

Designing an e-report system as a digital portfolio in early childhood education in Surabaya using the waterfall method

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Abstract: This study focuses on the design and implementation of an E-Report system as a digital portfolio for Early Childhood Education in Genteng District, Surabaya. The current manual process using Excel and Canva for generating learning reports limits efficiency and accuracy in tracking children's developmental progress. To address this, a web-based E-Report system was developed using the Waterfall method to streamline reporting processes, allowing educators to manage children's data digitally while providing parents accessible, real-time progress reports. Development stages included requirement analysis, system design, and implementation, leveraging modern web technologies for optimal performance. User satisfaction assessments reveal high satisfaction levels, particularly in the system's format (average score of 3.80) and content (average score of 3.65), indicating a strong alignment with user needs. The implementation of the E-Report system is expected to elevate Early Childhood Education services in Genteng District by delivering a more efficient, accurate, and collaborative reporting tool.

Keywords: E-report System, Early Childhood Education, End-User Computing Satisfaction (EUCS), Web-Based Application, Waterfall Method

History Article: Submitted 17 September 2024 | Revised 30 October 2024 | Accepted 5 December 2024

How to Cite: M. V. D. Alifkhan, and S. A. Laga, "Designing an e-report system as a digital portfolio in early childhood education in Surabaya using the waterfall method", *Matrix: Jurnal Manajemen Teknologi dan Informatika*, vol. 14, no. 3, pp. 146-161, 2024. doi.org/10.31940/matrix.v14i3.146-161

Introduction

Early Childhood Education plays a critical role in laying the foundation for children's overall development. The importance of Early Childhood Education is emphasized in Indonesia's National Education System Law No. 20 of 2003, which recognizes the significance of supporting children's holistic growth, both physically and mentally [1]. As part of this mandate, the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) introduced policies to strengthen the transition from Early Childhood Education to elementary school. A key element of this policy is the use of the Early Childhood Education Learning Outcome Report, which serves as a vital tool for evaluating a child's progress and involving parents in their education [2]. This report not only strengthens the connection between schools and families but also helps parents provide more targeted support based on their child's needs [3].

Despite its importance, many Early Childhood Education institutions in Genteng District, Surabaya, continue to rely on manual processes using Excel and Canva to create learning reports. While these digital tools provide basic functionality, they fall short in terms of efficiency and accuracy. Manual processes are time-consuming and prone to errors, such as data duplication and inconsistent formatting of student profiles [4]. This has highlighted the need for a more efficient and accurate approach to monitoring children's development. Information technology plays a pivotal role in improving the management and reporting of data in educational institutions, especially in Early Childhood Education, where monitoring growth and progress is crucial [5].

To address these challenges, this study proposes the development of a web-based E-Report system as a digital portfolio for Early Childhood Education in Genteng District. The system aims to streamline the process of data management, enhance the accuracy of reports, and pro-

vide online access for parents and educators [6]. By utilizing centralized data storage and advanced analysis features, the system will offer a comprehensive digital portfolio for children's development [7].

The development process will follow the Waterfall methodology, ensuring a structured approach from requirement analysis to system implementation [8]. The Waterfall Method is well-documented for its structured approach to software development. Afandi [9] discuss how this methodology, involving sequential phases such as requirements analysis, system design, implementation, testing, and maintenance, is effective for projects with well-defined requirements. Applying the Waterfall Method to the design of an e-report system ensures a systematic and organized development process, making it suitable for the project in Surabaya.

This solution is expected to not only improve the efficiency of progress monitoring in Early Childhood Education but also strengthen the partnership between educators and parents, ultimately enhancing the quality of Early Childhood Education services in Genteng District.

Methodology

This study focuses on designing an E-Report system for Early Childhood Education in Surabaya using the Waterfall method. The research aims to address the limitations faced by educational institutions in utilizing Excel and Canva for reporting purposes. The methodology for system development is illustrated in Figure 1.

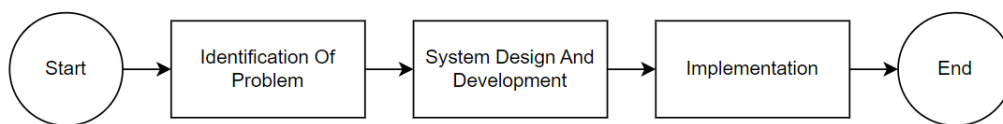


Figure 1. Methodology

The methodology begins with identifying the problems encountered by Early Childhood Education institutions in Surabaya. Field observations and interviews with key stakeholders, including educators and administrators, were conducted to gather insights into the current challenges and needs related to reporting. This initial phase is crucial for understanding the specific requirements and pain points of the users [10].

In the design phase, the identified requirements are translated into a structured system using the Waterfall model. This model is chosen for its sequential and systematic approach, which helps in developing a clear and organized E-Report system. Key features of the system include user logins for different roles (teachers, administrators, parents, and students), data entry for student information, and digital report management. The goal is to create a system that simplifies report generation and enhances communication between educators and parents.

The development process involves creating detailed design specifications, followed by the implementation of the system. Once the system is developed, it undergoes black-box testing to ensure that all functionalities, such as data management and report generation, work as intended.

By employing the Waterfall method, this study ensures that each phase of the system development is completed before moving on to the next, thereby providing a clear and structured approach to designing and implementing the E-Report system.

Identification Of Problem

In the problem identification phase, this research focuses on the challenges faced by Early Childhood Education institutions in Genteng District regarding their use of Excel and Canva for reporting student progress. This process begins with a field study that involves direct observation and interviews with district leaders and administrators to understand the challenges and needs for digital transformation. Following this, a literature review is conducted to establish a strong theoretical foundation by examining relevant literature and previous research [10]. This helps in

identifying gaps in knowledge and opportunities for innovation, which are essential for developing an effective E-report system that addresses the identified needs and provides relevant solutions.

System Design And Development

In the system design and development phase, the focus is on creating a comprehensive framework for the E-report system. This stage involves translating the identified needs and requirements into a functional design. Key elements of this phase include the development of use case diagrams, activity diagrams, and system wireframes [11].

Use case diagrams are created to outline the interactions between users and the system, detailing the various scenarios in which the system will be utilized. Activity diagrams are used to map out the flow of processes and actions within the system, providing a clear visualization of the steps involved in each process. System wireframes are developed to create a visual blueprint of the user interface, illustrating the layout and elements of the system to ensure that it meets user requirements and is easy to navigate. This comprehensive design approach ensures that all aspects of the system are well-defined and aligned with the project's goals before moving on to the implementation phase. Usecase diagram of the application shown in Figure 2.

