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Mobile Application for Monitoring Toddler Development

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Abstract

Stunting is a condition of chronic malnutrition that occurs from early life and has long-term effects on children's physical growth and cognitive development. Children who experience stunting are at risk of having learning limitations, low productivity in adulthood, and a decrease in the quality of human resources in Indonesia. Although the national stunting figures show a decline, significant barriers remain, including low parental participation in monitoring children's growth at the Posyandu, primarily due to limited access and inadequate health literacy. To address these challenges, this research develops an education-based mobile application designed to help parents monitor their toddlers' growth while also increasing their understanding of stunting prevention. Development of applications using the Software Development Life Cycle (SDLC) Waterfall model includes data collection, needs analysis, UI/UX design, implementation, testing, and evaluation. The mobile application has main features including digital anthropometric recording, immunization schedules, educational videos, and reward points that can be exchanged at Posyandu. Results from user testing in the community show that this application is easy to use and can increase parents' knowledge about children's health, thus potentially becoming a solution or support in the national program for accelerating the reduction of stunting and achieving a healthy and quality Indonesian generation.

Keywords: *Stunting, Mobile Application, Toddler Growth, Digital Health Education.*

1. Introduction

Stunting is a public health issue that remains a major challenge in Indonesia [1]. Data shows that in 2023, the national prevalence of stunting is at 21.6%, although it has declined from the previous year [2]. The Indonesian government aims to reduce this figure to 14% by 2024 and reach zero by 2030 as part of its commitment to the Sustainable Development Goals [3].

In this context, the mobile application is developed as an innovative digital platform that integrates infant growth monitoring with digital health education. This application is designed to assist parents in recording their children's anthropometric data, accessing immunization schedule information, and learning health materials through educational videos and interactive quizzes. Additionally, a gamification-based reward system is implemented to enhance user engagement and retention [4].

Various previous studies have shown that digital interventions can significantly contribute to improving the quality of public health services. The use of mobile technology has proven effective in reaching vulnerable populations, increasing adherence to health protocols, and expanding access to information. Therefore, the development of EduBalita is not only technologically innovative but also rooted in real needs in the field and supported by strong empirical evidence. The purpose of this research is to design and implement a toddler growth application as a technology-based solution to support the national stunting prevention program. Through the Software Development Life Cycle (SDLC) Waterfall model methodology, this research evaluates the application development process from the planning stage to testing. The hope for the results of this research is to provide practical contributions in efforts to improve parental health literacy, the efficiency of child growth monitoring, and data-driven policy formulation by relevant parties.

2. Research Method

This research uses a software engineering approach with the Software Development Life Cycle (SDLC) Waterfall model. This method was chosen because it allows the application development stages to be carried out systematically and structurally, from needs analysis to final evaluation.

