

Development of a Multi-Role Monitoring System for Teaching Factory (TEFA) Activities Using an Electron-Based Desktop Application

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ABSTRACT:

Teaching Factory (TEFA) requires structured and transparent monitoring to ensure that vocational students can conduct practical learning effectively. However, manual management often leads to issues such as inaccurate attendance tracking, delayed assessment input, unstructured job distribution, and inconsistent reporting. To address these problems, this study develops a desktop-based TEFA monitoring system designed specifically for lecturers and students. The system offers role-based dashboards that support real-time attendance monitoring, practical assessment management, jobdesk handling, and activity reporting. This study adopts a Research and Development (R&D) approach, starting from requirement analysis, interface design, prototyping, implementation using Electron, and initial testing with dummy data. Early results show that the system successfully delivers an intuitive user experience and improves the organisation of TEFA activities, even though real-time backend integration has not yet been implemented. The next development phase involves connecting the system to a live database, enabling real-time data processing and full operational deployment within TEFA environments.

Keywords: Teaching Factory (TEFA), monitoring system, jobdesk, desktop application, Electron..

1. Introduction and Literature Review

1.1 Background

Teaching Factory (TEFA) is designed to simulate real industry practices within a vocational education environment, allowing students to experience structured, hands-on work processes. As Sudira (2018) explains, vocational learning in the twenty-first century must be grounded in authentic production activities that mirror professional standards, and TEFA is precisely the model that operationalizes this principle. Kuswantoro (2014) further describes TEFA as a learning framework that integrates entrepreneurial values and planned production targets into daily student activities, making structured documentation and monitoring a core requirement of its implementation. However, despite the practical nature of TEFA, many institutions still rely on manual methods to record attendance, distribute jobdesk tasks, store assessments, and collect daily reports. These manual practices often lead to inconsistencies, misplaced records, unclear task distribution, and delays in evaluating student performance. As TEFA activities take place almost every day, even small inefficiencies can accumulate and disrupt the overall learning flow.

In most TEFA settings, students must complete multiple operational steps—checking in, understanding their daily tasks, submitting activity reports, and tracking their assessments—while lecturers must supervise all of these processes simultaneously. Without a centralized digital system, both parties tend to rely on fragmented tools such as paper forms, chat messages, or spreadsheets, all of which are prone to error and difficult to maintain over time. This gap creates a genuine need for a simple monitoring tool that can organize these activities into a consistent and reliable workflow.

This study develops a desktop-based TEFA monitoring system using Electron, focusing on practicality rather than complexity. The aim is not to redesign TEFA procedures but to support existing routines with a cleaner, more structured digital format. By separating interfaces for

lecturers and students, the system ensures that each user interacts only with features relevant to their responsibilities. Students can manage attendance, view tasks, and submit reports, while lecturers can monitor attendance, evaluate jobdesk completion, input assessments, and review student submissions.

The introduction of this system is expected to streamline daily TEFA operations and minimize the administrative burden on both sides. Although the current version still uses dummy data, the prototype provides a foundation for future integration with real-time databases and automated data processing.

1.2 Literature Review

Research on monitoring systems in vocational education has been carried out in various contexts, especially in environments where practical activities take place almost every day. Several studies indicate that the effectiveness of practice-based learning depends heavily on how consistently attendance, task execution, and performance assessments are recorded.

Previous works highlight recurring issues in manual monitoring processes. For example, Rahmawati (2018) reported that attendance in practice sessions is often inaccurate because it is recorded after the session ends, which reduces data reliability. Similar findings were presented by Simanjuntak and Yusuf (2020), who noted that delays in updating practical assessments cause inconsistencies in evaluating student performance.

In terms of jobdesk or task assignment, Wijaya (2019) observed that many vocational programs still rely on verbal instructions or informal communication. As a result, students do not have a clear record of what tasks they are responsible for each day, which becomes problematic when they need to prepare final reports or justify their workload.

On the technology side, recent studies show a growing interest in lightweight desktop applications built from web technologies. Arora and Singh (2019) conducted a systematic review

of cross-platform development tools and found that frameworks bridging web and desktop environments consistently outperform native alternatives in development speed and maintainability for institutional applications. Building on this, Sari and Nugroho (2021) discussed how Electron specifically provides a practical option for educational institutions that want cross-platform desktop applications without the complexity of native development. Electron is often viewed as a bridge between modern web development and desktop deployment, making it suitable for rapid development in educational contexts.

