

Mobile Gamification Application for Digital Literacy in Munaqosah Examination Preparation

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ABSTRACT

Preparation for the munaqosah examination at Islamic learning centers (TPQ) commonly relies on conventional methods such as repetitive manual memorization, which often leads to decreased learning motivation and boredom among santri. This study aims to design and develop a gamification-based mobile application to support digital literacy in munaqosah preparation at TPQ Darul Ishlah. The application was developed using the Research and Development (R&D) method, with the Waterfall model applied specifically to the system development stage, and implemented using Flutter and Firestore. The system provides interactive quizzes across four material categories (Aqidah and Akhlak, Fiqh, Tajwid, and Tahsin Kitabah), a point-, badge-, and challenge-based reward system, and a leaderboard to enhance learning motivation. Black box testing confirmed that the registration and login features function according to specification. A usability evaluation using the System Usability Scale (SUS) was conducted with 11 respondents (1 teacher and 10 students), yielding an average score of 90.23, categorized as Excellent according to both the standard SUS interpretation and the Bangor et al. acceptability scale. These results indicate that the gamification approach is well received by users and has strong potential to improve learning motivation in religious education. Further development is recommended to complete full database integration for the remaining features and to expand teacher-monitoring capabilities.



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I. INTRODUCTION

Taman Pendidikan Al-Qur'an (TPQ) is a non-formal Islamic education institution that plays an important role in shaping children's religious competence from an early age. Through daily learning activities, students are guided to read and memorize the Qur'an, understand tajwid rules, and internalize Islamic values as a foundation for everyday life. One of the essential learning evaluation activities at TPQ is munaqosah, an examination that assesses students' memorization, Qur'anic recitation fluency, application of tajwid rules, and basic religious understanding as a requirement for grade promotion or graduation [1]. Based on observations and interviews with teachers and students at TPQ Darul Ishlah, it was found that the conventional methods currently used to prepare for munaqosah, such as manual repetitive memorization and monotonous drilling, often lead to boredom and decreased

learning motivation among santri (students), particularly during the repetition of rarely reviewed material. Teachers also reported difficulty in objectively measuring each student's readiness before the examination using traditional, non-digital tracking methods.

On the other hand, today's students belong to the digital native generation, who grow up accustomed to interactive technology from an early age and are therefore more motivated by technology-based learning approaches [2]. Gamification, the application of game elements such as points, levels, badges, and challenges into non-game contexts, has been shown to increase motivation and engagement across various learning contexts [3], [4]. Several prior studies have examined the application of gamification in educational settings; however, most focus on general academic subjects such as mathematics or language learning [16], [20], while research specifically addressing gamification for Islamic religious education, particularly munaqosah preparation,

remains limited [17]. This gap motivates the present study to explore how gamification principles can be tailored to the specific context of Qur'anic and religious learning at TPQ.

Based on these issues, this study aims to design and develop a gamification-based mobile application to support digital literacy in munaqosah preparation at TPQ Darul Ishlah, and to analyze the level of user acceptance of the developed application using the System Usability Scale (SUS). The contribution of this study is twofold: first, it presents a concrete system design, including database structure and functional implementation, for a gamified religious-education application; second, it provides empirical usability evidence from real users, namely santri and a teacher, which can serve as a reference for similar future developments.

The remainder of this paper is organized as follows. Section II describes the research method, including the software development model, system and database design, and the testing and usability analysis instruments used. Section III presents the implementation results, functional testing outcomes, usability analysis results, and discussion of the findings in relation to prior studies. Finally, Section IV concludes the paper and outlines directions for future development.

II. METHOD

This study employed the Research and Development (R&D) method, a systematic research approach for developing a product and testing its effectiveness [5]. The R&D process in this study consisted of eight stages: problem identification, objective formulation, data collection and literature review, system design, application implementation, testing and evaluation, result analysis and revision, and report preparation. Each stage builds upon the results of the previous one, ensuring that the final application is grounded in the actual needs identified from the field.

A. Software Development Model

The implementation stage specifically applied the Waterfall model, a linear and sequential software development model consisting of requirement analysis, system design, implementation, testing, deployment, and maintenance [6]. This model was chosen because the system requirements had been relatively well defined since the initial interview and observation stage, making a linear and well-documented workflow more suitable than an iterative model such as Agile for a final-year research project developed by a single developer [14]. Table I summarizes how each Waterfall stage was concretely realized within this research.