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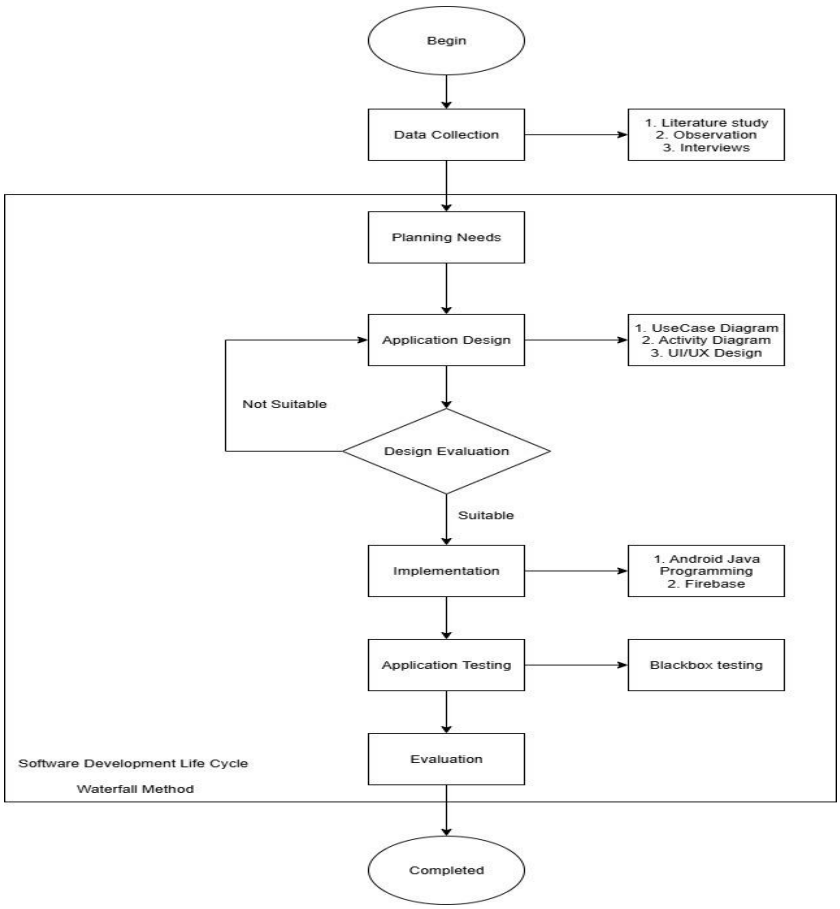


Figure 1. Mobile Application for Monitoring Toddler Development Research Method using the Waterfall Method

The Model Waterfall consists of six main stages, namely: data collection, needs analysis, system design, implementation, testing, and evaluation. In this research stage, developers collect data from various relevant sources to support the design and development process of the Mobile application in order to achieve the desired results. The data collection process is carried out through four main methods, namely:

1. Literature Study
   The literature study in this research was conducted by reviewing various reliable sources such as textbooks on child development [5], national guidelines for stunting [6], and recent research results related to early childhood education [7].
2. Online Survey
   An online survey was conducted among parents with children aged 0-5 years through a questionnaire involving 60 respondents. The questionnaire covered the habits of monitoring growth and development, the utilization of community health posts, and the need for information regarding child-rearing.
3. Observation
   Observations were conducted as direct observations of toddlers' activities and needs as well as parental caregiving patterns in various environments.
4. Interview
   Conduct interviews with parents, health workers, and staff at the integrated service post to gain in-depth insights into the educational needs of toddlers.

The stages of research in the SDLC (System Development Life Cycle) method are:

1. Software needs analysis, analyzing and gathering system requirements that contain the researched information. The approach in this research is obtained from the analysis of the school's cash reception mechanism. Users will be shown the results of the analysis and collection.
2. Design In the design process, it is carried out by formulating a flowchart or detailed procedural algorithm based on the planning results of the cash acceptance system that will be developed..

3. The creation of program code, by translating the design using programming languages into software programs. The result obtained is a computer program that runs according to the designed design.
4. The software testing phase is an important step aimed at ensuring the quality of the system and making sure that all application functions operate as designed. The testing process is conducted before the information system is fully implemented, by testing the possibility of errors or bugs in the system [8].
5. The final step in the software development cycle is maintenance. This maintenance includes:
   a. Corrective Maintenance, making repairs to errors found in the program after use.
   b. Adaptive Maintenance, making adjustments to the system based on actual conditions and needs in the field.
   c. Perfective Maintenance, aims to improve system performance by adding new features or optimizing existing functions.

In the Waterfall model approach, information gathering is conducted through various methods such as discussions, observations, surveys, and interviews. The data collected is then analyzed to obtain a comprehensive picture of the users' needs regarding the software to be developed [9]. Next, system and software design is carried out, where the results of the needs analysis are used to develop a design plan that will serve as a guideline in the system development process. The goal of this design phase is to provide a comprehensive visualization of the system to be built [10]. After that, the software development is carried out modularly, where the system is divided into small parts that will be combined again in the next integration phase.

