

Mobile-Based Digital Parenting Application to Support Children's Activities and Learning

Shulfani Maskur^{1✉}, Sri Wulandari²

^{1,2} Department of Informatics, Faculty of Science and Technology, Universitas Teknologi Yogyakarta, Sleman, Yogyakarta 55284, Indonesia

shulfani.5220411457@student.uty.ac.id

Abstract

Parents are often the first to respond when their children encounter learning difficulties. However, many of them struggle to determine the most appropriate strategy due to differences in each child's learning style. This study is designed to help parents identify their child's learning style (using the VARK model), create a personalized learning plan, and monitor the child's progress. The development process follows several stages of software engineering, including literature review, needs analysis, design, implementation, and system function validation. The application was developed using Flutter for the interface, Supabase for authentication and backend services, and PostgreSQL as the data storage system. Functional testing was carried out using the black-box method across key feature scenarios: login, VARK test, learning plan creation, and monitoring. The results show that the core features perform according to the development objectives, and the interface is easy to use for non-technical users. These findings highlight the potential of the application as a practical tool for parents to engage more actively in their children's learning process.

Keywords: digital parenting, mobile application, VARK, software engineering, tracking

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1. Introduction

The role of parents in children's education is not limited to academic supervision alone but also encompasses character formation and moral values based on Islamic teachings [1]. This explains the integration of Islamic values in the development of Islamic Religious Education curriculum in elementary schools, emphasizing that religious education should not be merely a formality but must also reach the formation of faith, morals, and the ability to adapt to changing times. Thus, the role of parents in understanding and supporting the integration of these values becomes key to ensuring that Islamic character education can run consistently and meaningfully.

Digital transformation in recent years has brought fundamental changes to how parents communicate and interact with their children. Technology is not only a medium of entertainment but also functions as an innovative tool in data-driven parenting practices, enabling parents to monitor, analyze, and guide children's learning in real-time. In the Industry 4.0 Revolution era, positive parenting is required to utilize digital media as a collaborative tool that strengthens emotional relationships between children and parents while facilitating active involvement in learning activities [2].

Mobile-based parenting applications can improve the effectiveness of communication and parental involvement, particularly in managing daily routines and supporting children's learning processes at home [3]. This application-based approach is designed with a simple and intuitive interface so that it can be accessed by parents from various backgrounds, including those with limited technical experience. This confirms that technology can be an inclusive tool in supporting modern parenting. Digital literacy among parents is crucial to prevent addictive behavior toward gadgets [4], and digital education programs are essential for parents to be able to recognize and reduce the risk of exposure to negative content in cyberspace [5].

In the realm of educational technology, developing mobile parenting information systems has been found to improve reporting efficiency and communication between caregivers and parents [6]. This aligns with the implementation of Android-based applications that can monitor children's development in real-time and strengthen the relevance of digital technology in the context of dynamic families [7].

From a pedagogical perspective, the VARK model (Visual, Auditory, Read/Write, Kinesthetic) introduced by Neil Fleming has been widely used to understand variations in individual learning styles. The VARK model has high validity in classifying children's learning preferences and their relationship with

academic achievement [8]. Integrating this model into digital parenting applications allows parents to understand children's learning tendencies in a measurable way, so that support strategies can be adapted to the unique needs of each child. This ensures that educational interventions provided by parents become more personal and effective in facilitating children's optimal learning potential. This data-driven approach is also capable of encouraging a continuous evaluation cycle of home teaching strategies, making parenting increasingly adaptive over time.

Based on ongoing research on the SMART-P application (Seamless Mobile Assisted Real Training for Parents), mobile-based parenting training has proven to be a highly effective intervention. Significantly, this program can improve parenting patterns and children's cognitive development [9], as well as strengthen parents' locus of control [10]. These findings emphasize that digital applications have a crucial and comprehensive role in supporting modern family functions and serve as an important foundation for developing technology-based mobile parenting applications oriented toward improving the quality of parenting and children's learning. Technology-based education approaches can strengthen parents' concern for children's development at home continuously [11]. Through this approach, it is expected to create more effective collaboration between parents and children in the learning process that suits the individual characteristics of children. In addition, the results of this research are also expected to become the basis for developing more adaptive technology-based education systems oriented toward family needs.