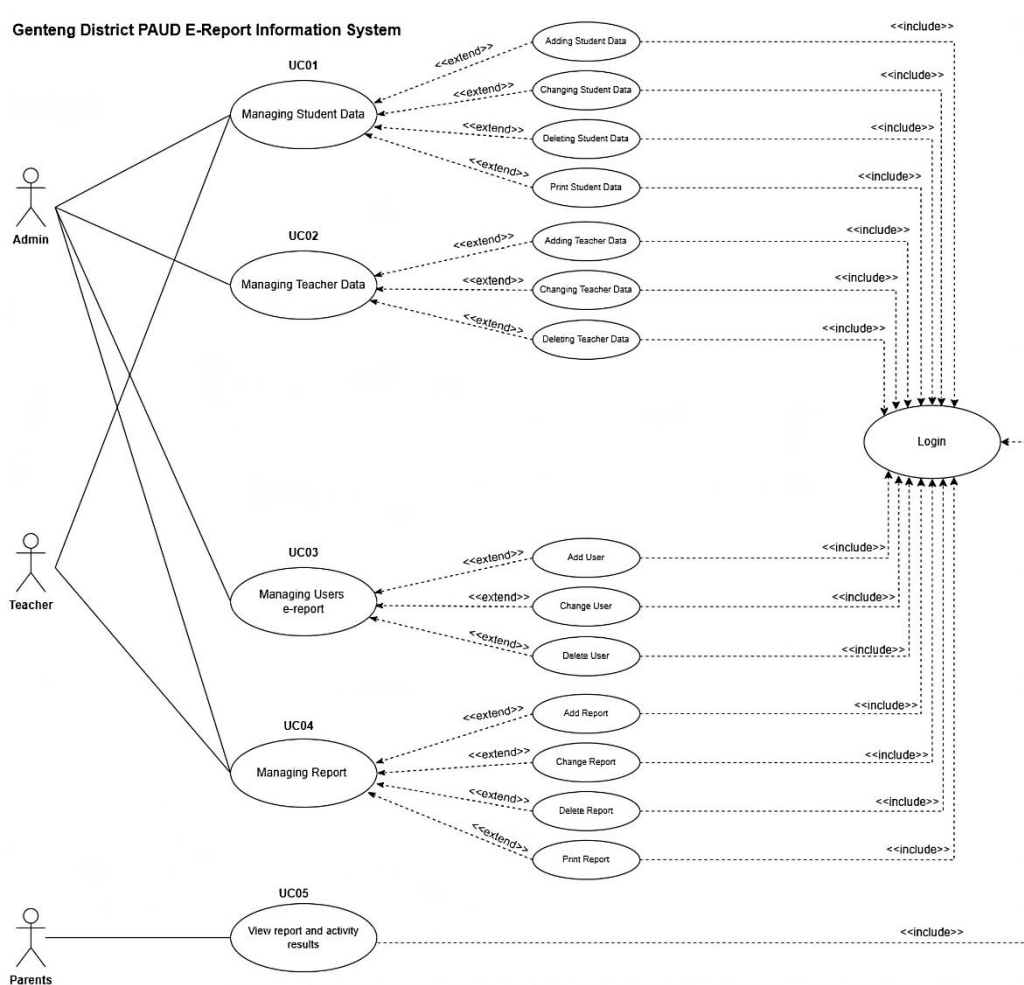


Figure 2. Use case diagram of application

Based on the use case diagram shown in Figure 2, there are three actors: Admin, Teacher, and Parent. Each use case has a prerequisite that must be met, indicated by the include arrow, which is the Login process. Therefore, actors must log in to access any use case. The following is a summary of the use cases detailed in Table 1 below:

Table 1. Description of use case diagram

Use Case	Description
UC01 Manage Student Data	Admin and Teacher can access functions to manage student data, including adding, updating, deleting, and printing student records, ensuring that the data remains current for school reporting purposes.
UC02 Manage Teacher Data	Admin can access functions to manage teacher data, including adding, updating, and deleting records, and assigning student groups to teachers to ensure effective education and monitoring.
UC03 Manage E-Report Users	Admin can access functions to manage E-Report users, including adding, updating, and deleting users to maintain system security and access validity.
UC04 Manage Report Card Grades	Teacher can access functions to manage report card data, including adding, updating, deleting, and printing grades based on defined developmental aspects to continuously monitor student progress.
UC05 View Report Card and Activities	Parents can access functions to monitor report card results and student activities, providing them with insights into their child's educational development and school activities.

All actors must log in to access these functions, ensuring that only authenticated users can manage and monitor the data.

In the activity diagram designed for this information system, there are six diagrams: managing student data, managing teacher data, managing activity information, managing e-report users, managing report card grades, and viewing report card results and activities.

An overview of the activity diagram for managing student data used in the e-report system can be seen in [Figure 3](#). [Figure 3](#) outlines the following process: First, the Admin or Teacher accesses the login page and enters their username and password. The system then verifies these credentials. If they are correct, the user is redirected to the dashboard page. From there, the Admin or Teacher can navigate to the student data management page, where they have the option to add, modify, or delete student data. After any action is performed, the system updates the data and displays the results.

