

Evaluating User Experience in Mobile Educational Games: A Case Study on Learning Research Methodology

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Abstract

User Experience (UX) in mobile educational games is essential for ensuring both learning quality and player engagement. However, most UX studies have focused on entertainment games, leaving limited understanding of UX in educational contexts. This study identifies key UX components for mobile educational games and proposes a model specifically for evaluating them. A quantitative post-game questionnaire was administered to 25 learners who had taken or were taking Research Methodology course. The instrument covered seven UX components: Challenge, Control, Motivation, Clear Goals, Playability, Content, and Knowledge Enhancement. Descriptive analysis using SPSS showed consistently positive results across all components, with Clear Goals ($M = 4.37$) and Playability ($M = 4.26$) rated highest. The findings highlight which UX features most strongly support engagement and learning, offering practical guidance for designers to balance educational content with enjoyable gameplay in mobile educational games.

Keywords: user experience, mobile educational games, UX components, research methodology, educational games evaluation

1. Introduction

Mobile educational games (MEGs) have become an emerging approach to improve learner motivation and engagement. Many students today, especially from Generation Z, prefer interactive and visual learning experiences that fit their mobile usage habits. As mobile gaming grows and reaches USD 92.2 billion in revenue in 2022 [1], its potential as a learning medium increases significantly. In relation to methods of learning, mobile educational games are gaining widespread popularity. This is due to the fact that there has been a wide range of mobile gaming users worldwide, and the mobile gaming app market has generated over USD 92.2 billion in 2022 alone [1]. This demonstrates how popular mobile gaming platforms are among individuals, not to mention how profitable this platform has become in the aspect of business.

Accordingly, this study explores mobile educational games as a technology-supported approach to sustain students' attention and engagement during learning. On top of that, teenagers, or more often known as Gen-Z, prefer random access, graphics-first, and networked activities because they are kinesthetic, experiential, hands-on learners who like to learn by doing rather than by being taught what to do or by reading text [2]. As a result, mobile educational games will be the ideal strategy to integrating learning material with mobile devices.

In reference to mobile educational games, there are a lot of benefits that one can obtain out of playing educational games. One of the most important advantages is that game-based learning can rouse the interest and excitement of the students and boost their motivation [3]. Game-based learning also creates an atmosphere for students in which they can safely experiment and make mistakes, builds real-world problem scenarios, and offers students a positive learning experience. Not to forget, students can still have fun even while they are acquiring new knowledge.

Apart from that, the educational game-based mobile application must have a high level of usability and user experience (UX) for it to be fully utilized, even though it has a great number of benefits. In order to guarantee that users will have positive overall experience with the mobile educational games that have been developed, a comprehensive evaluation needs to be carried out on them. Heuristic evaluation is a helpful method for evaluating the usability and user experience since they can be a great help in identifying potential issues [4].

Despite the advantages, the effectiveness of MEGs depends greatly on usability and user experience (UX). A positive UX ensures that users not only enjoy the game but also achieve the intended learning outcomes. Evaluating UX in MEGs therefore requires more than traditional usability testing; it must encompass enjoyment, motivation, learning relevance, and adaptability to mobile constraints such as small screens, interruptions, and touch-based interaction [5], [6].

Therefore, this study aims to: (i) identify UX evaluation components suitable for MEGs; (ii) design and develop a Research-Methodology mobile game prototype; and (iii) evaluate the game's UX using the proposed components. The study focuses on seven major components. Those are Challenge, Control, Motivation, Clear Goals, Playability, Content, and Knowledge Enhancement. The components examine how learning experience within a mobile context is shaped.

2. Literature Review

According to the reviewed studies, many UX components have been identified and can be grouped into broad categories such as flow, immersion, game usability, game system, player context, and learnability [7]. While these classifications offer a comprehensive overview, this study focuses more narrowly on player-level UX elements that are particularly relevant to mobile educational games. Specifically, the components addressed include challenge, clear goals, playability, control, motivation, content, and knowledge improvement, each of which plays a critical role in shaping learner engagement and experience.

Mobile educational game UX hinges on presenting clear goals, intuitive controls, and seamless playability to guide learners effortlessly through challenges. Norman and Nielsen [8] stress that visible system status and a close match between game

mechanics and real-world concepts help players understand objectives at a glance and maintain focus on learning goals. Jakob Nielsen's heuristics, especially visibility of system status, consistency of controls, and error prevention, ensure that game controls feel natural and forgiving, reducing friction so learners can engage with challenges rather than struggle with the interface [8], [9].

Balancing pragmatic and hedonic qualities drives motivation and sustained engagement. [10] [10] separate pragmatic usefulness (clear, achievable objectives) from hedonic stimulation (novel challenges) and identity (self-expression through gameplay), showing that well-designed challenges both reward skill development and foster a sense of achievement. By crafting levels that ramp difficulty in line with player progress, MEGs can tap into flow states by keeping players motivated without overwhelming them and reinforcing intrinsic motivation through meaningful feedback loops [10], [11].

Rich content and targeted feedback underpin knowledge enhancement. Learnability and memorability are two of Nielsen's core quality components, ensuring that instructional content is presented clearly, with scaffolded difficulty and responsive hints to support mastery [8]. Error-tolerant mechanics and immediate, informative feedback help learners correct misconceptions in real time, transforming mistakes into teaching moments. When content is blended into gameplay, through narrative context or problem-based scenarios, players will have the ability to absorb concepts more deeply, translating in-game success into real-world knowledge gains. Therefore, the following sections explain the crucial components needed by the mobile educational game UX.

2.1. Challenge

In educational games, challenges are recognized as a fundamental UX component. The past studies emphasize that games become more engaging and enjoyable when the reward the successful fulfilled challenges, ideally structured in levels. However, the challenge must consider the balance between difficulty and player ability, games risk that can frustrate the users and disengagement [12]. To sustain interest, the level of challenge must remain aligned with the player's evolving skills [7].

Challenges in games are not just about things being "hard to do"; they are about engaging players with tasks that demand mental, physical, or emotional effort, offering clear feedback, and letting actions meaningfully influence outcomes [13]. When challenge and skill are in balance, players enter a Flow state—driven by clear goals and immediate feedback—while elements of uncertainty (e.g., unpredictable outcomes) heighten suspense and keep engagement high [14].