TABLE I
REALIZATION OF WATERFALL STAGES

Stage	Realization
Requirement Analysis	Functional and non-functional requirements formulated from interviews and observation at TPQ Darul Ishlah
System Design	Use case diagram, entity relationship diagram, and interface wireframes

Implementation	Coding using Flutter and Firebase, producing a functional mobile interface
Testing	Black Box Testing and BVA on core features, followed by SUS usability testing
Deployment	Limited-scale deployment to teachers and students at TPQ Darul Ishlah
Maintenance	Bug fixing and refinement based on findings during trial use

B. System Design

The application was developed using the Flutter framework with Firebase as the backend service for authentication and data storage. Flutter was selected for its cross-platform capability and efficient rendering performance compared to other frameworks [12], [13]. The system involves three main actors, namely Santri (taking interactive quizzes, collecting points, and viewing the leaderboard), Guru/teacher (monitoring students' learning results), and Admin (managing question, reward, and user account data). Fig. 1 illustrates the overall system architecture, showing how each actor interacts with the mobile application and how data flows to the underlying database.

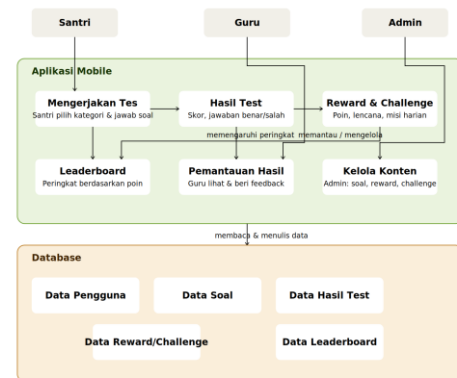


Fig. 1. Overall system architecture

The interaction between each actor and the system's use cases is further detailed in Fig. 3, which presents the use case diagram of the application. Santri can access five use cases, namely Login, Registration, Personal Data Entry, Taking Interactive Tests and Challenges, and Viewing Rewards and Leaderboard. The teacher can access Login, Viewing Student Test Results, and Providing Feedback, while the Admin can access Login, Managing Question Data, Managing Reward and Challenge Data, and Managing User Accounts. All use cases other than Login and Registration include the Login use case, reflecting the authentication requirement before accessing any protected feature.

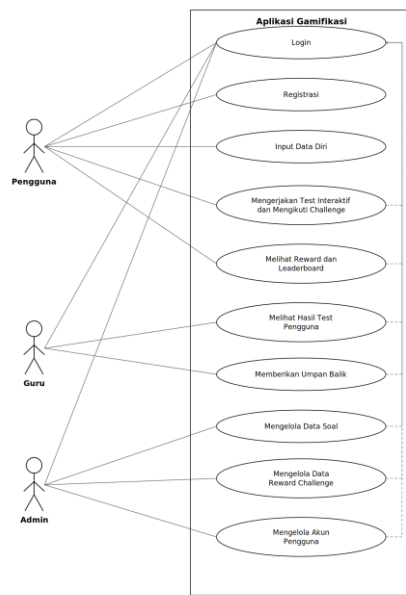


Fig. 3. Use case diagram of the application

The main features of the application include interactive quizzes across four material categories (Aqidah and Akhlak, Fiqh, Tajwid, and Tahsin Kitabah), a point- and badge-based reward system, daily challenges, and a leaderboard to encourage competitive and positive learning motivation.

C. Database Design

The database structure was designed using an Entity Relationship Diagram (ERD) with five main entities, namely Admin, Soal (Question), Kategori_Soal (Question Category), User, and Hasil_Test (Test Result), as illustrated in Fig. 2. The many-to-many relationship between User and Challenge or Reward is realized through associative entities, namely *Penyelesaian_Challenge* and *Penukaran_Reward*, each of which uses a composite primary key consisting of user ID, challenge or reward ID, and date. This structure is required because a single Challenge can be completed repeatedly by many users on different dates, so a direct one-to-many relationship cannot accurately represent such cardinality.