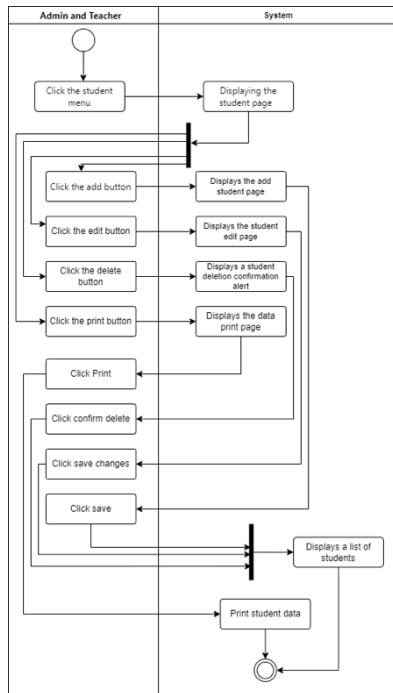


Figure 3. Student data management activity diagram

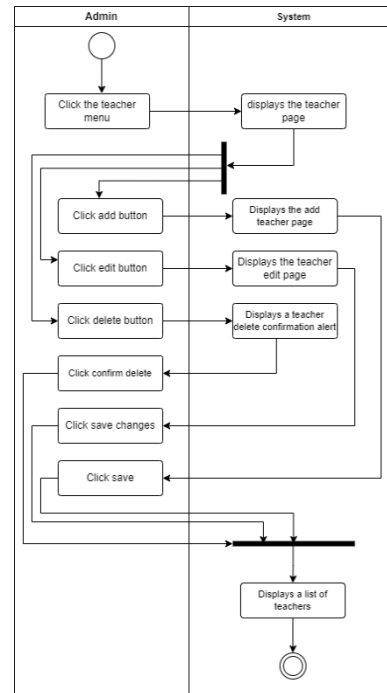


Figure 4. Teacher data management activity diagram

An overview of the activity diagram for managing teacher data used in the e-report system can be seen in Figure 4. Figure 4 illustrates the following process: The Admin begins by accessing the login page and entering their username and password. The system then verifies these credentials. If they are valid, the Admin is redirected to the dashboard page. From there, the Admin can navigate to the teacher data management page, where they have the option to add, modify, or delete teacher data. After any action is executed, the system updates the data and presents the results

An overview of the activity diagram for managing e-report users used in the e-report system can be seen in Figure 5. Figure 5 outlines the following process: The Admin starts by accessing the login page and entering their username and password. The system then verifies these credentials. If they are correct, the Admin is directed to the dashboard page. From there, the Admin can navigate to the e-report user management page, where they have the option to add, modify, or delete e-report users. After any action is performed, the system updates the data and displays the results.

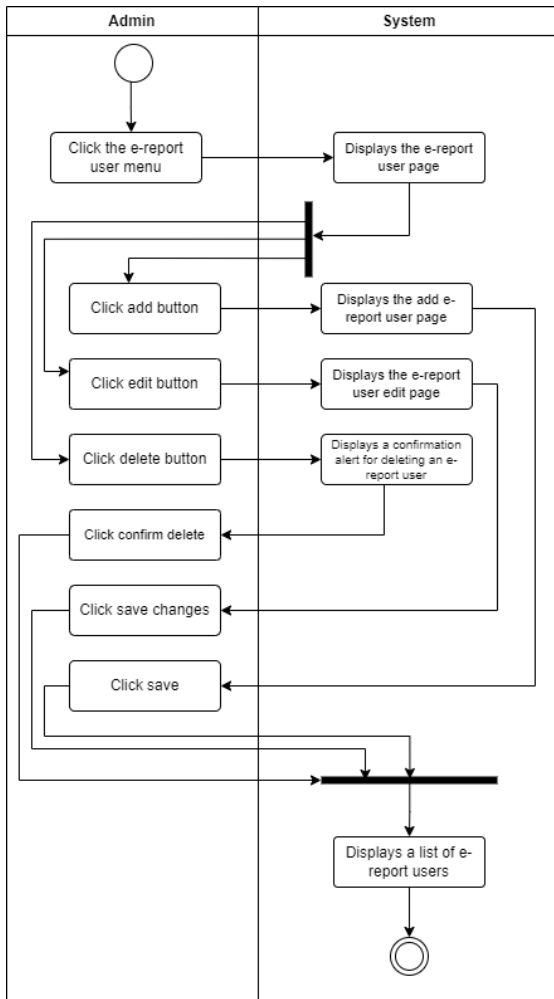


Figure 5. E-report user management activity diagram

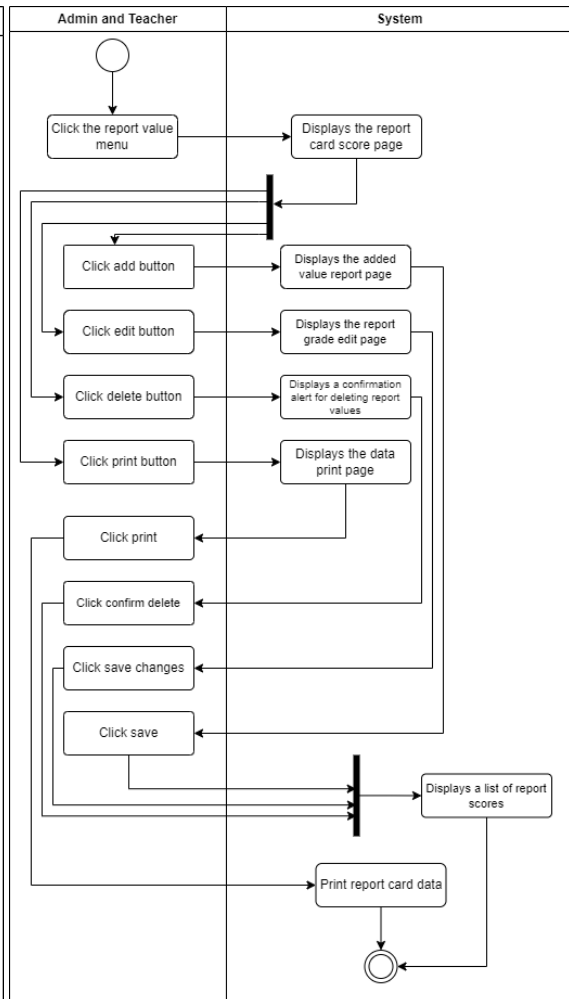


Figure 6. Report card grades management activity diagram

An overview of the activity diagram for managing report card grades used in the e-report system can be seen in Figure 6. Figure 6 describes the following process: The Teacher starts by opening the login page and entering their username and password. The system then verifies these credentials. If they are correct, the Teacher is redirected to the dashboard page. From there, the Teacher can access the report card grade management page, where they can add, modify, or delete student report card grades. Once an action is performed, the system updates the data and displays the results.

An overview of the activity diagram for viewing report card results and activities used in the e-report system can be seen in Figure 7. Figure 7 outlines the following process: The Student begins by opening the login page and entering their username and password. The system then verifies these credentials. If they are correct, the Student is directed to the dashboard page. From there, the Student can navigate to the page where they can view report card results and activity information.