2. Methods

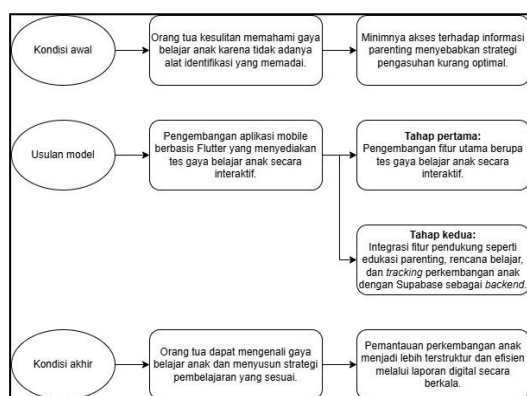


Figure 1. Research Flow

Figure 1 illustrates the research flow that begins with problem identification to the solution model implementation stage. In the initial condition section, the main problem faced by parents is difficulty in understanding children's learning styles due to limited information and the absence of adequate identification tools. This has implications for the low effectiveness of parenting strategies and learning support at home.

As a solution, in the proposed model section, the design of a Flutter-based mobile parenting application development is illustrated, designed to help parents understand children's learning styles through interactive tests. Development is carried out through two main stages. The first stage focuses on creating digital learning style assessment features for children using the VARK model (Visual, Auditory, Read/Write, Kinesthetic). The second stage involves integrating additional features including presentation of educational materials, planning of learning activities, and monitoring of children's development based on Supabase as a backend service. This integration allows the system not only to identify children's learning preferences but also to automatically provide personal parenting and learning strategy recommendations. Thus, this model design aims to create adaptive parenting guidance that is continuous and data-based.

The final stage of this research flow shows the ideal condition to be achieved, which is when parents can understand the characteristics of children's learning styles and create appropriate learning strategies. In addition, there is a process of monitoring children's development through tracking features so that learning outcomes and family interactions can be evaluated continuously. This research approach follows standard software engineering steps that can be reproduced by other researchers.

2.1 Literature Study

The literature review includes national and international scientific journals discussing digital parenting and the application of technology in education. The results of the review show the importance of integrating educational values in digital-based parenting [1], while emphasizing the development of educational features that can increase parental involvement through application-based training (Seamless Mobile Assisted Real Training) [10]. The principles of mobile learning development are also a major consideration in application design, because efficiency and ease of access are crucial focuses in the context of digital education [12].

The review also includes references regarding the technical design of simple and user-friendly mobile application interfaces [3], and provides a methodological basis in the application of the Rapid Application Development (RAD) model, which is considered suitable for rapid development in digital-based educational projects [13].

2.2 Needs Analysis

The needs analysis was conducted using a descriptive approach by combining observations of similar applications and interviews with psychology experts. Applications such as The Asian Parent and Parenting Hub were used as comparative references to identify feature structures, interface design, and interaction

patterns commonly found in digital parenting platforms. Meanwhile, interviews with Mrs. Nadea Zulfa Khairunnisa, M.Psi., provided practical insights into children's learning behavior and the needs of parents for guidance based on developmental psychology [14].

From both sources, four main system requirements were identified: a learning style test module (VARK) to understand children's preferences, a personalized learning plan feature, parenting-based educational materials, and child activity monitoring. These requirements were further confirmed by previous studies highlighting the importance of integrating digital education and parental involvement in home learning [11], as summarized in Table 1.