In a review of serious games for environmental education, [15] found that the challenges that is related to the real world scenario like managing pollution and species extinction was capable to boost critical thinking and sustain the players' motivation. These challenges helped players connect game tasks to authentic knowledge applications, increasing interest and content retention.

In educational games, designers create challenges through conflict (puzzles or narrative obstacles) and competition (timers, leaderboards); sustaining motivation without causing frustration must scale with learners' growing abilities [14].

[16] emphasize that challenges should be carefully designed to avoid overwhelming the players in a mobile learning environment. A study has been conducted on online degree students using mobile tools. Tools showed that effective challenge comes from relevant, well-scaffolded tasks that align with learning outcomes. The application improved when the difficulty level matched the learner's readiness, engagement, and knowledge. The authors also note that incorporating failure as part of the learning process within games can promote persistence and problem-solving.

[17] explore the relationship between challenge, goal clarity, concentration, and learning. They propose a model suggesting that challenge can enhance learning only when paired with clear goals. The pair can support the learner's concentration. They argue that without challenge, learners become bored and disengaged; too much challenge leads to anxiety. A balanced level of challenge is necessary for cognitive stimulation and effective knowledge transfer.

Another study by [18] reinforces the perspective that structured challenges support intrinsic motivation. In order to maintain the players' focus, progressively difficult tasks and immediate feedback are vital in educational games. These conditions are particularly relevant in mobile games where short, focused sessions demand efficient challenge design to keep players invested.

[14] proposed a detailed breakdown of challenge types, particularly the distinction between competition and conflict. This study suggests that conflict-driven challenges, such as problem-solving tasks embedded within narrative contexts, are more effective in promoting deep learning than externally driven competitions.

In mobile educational games, challenge plays two roles: it sustains engagement and serves as a platform for learning. When a challenge is embedded thoughtfully, which is aligned with learning goals, scaled to the learner's ability, and situated in relevant contexts, the challenge becomes an essential mechanism that transforms gameplay into a meaningful educational experience. Recent reviews confirm that appropriately balanced challenge remains a key driver of engagement and cognitive stimulation in MEGs [7], [16], [18].

2.2. Clear Goal

A clear goal is a fundamental element of user experience in serious as well as educational games. Previous literature stresses that players understand how to navigate the game and what is expected when they have clearly defined objectives. This clarity enhances their ability to engage meaningfully with the content and gameplay [12]. Serious games, by design, are structured with rules and defined goals, enabling participants to participate effectively and acquire knowledge through experience [19].

Clear goals help players understand what they must do and stay focused on the task. [17] describe goal clarity as how well a game communicates its objectives, showing that when learners grasp their tasks early on, they concentrate more easily and achieve better learning outcomes.

[20] places clear proximal goals alongside balanced challenge and timely feedback as one of three conditions for entering flow (task engagement). Games avoid confusion and keep players motivated to continue by signaling each next step.

In mobile educational games scope, [16] found that when learners use mobile devices for educational tasks, clear and straightforward goals help them stay focused and avoid confusion. This is important in short-term or on-the-go learning sessions, where unclear instructions can distract or frustrate.

Clear goals are not only instructional but also motivational. According to [18], clear, achievable goals contribute to intrinsic motivation by giving players a reason to act within the game. Combined with immediate feedback and appropriately scaled challenges, clear goals help guide players through tasks with purpose and confidence [14]. Current mobile learning studies continue to affirm that clearly defined goals support flow, motivation, and efficient learning [16], [18].

2.3. Playability

Playability is another crucial component of user experience, particularly in entertainment and serious games. It plays a very important role in determining a game's utility and overall effectiveness, standing out as one of the most emphasized aspects in gaming experience evaluations [21]. In serious games, functional playability reinforces that usability is needed to ensure a positive and effective gameplay experience [19]

Moreover, playability is understood as the qualities of a game that shape the player's experience—extending beyond mere usability to include mechanics, goals, and emotional engagement. In general gaming, playability heuristics have been framed as three interrelated modules (game usability, mobility, and gameplay) that guide expert evaluation of mobile titles [5]. The gameplay module, in particular, centers on core experiences such as providing clear goals, maintaining balanced challenge, and ensuring player control [5].

In educational contexts, [22] define educational playability as the properties that make a game both playable and learnable, where fun and learning coexist throughout play. They build on general playability by adding educational attributes (e.g., the “percentage of educational objectives achieved”) alongside traditional playful attributes like satisfaction and immersion.

Further refinement [22] introduces supportability (how seamlessly educational content is embedded) and an explicit educative playability facet (quality and delivery of learning material) to align game design with pedagogical goals. They also suggest concrete metrics—time to complete challenges, number of hints used, and concentration levels—to assess each attribute in practice. Finally, a recent systematic review conducted by [24] in the area of mobile educational games, playability remains a vital evaluation element, together with usability and challenge. Recent syntheses confirm that playability when integrated with usability and challenge, remains central to the quality of user experience in mobile educational games [24], [25].

2.4. Control

The next essential component identified is control. It is important for user experience in entertainment and educational games. Games must account for players' physical and cognitive limitations to foster a true sense of agency, ensuring that control mechanisms are intuitive and accessible [12]. Feedback from participants also suggests that when games allow open-ended choices, players feel empowered to navigate the experience according to their preferences—enhancing both satisfaction and personalization [26].

Player control in games encompasses how players interact with the interface and the game mechanics. Control directly shapes the users' sense of agency and confidence. Clear, visible controls help users understand available actions and recover from errors, while appropriately sized touch targets ensure reliable input on mobile devices [27]. Allowing players to adjust settings such as volume or text size adds another layer of personalization [27].

Consistent navigation structures and always-available exit paths prevent disorientation and frustration. Linear menus, clear back buttons, and minimal scrolling streamline flows so players focus on core activities rather than interface mechanics [27]. Providing undo or quit options reinforces control, allowing recovery from mistakes without severe penalties [28].

Meaningful choice architecture, such as branching skill trees or multiple solution paths, encourages experimentation and enhances perceived autonomy [29]. At the same time, simplifying interactions such as a considerable and limited number of buttons and prioritizing natural touch gestures reduces cognitive load, especially for novice or older players [18]. Together, these control considerations ensure that players feel empowered and comfortable, supporting deeper engagement and a more satisfying user experience in mobile educational games.