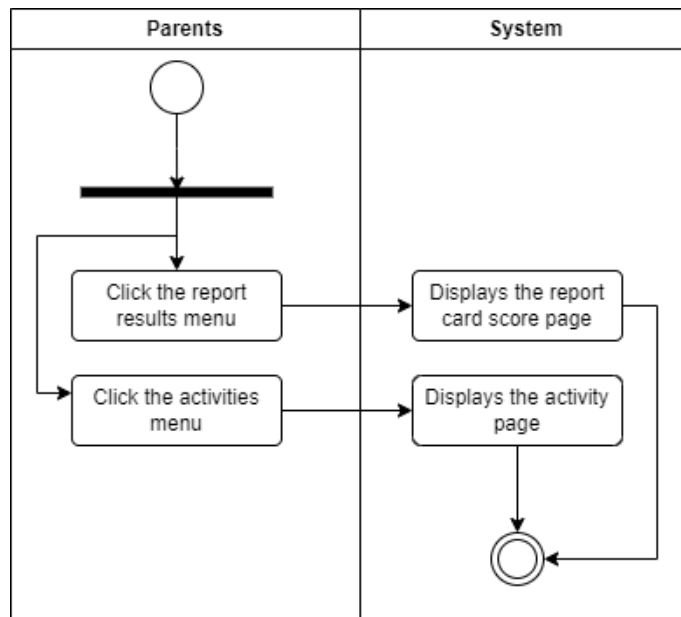


Figure 7. Activity diagram for viewing report card results and activities

The system wireframe is an abstract design for the website to be developed [12]. This design aims to identify which features will be implemented on the website and the layout that will be used during the development process [13]. The wireframe includes the core design elements of the website, such as the main dashboard view, the dropdown menu view on the main menu, the data input view, and the layout view of the e-report that will be generated as a PDF. These four wireframe designs encompass the entire website, as other menu displays are similar, differing only in data and naming conventions. This approach ensures that the website development process, when transitioning from a sketch to coding, can directly meet the required needs.

Figure 8 illustrates the wireframe for the main and dropdown menus. The main menu provides primary navigation options for users, including key sections of the application. The dropdown menu, accessible from the main menu, offers additional, context-specific choices. This design helps streamline user interactions by consolidating related options. Overall, the wireframe ensures a user-friendly layout and efficient navigation throughout the application.

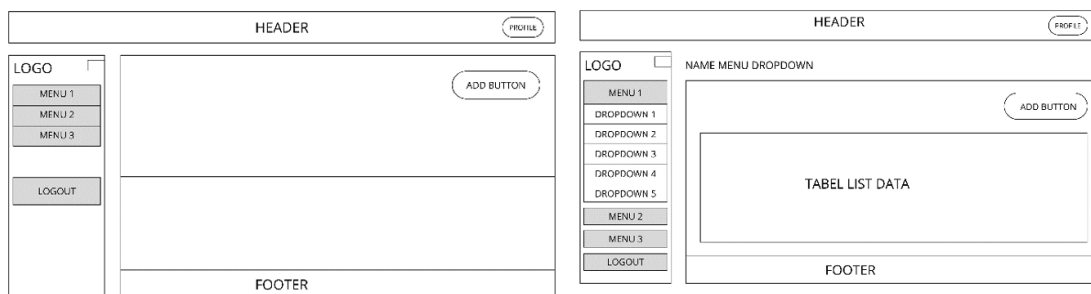


Figure 8. Main and dropdown menu wireframe

Figure 9 illustrates the wireframe for displaying a report as a PDF. It shows the layout and interface elements involved in generating and viewing the PDF report. The wireframe includes options for selecting print settings and previewing the document. This design aims to provide a clear, user-friendly method for accessing and managing PDF reports.

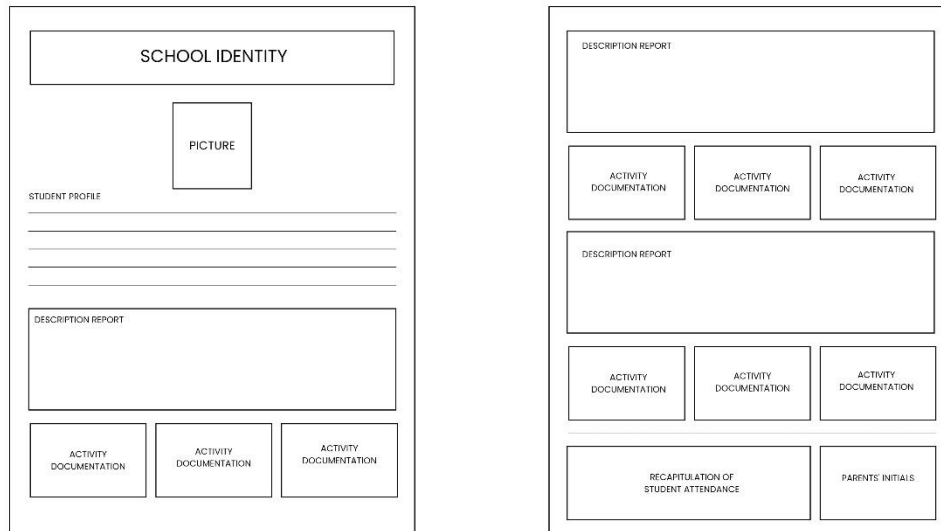


Figure 9. Print report as PDF wireframe

The next phase involves the implementation of the results from the problem identification and system design stages. Following this, the system undergoes testing using black-box testing methods to assess and adjust the features that will be evaluated. Black-box testing, focusing on the functionality of the system without peering into its internal structures, will help ensure that all components operate as intended and meet user requirements.

The aim of this comprehensive testing process is to validate that the system is robust, user-friendly, and aligns with the initial design specifications. By meticulously addressing any issues discovered during testing, we hope to deliver a fully functional and reliable system that effectively meets the needs and expectations of its users. This approach ensures that the final product will not only function correctly but also provide a seamless and satisfying user experience.

Results and Discussions

System Implementation

The following are displays of various menus that have been developed based on the problem identification findings from the methodology phase. Figure 10 depicts the wireframe for the login page. It features fields for entering a username and password, along with a button to submit the login credentials. The design includes options for password recovery and user registration, enhancing accessibility for new and existing users. Additionally, there is a visual indicator for input errors to guide users in correcting mistakes. The layout is streamlined to ensure a simple and intuitive login process. Overall, the wireframe aims to provide a clear and efficient entry point into the application.