With regard to Teaching Factory (TEFA), most existing research focuses on curriculum models or the alignment between educational practices and industry workflows. Only a small number of studies explore the operational side of TEFA, particularly the daily monitoring of student activities. Hendrawan et al. (2022) argued that TEFA effectiveness depends not only on its industry-simulated model but also on how well student activity data is managed throughout the program.

From these studies, several gaps become apparent: manual monitoring in TEFA environments is still inefficient; key components such as attendance, assessments, and jobdesk documentation require digital support; Electron-based apps offer a relevant and flexible technological solution; and there remains limited research on practical, day-to-day monitoring tools specifically designed for TEFA routines. These gaps form the basis for the system developed in this study: a monitoring tool that reflects the actual operational needs of TEFA activities, rather than merely serving as a theoretical prototype.

2. Methodology

This study uses a Research and Development (R&D) approach, focusing on producing a working software system that can be tested and evaluated. This approach follows the R&D framework established by Borg and Gall (2003), which emphasizes iterative cycles of analysis,

design, development, and testing to produce validated educational products. In the Indonesian vocational research context, this framework is further operationalized through the stages outlined by Sugiyono (2019), which include requirement identification, prototype development, and formative evaluation as sequential steps toward a deployable system.

2.1 Requirement Analysis

Key problems identified include: inaccurate or hard-to-track attendance data; delays in recording assessments; inefficient jobdesk assignment; and unstructured performance reports. From these issues, core features were defined for both lecturers and students.

2.2 System Design

Design processes included: UI/UX design for both role-based dashboards; navigation flow: login → dashboard → feature modules; mockup creation using Figma for interface visualisation; and planning of components such as attendance, jobdesk, reports, and assessments.

2.3 Implementation

The application was developed using Electron, with HTML/CSS/JavaScript as core technologies; Main.js and Preload.js for module communication and security; dummy data used for simulation of real conditions; and fully interactive dashboards for both roles. This web-on-desktop approach aligns with the lightweight application model described by Serrano et al. (2014), who demonstrated that embedding web technologies within a desktop shell produces responsive, maintainable interfaces well-suited for institutional tools with limited IT resources.

2.4 Testing

Initial testing focused on: navigation from login to each dashboard; functional behaviour of attendance, jobdesk, report submission, and assessments; and UI responsiveness and interactivity.

2.5 Evaluation

Evaluation was performed through usability observations involving both user roles, identifying improvements for navigation flow, layout clarity, and feature responsiveness.

2.6 Future Backend Integration

A real database will be integrated to handle: real-time attendance; secure assessment data; automatically updated jobdesk; and live report submission and feedback.

3. Results

3.1 System Overview

The TEFA monitoring system is structured around a role-based interface, separating the lecturer and student dashboards to reflect the different responsibilities in daily TEFA activities. This separation ensures that each user only interacts with the features relevant to their workflow, reducing confusion and making the system easier to adopt.

Lecturer Dashboard. The lecturer dashboard serves as the central workspace for supervising student performance. The attendance module provides a clear overview of student check-ins and check-outs, enabling lecturers to quickly identify absences or irregular patterns. The assessment module allows lecturers to record practical evaluations directly in the system, reducing delays and inconsistencies often found in manual grading. Jobdesk monitoring displays student task completion in a structured format,

giving lecturers a straightforward way to track progress. The performance report section compiles student activity submissions, allowing lecturers to review their work without relying on scattered documents or multiple communication channels.

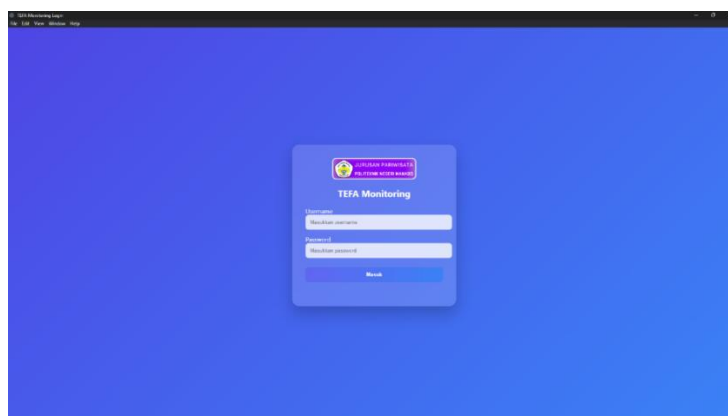
Student Dashboard. The student dashboard focuses on routine actions that students perform daily. The attendance feature allows quick check-in and check-out with minimal input. The task viewing module provides students with a clear list of assigned jobdesk items, helping them stay organized and aware of their responsibilities. Through the activity reporting module, students can submit structured daily summaries of their progress, reducing variation in reporting formats. The assessment viewing feature increases transparency by giving students easy access to their practical evaluation results.