Table 1. Data Sources

No.	Data Type	Description
1.	Research Journals and Scientific Articles	Theoretical sources about digital parenting, children's learning styles (VARK), and methods for developing educational applications.
2.	Similar Applications	Analysis of features and displays of The Asian Parent and Parenting Hub applications as design comparisons.
3.	Interview	Interview with child psychologist to obtain practical views related to parenting patterns and child development.

2.3. System Design

This system design utilizes Unified Modeling Language (UML) to describe the interaction between users and the system. It emphasizes a simple interface, ease of navigation, and readability. Mobile responsive UI design is designed considering the needs of non-technical users such as parents [6], [15].

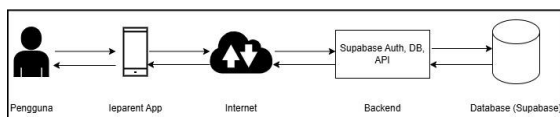


Figure 2. System Architecture

Figure 2 shows the overall system design of the IE-Parent application. This system uses a mobile application as the front-end that functions to interact directly with users, while the backend handles authentication logic and data management. The frontend communicates via the internet with the backend consisting of Supabase Auth, API, and Database. The backend is responsible for processing input data from users, performing authentication, managing data, and storing and retrieving information from Supabase as the Database. Other matters such as retrieving VARK test results, learning plans, educational materials, and tracking children's activity

monitoring are also the responsibility of the backend. This communication flow is bidirectional; users send input through the mobile application to the backend and database, then the backend processes the data and sends responses back to the application so that users can receive the information they need in real-time.

The Use Case Diagram in the IE-Parent application illustrates the interaction between users and the system in running various main functions that support digital parenting activities. Users can perform the registration and login process to access the application, then view the home page as the main page. After entering the home page, users can take the children's learning style test and see the results, access parenting education materials, create personal learning plans, and monitor development through tracking features. In addition, users can also access the profile page to edit profiles and exit the application through the logout feature. This diagram shows the direct relationship between users and all the main features of the application in supporting the role of parents in children's learning, as shown in Figure 3.

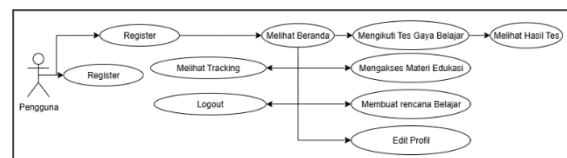


Figure 3. Use Case Diagram

The system design in the IE-Parent application uses Class Diagram to show how the data structure and relationships between classes are interconnected to form a system unit. This diagram includes several main classes such as User, Learning Style Test, Learning Plan, Materials, and Tracking, as well as supporting classes in the form of Register and Login which have functions to process user authentication. The User class is the center of activity because it regulates the interaction between users and the system, starting from the registration process, logging in, to accessing the features available in the application. Each class has its own role, such as Learning Style Test managing children's assessment results, Learning Plan creating appropriate activity schedules, while Materials contain educational content that can be accessed by parents. As for the Tracking class, it functions to record and monitor children's development. The relationships between these classes can reflect the integration between user data, test results, learning plans, and educational materials in one integrated and mutually supportive digital parenting system, as shown in Figure 4.

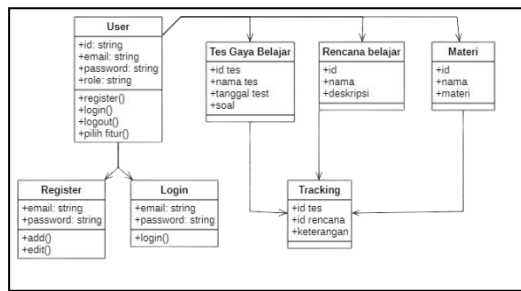


Figure 4. Class Diagram

The Activity Diagram in the IE-Parent application illustrates the flow of activities between users and the system in running the main process of the application. The process begins when the user opens the application which then displays the Splash Screen before entering the Register/Login page. After the user authenticates through Supabase, the system verifies the data. If the authentication process fails, the user will be directed back to the login page; if successful, the system will display the Home Screen. Next, users can choose the desired features such as Learning Style Test. The system then processes the display data and test result values that have been carried out by the user. After the process is complete, users can view test results and select other features or exit the application through the logout feature. This activity flow shows the integrated interaction between users and the system in running the main functions of the application, as shown in Figure 5.