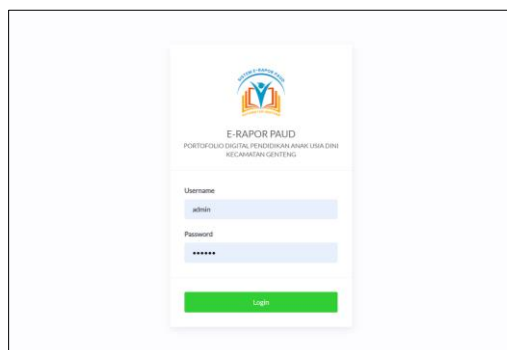


Figure 10. Login page

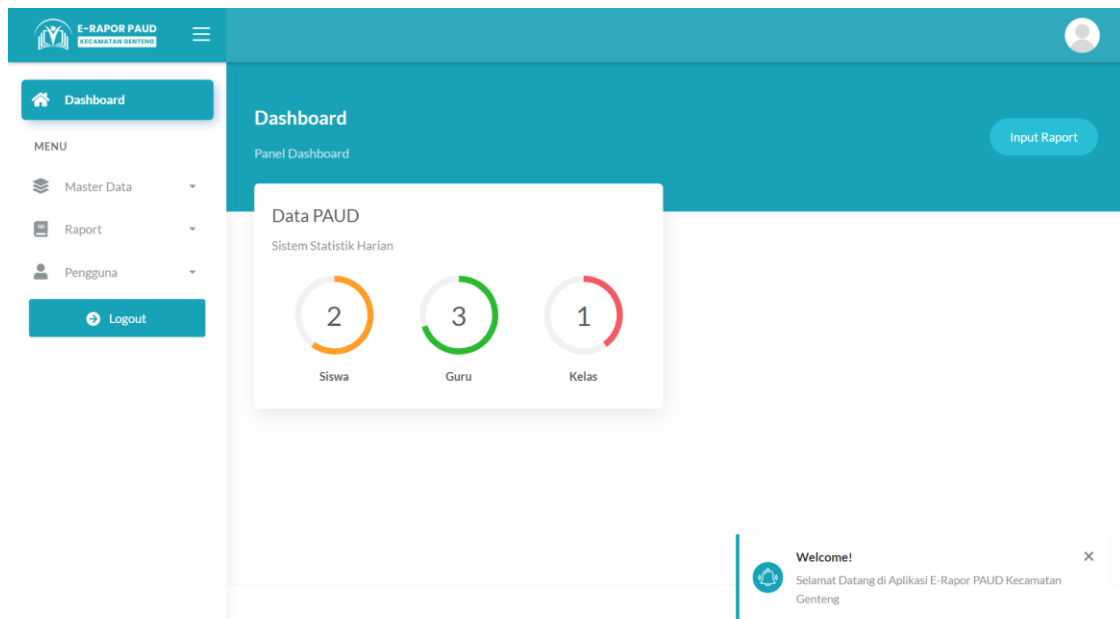


Figure 11. Main dashboard

Figure 11 represents the interface of an application or system called E-Report Early Childhood Education. This dashboard is designed to offer an overview of key metrics and performance indicators related to Early Childhood Education. It features widgets that display real-time data, allowing users to stay updated with the latest information. The layout of the dashboard is customizable, so users can adjust it according to their preferences, such as by adding, removing, or rearranging widgets. A navigation bar on the side provides easy access to various sections of the application, facilitating smooth transitions between different features or modules. Additionally, alerts and notifications are prominently displayed to ensure that important updates and critical information are not missed.