Overall, the system digitizes and streamlines activities that previously relied on manual recording, verbal instructions, or inconsistent documentation. By offering simple, role-specific dashboards, the application supports more organized TEFA operations and lays the groundwork for a future version with real-time database integration and automated data processing.

3.2 Interface Results

Including the following illustrations (placeholder):

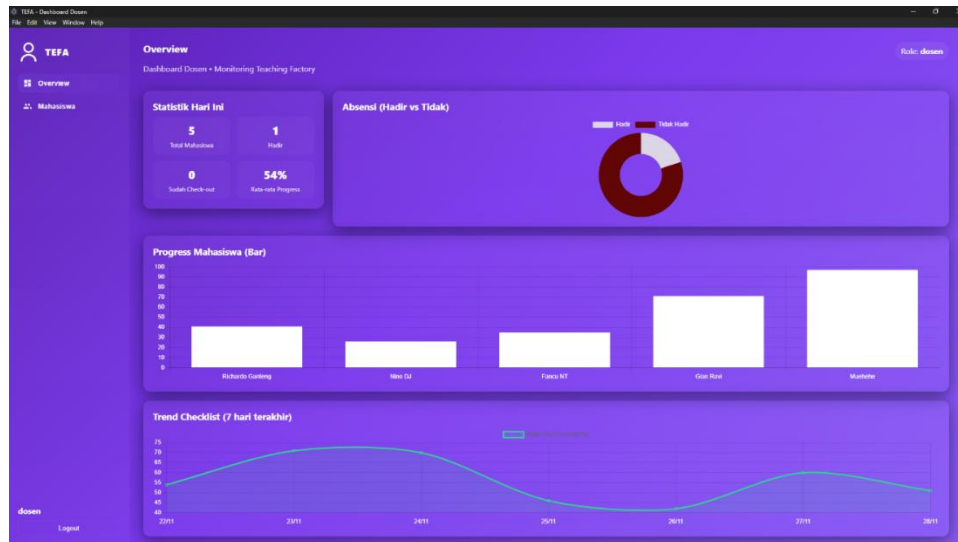
Figure 1 Login Interface.



This figure shows the login page that serves as the entry point for both user roles. The interface is designed to be simple and direct, allowing users to enter their credentials without unnecessary

distractions. The clean layout ensures that new users can immediately understand how to access the system.

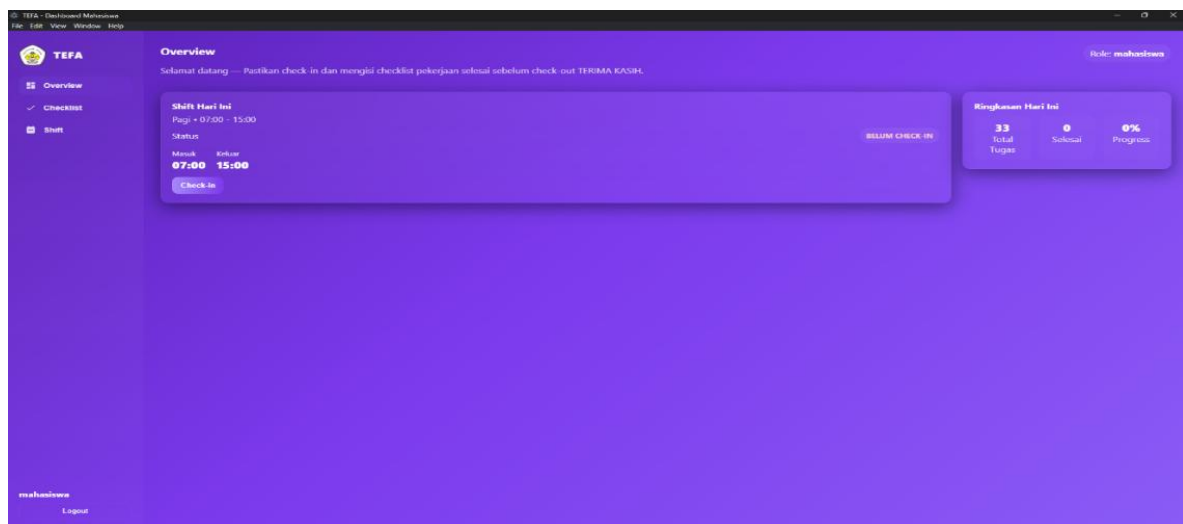
Figure 2 Lecturer Dashboard.