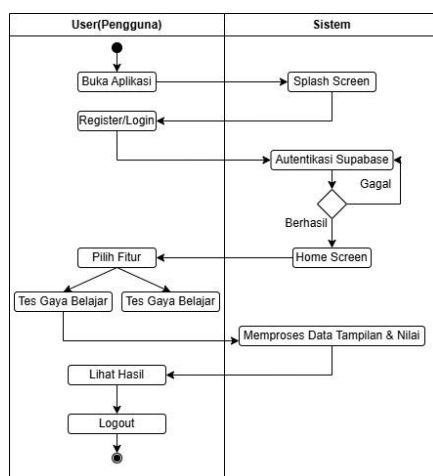


Figure 5. Activity Diagram

2.4 Implementation

The application was developed using Flutter as the main framework because it is able to support cross-platform development with one code base while providing high efficiency at the interface testing stage [16]. Flutter was also chosen because it has good performance stability and ease in building responsive interfaces suitable for non-technical users such as parents. As a backend service, this system utilizes Supabase to handle user authentication, API management, and data storage using PostgreSQL, which is known to be reliable in

maintaining data integrity and security in medium-scale applications [7].

In addition, the development structure also applies the separation of UI modules and business logic to facilitate the system maintenance process. The modular approach refers to rapid software development practices [13] and allows the system to be expanded at the next development stage according to the principles of scalable architecture [17]. This strategy also helps maintain application performance consistency when adding new features without having to change the existing core structure.

2.5 Testing

The black-box testing method is used to test the main functions of the application including the login process, VARK test, learning plan creation, and recording of children's activities. This testing aims to ensure that all data is stored correctly in the database and test results display recommendations according to the type of children's learning style. Success criteria are determined based on the level of system conformity with user needs [18].

3. Results and Discussions

This section presents the implementation results and evaluation of mobile digital parenting application development that has been designed based on software engineering stages. The research results are arranged systematically to form a logical flow of explanation, starting from the presentation of the application's main features, functional testing results, to interpretation of the system's effectiveness and ease of use. The discussion is carried out by interpreting the relationship between implementation results and the theory underlying the research, especially the concept of digital parenting and the VARK model as an approach to identifying children's learning styles. The explanation focuses on how the developed system is able to answer user needs and support research objectives, namely helping parents understand and adapt children's learning styles more directedly. In addition, the analysis also highlights the effectiveness of feature integration in the application on increasing parental involvement in children's learning processes. The results of this discussion are expected to provide a comprehensive picture of the application's contribution in supporting the role of parents as providers of adaptive and responsive learning facilities to children's needs.

In addition, this section also discusses the implications of testing results on aspects of system usability and reliability. Positive results from functional tests show that the application can be operated stably and provide responses according to the initial design, which strengthens the reliability of Flutter and Supabase-based architecture. The discussion also links these findings

with previous literature to confirm the suitability of innovations produced with previous research in the field of educational technology and digital parenting. If results are found that are not yet optimal, they are presented objectively as a basis for further research.