2.5. Motivation

User motivation plays another vital role in both entertainment and educational gaming experiences. [18] explain that the flow theory is that matching challenge to skill, setting clear goals, and providing immediate feedback creates a flow state that keeps players motivated to play. Schaffer further shows that narrative richness, polished visual and audio design, and intuitive controls contribute to positive emotions and reduced fatigue, reinforcing engagement beyond pure challenge (extrinsic motivators) [20]. Furthermore, integrating design elements that highlight fun visuals, satisfying interactions, and a sense of accomplishment has enhanced playfulness and sustained motivation [26].

In serious and educational contexts, motivation extends beyond enjoyment, including perceived usefulness, emotional well-being, social connection, and recognition. [30] found that when learners perceive a game as directly beneficial to their real-world goals, they are more likely to persist (utility motivation). Likewise, social interaction features and opportunities for praise or badges support emotional and social needs, sustaining engagement even when tasks become demanding [30].

Within mobile educational games, these motivational levers become even more critical. [16] highlight that aligning gameplay challenges with course content ensures relevance and maintains learner interest (contextual relevance). Mistakes

during playing the games are assumed as a part of the learning process, and meaningful rewards mark progress. Therefore, providing a safe exploration environment helps reduce anxiety and nurture intrinsic motivation [16]. Moreover, the portability of mobile devices allows learners to engage in brief, focused sessions that fit into daily routines, while touch-based interfaces simplify interaction and keep attention on learning rather than controls [18].

Together, these studies underline that designing for intrinsic and extrinsic motivation, through balanced challenge, clear learning value, supportive feedback, and mobile-friendly delivery, is essential to creating effective, engaging mobile educational games. Recent work underscores that effective MEG motivation design combines intrinsic factors such as curiosity and mastery with extrinsic feedback mechanisms ([18], [30]).

2.5. Content

Content is the heart of an engaging game, in the case of educational games, effective learning tools. It is one of the primary factors that drives student engagement, encouraging learners to interact with digital games frequently [7]. In entertainment games, narrative and audiovisual content shape players' emotional involvement: plot, visual design, sound effects, and interaction mechanics drive intrinsic and extrinsic motivation by crafting immersive experiences that sustain attention and encourage continued play [30].

On mobile platforms, content must also be context-aware, bite-sized, and optimized for small screens and on-the-go consumption. Mobile learning systems leverage rich, highly-localized content that draws on the device's location, time, and user profile—to deliver just-in-time information and activities that feel relevant and immediate. In higher educational settings, mobile learning content and responsive design that adapts to shorter attention spans have boosted usability and the learners' satisfaction [25]. Moreover, by offering context-aware content that aligns with real-world settings, mobile educational games can engage learners in authentic tasks that reinforce conceptual understanding [31].

In mobile educational games, content becomes the primary vehicle for learning. When game subject matter, challenge scenarios, and reward structures are carefully aligned with curricular goals, they create a meaningful learning journey in which play and pedagogy reinforce each other. The content clarity and structure are also significantly influence the enjoyment and learning outcome, where the player can get good benefits [12]. In a lesson that need geography context, mobile educational games can sustain motivation and deliver educational value by framing activities within real geographies with the relevant contents to match learners' evolving skills [32]. Contemporary MEG designs emphasize context-aware, concise, and authentic content that enhances relevance and learner engagement [25], [31].

2.5. Knowledge Enhancement

Knowledge enhancement has been identified as a crucial UX component for a mobile educational game. This is because accidental learning that contributes to knowledge enhancements motivates participants to want to learn more [33]. Moreover, the players support the mobile educational games app because the

process of discovering new places, reading interesting stories, and sharing their views gives them a sense of accomplishment [26].

Knowledge is central in games when success depends on applying subject-specific information[34] emphasize that literacy and content learning in serious and entertainment games can be supported by embedding knowledge tasks directly into the gameplay. When players must understand language, narratives, or systems to progress, learning becomes part of the play experience. This incidental learning can enhance the learning in a few motivating ways that encourage players to learn more [33].

[14] note that prior knowledge among the players contributes to better performance, and the players can learn more efficiently. They stress that designing knowledge-based challenges adds meaning and educational value, especially in learning contexts.

[15] report that many serious games are built around delivering structured knowledge in environmental education. Nearly half of the studies they reviewed focused on improving understanding of ecological and scientific content through immersive gameplay.

[35] show how mobile platforms can enhance knowledge delivery by offering short, accessible content. Mobile tools like WhatsApp and video modules help learners retain and apply knowledge flexibly, which can inform mobile educational game design.

In mobile educational games, embedding subject content into the core gameplay ensures alignment between learning and engagement. When games challenge players to apply concepts in authentic, interactive contexts, they support motivation and knowledge acquisition. Recent studies confirm that short, accessible, and feedback-rich mobile experiences improve learners' knowledge acquisition and retention [34], [35].

2.6. Comparison with established frameworks

The previously mentioned UX elements share conceptual similarities with several UX frameworks for game evaluation. For instance, the Gameflow framework highlights enjoyment through clear goals, meaningful feedback, and a balance between challenge and player ability, where this study represents Clear Goals, Motivation, and Challenge. Another framework, Octalysis, is a gamification framework that focuses on eight core motivational drives, including accomplishment, ownership, and empowerment, and highlights the psychological factors that sustain user engagement. These factors correspond closely to the Motivation and Control components of the proposed model. In addition, the previously discussed UX elements originate from the elements of Nielsen's principle. This study incorporates Content and Knowledge Enhancement. Therefore, this study connects the user experience with educational outcomes, which are often underrepresented in entertainment-focused frameworks.

3. Methodology

3.1. Prototype Development

A mobile crossword-based educational game was developed to support the learning of Research Methodology concepts. The prototype was created using the Ionic UI Toolkit for the user interface and the .NET framework for the underlying logic. The game was deployed on Android mobile devices for accessibility.

The gameplay required learners to solve a series of crosswords related to key Research Methodology terms. Each puzzle was designed to progressively increase in difficulty, encouraging sustained engagement. A built-in timer and scoreboard created an element of challenge, while a hint feature offered guidance without compromising autonomy. Upon completion, the system provided feedback and displayed the correct answers for self-correction.

The design of these features was guided by the proposed UX model shown in Figure 1, which includes the seven components of Challenge, Control, Motivation, Clear Goals, Playability, Content, and Knowledge Enhancement. The overall user flow of the prototype, from registration to gameplay and feedback is presented in Figure 2. This structure ensured that both game usability and educational relevance were embedded in the prototype before user testing.