The lecturer dashboard provides an overview of the main functions needed for supervising TEFA activities. The menu layout is intentionally minimal so lecturers can move quickly between

attendance records, assessments, jobdesk monitoring, and student reports. Each module is represented as a dedicated button to reduce navigation complexity.

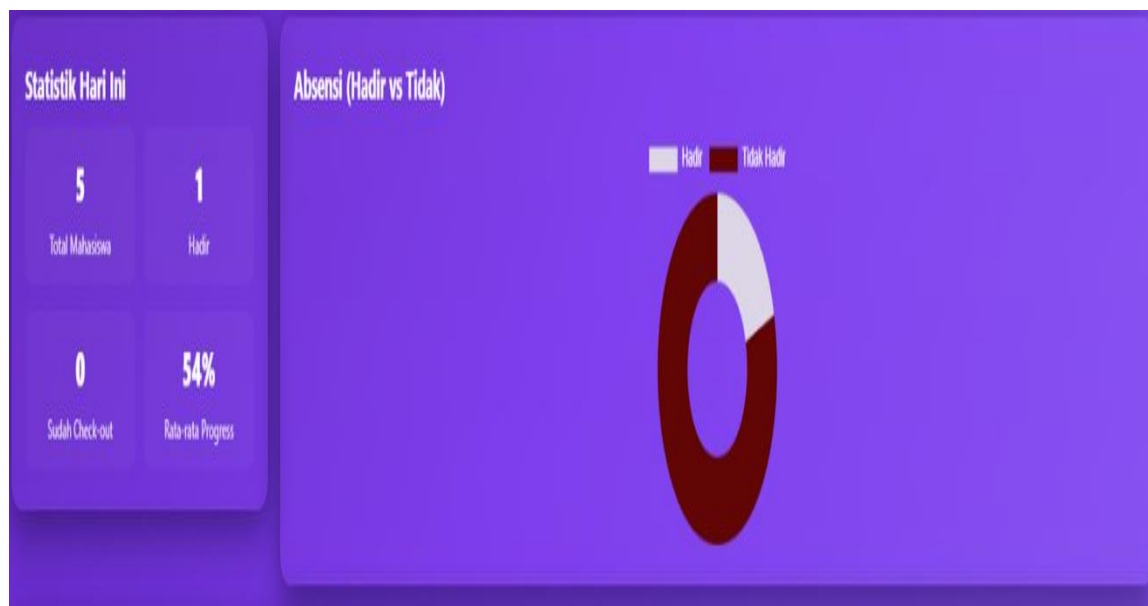
Figure 3 Student Dashboard.



This figure displays the student dashboard, which presents only features relevant to student routines. The design focuses on clarity: students can easily check in their attendance, view their