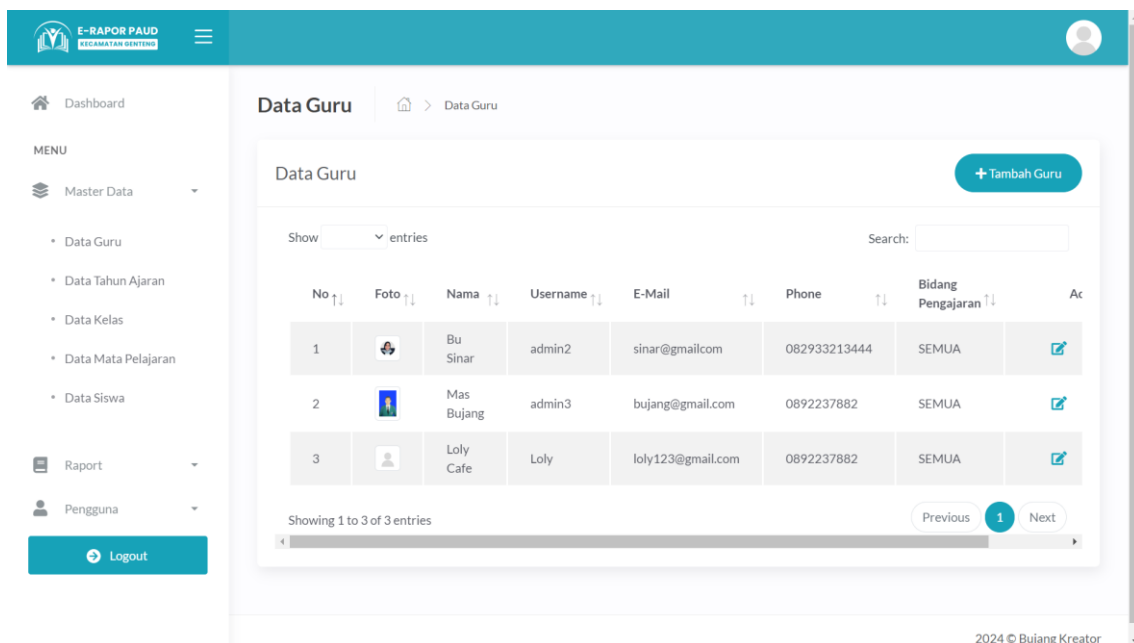


Figure 12. Main menu of teacher data

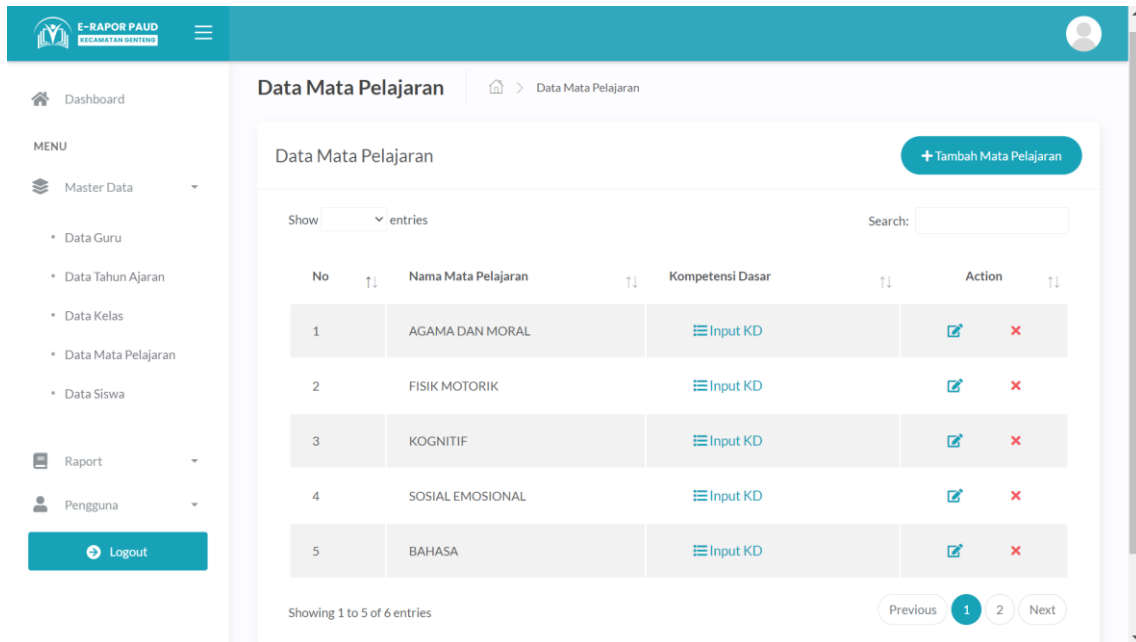


Figure 13. Main menu of subjects

Figure 13 displays the primary interface for accessing various educational subjects, including Religion and Morality, Physical Motor Skills, Cognitive Development, Socio-Emotional Skills, and Language. Each subject area is represented as a separate category on the menu, allowing users to navigate directly to the relevant section. The menu is designed to provide an organized overview of the different domains of early childhood education, ensuring that educators can easily find and manage content related to each subject. Users can click on each category to access detailed information, resources, and tools specific to that area. This structured layout helps streamline the process of curriculum planning and tracking student progress across multiple domains of development.

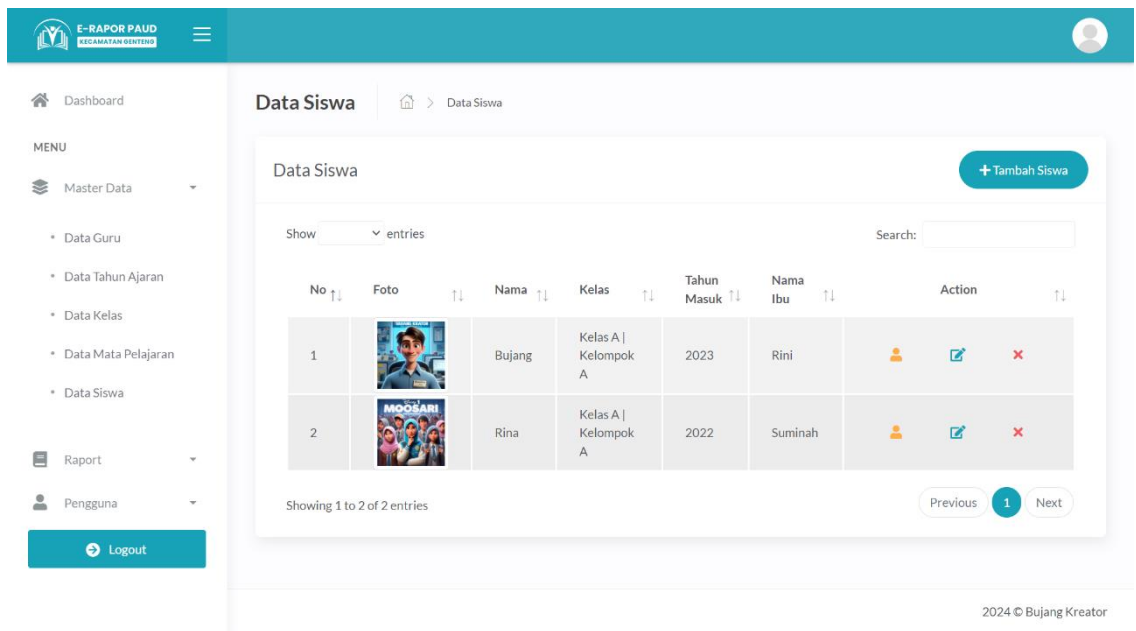


Figure 14. Main menu of student data

Figure 14 shows the main interface used for managing student data within the application. This menu provides direct access to various important information about each student, including personal data and enrollment year.

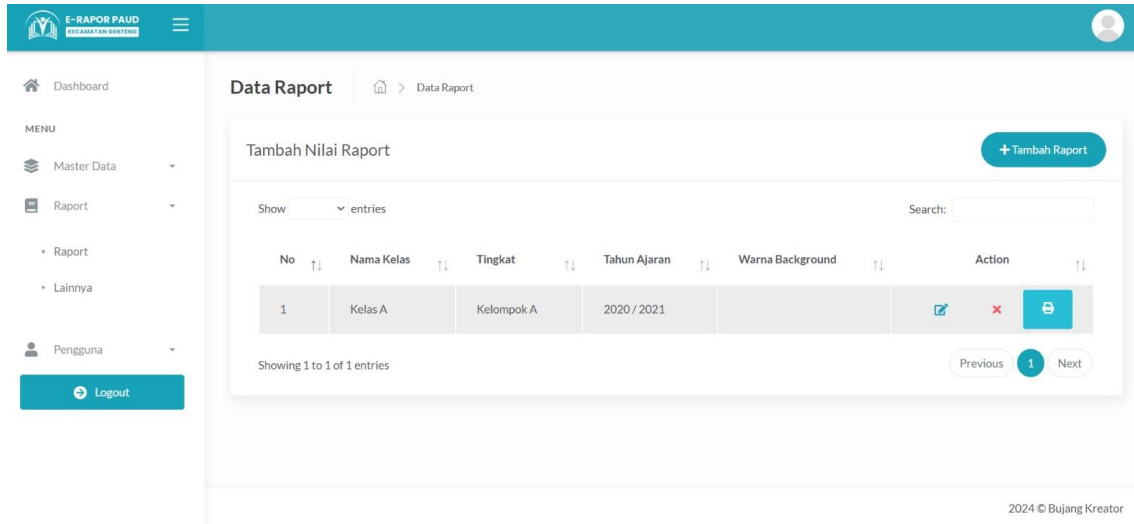


Figure 15. Report data menu

Figure 15 provides access to various reporting features, allowing users to generate and view detailed reports on student performance and academic progress. This menu includes options for creating reports that cover key areas such as Religion and Morality, Physical Motor Skills, Cognitive Development, Socio-Emotional Skills, and Language. Users can customize reports to focus on these specific domains, enabling a comprehensive analysis of each student's development across different areas. The interface allows for filtering and sorting data to refine the reports according to particular criteria or time periods. Additionally, reports can be exported in various formats, making it easier to share and utilize the information for educational planning and assessments.