3. Results and discussion

3.1 Android-based User Interface Application

Based on the SDLC (Software Development Life Cycle) methodological approach of the Waterfall model, this mobile application for toddler growth has been developed as a digital solution to support the monitoring of toddler growth and health education for parents. The application development process starts from the problem identification stage, user needs study, UI/UX design, system implementation, to the evaluation stage.

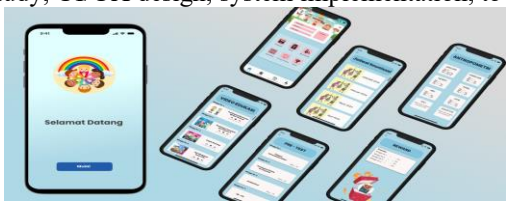


Figure 2. User Interface of the Mobile Application for Monitoring Toddler Development

The main features in this application are designed based on the results of a survey of 60 parents who have children aged 0-5 years and interviews with healthcare professionals. These features include:

1. Anthropometric Data Input, parents can record the height and weight of toddlers every month. This data is automatically visualized in the form of a growth chart, helping in the early detection of growth disorders.
2. Reward System, users earn points after completing quizzes or consistently recording growth data. These points can be exchanged for rewards at the Posyandu, encouraging continued usage.
3. Integrated Immunization Schedule, Based on the selected Posyandu location, the application displays a complete immunization schedule, including the place and time of implementation.
4. Educational Videos and Interactive Quizzes, educational video content about nutrition and child development is available in an engaging format. Pre-tests and post-tests are also included as evaluation tools to assess users' understanding.
5. Account Management Admin, the Posyandu admin can manage user data, educational videos, quiz questions, and the reward system.

Table 1. Main Features of Mobile Applications for Monitoring Toddler Development

Nu	Application Feature	Destination
1	Anthropometric Input Data	Monitoring child growth and detecting disorders early
2	Integrated Immunization Schedule	Reminding parents not to miss important vaccinations
3	Educational Video	Improving parents' understanding in a fun and easily understandable way
4	Pre-test and Post-test	Evaluating the effectiveness of digital education
5	Reward System	Increasing user retention and engagement in the long term

The application prototype is designed using Figma to ensure an intuitive and user-friendly interface. Implementation is done on the Android platform using the Java programming language, and thorough testing is carried out for each feature.

3.2. Design

The design aims to evaluate, analyze, enhance, and form a system, both physical and non-physical, optimally for future use by utilizing available information. The stages in the design process include:

1. Data Flow Diagram

   The data flow diagram is used to see the flow of information in the system. DFD illustrates how data from users and admins enters the system, is processed by the system, and how the data flows and is stored.

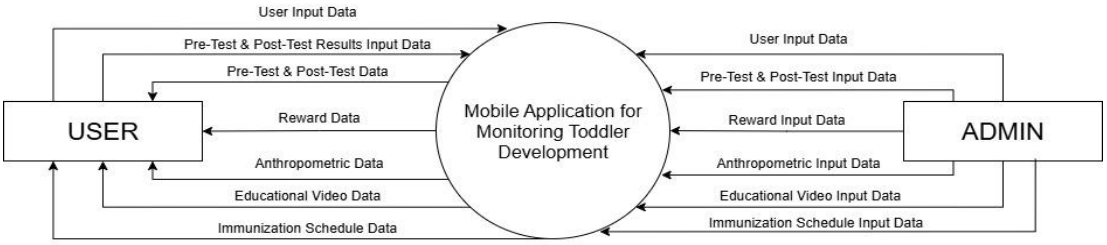


Figure 3. Data Flow Diagram of the Mobile Application for Monitoring Toddler Development

The Data Flow Diagram (DFD) above illustrates the flow of data exchange between users and admins in the mobile application system for toddler development. Users can input and receive data such as user information, pre-test and post-test results, rewards, anthropometry, educational videos, and immunization schedules. On the other hand, admins can manage and input all types of data into the system so that they can be accessed and used by users to monitor toddler development.

