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Cloud-Integrated Offline-First HTML Attendance System for Classroom Administrative Efficiency

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Abstract

The administration of student attendance in elementary schools frequently encounters challenges related to the physical vulnerability of documents and inadequate network infrastructure. This study aims to describe the development of an offline-first, HTML-based digital classroom attendance system integrated with cloud storage (Google Sheets) via Human-AI collaborative programming using Gemini AI. Furthermore, it evaluates the system's practicality and efficacy in reducing the administrative burden on teachers at SDN Cangkringrembang. Employing a Research and Development (R&D) methodology anchored in the ADDIE procedural framework (Analysis, Design, Development, Implementation, Evaluation), the instrument was developed and pilot-tested in Grade 3B. Practicality testing involving six peer elementary school teachers yielded a feasibility score of 94.17%, categorizing the system as "Highly Practical." The implementation significantly curtailed the monthly attendance recapitulation time from 30–45 minutes to mere seconds through automated processing. Crucially, the offline-first architecture leveraging browser Local Storage ensured seamless attendance tracking in classrooms with Wi-Fi blind spots, enabling reliable data synchronization via personal cellular networks at zero operational cost.

Keywords: Digital Attendance, Offline-First, Google Apps Script, Teacher Workload, Human-AI Collaboration.

Introduction

Student attendance is a crucial indicator in classroom management, closely linked to discipline, participation monitoring, and evaluating instructional effectiveness at the elementary level. Accurate attendance tracking allows educators to monitor student consistency and serves as a foundation for administrative decision-making and performance reporting. However, in practice, attendance administration remains dominated by conventional methods utilizing physical logbooks. In areas with specific geographical or infrastructural constraints, this paper-based data management exhibits high vulnerability to physical damage and temporal inefficiency (Fitriati et al., 2023). The heavy administrative workload imposed on classroom teachers often detracts from the focus and time that should ideally be allocated to lesson preparation and pedagogical interactions (Aulia et al., 2024).

Based on observations and empirical experience at SDN Cangkringrembang, classroom administrative governance faces systemic hurdles that impede teacher performance. The high risk of physical document vulnerability is a primary issue; attendance books are frequently misplaced, lost, or suffer fatal damage from floods, resulting in the permanent loss of student records. Furthermore, temporal inefficiency occurs during the daily-to-monthly data recapitulation process, consuming approximately 30 to 45 minutes of a teacher's productive time per class—a problem that can be effectively mitigated through automated digital recording (Aulia et al., 2024; Prasetia et al., 2024). Attempts to digitalize using commercial attendance applications are often impractical due to unstable school wireless networks that fail to cover all classrooms (blind spots). These infrastructural limitations necessitate an independent, flexible tool that remains securely integrated with a cloud database (Fitriati et al., 2023).

Responding to these constraints, there is a pressing need for an attendance instrument that adapts to the infrastructural realities of elementary schools. This spirit of innovation aligns with recent local government policies, specifically the Technical Guidance (Bimtek) on Enhancing Innovative Teaching Competencies based on AI and Coding for Elementary Teachers (Demak District Education and Culture Office, 2026). This program explicitly emphasizes the urgency of utilizing Artificial Intelligence (AI) and foundational programming (Coding) to solve practical classroom problems. As a concrete follow-up, the researcher explored Human-AI collaboration utilizing a Large Language Model (LLM) to precisely design a digital administrative tool. Integrating AI into programming offers a significant opportunity for teachers without formal technological backgrounds to act as software innovators for classroom support (Musdalifa et al., 2024).

This study aims to develop an independent, HTML-based attendance system adopting an offline-first architecture. The system leverages Local Storage within the web browser, enabling teachers to record attendance without internet connectivity. It then automatically synchronizes data to a cloud database (Google Sheets) via Google Apps Script (GAS) once the device reconnects to a network (Hamdani et al., 2024). This solution offers novelty in data security against physical damage, instant recapitulation efficiency, and zero-cost implementation by optimizing the existing digital learning account ecosystem (Hamdani et al., 2024). Therefore, this Research and Development (R&D) study focuses on describing the system development process through Human-AI collaborative programming, assessing system feasibility based on peer evaluations, and measuring its effectiveness in reducing educators' administrative workload.

