

Innovation of Digital Marital Education using Waterfall Approach

Iqbal Maulana¹, Tutik Khotimah², Hanik Hidayati³

Abstract

Marital education, traditionally delivered through in-person workshops or counseling sessions, faces challenges related to accessibility, engagement, and customization. This paper explores the innovation of digital marital education by implementing the Waterfall approach to systematically design and develop a mobile application tailored for couples. The Waterfall methodology, known for its structured, step-by-step development process, ensures that the design of the app is meticulously planned and executed with clear objectives for each stage, from initial requirements gathering to final deployment. The proposed application integrates interactive modules on communication, conflict resolution, and relationship-building, along with features designed to increase user engagement, such as self-assessments and feedback loops. Through the Waterfall approach, each development phase is thoroughly documented, ensuring a user-centered design that addresses usability and content relevance. The effectiveness of the application is evaluated through a series of testing phases, which include feedback collection from target users to ensure the app meets the educational needs of couples. The findings suggest that the Waterfall approach, while rigid, results in a highly structured, reliable system for the development of a marital education tool, with positive implications for enhancing relationship quality and communication. Future work will explore iterative improvements and the potential integration of adaptive learning techniques.

Keywords:

Digital Marital Education, Waterfall Approach, Software, Engineering.

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1. Introduction

Conventional marital education programs are often delivered through in-person workshops or counseling sessions that face low accessibility and engagement, especially among younger or geographically dispersed couples. These methods rely heavily on scheduling, travel, and facilitator availability, which may deter participation due to time constraints, stigma, or resource limitations. Such barriers underscore the need for innovative delivery modes that offer flexibility, anonymity, and scalability while maintaining educational efficacy [2]. Various studies have shown that the use of Android-based mobile applications can increase students' interest in learning and understanding of Islamic material. A study demonstrated that the use of mobile learning in Islamic jurisprudence learning can improve student understanding and make the learning process more interactive [2].

Many existing programs use lecture-based formats focusing on knowledge transmission, such as communication techniques or conflict resolution skills, often failing to engage participants in active learning or behavior change. While such curricula may produce short-term gains, sustaining long-term behavioral adoption is difficult without interactive and practical application components. The repetitive nature and lack of customization limit deeper impact in real-life relationship contexts [3], [7]. Recent mobile-

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based interventions—such as Iran’s premarital app that have demonstrated measurable improvements in knowledge, attitudes, and practice among youth regarding healthy marriage [2]. Similarly, the “Love Every Day” app improved daily couple communication, relationship satisfaction, cohesion, and conflict management over a 21-day engagement period [0]. Yet these platforms often lack iterative design stages (e.g., prototyping), limiting optimization based on early user feedback.

Despite positive outcomes, many existing relational and marital education apps suffer from usability and engagement challenges. Issues include poor user interface design, low perceived relevance, and modular inflexibility. Without systematic prototyping, including usability testing and interface refinement, apps may fail to meet user expectations or support sustained engagement over time, reducing efficacy [13]. Prototype development methods—such as paper prototyping or iterative low-fidelity wireframing—have long been recognized in user-centered design and software development to improve usability and feature relevance early in the process [13]. In the context of marital education, prototyping allows designers to test interactive content and navigation flows with target users, ensuring the educational app resonates with couples’ needs before full-scale deployment.

Effective marital education requires more than information delivery; it needs to support self-management, communication routines, and conflict resolution practice. Features like daily prompts, self-assessments, or reflection exercises (as seen in Paired or Love Every Day) support habit formation and sustained relationship effort [0], [2]. However, many apps omit structured reinforcement mechanisms, reducing their long-term behavioral impact. Current digital interventions often rely on static textual content or generic modules, lacking multimedia elements and adaptive personalization. Studies show that engaging formats—such as videos, interactive quizzes, and personalized feedback—enhance retention and satisfaction [2], [6]. Prototyping can help refine which content modalities resonate with users and how to tailor workflows to couple profiles or relationship stages.