2. Use Case Diagram

   Has a role to show the flow of the process from the system that will be developed. Below is the Use Case Diagram contained in the application:

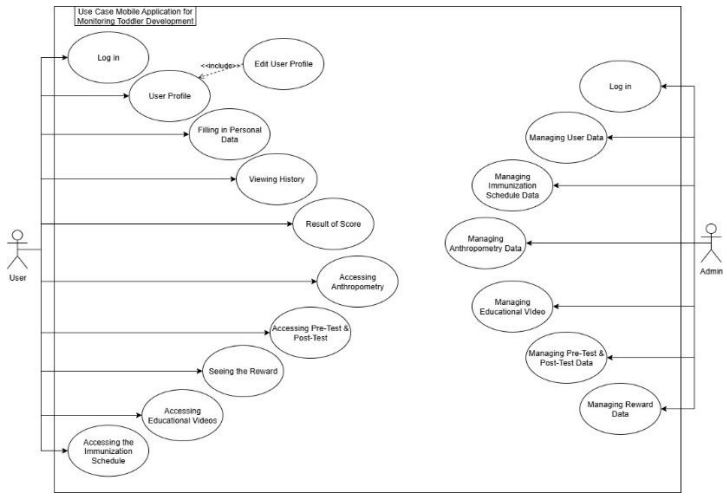


Figure 4. Use Case Diagram of the Mobile Application for Monitoring Toddler Development

The use case diagram above illustrates the interaction between two main actors, namely the user and the admin, in the toddler development mobile application system. Users have access to log in, manage profiles, fill in biodata, view the history of watching educational videos, access scores, anthropometric data, pre-tests and post-tests, rewards, as well as immunization schedules. Meanwhile, the admin plays a role in managing all related data, such as user data, immunization schedules, educational videos, results of pre-tests and post-tests, and reward data.

3. Activity Diagram
   The form of a diagram used to model the flow of activities or business processes within a system. The Activity Diagram illustrates activities in accordance with the sequence along with the decision-making present in the system.

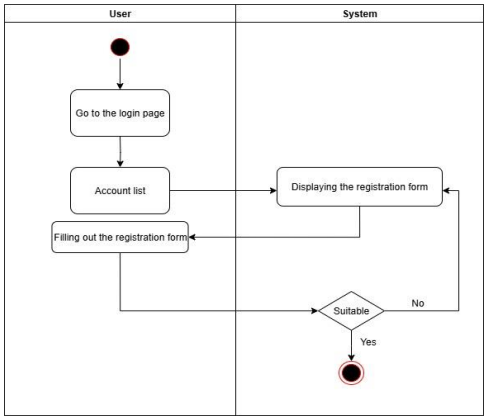
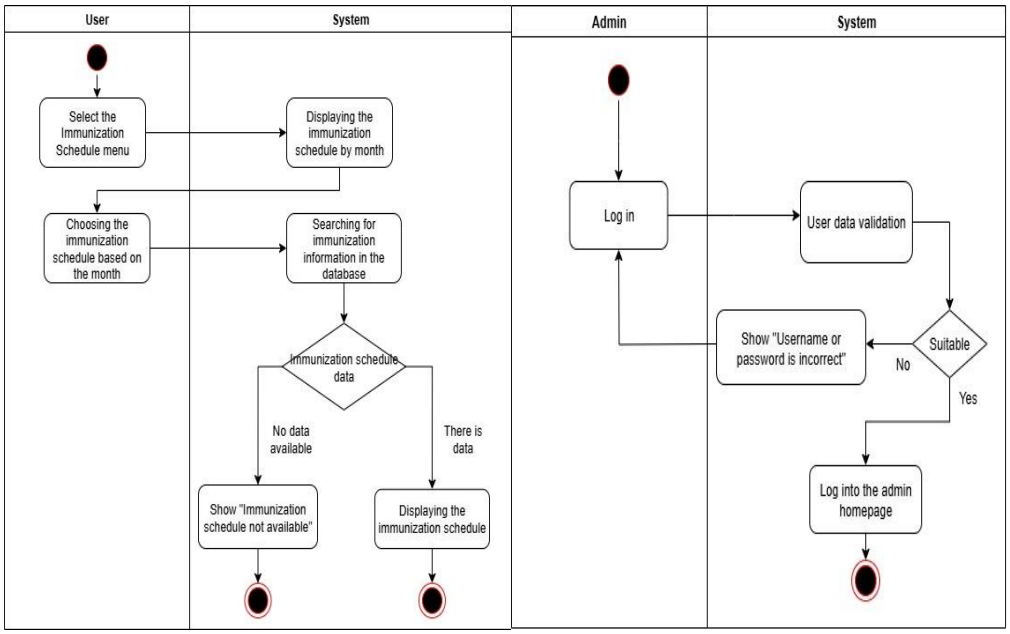