3.1 Main Features

Four main features developed include:

a. Learning Style Test (VARK)

The learning style test page shows the interface display of the children's learning style test feature developed in the IE-Parent application. This feature is designed based on the VARK model (Visual, Auditory, Read/Write, and Kinesthetic), which functions to recognize individual learning tendencies through differences in how they receive and process information. In implementation, children answer a number of simple questions related to daily learning habits. For example, questions like "I get bored quickly if I have to sit for a long time" are used to assess kinesthetic type learning tendencies. Each question will be accompanied by three answer choices, namely Yes/Agree, Neutral/Sometimes, and No/Disagree so that users can choose according to the child's condition. The answers given are then automatically processed by the system to determine the most dominant type of learning style. The results of this test will be presented in the form of a summary and explanation that is easy for parents to understand, so that they can know the child's learning character more objectively, measurably, and can be used as a reference in developing appropriate learning strategies at home. This can be seen in Figure 6.



Figure 6. Learning Style Test

b. Learning Plan

The learning plan is compiled based on the analysis results from the learning style test conducted previously. This feature helps parents arrange learning activities that suit the child's character, both in terms of method, duration, and level of difficulty. Thus, learning patterns are no longer just general but also adapt to the

needs and abilities of each child. This concept refers to the personalized learning plan model, which emphasizes the importance of adjusting learning activities to each individual's potential. This approach is in line with Problem Based Learning principles that emphasize active involvement in problem-solving to foster critical and independent thinking abilities [19]. With this approach, the IE-Parent application does not only serve as an identification tool but also as adaptive guidance for parents in accompanying children's learning processes in a directed and continuous manner. The system will automatically adjust learning plan recommendations based on evaluation results and children's development, so that learning activities become more effective, enjoyable, and appropriate to needs. This can be seen in Figure 7.



Figure 7. Learning Plan

The page displays the children's learning plan feature that functions as the implementation of the personal learning plan concept. This plan is compiled based on previous learning style test results. This feature is designed following the personalized learning plan model to help users in arranging children's activities, both academically and non-academically. There are examples of plans listed such as "swimming" activity categorized as sports with difficult difficulty level and implementation deadline of October 9, 2025. Users can add new activities through the "Add Plan" button. In addition, this feature allows monitoring of progress through simple periodic visuals so that parents can assess the extent to which children follow the learning schedule that has been designed, and conduct evaluations if needed in the process.

c. Digital Parenting Materials

Digital Parenting Materials is a collection of articles curated from current research on digital literacy and parenting patterns. This content functions as an educational tool for parents in understanding various aspects of parenting in the ever-evolving digital era. This page displays the educational materials feature that

serves as a digital library containing various articles related to modern parenting topics. Each content in this feature is selected based on suitability with user needs and is based on credible research results. Materials are presented in several categories, including parenting, health, lifestyle, and eating patterns. This can be seen in Figure 8.



Figure 8. Educational Materials

Each article is equipped with a short summary that helps users recognize the content before reading the entire material. This feature does not only present information but also encourages parents to increase digital literacy and apply adaptive parenting practices to technological changes. Thus, educational materials become an important element in supporting the goals of the IE-Parent application as an interactive learning medium for families in the digital era. The presence of this feature also adds to users' insights by providing credible and easily accessible learning sources at any time. Materials presented in a structured manner have the function of practical guidance to bridge theoretical knowledge with the application of digital parenting in daily life. This can allow parents to be active and independent in seeking solutions to digital-based parenting challenges.

d. Child Development Tracking

This feature uses visualization in the form of simple graphs to display children's learning progress dynamically, following the concept of Android-based monitoring systems that have been developed [10]. This visualization is designed so that parents can easily understand children's development through informative trends. In addition to being a monitoring tool, this graph also helps identify patterns of changes in children's learning performance so that parents can adjust learning strategies appropriately and continuously. Data recorded periodically functions as important historical data to assess the long-term efficacy of learning plans

that have been implemented. With this data, parents can have an objective basis to conduct consultations or make appropriate decisions regarding children's education in the future. This can be seen in Figure 9.



Figure 9. Tracking

This page displays the main tracking feature of children's development that presents a summary and children's learning progress on one page by adopting an Android-based monitoring system model that is integrated dynamically. This page displays the dominant results of learning style tests that have been conducted. There is also a display of active learning plans that list current activities such as "swimming" and "weekly lessons" complete with deadlines and implementation status. There is also a graph display combining learning style results with learning plan suitability with total progress calculation (VARK 50% + plan 50%) reaching 100%.