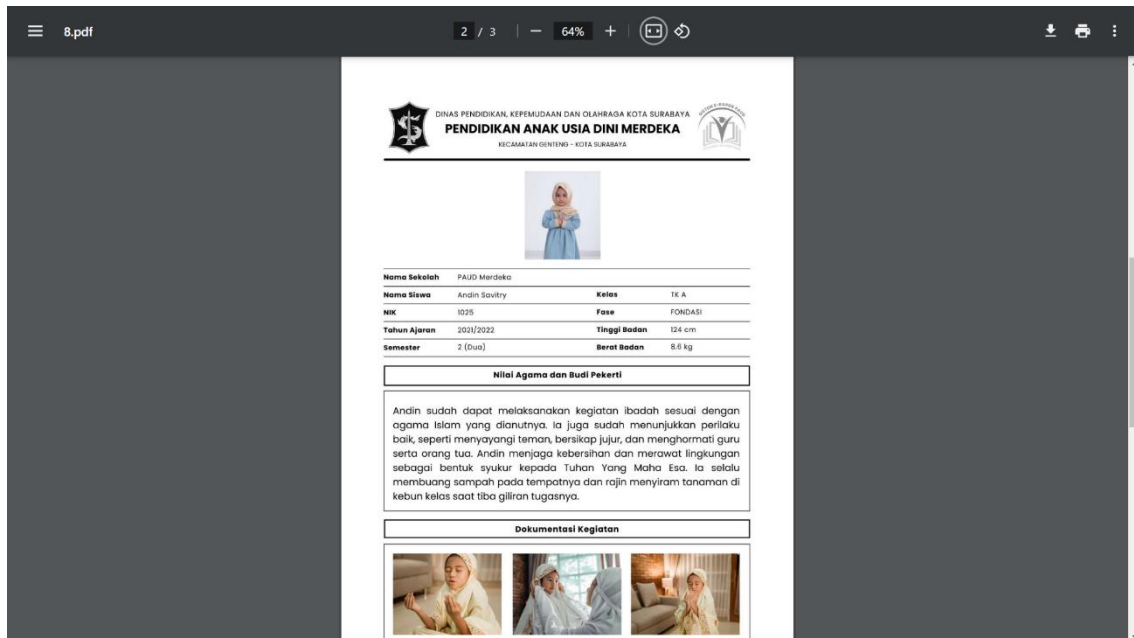


Figure 16. Result of print data s-rapor

Figure 16 provides access to various reporting features, allowing users to generate and view detailed reports on student performance and academic progress. This menu includes options for creating reports that cover key areas such as Religion and Morality, Physical Motor Skills, Cognitive Development, Socio-Emotional Skills, and Language. The results of printed data from E-Rapor include comprehensive details along with photos of student activities, providing a visual

representation of their engagement and progress. Each report highlights specific aspects of the student's development in the mentioned areas, offering a well-rounded view of their performance. The inclusion of photos and detailed evaluations helps educators and parents gain a deeper understanding of the student's achievements and areas for improvement. The interface allows for easy customization and export of these reports, ensuring that all relevant information is effectively communicated and utilized.

Blackbox Testing

Following the implementation phase, the next step is to test the system to confirm that it meets the requirements of its users [15]. In this study, Black-box testing is employed to evaluate the e-report system. This testing method focuses on assessing the system's functionality without examining its internal workings. The goal is to identify any residual errors and ensure that the system functions as intended and meets the specific needs outlined during the design phase. The results of black-box testing can be shown in Table 2, Table 3, Table 4, Table 5, and Table 6.

Table 2. Black-box testing for login and dropdown menu

Type of Request	Type of User	Input	Expected Output	The Output Produced	Concluded
Login	Admin/Teacher	Email and Password	Dashboard view	Dashboard view	Succeeded
Dropdown Menu	Admin/Teacher	Click on dropdown	Dropdown menu opens	Dropdown menu opens	Succeeded

Table 3. Black-box testing for input data and manage student data

Type of Request	Type of User	Input	Expected Output	The Output Produced	Concluded
Input Data	Admin	Teacher details	Data input form displayed, data saved	Data input form displayed, data saved	Succeeded
Manage Student Data	Admin/Teacher	Add/Update/Delete records	Student records updated or added	Student records updated or added	Succeeded

Table 4. Black-box testing for manage teacher data and manage e-report users

Type of Request	Type of User	Input	Expected Output	The Output Produced	Concluded
Manage Teacher Data	Admin	Add/Update/Delete records	Teacher records updated or added	Teacher records updated or added	Succeeded
Manage E-Report Users	Admin	Add/Update/Delete users	E-Report users updated or added	E-Report users updated or added	Succeeded

Table 5. Black-box testing for manage report card grades and view report card and activities

Type of Request	Type of User	Input	Expected Output	The Output Produced	Concluded
Manage Report	Teacher	Add/Update/Delete grades	Grades updated or added	Grades updated or added	Succeeded

Card Grades					
View Report Card and Activities	Parent	View report card and activities	Report card and activity information displayed	Report card and activity information displayed	Succeeded

Table 6. Black-box testing for logout

Type of Request	Type of User	Input	Expected Output	The Output Produced	Concluded
Logout	Admin/Teacher/Parent	Click Logout	Redirect to login page	Redirect to login page	Succeeded

End User Computing Satisfaction

End user computing satisfaction in the context of designing an e-report system as a digital portfolio for early childhood education in Surabaya is crucial to ensure the system's effectiveness. By employing the Waterfall method, each development phase from requirements analysis to implementation can be tailored to meet the expectations of users, such as teachers and parents, regarding ease of access and clarity of information. An intuitive interface and features that align with the specific needs of early childhood education will significantly enhance user satisfaction. Additionally, gathering feedback from users during the testing phase can help identify and resolve issues before the final launch, creating a system that is not only functional but also enjoyable to use. Ultimately, this approach aims to improve the management of data and documentation of children's development effectively.