Method

This study employs a Research and Development (R&D) approach adopting the ADDIE procedural framework, which encompasses Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). This systematic procedure was selected for its high relevance in producing functional applied technology products that support educational administration efficiency (Sugiyono, 2019).

The analysis phase commenced with mapping administrative constraints in the classroom, specifically concerning the vulnerability of physical attendance books to natural disasters and the lack of school wireless network (Wi-Fi) coverage in classrooms. In the design phase, a responsive User Interface (UI) was architected and specifically optimized for smartphone screens to facilitate educator mobility while taking attendance directly at students' desks.

The development phase was executed through an iterative engineering approach based on Human-AI collaboration using Gemini AI (Musdalifa et al., 2024). The researcher conducted a series of iterative revisions to the HTML5, CSS3, and JavaScript code to produce an intuitive, single-click operation system. This process also included the integration of the Google Apps Script Application Programming Interface (API) to ensure secure data flow to Google Sheets as the cloud-based database storage (Google Apps Script Documentation, 2025).

Subsequently, during the implementation phase, the system was actively deployed by the researcher using a personal smartphone during teaching and learning activities in Grade 3B of SDN Cangkringrembang. Network infrastructure constraints were overcome by automatically synchronizing data in real-time utilizing a personal cellular data connection. The final evaluation phase measured comparative recapitulation time efficiency and assessed practicality feasibility through a Likert-scale peer validation questionnaire. The collected data were then analyzed descriptively to confirm the significance of the reduction in educators' administrative workload. The small-group trial subjects involved 6 classroom teachers at SDN Cangkringrembang who experience similar administrative workloads.

Results and Discussion

The development of this HTML-based digital attendance instrument via a Human-AI collaboration approach resulted in an administrative web app that operates optimally on smartphone interfaces (Ardiansyah & Toyib, 2024). The development outcomes highlight a responsive, student card-based visual design, allowing educators to modify attendance status—namely Present, Excused, Sick, and Absent—through a single-click mechanism. Functionally, the offline-first architecture built utilizing browser Local Storage proved successful in maintaining attendance record persistence without relying on direct internet connection stability (Fitriati et al., 2023).

System implementation in a real classroom environment demonstrated a highly significant increase in educator administrative efficiency. Based on actual usage trials during teaching and learning activities, the attendance recording process can be executed instantly and comprehensively. Infrastructure limitations, such as the absence of school Wi-Fi coverage in the classroom, were smoothly overcome; data synchronization to the cloud database (Google Sheets) was executed precisely through the Google Apps Script (GAS) interface utilizing the teacher's personal cellular data connection (Hamdani et al., 2024).

Regarding reporting time efficiency, this system provides a positive disruption to the educator's workload. Monthly attendance recapitulation, which in the conventional method consumed between 30 and 45 minutes of productive time for manual calculation, is now radically reduced (Aulia et al., 2024; Prasetia et al., 2024). Data calculation and accumulation are executed automatically by the system, allowing educators to download a comprehensive recapitulation in spreadsheet format within seconds. Furthermore, in terms of information security and integrity, this administrative digitalization effectively eliminates the physical vulnerabilities inherent in paper-based recording methods (Fitriati et al., 2023). Student attendance records are permanently integrated into cloud storage, thereby protected from the risks of document loss, misplacement, or fatal damage due to incidental physical environmental factors like flooding.