In light of these limitations, this study proposes an innovative prototype-based mobile application for marital education. By employing iterative prototyping—starting from low-fidelity sketches through interactive mockups and user-tested versions—the aim is to co-design an app that addresses usability, multimedia relevance, personalized content, and behavior change integration. This approach ensures the final product is both educationally effective and user-centered, filling gaps left by existing apps.

2. Related Works

Several previous studies have shown that Android applications can increase user access and participation in understanding Islamic material, although attention to the jurisprudence of marriage remains relatively limited. Research conducted by Muhammad Yusup, Rudi Hermawan, and Shinta Dwi Handayani in 2025 entitled *Android Application for Alphabet Pronunciation as a Learning Tool for Speed Reading Without Spelling Using Flutter*, explains that Flutter can accelerate development and create applications with a responsive appearance and light performance. Although not focused on religious themes, this study highlights the advantages of Flutter as a suitable framework for educational applications that are simple yet efficient in delivering material [6].

Research conducted by Ramadhanni and colleagues in 2024 in the *Tashdiq* journal emphasizes the significance of the use of digital technology in the spread of Islamic teachings. This study states that digital platforms such as mobile applications can function as a strategic means to convey Islamic values widely and effectively, especially to generations growing up in the digital era. This study also highlights the obstacles in

delivering content that needs to be adaptive, relevant, and still follow the principles of sharia, which is the basis for developing this Android-based fiqh application [7].

On the other hand, research by Hilal Ali Algari and colleagues in 2021 at the National Seminar on Information and Communication Technology, entitled "Smart Quran Application," also utilized Flutter as a framework for its development. This application leverages Flutter's advantages in creating a modern interface and efficient performance, focusing on innovative Quranic learning. The adoption of Flutter in the context of this Islamic application demonstrates that this framework is highly suitable for religiously based educational content [8].

The latest research by Matondang and Triandi in 2025 through JID (Jurnal Info Digital) created an Android-based Al-Qur'an application using the HTTP GET method. This study reveals Flutter's ability to combine dynamic features such as retrieving data from external sources while maintaining application performance, making it the right framework for religious education applications [9]. The research concluded that Flutter has proven to be an efficient and effective tool for developing Islamic educational applications. Therefore, this study applied Flutter to create a marriage fiqh application divided into three stages: before marriage, during marriage, and after marriage. Designed for offline use, this application is small in size and easy to use, and is expected to be a practical learning tool for the community, especially for the younger generation approaching marriage.

3. Proposed Method

This study adopts Waterfall approach because it is suitable for producing a fast and efficient application for educational services. The Waterfall model is a linear and sequential approach that comprises five fundamental phases: requirements analysis, system design, implementation, testing, and maintenance. In this study, we construct the Waterfall model mathematically as a sequential process where each phase must be completed before the next one begins. We can express this progression using a series of dependent functions and transition mappings between the stages of software development.

Mathematical Formulation of the Waterfall Model.

Let the development process be modeled as a set of functions:

$$W = R, D, I, T, M \quad (1)$$

Where:

- R = Requirements analysis phase
- D = System design phase
- I = Implementation phase (coding)
- T = Testing phase
- M = Maintenance phase

Each phase P_i depends on the successful completion of the previous phase P_{i-1} , such that:

$$P_i = f_i(P_{i-1}) \text{ for } i = 2, 3, 4, 5 \quad (2)$$

Where:

- $P_1 = R$
- $P_2 = D = f_2(R)$
- $P_3 = I = f_3(D)$
- $P_4 = T = f_4(I)$
- $P_5 = M = f_5(T)$

The total development function W is a composition of these stages:

$$W = f_5 \left(f_4 \left(f_3 \left(f_2(R) \right) \right) \right) \quad (3)$$

Alternatively, the overall process can be described as:

$$W = M \left(T \left(I \left(D(R) \right) \right) \right) \quad (4)$$

The formulation shows that the Waterfall model is a deterministic and linear pipeline in which output from one phase is the input for the next. No phase can begin until the previous one is completed. In the context of the *Digital Marital Education App* development:

- *R*: Collection and analysis of marital fiqh materials.
- *D*: Designing UI/UX and database schema.
- *I*: Programming the app using Flutter and Dart.
- *T*: Verifying the functionality through Blackbox testing.
- *M*: Updating and refining the app based on user feedback.