Figure 5. Activity Diagram User Menu Register and



(a) (b)

Figure 6. Activity Diagram User Menu Immunization Schedule (a) and Figure 7. Activity Diagram Admin Menu Login (b)

The first activity diagram illustrates the flow of account registration by the user, starting from entering the login page, choosing to register, to filling out the registration form. The system will display the form and validate the data before the process is completed. The second diagram shows the process of the user searching for immunization schedules based on the month. After the user selects the menu and determines the month, the system will search for related data and display the schedule if available, or provide information that the schedule is not yet available. The third diagram depicts the admin login process, where the system will validate the user data and display an error message if the data does not match, or redirect to the admin main page if the validation is successful.

4. Class Diagram
   A Class Diagram is a diagram used to visualize, define, and document the features present in a system from a business perspective.

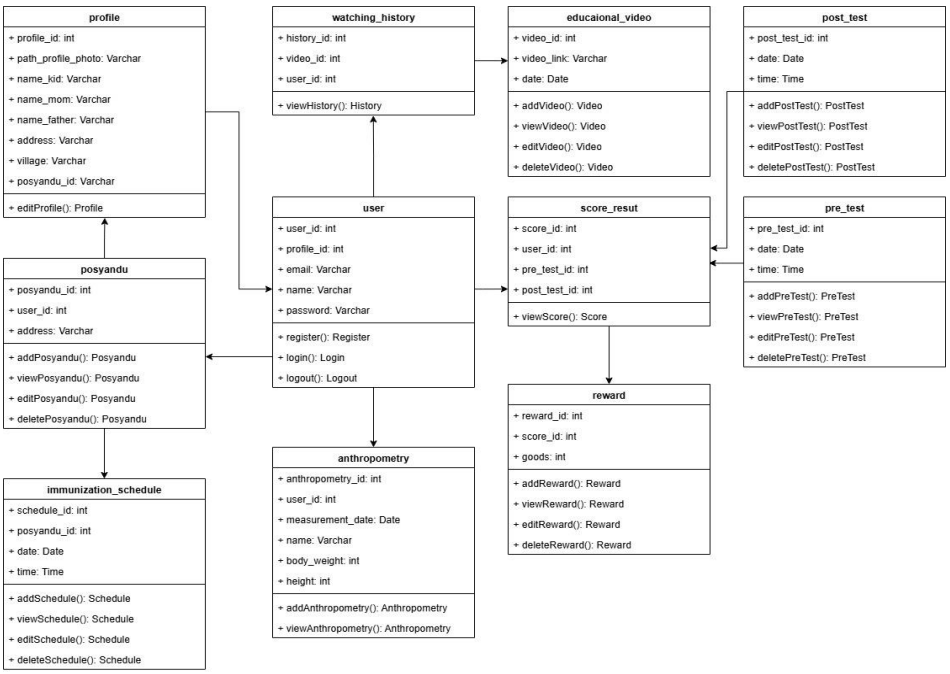


Figure 8. Class Diagram of the Mobile Application for Monitoring Toddler Development