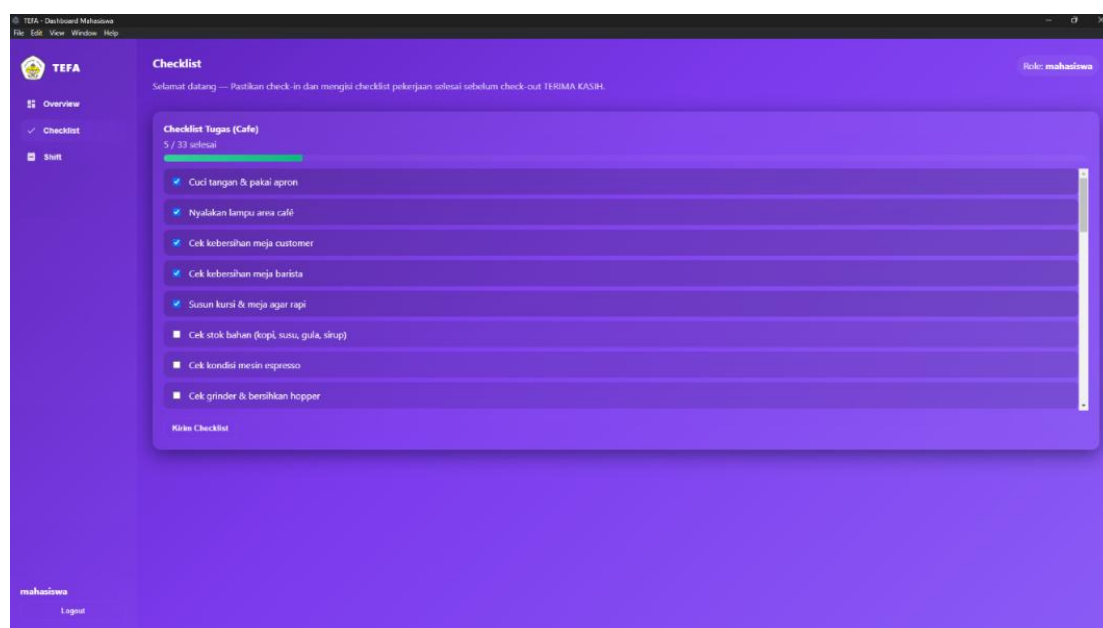
jobdesk, submit activity reports, and review assessment results. The streamlined interface helps reduce confusion for first-time users.

Figure 4 Results of practice learning for subject of Food Processing 1 (see online version for colours).

Figure 5 Lecturer Attendance View.

This figure illustrates how lecturers can review student attendance. The interface summarizes attendance records in a structured list, allowing

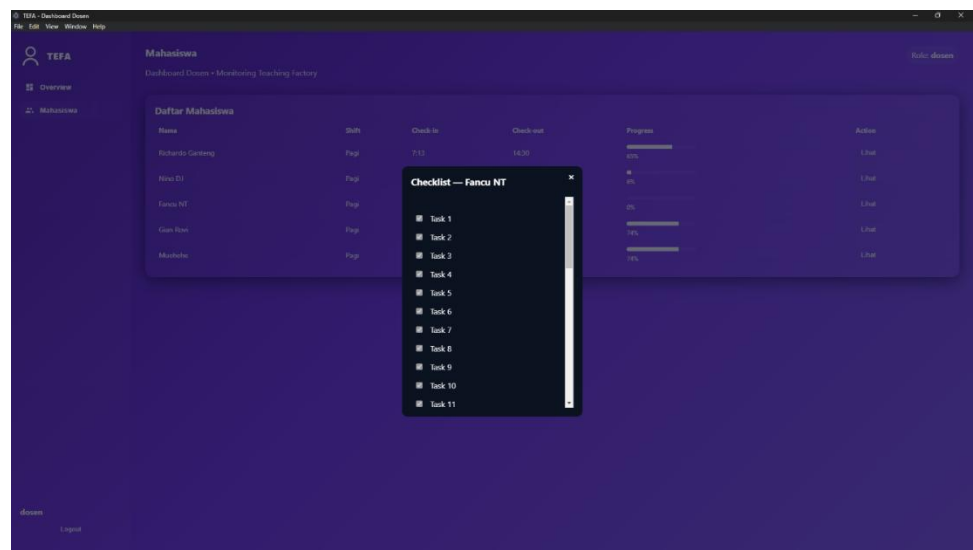
lecturers to identify who is present, absent, or late. This feature supports more transparent and accurate monitoring during practical sessions.

Figure 6 Jobdesk Checklist.

The jobdesk checklist is used by students to document daily tasks. Each jobdesk item can be marked as completed, allowing students to

maintain a clear record of their responsibilities. This feature also helps prevent forgotten tasks and contributes to more consistent reporting.