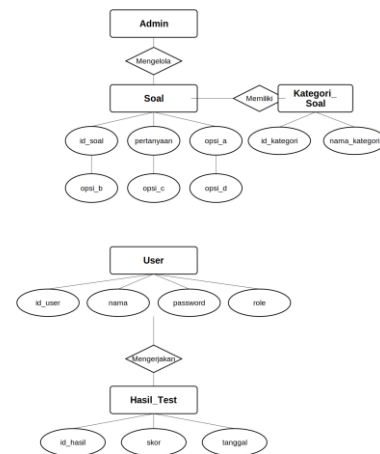


Fig. 2. Entity Relationship Diagram of the main entities

D. Testing Method

Functional testing was carried out using Black Box Testing and Boundary Value Analysis (BVA), a technique that evaluates system behavior at the boundary values of valid input ranges to detect defects that are commonly missed by testing only typical values [9], [15]. This method was applied to the Registration and Login features, examining boundary conditions such as minimum and maximum username length, password length, and email format validity, since these two features are fully connected to Firebase Authentication and can therefore be verified against real system behavior.

E. Usability Analysis Instrument

The application's usability was analyzed using the System Usability Scale (SUS), a standardized questionnaire consisting of 10 statements rated on a 1-5 Likert scale [7]. The final SUS score is calculated by summing the contribution of each item (the score minus 1 for odd-numbered items, or 5 minus the score for even-numbered items), then multiplying the result by a factor of 2.5 to obtain a final score ranging from 0 to 100. The SUS score interpretation follows Bangor, Kortum, and Miller [8], which classifies results into Excellent, Good, Acceptable, and Poor categories, along with three additional dimensions: Acceptability Range, Adjective Rating, and Grade Scale.

The usability test was conducted with 11 respondents from TPQ Darul Ishlah, consisting of 1 teacher and 10 students who had directly used the application. Responses were collected through a Google Form questionnaire distributed after each respondent used the application. In addition to the usability test, functional testing described in Section II.D was also carried out to verify that the application features operate according to the designed specifications.

F. Interview Findings

Prior to system design, semi-structured interviews were conducted with a teacher and several students at TPQ Darul Ishlah to identify concrete pain points in munaqosah

preparation. The teacher reported that preparation was typically carried out through ziyadah (adding new memorization) and murajaah (reviewing previous memorization) with increased time allocation, peer-based recitation checking (semaan), and pre-examination simulations. Despite this structured approach, the teacher observed that fatigue and boredom frequently emerged, particularly during the review of long chapters or infrequently repeated sections, evidenced by students becoming drowsy during group sessions and a noticeable, consistent decline in recitation quality.

The teacher also noted prior experience with generic digital tools, such as murattal audio players and voice recorders, which helped students self-check their recitation but introduced distraction risks, such as students being tempted to access social media or games on the same device. These findings directly informed the design decision to build a purpose-specific, distraction-minimized application rather than relying on general-purpose media players, and motivated the inclusion of gamification elements such as points, badges, and challenges, which the teacher specifically suggested as features that could help sustain students' motivation over the course of daily practice.

III. RESULTS AND DISCUSSION

A. Implementation Results

Of the 11 functional requirements designed, 8 requirements (registration, login, logout, question display, test result display, reward-challenge system, leaderboard, and reward collection) were successfully implemented and can be demonstrated through the application interface, as shown in Fig. 4. The remaining three requirements, namely reminder notifications, offline access, and a learning-result summary for teachers, have not yet been implemented in the current version and are planned as future development. Table VI presents the complete list of functional requirements alongside their realization status.

TABLE VI
FUNCTIONAL REQUIREMENTS AND REALIZATION STATUS

ID	Functional Requirement	Status
AB-01	User registration	Done
AB-02	User login	Done
AB-03	User logout	Done
AB-04	Display quiz questions by category	Done
AB-05	Display score, duration, and answer review	Done
AB-06	Tiered daily challenges	Done
AB-07	Leaderboard ranking	Done
AB-08	View completed quizzes and reward collection	Done
AB-09	Reminder notifications	Not yet
AB-10	Offline access	Not yet
AB-11	Learning-result summary for teachers	Not yet

The registration and login features are fully connected to Firebase Authentication, while the interactive quiz, reward, leaderboard, and challenge features currently use mock data for interface demonstration purposes, with full integration

into the Cloud Firestore database planned as the next development priority.

