DIVERSE DIRECTIONS: STEERING THE FUTURE OF INNOVATIVE E-LEARNING

VOLUME 12, 2026



SIG CS@e-Learning
Unit Penerbitan
Jabatan Sains Komputer & Matematik
Kolej Pengajian Pengkomputeran, Informatik & Matematik
Universiti Teknologi MARA Cawangan Pulau Pinang

e-ISBN : 978-629-92870-0-1

SIG : e-Learning@CS
https://appspenang.uitm.edu.my/sigcs/
Publication Date : 05 - Oct - 2026

DESIGN AND DEVELOPMENT OF THE ALPA PLAY AS DIGITAL BOARD GAME MOBILE APPLICATION

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ABSTRACT

Traditional primary academic revision relies heavily on repetitive, paper-based drills, which frequently induce student fatigue and passive learning during self-directed study. To address these motivational and operational limitations, this paper presents Alpha Play, a gamified digital board game application engineered to transform routine revision into an interactive, self-regulated learning experience across core subjects, specifically Mathematics and English. Developed using a Waterfall-Agile Hybrid Model to balance structured software engineering with rapid iterative refinement, Alpha Play uniquely merges classic board game dynamics with multi-subject academic challenges. The application incorporates a risk-reward framework featuring digital die rolls, tile-triggered problem-solving tasks, and a dynamic three-heart life system. This mechanism mitigates random guessing by penalizing repeated errors, thereby incentivizing accuracy and strategic thinking. By combining spatial game mechanics with immediate feedback, Alpha Play offers significant pedagogical benefits, including enhanced knowledge retention, improved English spelling proficiency, elevated mathematical problem-solving skills, and sustained student engagement.

Keywords: Mobile Applications, Interactive, Waterfall Agile Hybrid Model, Multiplayer, Digital Game Board

Introductions

In primary education, self-directed study and routine academic revision play a pivotal role in reinforcing fundamental concepts across core subjects such as Mathematics and English. However, traditional pedagogical practices for self-learning predominantly rely on static, paper-based drills and repetitive worksheets. These conventional methods frequently induce cognitive fatigue, disinterest, and passive learning among young learners, ultimately undermining knowledge retention and intrinsic motivation. As mobile devices become increasingly ubiquitous in primary learning contexts, integrating mobile learning applications has emerged as a crucial approach to transition students from passive task

execution to active, self-regulated learning environments. Gamified mobile applications have been shown to significantly enhance mathematical problem-solving skills in elementary students (Diouf et al., 2025).

Digital game-based learning (DGBL), particularly through gamified mobile board game applications, offers an interactive framework tailored to contemporary learning behaviors. By digitizing classic board game dynamics, mobile platforms combine spatial navigation, immediate feedback, and structured challenge mechanics to sustain student engagement during self-study (Acquah, E. O., & Katz, H. T., 2020). Gamified board applications provide a structured environment where players exercise autonomy, navigate multi-subject challenges, and receive immediate feedback without continuous teacher supervision (Arzfi, B. P. et al., 2025). Furthermore, incorporating risk-reward frameworks, such as life point deductions for incorrect answers regulates user behavior by discouraging passive guessing and encouraging strategic thinking.

To address the motivational and structural limitations of traditional revision, this paper introduces Design and Development of Alpha Play, a gamified digital board game mobile application designed to enhance self-directed revision for elementary students. Developed using a Waterfall-Agile Hybrid Model, Alpha Play integrates traditional physical board game elements with digital academic tasks in Mathematics and English. Players navigate board tiles via digital die rolls, complete subject-specific problem-solving challenges, and manage a dynamic three-heart life system designed to penalize repeated errors. By digitizing spatial game mechanics into a mobile format, Alpha Play seeks to deliver a scalable, highly engaging tool that improves English spelling proficiency, mathematical reasoning, and overall self-learning efficiency in primary education

Methodology

The development of Alpha Play utilized a Waterfall-Agile Hybrid Model, combining structured upfront governance with flexible, iterative execution (Kirpitsas & Pachidis, 2022). In the initial Waterfall macro-phase, preliminary requirements gathering and systematic analysis were executed to define the project scope and pedagogical objectives aligned with primary school Mathematics and English curricula. This phase established the system architecture, database design for item banks, and high-level functional specifications. Crucial game mechanics—including board tile mapping, digital die-rolling mechanics, subject-specific challenge triggers, and the core three-heart life system—were fully conceptualized and documented prior to coding, ensuring structural predictability and technical alignment.