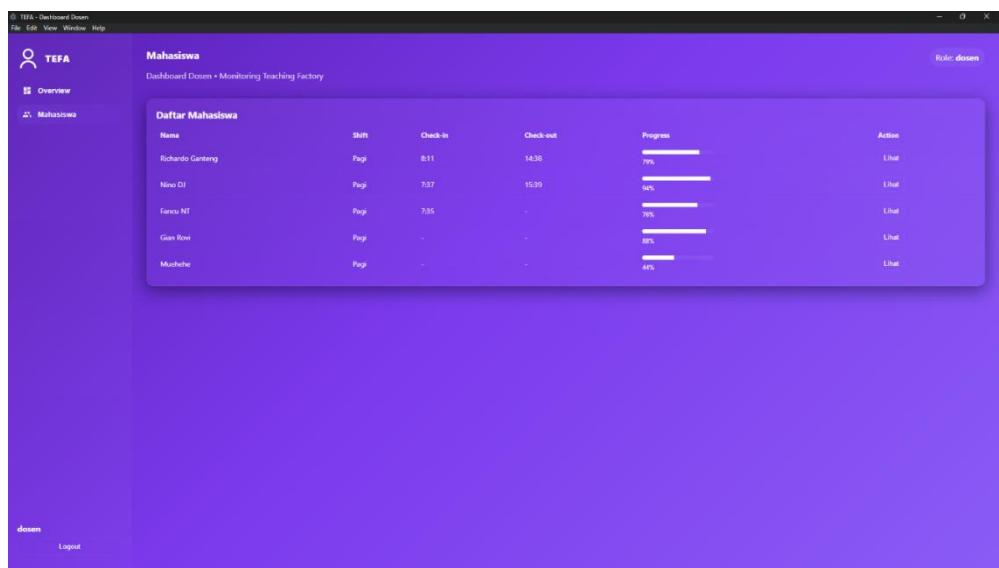
Figure 7 Jobdesk Monitoring (Lecturer Side).



This visual shows the lecturer’s view of the jobdesk progress. Lecturers can track which tasks have been completed by each student and identify missing or incomplete work. The monitoring

layout improves coordination and provides lecturers with a quick method to evaluate daily performance.

Figure 8 Student Report Module.



The student report module enables students to submit written activity reports directly through the system. The interface supports structured input, allowing students to describe their tasks, progress, and challenges. This feature aims to standardize the format of TEFA reports and make them easier for lecturers to review.

3.3 Interface Results

The implemented features provide: faster attendance tracking; structured jobdesk

management; simplified performance review; easier report submission; and clearer communication between lecturer and student. Even with dummy data, the system runs smoothly and validates interface design and workflow structure.

4. Discussion

4.1 Interpretation of Results in Relation to Objectives and Literature

The primary objective of this study was to develop a desktop-based monitoring system that addresses the operational inefficiencies commonly observed in TEFA environments. The results demonstrate that the system successfully achieves this objective at the prototype level: role-based dashboards for both lecturers and students were implemented with clearly separated functional modules, and initial usability observations confirmed that users could navigate the interface without requiring external guidance. These findings align with the study's design rationale and are consistent with prior literature on the benefits of structured digital tools in vocational settings.

Rahmawati (2018) and Simanjuntak and Yusuf (2020) identified delayed and inaccurate attendance recording as persistent issues in manual monitoring systems. The attendance module in this system addresses these concerns directly by enabling real-time check-in and check-out through a digital interface, eliminating the lag that occurs when records are manually filled after sessions conclude. Similarly, the jobdesk module responds to the problem identified by Wijaya (2019), where task distribution through verbal or informal channels created accountability gaps. By presenting assigned tasks in a visible and trackable format, the system provides students with a clear daily work reference and gives lecturers a reliable record for performance evaluation.

The choice of Electron as the development framework is further validated by the results. As noted by Sari and Nugroho (2021), Electron enables institutions to deploy cross-platform desktop applications using familiar web technologies, which reduces development complexity. The prototype's ability to run a fully interactive interface using HTML, CSS, and JavaScript confirms the practical viability of this approach for TEFA contexts where institutions may lack infrastructure for complex web servers or native application development. These observations reinforce the argument made by Hendrawan et al. (2022) that operational data

management is a critical, yet underserved, aspect of TEFA effectiveness.

4.2 Implications for Theory, Practice, and Policy

From a theoretical perspective, this study contributes to the growing body of knowledge on technology-enhanced vocational learning by demonstrating that role-differentiated digital interfaces can meaningfully support industry-simulated educational environments. The system's design draws on the principle that learner engagement and task accountability are strengthened when responsibilities are clearly defined and digitally traceable—a concept supported by Carvalho and Yeoman (2021), who argue that structured task design in digital environments encourages both autonomy and discipline. This study extends that principle into the TEFA context, where the dual-role structure of lecturer and student creates a natural alignment between role-specific digital interfaces and effective monitoring practice.