This class diagram describes the structure of a mobile application system for toddler development, which consists of various entities such as users, profiles, posyandu, immunization schedules, educational videos, pre-tests, post-tests, score results, rewards, anthropometry, and viewing history. Each class has basic attributes and operations such as adding, viewing, editing, and deleting data. The relationships between classes are indicated through the connections between the IDs of each entity, such as users having relationships with profiles, score results, and viewing history, as well as score results being connected to pre-tests, post-tests, and rewards.

3.3. Admin View Page

Here is the display that is present on the admin view page:

1. Dashboard

   On the dashboard page, there is quick access to the main features of the system, namely User Data, Immunization Schedule Data, Pre-test & Post-test Data, Reward Data, and Educational Video Data.

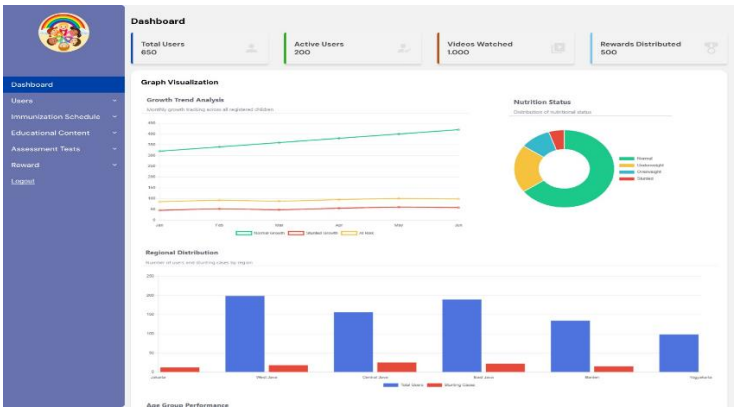


Figure 9. Admin Dashboard Page

The admin dashboard view in the mobile application for toddler development displays an important statistical summary visually, including total users (650), active users (200), number of videos watched (1,000), and rewards given (500). In the main part of the dashboard, there are user growth graphs, daily activities such as logins, video views, and test take-ups, as well as the performance of educational content. The navigation on the left side provides quick access to menus such as Users, Immunization Schedule, Educational Content,

Assessment Tests, Reward, and Logout, which facilitates the admin in managing data and monitoring the overall development of the system.

3.4. User View Page

Here is the screen display of the menu available on the mobile application for monitoring toddler development used by the user:

Figure 10. User Home Page (a) and Anthropometry Page (b) and Immunization Schedule Page (c)

The Home Page is the page that appears after the user successfully logs into the application. This page provides a personalized welcome to the user and displays access to several features or menus available in the application, namely anthropometry, immunization schedule, educational videos, pre-test and post-test, and finally, a gift exchange. At the bottom, there is navigation that makes it easy for users to switch to the results page, educational viewing history, and profile pages. The Anthropometry Page has the function of recording and monitoring the growth data of toddlers every month. This page displays a column format for entering growth data for children. The data that can be recorded and saved includes the date of entry, weight, and height of the toddler. The Immunization Schedule page in the app displays information about the available immunization schedule at the posyandu selected by the user based on the name of the place or posyandu, address, date of implementation, and time of the immunization conducted by that posyandu.

Educational Video Page

The Educational Video page presents a view for playing educational videos divided into several weeks within a month. Each week has a different learning topic. Each video is equipped with a title and video playback controls that make it easier for users to access learning material interactively.

