons.org/licenses/by-nc/4.0/>
- Yusuf, N., Marafa, K. A., Shehu, K. L., Mamman, H., & Maidawa, M. (2020). A survey of biometric approaches of authentication. *International Journal of Advanced Computer Research*, 10(47), 96–104. <http://dx.doi.org/10.19101/IJA CR.2019.940152>.