In terms of practical implications, the system offers a replicable model for vocational institutions that seek to digitize their TEFA operations without significant investment in custom software or server infrastructure. The use of Electron allows the application to be distributed and run on standard computers without internet dependency, which is particularly relevant for institutions in regions with limited connectivity. The modular design—where attendance, jobdesk, assessments, and reports each occupy dedicated interface panels—means that institutions can adapt the system incrementally to their existing workflows rather than overhauling their entire operational process at once. This is consistent with the practical framework proposed by Bergdahl et al. (2020), who emphasize that effective technology integration in education must prioritize low entry barriers and clear functional value for users.

From a policy perspective, the findings suggest that vocational education institutions and governing bodies should consider integrating digital monitoring tools as a standard component

of TEFA program requirements. As Pilz and Li (2020) note, the effectiveness of vocational education systems depends not only on curriculum quality but also on the operational structures that support learning delivery. This study provides empirical grounds for the argument that lightweight, purpose-built monitoring applications represent a cost-effective and scalable policy intervention to improve TEFA accountability and data transparency at the institutional level.

4.3 Limitations of the Study

Several limitations must be acknowledged in interpreting the results of this study. First, the system currently operates entirely on dummy data, meaning that the prototype has not been validated under real operational conditions. All attendance records, jobdesk entries, assessment scores, and activity reports used during testing were simulated, and therefore the system's ability to handle actual data inconsistencies, edge cases, or high-volume inputs remains unverified. The absence of a live database backend also means that data persistence, synchronization, and security—all critical concerns in a real deployment scenario—have not yet been addressed.

Second, the usability evaluation was conducted through informal observation rather than formal user testing with standardized instruments such as the System Usability Scale (SUS) or task-completion metrics. Nielsen (1994) established that rigorous usability engineering requires structured heuristic evaluations and measurable performance criteria to produce reliable conclusions about interface quality. The absence of such instruments in this study limits the generalizability of the usability findings, as subjective observations may not fully capture the range of difficulties that actual lecturers and students would encounter in daily use. A structured usability test involving real TEFA participants, conducted in accordance with Nielsen's usability principles, would provide stronger empirical support for the interface design decisions made in this study.

Third, the study was conducted within a single institutional context—the Tourism Department of Manado State Polytechnic—which may limit the transferability of findings to TEFA programs in other disciplines or institutions with different operational structures. Vocational programs in manufacturing, hospitality, or health services may have distinct monitoring requirements that the current feature set does not fully address. Future research should explore how the system performs across multiple TEFA settings to better assess its adaptability and broader applicability.

5. Conclusion

5.1 Conclusions

The development of this TEFA monitoring system shows that a simple, role-based desktop application can significantly reduce the friction that usually happens in daily TEFA operations. By separating the lecturer and student interfaces, the system helps both sides focus on the actions that matter—submitting attendance, completing jobdesk, reviewing progress, and validating student reports—without having to deal with scattered documents or inconsistent manual records.

Even though the prototype still runs on dummy data, the overall workflow already reflects how the final system is intended to behave. The early testing phase indicates that users can navigate the interface intuitively and complete tasks without additional instructions. This suggests that the design decisions—such as keeping the menus minimal and structuring features into clear modules—align well with how TEFA routines naturally unfold.

At the same time, the prototype reveals what still needs to be improved. The absence of a real database limits the system's ability to handle live data, automate assessments, or generate updated summaries. In other words, the interface is ready, but the engine behind it still needs to be built before the system can operate in a real TEFA environment. Overall, this study establishes the groundwork for a practical monitoring tool that reflects the actual needs of TEFA activities.

Rather than serving as a theoretical model, the system is designed to solve everyday issues that have long been overlooked in manual processes.