In the Waterfall approach, the linear and hierarchical approach ensures structured development and is especially suitable when the requirements are clearly understood from the outset. It also enables phase-wise documentation, which is useful for educational software targeting Islamic marital jurisprudence, where material correctness and stability are essential. In this study, we conduct Blackbox Testing techniques to verify the functionality of all features without direct reference to the source code. The application was tested on a range of Android devices to ensure compatibility and performance. Finally, the maintenance phase focused on refining the system based on initial user feedback to ensure ongoing stability and usability across various platforms.

In this study, we construct the system architecture of the Android-Based Marriage Fiqh Application is structured into two main user roles: admin and user, each with specific responsibilities and interactions with the application. The admin serves as the content and data manager, responsible for uploading, updating, and maintaining the learning materials contained in the application. This role ensures that all educational content regarding Islamic marital jurisprudence is accurate, relevant, and consistently maintained within the system. Additionally, the admin manages other internal application data necessary for smooth functionality.

On the other hand, users represent the target audience of the application who access and utilize its educational features. Users can interact with structured content related to pre-marriage, marriage, and post-marriage teachings directly through their mobile devices. The system is designed to be intuitive and offline-friendly, allowing users to benefit from the learning material without requiring a constant internet connection. This division of roles enhances content integrity on the backend while ensuring ease of use and accessibility on the frontend. Fig. 1 depicts a data flow diagram of education marital apps.

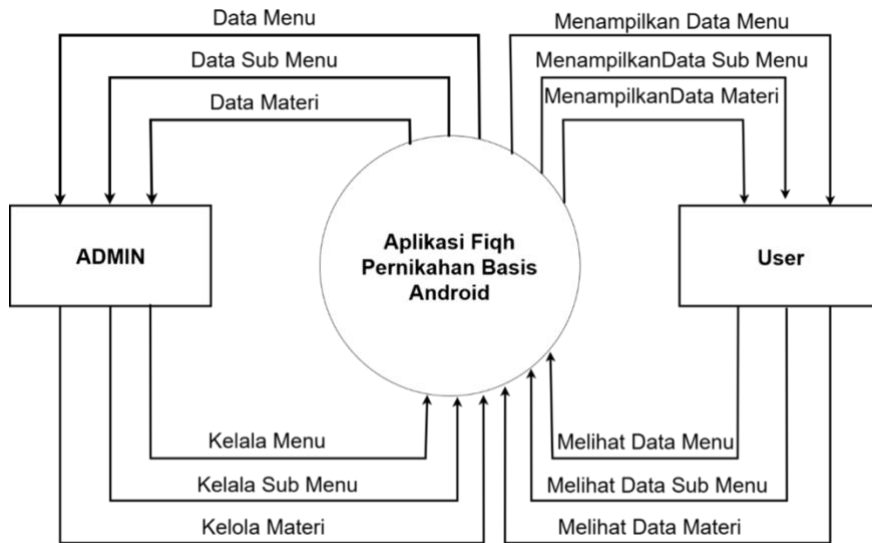


Fig. 1. Data Flow Diagram of Marital Apps

In the development of the Marriage Fiqh educational application, both software and hardware components were essential. The software tools included Flutter SDK, selected for its cross-platform capability and modern UI development using the Dart programming language, and Android Studio, used as the Integrated Development Environment (IDE) for writing, testing, and running code. Android Studio also provided an emulator to simulate the application environment. SQLite was implemented as the local database to store all educational content, enabling the app to function offline. For the user interface and experience (UI/UX) design, tools like Adobe XD or Figma were employed to create interactive prototypes and ensure a user-friendly experience. On the hardware side, a laptop with at least 8GB RAM and a multi-core processor was required to handle the development environment efficiently. Additionally, Android smartphones running at least Android 9.0 (Pie) were used to test the application across various screen sizes and system versions, ensuring broad compatibility and usability.