Following the fixed architectural design, the project transitioned into an Agile micro-phase to handle module development and rapid refinement (Mitsuyuki et al., 2017). Implementation was partitioned into iterative sprints focusing on specific software components, such as user interface (UI) rendering,

active game-state management, scoring algorithms, and dynamic feedback systems. Each sprint incorporated continuous unit testing and rapid prototyping, allowing for incremental adjustments to software logic. This hybrid approach allows a faster system development process and high-quality outcomes because both approaches are complementary to each other to create a high-quality and well-structured system (Alif Ramadhan et al., 2023). Figure 1 shows the Waterfall Agile Hybrid flow used in this project.

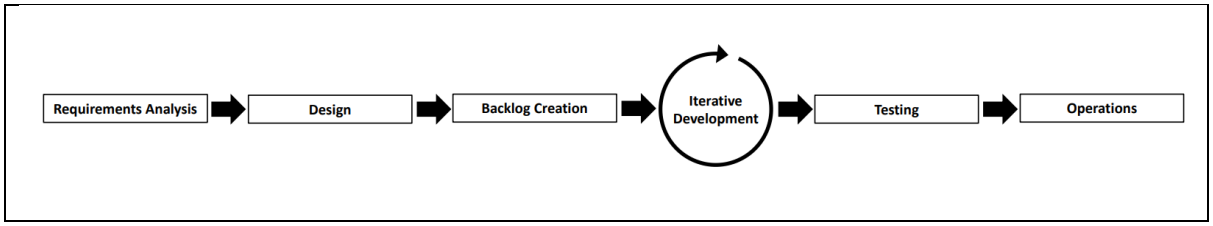


Figure 1: The Waterfall–Agile Approach (Prenner et al., 2020)

Design And Development

During this stage, a system architecture and interface design is created. To demonstrate the process flow and user interaction of the applications, visual aids like storyboards and flowcharts were created. Waterfall works well in this case as the design decisions are made before the code is written, which decreases the amount of rework and enhances comprehension. Figure 2 illustrates a summary of the interface and navigation of the Alpha Play.