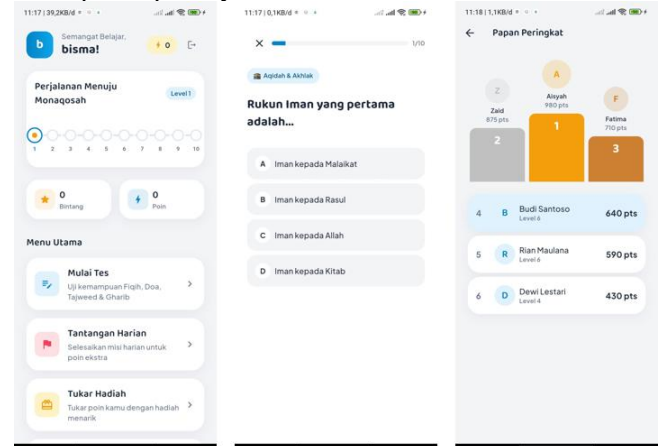


Fig. 4. Application interface: dashboard, quiz, and leaderboard screens

B. Functional Testing Results

Table II summarizes the results of Black Box and BVA testing on the Registration and Login features. All scenarios, including username length boundary validation (3-20 characters), password length, and email format, were rated Pass, as they conformed to the validator functions implemented in the application code. Testing on other features that still use mock data was conducted at the interface level, showing that navigation and interaction behaved as designed, although data-level validation could not yet be fully tested pending complete database integration.

TABLE II
BLACK BOX AND BVA TESTING RESULTS

Feature	Type	Test Condition	Result
Registration	Functional	All fields filled according to requirements	Pass
Registration	BVA	Username of 2 characters (below minimum)	Pass
Registration	BVA	Username of 21 characters (above maximum)	Pass
Registration	BVA	Password of 5 characters (below minimum)	Pass
Registration	BVA	Invalid email format	Pass
Login	Functional	Registered email and matching password	Pass
Login	BVA	Email or password left empty	Pass

C. Usability Analysis Results

The average SUS score obtained from 11 respondents was 90.23, categorized as Excellent. The detailed results by respondent group are shown in Table III.

TABLE III
SUS SCORE RESULTS BY GROUP

Group	n	Mean	Category
Teacher	1	92.5	Excellent
Student	10	90.0	Excellent

Overall	11	90.23	Excellent
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To provide a more comprehensive interpretation, the overall score was further analyzed using the three additional dimensions proposed by Bangor, Kortum, and Miller [8], as shown in Table IV. The consistency of results across all three dimensions strengthens the validity of the finding that the application has a high level of usability.

TABLE IV
SUS SCORE INTERPRETATION BASED ON BANGOR ET AL. [8]

Dimension	Result	Description
Acceptability Range	Acceptable	Score is well above the 70 threshold
Adjective Rating	Excellent	Score is above the 85 threshold
Grade Scale	Grade A	Score falls within the 90-100 range

D. Item-Level SUS Analysis

Further analysis of the raw mean score (1-5 scale) for each SUS item shows that all items contributed positively to the final score. Table VII presents the raw mean score for each item. Even-numbered items (negative statements, such as perceived complexity or dependency on assistance) consistently received low raw scores, indicating general disagreement with the negative statements. Conversely, odd-numbered items (positive statements, such as ease of use and confidence in using the application) received high raw scores, indicating general agreement with the positive statements.

TABLE VII
RAW MEAN SCORE PER SUS ITEM

Item	Mean	Item	Mean
Q1	4.82	Q6	1.55
Q2	1.55	Q7	4.73
Q3	4.73	Q8	1.55
Q4	1.64	Q9	4.82
Q5	4.45	Q10	1.18

The most favorable item was the negative statement regarding the need to learn many things before being able to use the application (Q10, mean 1.18), indicating that the application was perceived as very easy to learn, consistent with the simple, child-friendly interface design described in Section II.B. The relatively lowest-scoring positive item, though still high, concerned the integration between features within the application (Q5, mean 4.45), which may serve as an input for further interface refinement in future development.

E. Discussion

The usability test results show that the gamification approach was very well received by both students and teachers at TPQ Darul Ishlah. The consistency of scores across all measurement dimensions in Tables III and IV

reinforces the indication that the application's simple, child-friendly interface contributes to a positive user experience. This finding is consistent with previous studies showing that gamification elements such as points, badges, and leaderboards consistently increase learning motivation in mobile-based learning applications [16], [20].

Based on Self-Determination Theory [11], the gamification elements in this application were designed as reinforcement for meaningful learning activities, rather than as standalone end goals. Points and badges can only be earned when students correctly answer questions on religious material, so the process of earning rewards indirectly reinforces students' religious understanding, even though the initial motivation to participate may stem from interest in the game elements themselves. This design principle distinguishes the present application from generic point-collection systems that may inadvertently shift student focus away from the learning content itself.