Table 7. List of questions

Category	ID	Question
Content	C01	I understand the purpose of this system
	C02	I feel that this system has helped me in conducting student assessments
Format	F01	I feel that the design of this system is very modern and elegant.
	F02	I feel that the layout of this system is well-organized
Timeline	T01	I often encounter difficulties in using and accessing this system
	T02	This system is difficult to access under certain circumstances
Ease of Use	E01	I need help using this system
	E02	I feel that this system is complicated to use.
Accuracy	A01	I feel that there are many inconsistencies in this system
	A02	I find this system confusing

To quantitatively measure user satisfaction with the e-report system, a structured questionnaire based on the End User Computing Satisfaction (EUCS) framework was developed. This questionnaire evaluates five key variables: Content, Format, Timeliness, Ease of Use, and Accuracy. Each variable comprises specific questions aimed at assessing different aspects of user interaction and experience with the system. The responses to these questions were gathered using a Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), allowing for a detailed analysis of user perceptions and satisfaction. The results from this survey provide valuable insights into areas where the system performs well and where improvements are needed to enhance overall user satisfaction.

Table 8. Likert scale

Perceptions	Score
Strongly Disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly Agree	5

Table 9 represents the satisfaction levels from the Likert scale:

Tabel 9. Satisfaction levels

Range	Perception Rating	Satisfaction Rating
1 – 1.79	Strongly Disagree	Very Dissatisfied
1.8 – 2.59	Disagree	Dissatisfied
2.6 – 3.39	Neutral	Moderately Satisfied
3.4 – 4.19	Agree	Satisfied
4.2 – 5	Strongly Agree	Very Satisfied

Table 9 can be used to assess satisfaction for each variable. It also serves as a reference for calculating the average of the responses collected from the questionnaire.

Tabel 10. Questionnaire results for each category

Variable	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
C01	0	0	17	5	8
C02	0	0	17	8	5
F01	0	0	15	5	10
F02	0	0	12	13	5
T01	0	0	20	5	5
T02	0	0	25	0	5
E01	0	8	17	0	5
E02	0	3	17	5	5
A01	0	10	15	0	5
A02	0	5	20	0	5

The results presented in Table 10 highlight the average scores and corresponding satisfaction categories for various variables evaluated in this study. Each variable—Content, Format, Timeliness, Ease of Use, and Accuracy—was assessed to gauge user satisfaction with the e-report system designed for early childhood education in Surabaya.

The average scores were derived from a user satisfaction survey conducted among the system's end-users, including educators and parents in the Early Childhood Education community. A total of 30 respondents participated in the survey, which was designed based on the EUCS (End-User Computing Satisfaction) model. The questionnaire consisted of variables such as Format, Content, Ease of Use, Accuracy, and Timeliness.

Each variable was rated on a Likert scale ranging from 1 (Strongly Dissatisfied) to 5 (Strongly Satisfied). The "Format" variable, with an average score of 3.800, indicated a "Highly Satisfied" perception among users, reflecting their approval of the system's layout and design. Conversely, the "Accuracy" variable received an average score of 3.083, categorized as "Neutral or Moderately Satisfied," highlighting potential concerns with the reliability of data or system outputs.

These scores were calculated by averaging the responses for each variable across all respondents. The results provide insights into user experiences and suggest that while the system excels in formatting, improvements are needed in ensuring the accuracy of information.

Tabel 11. Average of each variable

Variable	Average Score	Category
Content	3.650	Satisfied
Format	3.800	Highly Satisfied
Timeliness	3.417	Satisfied
Ease of Use	3.233	Moderately Satisfied
Accuracy	3.083	Neutral or Moderately Satisfied

Conclusion

The implementation of the E-Report system represents a transformative step in addressing the challenges faced by Early Childhood Education institutions in Genteng District, Surabaya, which previously relied on manual reporting methods using Excel and Canva. The system has garnered significant positive feedback, particularly in its design and information quality. The format dimension, with an average satisfaction score of 3.80, highlights the system's success in delivering an intuitive and visually appealing layout that meets user expectations. Similarly, the content dimension scored 3.65, reflecting the system's capability to provide accurate, relevant, and well-structured information that enhances the reporting process.

Beyond these strengths, the E-Report system has also proven to be an effective tool in enhancing data accessibility and fostering stronger engagement between parents and educators. By enabling real-time access to detailed student progress reports, the system bridges the gap between home and school, supporting a more collaborative approach to monitoring and encouraging children's development. This functionality not only simplifies communication but also empowers parents to take a more active role in their child's education, aligning with the broader goals of Early Childhood Education.

However, despite these notable achievements, the analysis revealed areas that require further refinement. The ease of use dimension, with an average score of 3.23, indicates that while the system is functional, some users encountered challenges in navigating the interface. This suggests a need for enhancing the system's intuitiveness to ensure it is accessible to a broader range of users with varying levels of digital literacy. Similarly, the accuracy dimension, which scored 3.08, points to concerns about the reliability of data presented by the system. These findings underscore the importance of improving backend data validation processes and minimizing discrepancies to strengthen user trust in the system's outputs.

Timeliness also emerged as a factor with room for improvement. Although the system's responsiveness was generally satisfactory, achieving an average score of 3.42, further optimization could enhance its performance, particularly under conditions of high usage. Ensuring faster load times and seamless access across devices will not only improve user satisfaction but also solidify the system's reliability as a daily operational tool.

One of the most tangible benefits of the E-Report system lies in its potential to deliver significant cost efficiencies. By transitioning from traditional paper-based reporting methods to a fully digital platform, educational institutions can reduce expenses related to paper and printing. This shift not only aligns with sustainable practices but also provides long-term financial benefits, allowing resources to be redirected toward other educational priorities.

In conclusion, the E-Report system has demonstrated its capacity to address key reporting challenges in Early Childhood Education by providing a modern, efficient, and user-friendly solution. While the system has successfully delivered high satisfaction in areas such as format and content, it also offers valuable insights into areas that require further refinement, including ease of use, accuracy, and timeliness. These findings serve as a roadmap for future enhancements, ensuring that the system continues to evolve in response to user needs. Ultimately, the adoption of the E-Report system marks a significant milestone in modernizing educational practices, fostering better collaboration, and enhancing the overall quality of Early Childhood Education services in the Genteng District.

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