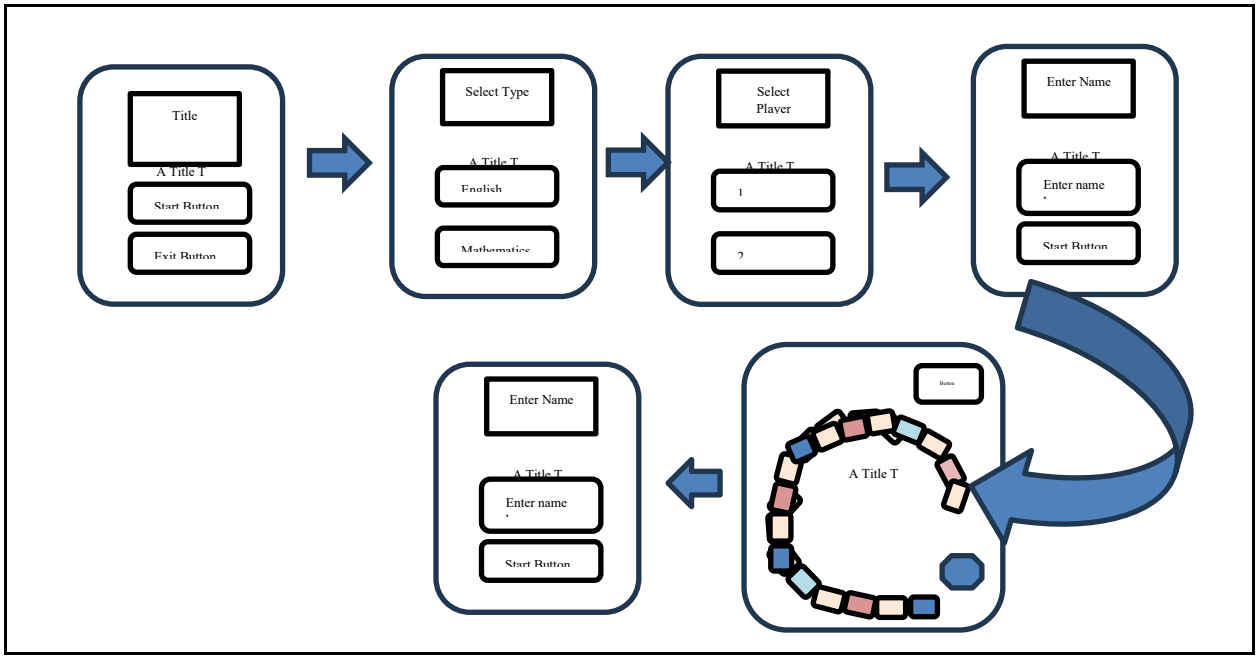


Figure 2: Storyboard of the Alpa Play Mobile Applications

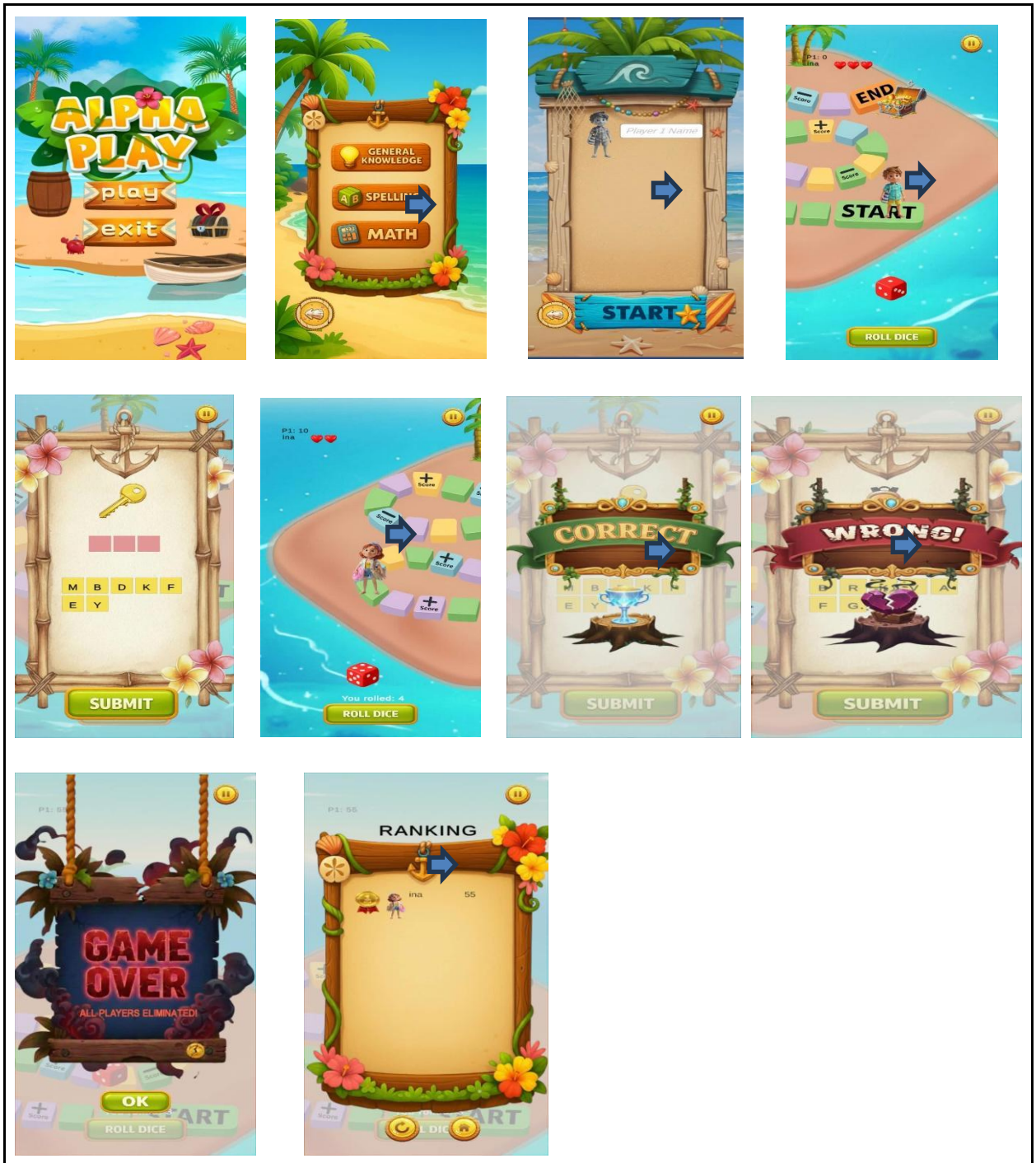


Figure 3: Design of the Alpa Play Mobile Applications

Figure 3 illustrates the flow and the interface of Alpha Play Mobile Applications. The design are colorful and cartoon base design.

Conclusion

The design and development of Alpha Play successfully demonstrate the viability of integrating classic board game mechanics into mobile digital learning environments to elevate primary school students' self-directed revision. By leveraging a Waterfall-Agile Hybrid Model, the project effectively balanced structured software architecture with iterative usability enhancements, resulting in an intuitive and highly engaging educational application. The implementation of a dynamic three-heart life system and tile-triggered academic challenges directly mitigates passive guessing, reinforcing accuracy and critical thinking in core subjects such as Mathematics and English (Sailer & Homner, 2020). Field evaluations with primary students confirmed exceptional system usability while transforming traditional, repetitive study into an active, enjoyable learning process that boosts academic motivation and core skill proficiency (Subhash & Cudney, 2018). Ultimately, Alpha Play offers a scalable and effective framework for digitizing conventional educational tools, providing modern primary education with a robust solution to foster autonomous, game-based learning.

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