3.2 Functional Testing

Testing results show that all features run according to established needs and specifications. Data entered by users is stored consistently and securely in PostgreSQL through Supabase services, without any data loss or duplication. The average application response time is under two seconds for each data transaction, indicating system efficiency in processing user requests. In addition, non-technical testing shows that users can run all features easily without requiring assistance according to human-centered interaction principles [20]. These results confirm that the interface design and system architecture applied have supported an intuitive,

responsive, and user-friendly application experience. This can be seen in Table 2.

Table 2. Functional Testing

No.	Feature	Input	Expected Output	Status
1.	Login	Email and Password	User successfully logs in	Success
2.	Learning Style Test	Answer questions Yes, Neutral, No	Display learning style results	Success
3.	Educational Materials	Click access link to educational materials	Redirect to materials outside application	Success
4.	Learning Plan	Fill in learning plan detail form	Data saved then displayed	Success
5.	Tracking	Open Tracking page	Display latest achievement results	Success

3.3 Discussion

The findings of this research strengthen various previous studies showing that the implementation of application-based digital parenting can increase participation and parental involvement in children's learning processes. Compared with previous research, the prototype developed in this study does not only focus on providing educational content but also adds an adaptive learning style assessment component (VARK) that is directly connected to personal learning plan preparation, thereby providing a more directed and individual support experience for each child.

These test results show that simple and intuitive interface design makes it easier for non-technical users to operate the application while increasing their confidence in utilizing technology. This aligns with the importance of applying human-centered interaction principles in family education systems so that technology truly functions as a collaborative bridge between the role of parents, children, and the learning process itself [13], [14].

4. Conclusions

This research successfully produced a mobile digital parenting application that integrates four main features: learning style test based on VARK model, adaptive learning planning, parenting educational content materials, and child development tracking. All features are designed to complement each other to help parents get better parenting guidance based on easily accessible data. The application runs stably, responsively, and is

easy to use on mobile devices with a simple interface with directed features, thus able to increase parental involvement in accompanying children's learning processes at home.

In addition to providing practical contributions in implementing technology-based digital parenting, this research also strengthens studies on the integration of learning style assessments in family learning. For future development, it is recommended to add automatic schedule reminder features, discussion forums, and data-based progress visualization so that the application develops into a collaborative platform for parents in evaluating children's learning strategies.

Funding Information

Authors state no funding involved.

Author Contributions Statement (mandatory) (10 PT)

This section presents the individual contributions of each author to ensure transparency and accountability in the research process. The statement follows the Contributor Roles Taxonomy (CRediT) framework adopted by this journal, which identifies specific roles performed by each contributor during the development of the study and manuscript preparation.

Name of Author	C	M	So	Va	Fo	I	R	D	W
Shulfani Maskur	✓	✓	✓	✓	✓	✓		✓	✓
Sri Wulandari	✓	✓	✓			✓		✓	✓

C : Conceptualization I : Investigation
M : Methodology R : Resources
So : Software D : Data Curation
Va : Validation W : Writing - Review
Fo : Formal analysis

Conflict of Interest Statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Biographies of Authors (10 PT)

	Shulfani Maskur is a student in the Informatics Department at Universitas Teknologi Yogyakarta. Her research interests include mobile application development, digital parenting, and educational technology. She is currently working on developing innovative solutions to support parental involvement in children's education through technology-based approaches. She can be reached at shulfani.5220411457@student.ut.ac.id.
	Sri Wulandari is a lecturer in the Informatics Study Program at Universitas Teknologi Yogyakarta. She research focuses on software engineering, mobile applications, and artificial intelligence. She has been actively involved in guiding students in developing practical applications that address real-world educational challenges.