The product evaluation phase was conducted through a practicality test involving six classroom teachers as practitioners and end-users at SDN Cangkringrembang. Quantitative data

were obtained through a Likert-scale validation instrument (1-5) comprising 12 assessment indicators. The recapitulation of the assessment data tabulation is presented in Table 1 below:

Table 1. *The recapitulation of the assessment data tabulation*

Assessment Indicators	R1	R2	R3	R4	R5	R6	Score
1. The system interface looks clean and professional.	5	5	5	5	5	5	30
2. Status colors are easily distinguishable.	5	5	5	5	4	5	29
3. Student name layout is neat and easy to read.	5	5	5	5	5	5	30
4. The system is easy to run without complex installation.	4	5	5	4	5	5	27
5. The "single-click" feature aids teacher speed.	5	4	4	5	5	4	27
6. Date selection via the calendar functions accurately.	5	5	5	5	5	5	30
7. Local storage keeps data safe in the browser.	4	4	5	4	5	5	27
8. Google Sheets integration is accurate and synchronized.	5	4	5	4	5	5	28
9. Excel recapitulation export facilitates archiving.	4	5	5	5	5	5	29
10. Reduces the burden of monthly attendance recapitulation	4	4	4	5	4	4	25
11. Offline-First technology is suitable for elementary schools.	5	5	5	5	4	5	29
12. The system is viable for permanent use (replacing manual methods).	4	4	4	5	5	5	28
Total Actual Score	**54**	**55**	**57**	**54**	**57**	**58**	**339**

To determine the feasibility percentage of the digital attendance system's practicality level, the following score calculation formula was used:

$$\mathbf{P = (\Sigma X / \Sigma M) \times 100\%}$$

Where ΣX is the total actual score obtained (339) and ΣM is the maximum ideal total score (6 respondents × 12 indicators × maximum score of 5 = 360). Based on this formula, the practicality value obtained is:

$$\mathbf{P = (339 / 360) \times 100\% = 94.17\%}$$

The percentage calculation result shows a value of **94.17%**, which places this innovation in the "**Highly Practical**" criteria range, making it highly feasible for permanent application in classroom administration activities.

Beyond quantitative data, this testing also gathered essential qualitative feedback from practitioners for continuous system refinement. Generally, the system implementation received full support, as affirmed by a respondent who recommended that this HTML-based system be continuously developed institutionally at the school to assist teachers in managing classroom administration (Respondent 4).

Alongside positive responses, there were several constructive findings for product evaluation. Operationally, it was noted that the system is highly dependent on a single physical device (smartphone), which poses a potential constraint if the educator's device is left behind (Respondent 3). Regarding interface development and data processing, practitioners suggested adding formula algorithms to automatically calculate monthly attendance recapitulations, as well as providing specific interactive option buttons in the student remarks section (Respondent 2). Furthermore, on the document output aspect, the visual layout of the exported Excel document format was deemed to still require refinement to look visually neater and print-ready (Respondent 1). These empirical inputs prove that the digital attendance system possesses highly promising feature expansion room for future research and development.

Conclusion

Based on the research and development conducted, it can be concluded that the offline-first HTML-based digital classroom attendance system was successfully developed through Human-AI collaborative engineering. The system architecture, integrated with the Google Apps Script interface, proved reliable in synchronizing data to the cloud database (Google Sheets) without requiring additional server costs. The implementation of this system was deemed significantly effective in reducing educators' administrative workload, with peer practicality testing yielding a feasibility level of 94.17% (Highly Practical). This innovation successfully accelerates the data recapitulation process, which previously took 30 to 45 minutes manually, to mere seconds automatically.

Referring to the field evaluation and user feedback, there are several crucial recommendations for further research development:

1. Refining the source code for the export feature so that the data layout on the Excel spreadsheet output is visually neater and ready for direct printing.
2. Adding a calculation algorithm containing automatic summation formulas for monthly attendance recapitulation, and expanding specific interface button options for the student remarks column.
3. Developing account identity-based system synchronization capabilities (not just device browser Local Storage) to minimize operational risk constraints when the teacher's primary physical device is unavailable.

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