Figure 1. Proposed model of UX evaluation for mobile educational games

3.2. Research Design

This study adopted a quantitative design using a post-game questionnaire to evaluate the user experience of the developed prototype. The questionnaire measured seven components of user experience: Challenge, Control, Motivation, Clear Goals, Playability, Content, and Knowledge Enhancement. The design allowed data collection immediately after gameplay to capture authentic user perceptions.

3.3. Participants

A total of 25 undergraduate students from Universiti Teknologi Malaysia (UTM) participated voluntarily in the study. All participants had taken or were taking a Research Methodology course. They represented both male and female students from various academic backgrounds. Participation was anonymous, and respondents provided informed consent before taking part.

3.4. Instruments and Measures

The questionnaire items were adapted from previous validated instruments on game usability and learning experience. The overall elements of the instruments are illustrated in Figure 1. Each item was rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Two subject-matter experts reviewed the items for clarity and content validity. Table 1 presents the questionnaire items according to each user-experience component.

3.5 Procedure

Participants were briefed on the study objectives and then played the game individually on their mobile devices. Immediately after gameplay, they completed the post-game questionnaire. The entire session took approximately 15 to 20 minutes. Figure 2 shows the data-collection procedure, which consisted of five stages: recruitment, briefing, gameplay, questionnaire completion, and debriefing.

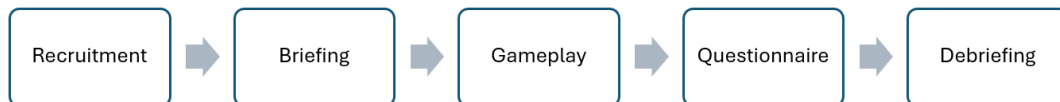


Figure 2. Data-collection procedure flow

Table 1. Past studies summary on user experience (UX) components

UX Components	References/Sources
Challenge	The challenge is adequate, neither too difficult nor too easy My skill gradually improves through the course of overcoming the challenges It stimulated me to learn new things. The game provides “hints” to assist me. The game provides different level of challenges in different modules.
Clear Goals	Overall game goals were presented clearly Overall game goals were presented in the beginning of the game Learning goals were presented in the beginning of the game I understand the learning goals through the game
Playability	This game is good and efficient The challenges and playability level of the games are balanced

	It is easy to play the games. I can learn to play game by myself. I know what I should be doing in order to play this game.
Control	I felt the game give me sense of control during game play. I know the next step in the game I had the capability to influence what was happening. I enjoyed being in control during the gameplay.
Motivation	The currency implementation motivates me to do better in the game The feedback helps me to do better in the next topic The score board encouraged me to want to do better. The way the game works suits my way of learning Playing Research Methodology games is fun. It was easy to understand the game and start using it as study material.
Content	(I am able to learn Research Methodology through this game I can easily learn Research Methodology through this game This game helps me in studying the Research Methodology I feel the game has sufficient elements.
Knowledge Enhancement	The game increases my knowledge I catch the basic ideas of the knowledge taught I try to apply the knowledge in the game The game motivates the player to integrate the knowledge taught I want to know more about the knowledge taught

3.6. Scope

This study focused on a single mobile educational game prototype designed for the Research Methodology course within one institutional context (UTM). The evaluation emphasised learners' perceptions of user-experience components rather than the measurement of learning outcomes or comparison across game types.

3.7. Data Analysis

Descriptive statistics, including mean, median, mode, and standard deviation, were computed using SPSS version 29 to analyse the questionnaire responses. Results were used to identify which UX components were rated most positively and to provide insights for further improvement of the proposed model.

3.8. Game prototype

For the User Interface (UI) development of the mobile educational game prototype, the Ionic UI Toolkit was utilized, while the .NET framework was utilized for the underlying functionality. Figure 2 depicts the game's user flow, in which the user lands on a page that requires them to register by entering their preferable name. The user will then be directed to the homepage, where they can view the game's instructions and how to play. Next, users can navigate to the gameplay page, where they can select any of the listed Research Methodology topics to attempt. Once they

have attempted it, explanations for incorrect answers will be provided, and the user will be able to view their position on the scoreboard.