Figure 11. Educational Video Page

3.5. Application Testing Results

The application was tested using two methods: blackbox testing and usability testing. Blackbox Testing showed that all features worked as expected. The inputs provided by users generated accurate outputs, such as growth charts and quiz scores. Navigation between menus was smooth without technical errors. Usability Testing was conducted with representatives of parents and healthcare workers who tried to use the application in real-life scenarios. Most respondents stated that:

1. The application interface is easy to understand and operate.
2. The educational features in the form of videos are considered interesting and informative.

3. The existence of a reward system provides additional motivation to remain active in using the application.

In addition, respondents also suggested the development of more varied content and a reminder feature for immunization schedules and monthly data input as an advanced feature.

Table 2. Result of Mobile Application for Monitoring Toddler Development using Black Box method directed towards Usability Testing

No	Testing Scenario	Test Case	Expected Result	Test Result	Conclusion	Description
1	Log in with valid data	User enters correct email and password	The system displays the Toddler Development Application dashboard	As per	Pass	Authentication successful
2	Log in with invalid data	The user entered the wrong email or password	The system displays a login error message	As per	Pass	Login validation works well
3	Edit user profile	User accesses the profile menu and updates their bio	Profile data is updated and a successful notification appears	As per	Pass	Data update success
4	Accessing viewing history	The user opens the video history menu that has been viewed	The system displays a list of videos that have been viewed	Appropriate	Pass	History is recorded correctly
5	View pre-test and post-test score results	The user opens the pre-test and post-test score results menu	The system displays pre-test and post-test scores According to the data	Appropriate	Pass	The accuracy of value data is guaranteed
6	Fill out the pre-test and post-test	User answers all pre-test and post-test questions	The system saves and provides pre-test and post-test scores	Suitable	Pass	Question and assessment function
7	Access the immunization schedule	The user opens the child immunization schedule	The system displays the immunization schedule	Appropriate	Pass	Dynamic data based on biodata
8	Accessing educational videos	The user opens an educational video	The system can play the educational video and count as viewing history	Appropriate	Pass	Multimedia features run well
9	Viewing rewards	User accesses the The reward that has been given	The system can display the reward according to the data	Suitable	Pass	Redemption and validation logic runs
10	Admin manages immunization schedule data	Admin inputs or edits t h e immunization schedule	The schedule is updated and displayed in the user system	Appropriate	Pass	Active admin function
11	Admin manages educational video data	Admin inputs or edits educational video data	Educational videos are updated and displayed in the user system	Appropriate	Pass	Upload and synchronization successful
12	Admin manages user data	Admin inputs or edits user data	User data is updated and displayed in the user system	Appropriate	Pass	Secure user management
13	Admin manages pre-test and post-test data	Admin inputs or edits pre-test and post-test data	Pre-test and post-test data is updated and displayed in the user system	Corresponding	Pass	Monitoring user evaluation

14	Admin manages anthropometry data	Admin inputs or edits anthropometry data	Anthropometry data is updated and displayed in the user system	Appropriate	Pass	Inventory reward system running
15	Admin manages reward data	Admin inputs or edits reward data	Reward data is updated and displayed in the user system	Appropriate	Pass	Inventory reward system running

4. Conclusion

The mobile application 'Mobile Application for Monitoring Toddler Development' serves as a mobile-based digital solution to support the monitoring of child growth and educate parents to prevent stunting in Indonesia. This application is designed using the Waterfall SDLC model and is equipped with important features such as anthropometric data recording, immunization schedules, educational videos, pre-test and post-test systems, as well as a gamification-based reward mechanism. Test results show that the application is not only technically functional but also easy to use, receiving positive feedback from parents and healthcare professionals. Through an interactive digital education approach and an incentive system that encourages active participation, the application can enhance health literacy and parental involvement in monitoring child development. This application also has the potential to become a valuable data source for the government in crafting evidence-based policies to accelerate stunting reduction. By prioritizing the principles of accessibility, personalization, and prevention, this serves as a concrete example of the contribution of technological innovation in supporting the transformation of public health services.

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