Nevertheless, this study has several limitations. The number of teacher respondents, being only one person, is not yet sufficiently representative for generalization, and all respondents came from the same TPQ, which may affect the objectivity of the assessment. In addition, some application features still use mock data and are not yet fully connected to the database, so the usability evaluation obtained reflects the experience at the interface level rather than a fully integrated production system. Further research involving a larger and more varied number of respondents from multiple TPQ institutions, along with the completion of full database integration, is recommended to validate these findings more independently and to strengthen the generalizability of the results.

F. Comparison with Related Studies

To position the present findings within the broader literature, Table V compares the usability outcomes of this study with several prior studies on gamification in mobile learning applications. The comparison indicates that the SUS score obtained in this study is consistent with, and in some cases higher than, results reported in related educational gamification research, further supporting the effectiveness of the design approach adopted.

TABLE V
COMPARISON OF SUS SCORES WITH RELATED STUDIES

Study	Domain	SUS Score
Yusup [16]	General academic gamification	78.4 (Good)
Sukanto [18]	Mobile learning application	81.2 (Good)
This study	Islamic religious education (munaqosah)	90.23 (Excellent)

Although direct comparison should be interpreted with caution due to differences in respondent characteristics and sample size, the relatively higher score obtained in this study

may be attributed to the highly familiar and supportive testing environment, as all respondents were drawn from a single TPQ with close guidance from the researcher during the trial period.

G. Threats to Validity

Several threats to the validity of this study should be acknowledged. Regarding internal validity, respondents completed the SUS questionnaire shortly after receiving guidance from the researcher, which may have introduced a degree of social desirability bias toward more favorable responses. Regarding external validity, the sample of 11 respondents from a single TPQ limits the generalizability of the usability findings to other religious education institutions with different technological familiarity or infrastructure. Regarding construct validity, since several features were tested using mock data rather than a fully integrated backend, the usability scores primarily reflect interface-level perception rather than end-to-end system reliability under real, concurrent multi-user conditions. These threats are consistent with the limitations discussed in Section III.E and motivate the future work outlined in Section IV.

IV. CONCLUSION

This study successfully designed and developed a gamification-based mobile application to support munaqosah preparation at TPQ Darul Ishlah, with 8 of the 11 designed functional requirements successfully realized. The interactive quiz feature and the reward-challenge system were successfully implemented as a means of increasing students' learning motivation, supported by a database design capable of representing many-to-many relationships between users and daily challenges through composite-key associative entities. Black box testing confirmed that the registration and login features function correctly according to specification. The usability test using SUS with 11 respondents showed an average score of 90.23, categorized as Excellent across the standard interpretation as well as the Bangor et al. acceptability, adjective rating, and grade scale dimensions, indicating a very high level of user acceptance toward the developed application.

Future work is recommended to complete full integration with the Cloud Firestore database for the remaining mock-data-based features, add reminder notification and offline access features, develop a fully functional teacher account and monitoring features, and involve a larger and more varied number of respondents from multiple TPQ institutions in further usability testing to strengthen the generalizability of the findings.

From a practical standpoint, the findings suggest that TPQ administrators and religious education practitioners considering similar digital interventions should prioritize a simple, low-friction interface design over feature complexity, as the high usability score in this study was closely linked to the application's minimal and child-friendly interaction

design. Furthermore, involving teachers early in the requirement-gathering process, as demonstrated in Section II.F, proved valuable in surfacing practical constraints, such as distraction risks from general-purpose devices, that directly shaped design decisions and are unlikely to emerge from technical requirements alone.