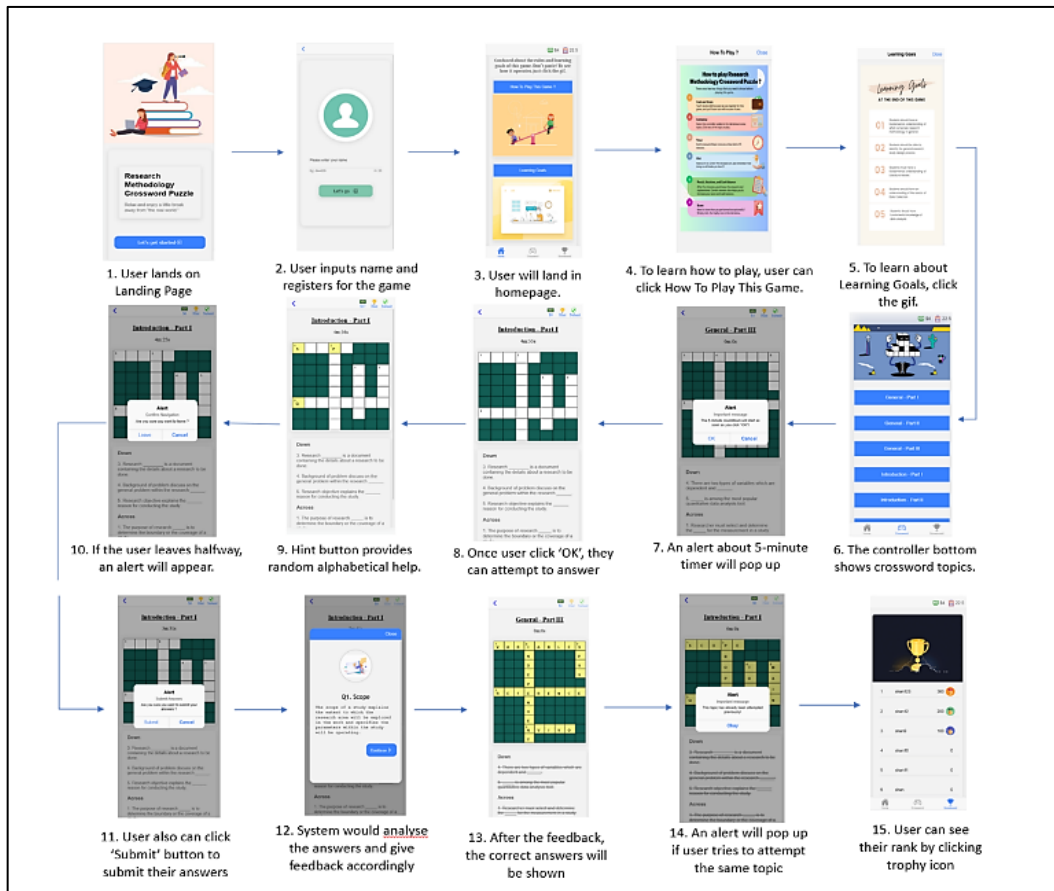


Figure 2. User flow of the game

In relation to data collection, a quantitative approach has been utilized in the gathering of the data that is required for this study. Post-game questionnaires have been distributed to twenty-five students that currently or previously enrolled in a Research Methodology course from University Technology of Malaysia (UTM) using a quantitative research method.

The questionnaire was developed using resources as presented in Table I from similar studies to assure its accuracy. The questionnaire items were adapted from prior validated instruments and reviewed by two subject matter experts to ensure relevance and clarity for this study's context. As indicated in the conceptual framework, the questionnaire enquires about the components of the proposed conceptual framework of mobile educational games. There has been a total of 7 components. Table II describes the components and the questionnaire item for components which has been taken and modified from standardized questionnaires [36][36], [37], [38], [39].

Once the data collection has been done, The Statistical Package for the Social Sciences, more commonly known as SPSS, has been used as the primary instrument in the process of analyzing the data that has been collected.

4. Findings and Discussions

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4.1. Prototype Features

The prototype implemented all seven UX components defined in the proposed model. The timer and the scoreboard are shown integrated in Figures 3(left) and Figure 3(right), which demonstrates that the Challenge component has been successfully implemented. This is because a timer would push the user to complete the crossword within the allotted period of five minutes, while a scoreboard would challenge the user to do better while playing the game.

Next, the Control component has been programmed in such a manner that it allows students unrestricted access to all topics, as well as the ability to always exit the game in the middle of their current session while still having their progress stored. Figures 4(left) and 4(right) each provide a visual representation of the implementation.

In this main crossword puzzle game, the motivation component has been added in which players can earn \$2 for each correct answer and receive a score of 2.5. In addition, a hint icon has been provided to assist the user whenever he or she is unable to answer a question. Figure 5(left) and Figure 5(right) illustrate the implementation.

Apart from that, the Clear Goals component has been implemented on the homepage where a subpage of Learning Goals and How to Play Research Methodology, so that the user understands what we are attempting to accomplish with this game. The homepage and mentioned subpages are depicted in Figures 6(left), 6(middle) and 6(right).

The Playability and Content component has been implemented so that for each topic, the user must endeavor to answer five research methodology-related questions in less than five minutes. In addition, for the Playability element, a hint icon and a point system have been incorporated to facilitate gameplay. The general page of a 5-question crossword puzzle can be seen in Figure 7(left).

Finally, the Knowledge Improvement component has been implemented on the feedback page so that, once the 5-minute deadline expires or if the user submits the answers earlier, the system analyses the responses and returns the correct answers with an explanation. Figure 7(right) demonstrates the implementation.

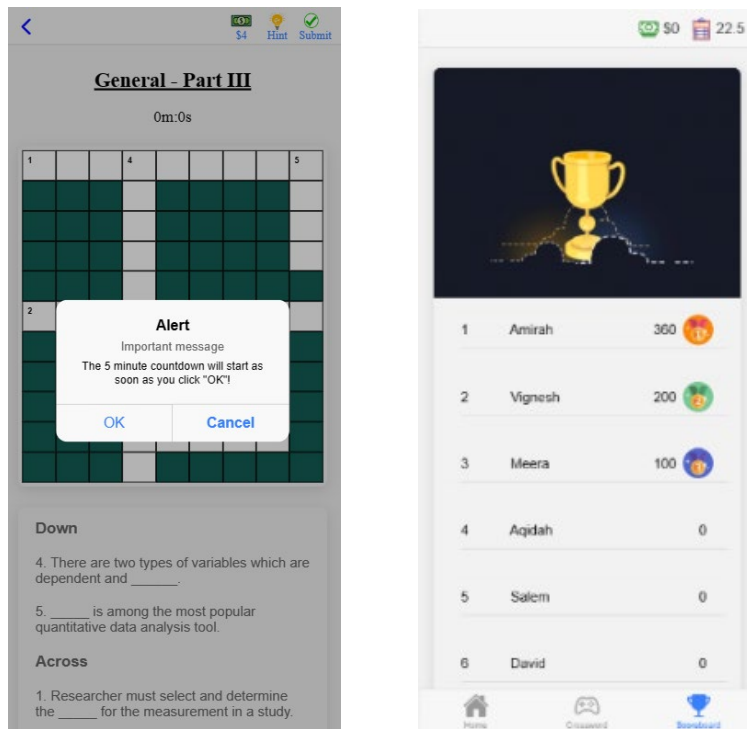


Figure 3. Screenshot of the application that shows the alert about 5-minute countdown in crossword puzzle page (left) and scoreboard page (right)