4. Experimental Setup

4.1 Data Collection

The Marriage Fiqh educational application underwent internal testing in June 2025 with the primary aim of assessing its core functionalities, system stability, and user interface (UI) usability in the context of supporting Islamic marital education. This evaluation was conducted on two Android smartphones running different operating systems. The testing procedures emphasized several technical aspects critical to user experience and system performance. Firstly, menu accessibility was tested to confirm that all navigation components operated without lags or errors. Secondly, the presentation of educational content was verified to ensure that all materials appeared accurately and legibly, reflecting the source without distortion. The third aspect evaluated was the user interface design, with attention given to clarity, readability, and accessibility for users across varying levels of digital proficiency. Lastly, application stability was tested under prolonged usage to confirm that no system crashes or force closures occurred during user interaction.

5. Results and Analysis

In this study, the testing process is developed based on predefined functional criteria of the application. This checklist facilitated systematic observation and recording of test outcomes. The findings from this evaluation phase provided critical insights for further refinement of the application, ensuring a stable, user-friendly, and pedagogically sound digital learning tool. To support the evaluation, testing was conducted based on a checklist developed according to the application's functionality criteria. The results of this testing served as the basis for system refinement before its public launch.

Table 1. Testing results of the application

No.	Aspects Tested	Realme C35 Status	Redmi Note 8 Status	Information
1	Login page	Functioning	Functioning	Succeed
2	Home page application	Functioning	Functioning	Succeed
3	Sub Menu can be accessed	Functioning	Functioning	Succeed
4	The material appears correctly	Functioning	Functioning	Succeed
5	Additional features of the default and light display themes	Functioning	Functioning	Succeed
6	Neat interface display	Yes	Yes	Consistent
7	No force close occurs	No	No	Stable

The testing result demonstrated a high level of functional consistency and stability. A total of seven aspects were evaluated, encompassing key features such as the login page, homepage navigation, submenu accessibility, educational content display, theme switching between default and light modes, interface neatness, and overall application stability. Each of these aspects functioned properly on both devices, with no errors or interface inconsistencies identified during the test process. The results indicate a 100% success rate, both numerically (7 out of 7 aspects) and in percentage terms. No force closes or interruptions occurred during usage, and the application's visual presentation remained consistent across different screen sizes and operating systems (Android 13 and Android 11). This outcome reflects the application's readiness for broader deployment, supporting its usability across a range of user environments and ensuring that core functionalities operate reliably on various Android platforms.

Based on the test results, the application shows stable and responsive performance. No crashes or force closes were found during the usage process in various menu navigation conditions. The application file size is relatively light, which is around 15MB, so it is quite efficient to download and install on devices with limited storage. Design. The application's simple interface and focus on delivering the material make it easy to use, especially for beginners. All content is presented in a clear and systematic structure, making it easy for users to understand each stage of the marital education, including pre-marriage, marriage, and post-marriage. This analysis shows that the application has successfully fulfilled its purpose as a mobile-based educational media. The advantages of offline use, neat material structure, and cross-device compatibility make it a practical solution for the widespread dissemination of marital knowledge in the digital era. Fig.2 depicts the user interface of marital apps