5.2 Suggestions

Based on the development and initial testing of the system, several recommendations can be made to improve the next phase: (1) Integrate a real database — a live backend using MySQL, PostgreSQL, or Firebase should become the immediate next step for real-time attendance, synchronized jobdesk updates, and centralized assessment storage; (2) Implement a more reliable attendance mechanism — QR-code attendance or device-based validation would increase accuracy and reduce the chance of improper submissions; (3) Strengthen the reporting module — adding options to upload files, images, or supporting documents will make student reports more descriptive and valuable for assessment; (4) Enable analytics and performance summaries — data visualizations such as

completion graphs, attendance charts, or assessment progress can help lecturers evaluate student performance more objectively over time; (5) Introduce notification and reminder features — automatic reminders for incomplete jobdesk, pending reports, or scheduled assessments can improve student discipline and reduce miscommunication; (6) Gather feedback from actual TEFA users — before the system is deployed fully, it is important to collect input from lecturers and students to refine the interface, identify confusing elements, and adjust the workflow to match real classroom dynamics; and (7) Prepare deployment and maintenance guidelines — if the system is intended for long-term use, documentation for installation, updates, and troubleshooting will be essential for sustainability.

Author Declaration

The authors confirm the originality of this work. There are no conflicts of interest to declare.

References

- Arora, H., & Singh, M. (2019). Cross-platform mobile and desktop application development tools: A systematic review. *International Journal of Computer Applications*, 178(39), 1–6. <https://doi.org/10.5120/ijca2019918825>
- Bergdahl, N., Nouri, J., & Fors, U. (2020). Disengagement, engagement and digital skills in technology-enhanced learning. *Education and Information Technologies*, 25, 957–983. <https://doi.org/10.1007/s10639-019-09984-1>
- Borg, W. R., & Gall, M. D. (2003). *Educational Research: An Introduction* (7th ed.). Longman. ISBN: 978-0801318023
- Carvalho, A., & Yeoman, P. (2021). Task design in digital learning environments: Balancing structure and autonomy. *British Journal of Educational Technology*, 52(1), 369–384. <https://doi.org/10.1111/bjet.13013>
- Hendrawan, B., Mustari, M., & Pratiwi, N. (2022). Efektivitas Teaching Factory ditinjau dari pengelolaan data aktivitas harian mahasiswa vokasi. *Jurnal Pendidikan dan Kejuruan*, 14(1), 23–35. <https://doi.org/10.23887/jpku.v14i1.44523>
- Kuswantoro, A. (2014). *Teaching Factory: Rencana dan nilai entrepreneurship*. Graha Ilmu. ISBN: 978-602-262-227-4
- Nielsen, J. (1994). *Usability Engineering*. Academic Press. <https://doi.org/10.1016/B978-0-08-052029-2.50004-2>
- Pilz, M., & Li, J. (2020). Comparative vocational education research: Enduring challenges and new ways forward. *International Journal of Research in Vocational Education and Training*, 7(1), 1–14. <https://doi.org/10.13152/IJRVET.7.1.1>
- Rahmawati, D. (2018). Analisis ketepatan pencatatan kehadiran mahasiswa dalam pembelajaran praktik kejuruan. *Jurnal Pendidikan Vokasi*, 8(2), 112–121. <https://doi.org/10.21831/jpv.v8i2.18912>

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- Sari, R. P., & Nugroho, A. (2021). Pengembangan aplikasi desktop lintas platform menggunakan Electron.js untuk kebutuhan administrasi akademik. *Jurnal Informatika dan Rekayasa Perangkat Lunak*, 3(2), 67–76. <https://doi.org/10.36499/jinrpl.v3i2.4217>
- Serrano, N., Hernantes, J., & Gallardo, G. (2014). Mobile-web app approach for lightweight devices. *IEEE Software*, 31(2), 46–53. <https://doi.org/10.1109/MS.2014.23>
- Simanjuntak, R., & Yusuf, M. (2020). Keterlambatan input penilaian praktik dan dampaknya terhadap konsistensi evaluasi mahasiswa vokasi. *Jurnal Ilmiah Pendidikan Teknik dan Kejuruan*, 13(1), 45–54. <https://doi.org/10.20961/jiptek.v13i1.38741>
- Sudira, P. (2018). Metodologi pembelajaran vokasional abad XXI: Inovasi, teori dan praktis. UNY Press. ISBN: 978-602-498-035-1
- Sugiyono. (2019). Metode Penelitian dan Pengembangan: Research and Development (3rd ed.). Alfabeta. ISBN: 978-602-444-175-2
- Wijaya, T. A. (2019). Distribusi tugas kerja berbasis digital sebagai solusi pengelolaan jobdesk dalam pendidikan vokasi. *Jurnal Teknologi dan Pendidikan*, 7(3), 88–97. <https://doi.org/10.31227/osf.io/xn3mb>