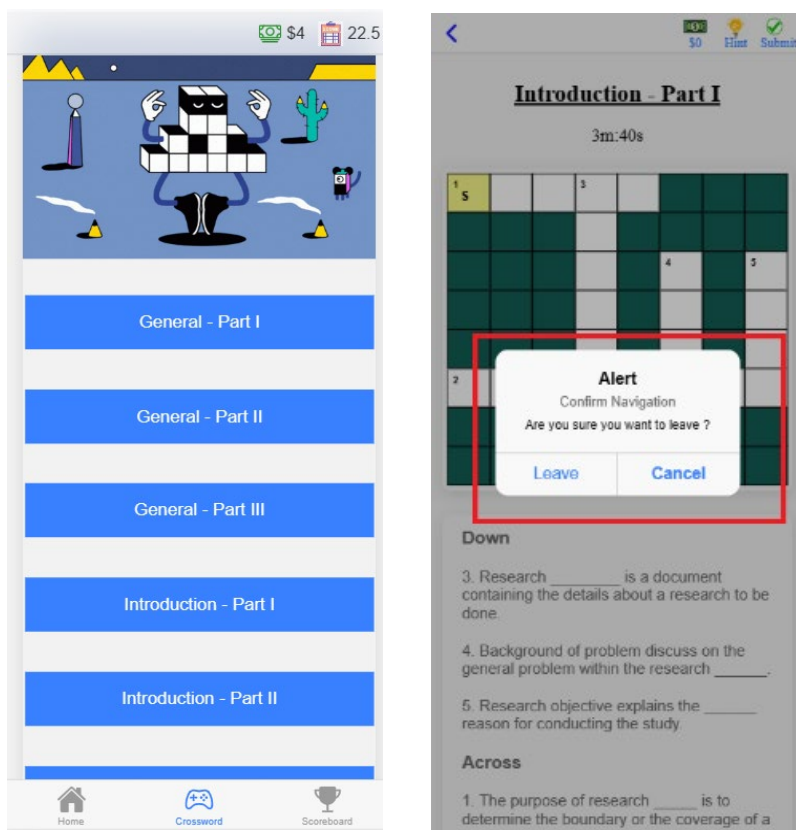


Figure 4. Screenshot of the application that shows Research Methodology topic listing (left) and alert about existing the game session in the crossword puzzle page (right)

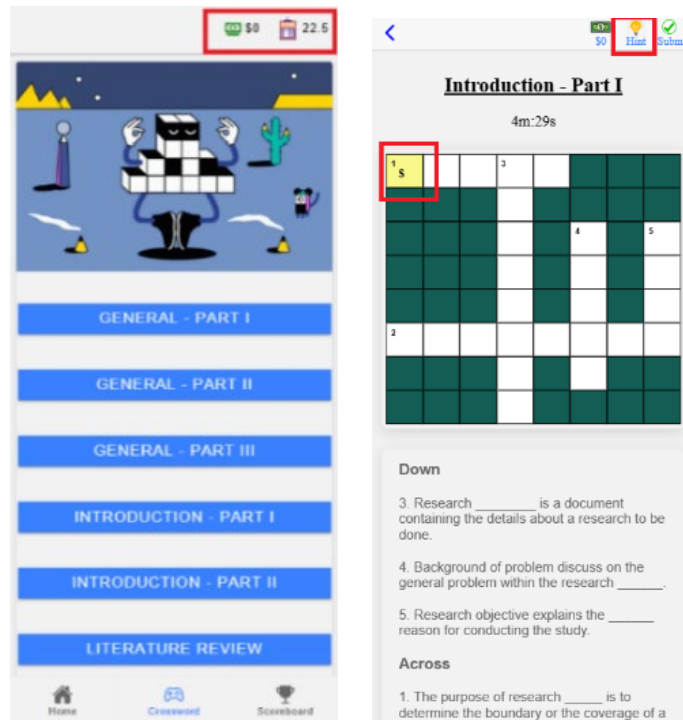


Figure 5. Screenshot of the application that shows money and score in gameplay page (a) hint in crossword puzzle page (b)

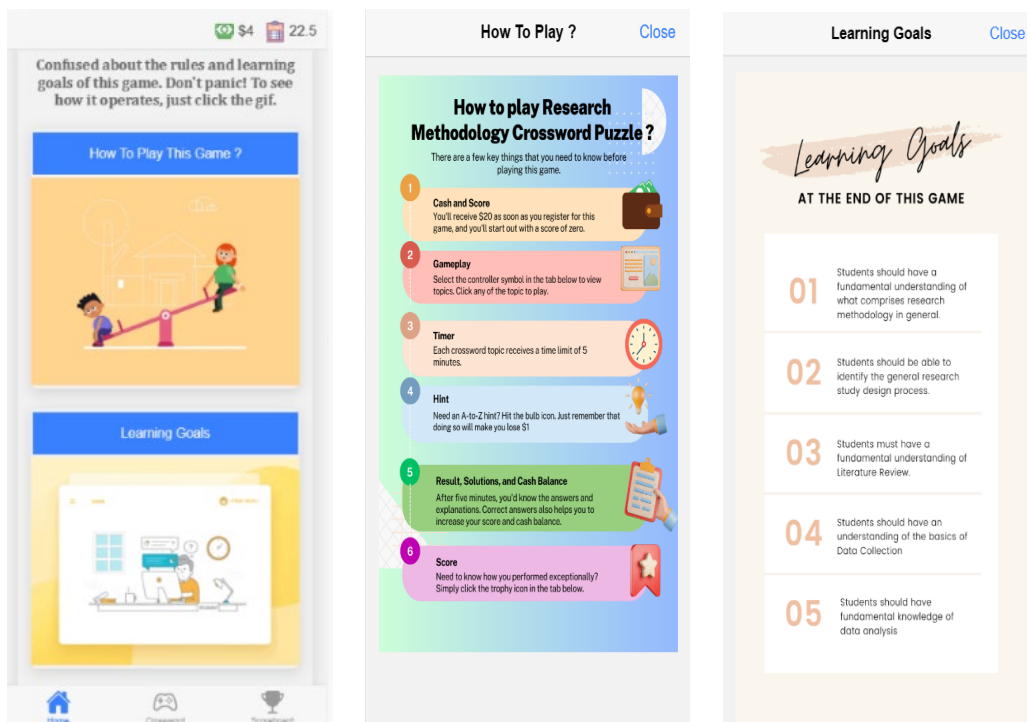


Figure 6. Screenshot of the application that shows homepage (left), how to play Research Methodology crossword page (middle) and learning goals page (right)