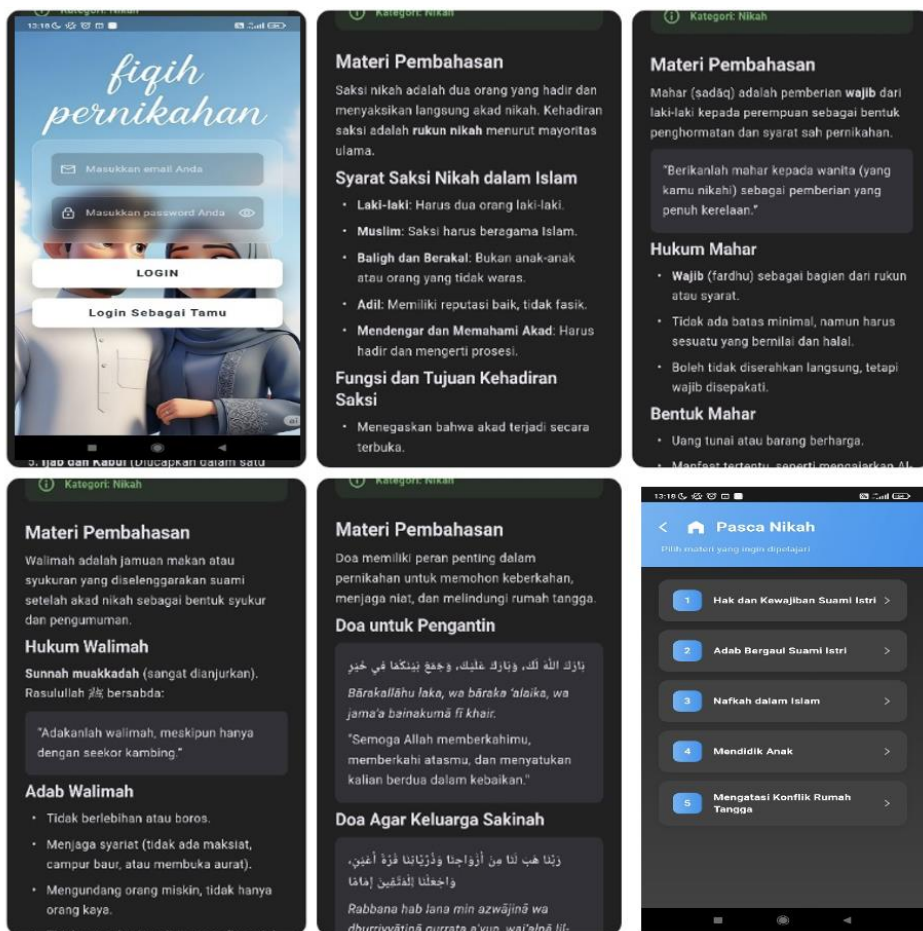


Fig 2. User interface of Marital Apps

6. Conclusion

Based on the results of the functional testing, the Marriage Fiqh educational application demonstrates excellent performance and stability across different Android devices and operating systems. The testing process, which encompassed seven key functional aspects, showed a 100% success rate with no errors, crashes, or performance inconsistencies. Features such as submenu navigation, content rendering, user interface appearance, and theme switching were verified to function optimally on both the Realme C35 and Redmi Note 8. These results indicate that the application meets all essential operational requirements and is ready for deployment in real-world learning environments.

Furthermore, the application's lightweight nature (approximately 15 MB) and offline capability make it a highly accessible tool for users with limited device resources or restricted internet access. It's a structured content presentation that covers pre-marriage, marriage, and post-marriage stages to ensure clarity and pedagogical alignment with Islamic educational objectives. The user interface was reported as neat and beginner-friendly, making the application usable by a wide range of audiences regardless of their digital literacy levels. These strengths reinforce the value of the application as a practical and scalable solution for disseminating religious education through mobile platforms.

Future work may include integrating interactive features such as quizzes, progress tracking, or multimedia enhancements to increase user engagement and learning effectiveness. In addition, expanding the platform to iOS devices and incorporating cloud-

based synchronization features may further enhance the application's accessibility and adaptability. Conducting user trials with a larger demographic and collecting quantitative feedback will also be essential to iteratively improve the user experience and ensure the application's long-term relevance and impact in digital Islamic education.

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