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REFERENCES

- [1] A. Hasan, "Manajemen Pembelajaran Al-Qur'an di Taman Pendidikan Al-Qur'an," *Jurnal Pendidikan Islam*, vol. 8, no. 2, pp. 45-58, 2020.
- [2] M. Prensky, "Digital Natives, Digital Immigrants," *On the Horizon*, vol. 9, no. 5, pp. 1-6, 2001.
- [3] K. M. Kapp, *The Gamification of Learning and Instruction: Game-Based Methods and Strategies for Training and Education*. San Francisco, CA: Pfeiffer, 2012.
- [4] S. Deterding, D. Dixon, R. Khaled, and L. Nacke, "From Game Design Elements to Gamefulness: Defining Gamification," in *Proc. 15th Int. Academic MindTrek Conf.*, 2011, pp. 9-15.
- [5] Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta, 2016.
- [6] I. Sommerville, *Software Engineering*, 10th ed. Boston, MA: Pearson, 2016.
- [7] J. Brooke, "SUS: A Quick and Dirty Usability Scale," in *Usability Evaluation in Industry*, P. W. Jordan, B. Thomas, B. A. Weerdmeester, and A. L. McClelland, Eds. London: Taylor & Francis, 1996, pp. 189-194.
- [8] A. Bangor, P. Kortum, and J. Miller, "Determining What Individual SUS Scores Mean: Adding an Adjective Rating Scale," *Journal of Usability Studies*, vol. 4, no. 3, pp. 114-123, 2009.
- [9] Y. Bassil, "A Simulation Model for the Waterfall Software Development Life Cycle," *International Journal of Engineering & Technology*, vol. 2, no. 5, pp. 1-7, 2012.
- [10] R. S. Pressman, *Software Engineering: A Practitioner's Approach*, 8th ed. New York, NY: McGraw-Hill, 2019.
- [11] E. L. Deci and R. M. Ryan, *Intrinsic Motivation and Self-Determination in Human Behavior*. New York, NY: Plenum Press, 1985.
- [12] S. Białkowski and P. Smółka, "Performance Comparison of Cross-Platform Mobile Application Development Frameworks," *Journal of Computer Science*, vol. 18, no. 3, pp. 210-221, 2022.
- [13] A. K. Panda, "Comparative Analysis of Flutter Framework for Cross-Platform Mobile Application Development," *International Journal of Computer Applications*, vol. 186, no. 12, pp. 15-22, 2025.
- [14] R. Balaji and S. Murugaiyan, "Waterfall vs V-Model vs Agile: A Comparative Study on SDLC," *International Journal of Information Technology and Business Management*, vol. 2, no. 1, pp. 26-30, 2012.
- [15] D. J. Nielsen, *Usability Engineering*. San Francisco, CA: Morgan Kaufmann, 1993.
- [16] F. F. Yusup, "Pengembangan Media Pembelajaran Interaktif Berbasis Gamifikasi untuk Meningkatkan Motivasi Belajar

- Siswa,” Jurnal Teknologi Pendidikan, vol. 12, no. 1, pp. 33-42, 2021.
- [17] N. A. Rahman and S. Ismail, “The Effectiveness of Gamification in Islamic Education: A Systematic Literature Review,” International Journal of Academic Research in Business and Social Sciences, vol. 11, no. 7, pp. 890-902, 2021.
- [18] R. A. Sukamto, “Penerapan System Usability Scale untuk Evaluasi Aplikasi Mobile Pembelajaran,” Jurnal Sistem Informasi dan Teknologi, vol. 5, no. 2, pp. 78-89, 2023.
- [19] M. Y. Firmansyah and D. Kurniawan, “Implementasi Firebase sebagai Backend as a Service pada Aplikasi Mobile Berbasis Flutter,” Journal of Applied Informatics and Computing, vol. 6, no. 1, pp. 55-63, 2022.
- [20] H. Kim and J. Lee, “Gamification in Mobile Learning Applications: A Meta-Analysis of Motivational Outcomes,” Computers & Education, vol. 178, pp. 104-118, 2022.
- [21] T. Nurhayati and A. Wibowo, “User-Centered Design Approach in Developing Educational Mobile Applications for Children,” Jurnal Rekayasa Perangkat Lunak, vol. 7, no. 1, pp. 12-21, 2023.
- [22] P. Chen and D. Wu, “Evaluating the Usability of Mobile Learning Applications Using the System Usability Scale: A Review,” International Journal of Human-Computer Interaction, vol. 39, no. 4, pp. 701-715, 2023.
- [23] S. Handayani and M. Ridwan, “Firebase Realtime Database untuk Aplikasi Mobile Berbasis Android: Studi Kasus Sistem Informasi Sekolah,” Jurnal Ilmiah Teknologi Informasi, vol. 9, no. 2, pp. 145-154, 2022.
- [24] L. Wulandari, “Gamification-Based Learning Media to Improve Elementary Students' Motivation in Islamic Studies,” Jurnal Pendidikan dan Pembelajaran Islam, vol. 9, no. 1, pp. 22-31, 2022.
- [25] B. Setiawan and R. Anggraeni, “Penerapan Metode Waterfall pada Pengembangan Sistem Informasi Berbasis Mobile,” Jurnal Sistem Informasi dan Informatika, vol. 6, no. 1, pp. 40-49, 2023.
- [26] C. Alves and M. Santos, “Child-Centered Design Principles for Educational Mobile Applications: A Systematic Review,” Interaction Design and Architecture(s) Journal, vol. 54, pp. 88-104, 2022.