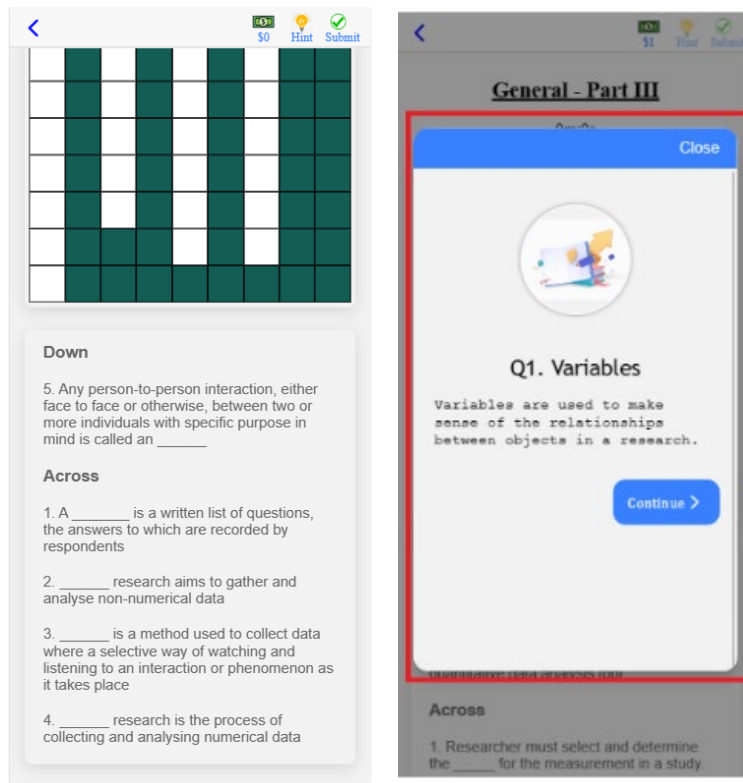


Figure 7. Screenshot of the application that shows crossword puzzle page (left) and feedback pop up page (right)

4.2. Alignment with prior studies.

The inclusion of time limits and scoreboards follows Gameflow’s highlighting on structured challenge and immediate feedback (Wang et al., 2014; MacHado et al., 2018). The free-navigation design be consistent with the control elements outlined by Korhonen and Koivisto (2006). The “How to Play” instructions and explicit learning goals support findings by Fiorucci et al. (2023), who identified goal clarity as crucial for maintaining learner flow. The feedback mechanism confirms Bonsu et al. (2024), demonstrating that reflection on errors can transform gameplay into reinforcement learning.

4.3. Demographic analysis

A frequency table, as shown in Table III below, was utilized to display the demographic information of the respondents and to identify any missing data values.

Table 3. Past studies summary on user experience (UX) components

Measures		Frequency	Percent	Valid	Cumulative
Gender	Male	13	52	52	52
	Female	12	48	48	100
	Total	25	100	100	
Age	21 - 30	20	80	80	80

	31 - 40	5	20	20	100
	Total	25	100	100	
Employment Status	Student	2	8	8	8
	Employed	22	88	88	96
	Other	1	4	4	100
	Total	25	100	100	

Based on Table 3, it can be concluded that there were more male respondents with a total of 13 (or 52%) than there were female respondents with a total of 12 (or 48%). In addition, it was discovered that the vast majority of the respondents, a total of 20 people (80%), fell within the age range of 21 to 30 years old, while only five people, or 20% of the respondents, fell within the age range of 31 to 40 years old. Finally, it was determined that 2 (or 8%) of the respondents were full-time students, 22 (or 88%) are employed, and 1 (or 4%) have Other as their employment status.

4.4. Descriptive analysis

The descriptive analysis presented below provides the mean, median, mode, and standard deviation for each proposed component of the conceptual framework. The descriptive analysis results for the challenge component are displayed in Table 4. Overall, students were uncovered with a high level of agreement to the challenges provided by the games. Students rated the games' challenges as acceptable, with a mean score of 4.07. The mean score of 4.24 indicates a high level of agreement among students that the games offer varying levels of difficulty for each topic (CA5). The mean for adequacy of game challenge (CA1) is the lowest at 3.76.

Table 4. Challenge descriptive results

Items		Mean	Med	Mod	Std. Dev
CA1	The challenge is adequate, neither too difficult nor too easy	3.76	4	4	0.88
CA2	My skill gradually improves through the course of overcoming the challenges	4.16	4	4	0.62
CA3	It stimulated me to learn new things.	4.04	4	4	0.73
CA4	The game provides "hints" to assist me.	4.16	4	4	0.85
CA5	The game provides different levels of challenges in different modules.	4.24	4	4	0.72

The descriptive analysis results for the control component are displayed in Table 5. With a mean score of 4.06, students assessed their ability to control the game as acceptable. The mean score of 4.32 suggests that students firmly believe they know what they should be doing (CO2). The mean level of control during gameplay is lowest at 3.8.

Table 5. Control descriptive results

Items		Mean	Med	Mod	Std. Dev
CO1	I felt the game give me sense of control during game play.	3.8	4	4	0.82
CO2	I know the next step in the game	4.32	4	4	0.63
CO3	I had the capability to influence what was happening.	4.04	4	4	0.79
CO4	I enjoyed being in control during the gameplay.	4.08	4	4	0.70

Table 6 displays the results of the descriptive analysis of the motivation component. Students rated their motivation during gameplay positively with a mean score of 4.21. The mean score of 4.52 indicates that the scoreboard motivates pupils to perform better (MO3). The mean level of crossword-related feedback during gameplay (MO2) is lowest at 3.96.

Table 6. Motivation descriptive results

Items		Mean	Med	Mod	Std. Dev
MO1	The currency implementation motivates me to do better in the game	4.16	4	4	0.69
MO2	The feedback helps me to do better in the next topic	3.96	4	4	0.84
MO3	The score board encourage me to wanting to do better.	4.52	5	5	0.51
MO4	The way the game works suits my way of learning	4.16	4	4	0.8
MO5	Playing Research Methodology games is fun.	4.16	4	5	0.85
MO6	It was easy to understand the game and start using it as study material.	4.28	4	4	0.54

The descriptive analysis results for the clear goals component are displayed in Table 7. Students rated that they have clear goals during the gameplay with a mean score of 4.37. The mean score of 4.48 indicates that overall game goals were presented in the beginning of the game (CG2). The mean level of overall game goals portrayed clearly is lowest at (CG1).

Table 7. Clear goal descriptive results

Items		Mean	Med	Mod	Std. Dev
CG1	Overall game goals were presented clearly	4.28	4	4	0.54
CG2	Overall game goals were presented in the beginning of the game	4.48	4	4	0.51
CG3	Learning goals were presented in the beginning of the game	4.36	4	4	0.57
CG4	I understand the learning goals through the game	4.36	4	4	0.57

The descriptive analysis results for the playability component are displayed in Table 8. Students rated that the game playability is good with a mean score of 4.26. The mean score of 4.48 indicates that the students could play the game by themselves (PA4). The game's mean level is good and efficient (PA1), and its challenges and playability are at a balanced level (PA2), which is lowest at 4.08.

Table 8. Playability descriptive results

Items	Mean	Med	Mod	Std. Dev	
PA1	This game is good and efficient	4.08	4	4	0.76
PA2	The challenges and playability level of the games are balanced	4.08	4	4	0.64
PA3	It is easy to play the games.	4.32	4	4	0.75
PA4	I can learn to play game by myself.	4.48	4	4	0.51
PA5	I know what I should be doing in order to play this game.	4.36	4	4	0.64

The descriptive analysis results for the content component are displayed in Table 9. Students rated that the game content is acceptable with a mean score of 4.07. This game allows students to learn Research Methodology (CT1), and this game helps students learn Research Methodology (CT3), received the highest mean score of 4.2. The game's mean level of being able to learn Research Methodology easily (CT2) and the games has sufficient element (CT4) is lowest at 3.96.

Table 9. Context descriptive results

Items	Mean	Med	Mod	Std. Dev	
CT1	I am able to learn Research Methodology through this game	4.2	4	4	0.71
CT2	I can easily learn Research Methodology through this game	3.92	4	4	0.81
CT3	This game helps me in studying the Research Methodology	4.2	4	4	0.71
CT4	I feel the game has sufficient elements.	3.96	4	4	0.68

The descriptive analysis results for the knowledge improvement component are displayed in Table 10. Students rated the ability to gain knowledge is acceptable with a mean score of 4.16. This game increases student's knowledge (KI1) indicates the highest mean score of 4.2. The game motivates the player to integrate the knowledge taught (KI4) is lowest at a mean of 4.08.

Table 10. Knowledge improvement descriptive results

Items	Mean	Med	Mod	Std. Dev
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CT1	I am able to learn Research Methodology through this game	4.2	4	4	0.71
CT2	I can easily learn Research Methodology through this game	3.92	4	4	0.81
CT3	This game helps me in studying the Research Methodology	4.2	4	4	0.71
CT4	I feel the game has sufficient elements.	3.96	4	4	0.68

MO3, “The score board encourages me to want to do better.” and MO5, “Playing Research Methodology games is fun.” records 5 as the highest mode, while MO3, “ The score board encourages me to want to do better.” records 4.52 as the highest mean. In general, the mean range for all the components is between 4.06 and 4.37, the mode and median range is between 4 and 5, and the standard deviation range is between 0.51 and 0.88.

Based on the tabulation of data from Table IV through Table X, the clear goals components stood out the most among all the proposed components, indicating that the students comprehended the overall game and learning objectives very well. There are studies that had similar findings for the clear goals component where when users comprehend the aims of a mobile serious game, they are better able to comprehend how to play, [12] and on two S-Cube trials, the clear objective components had a significant impact [19].

The following outstanding components are playability and motivation, where the analysis demonstrates that the game is enjoyable and encourages students to continue playing despite any difficulties. Similar results were found in the study in which it was stated that players require motivation throughout a game [33], and playability stood out the most in the study because it is fundamental to the effectiveness of a game [21].

The following outstanding component is knowledge enhancement, as this game has helped students acquire knowledge of Research Methodology. There have been a few studies revealing similar findings and emphasizing the importance of knowledge improvement, where the game should allow the user to enjoy playing while also improving their knowledge through play [12], and players desire to learn without realizing it [33].

Challenge, Control, and Content are the concluding three elements. It is evident that the challenge components have made the students addicted to the games, while the integration of the control components has given the user a greater sense of control over the game, making it simpler to play without restrictions. The content of the Research Methodology-related materials made them simple to comprehend. Additionally, few studies have found that the findings for the challenge [33], [40], control [12], and content [19], [33] components are remarkably similar.

4.5. Component Ranking

To visualise the relative strengths of the UX components, Table 4 summarises the ranking by mean value.

Table 4. Ranking of UX components by mean score

Rank	Component	Mean
1	Clear Goals	4.37
2	Playability	4.26
3	Motivation	4.21
4	Knowledge Enhancement	4.16
5	Content	4.07
6	Challenge	4.07
7	Control	4.06

The ranking indicates that clarity of goals and smooth interaction had the greatest influence on positive experience, while challenge and control were slightly less dominant but still favourable.

5. Discussion

The findings show that students liked how the game set clear goals and was easy to play. They felt guided through each task and easily manage to move around in the game. This supports earlier studies such as GAMEFLOW and MEG research, which also showed that clear goals help players stay focused and immersed [12], [16]. Motivation came next in importance. The feedback and rewards kept students interested and engaged in the game. These findings aligned with the findings by [18]. Moreover, students also gave good feedback on knowledge enhancement and content. This suggested that learning material is part of a fun activity. The fun learning materials help the students understand better, which is aligned with [35] and [25] studies. Challenge and Control were rated slightly lower, showing that students preferred moderate difficulty and simple controls. Too many challenges can break concentration, as [5] pointed out. For future work, the game could include adjustable levels of difficulty and better feedback features in the player engagement feature. Overall, the results show that the proposed UX model works well for evaluating mobile educational games because it captures what makes students enjoy the game while still learning from it.

6. Conclusion and Future Works

This study would be of great assistance to those who wish to delve deeper into the field of mobile educational games. The study contributes to the growing literature by proposing a tailored UX evaluation model specific to mobile educational games for research methodology, highlighting the importance of clear goals and playability in driving engagement. Even though this research was conducted specifically for a Research Methodology course, the suggested components can be implemented in any mobile educational game-related design. In addition, this research can be applied to any level of mobile educational game design, regardless of the level. Given that it is a mobile educational game, this study can be implemented in pre-school, elementary, secondary, and even the workplace.

For future research with better results, certain recommendations were made. The content for the Research Methodology course can be enhanced and extended. Furthermore, based on student responses to the questionnaire, mobile educational games can be designed to include a diversity of games in addition to crossword puzzles. The design can also be enhanced by having several iterations after involvement with the students.

This study was limited by the small sample size of 25 students from a single institution. Therefore, the generalizability of the results may be affected. Then, the study only utilized one mobile educational game with one format (crossword puzzles), which may not represent all learning preferences. Hence, future studies could involve larger, more diverse groups and various educational game formats.

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Conflicts of Interest

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

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