Evaluating User Experience of Mobile Game-Based Learning (Kenali Semai)

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ABSTRACT

Kenali Semai is a mobile game-based learning about the cultural heritage of the indigenous Semai in Malaysia. This research aimed to measure the significant User Experience (UX) elements of the Kenali Semai application and to propose design recommendations for improving the UX. A quantitative research approach was adopted by using the UEQ framework. The UEQ had six (6) UX scales: novelty, stimulation, dependability, efficiency, perspicuity, and attractiveness. This research is conducted by using the User Experience Questionnaire (UEQ) framework, tool, and analysis. The research methodology begins with designing the survey questionnaire, which can be broken down into two parts: the respondent demographic profile and the adoption of the standard questions provided by the User Experience Questionnaire (UEQ) framework. Then, the questionnaire was provided through Google Forms. The questionnaire is designed in English and is distributed to students at a public university in Malaysia by using e-mails. The sample collected is 200 sample. The data is then extracted and analysed using the User Experience Questionnaire (UEQ) Analysis Tool. The UX elements of the application were proposed for future improvement.

Keywords:
User experience; Mobile-game based learning; Mobile learning

1. Introduction

The evolution of technology has revolutionized the educational sector by introducing various innovative learning methods, one of which is mobile game-based learning. This method integrates gaming elements with educational content, thereby making learning more engaging and enjoyable for students [1]. With the prevalence of smartphones and mobile devices, mobile game-based learning has garnered considerable attention as a significant tool for offering accessible and convenient learning opportunities to a broad audience.

The user experience (UX) in mobile game-based learning is a crucial aspect to ensure the effective delivery of educational content. The quality of UX significantly impacts learners' motivation, satisfaction, and overall learning outcomes [2]. A comprehensive evaluation of UX in mobile game-

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based learning is essential for understanding learners' perceptions, preferences, and pain points, thereby enabling the enhancement of educational game design and functionality.

One of the commonly used methods to evaluate the user experience of mobile game-based learning is through surveys and questionnaires, which gather user feedback regarding various aspects such as usability, engagement, aesthetics, and satisfaction [3]. This feedback is instrumental in identifying the strengths and weaknesses of the mobile game-based learning platform, ultimately contributing to the improvement of game design and content delivery. Besides surveys, observational methods and interviews are also used to gain deeper insights into users' experiences and challenges in mobile game-based learning.

However, several challenges impede the evaluation of user experience in mobile game-based learning. These include the diversity of user preferences, varying levels of technological literacy among users, and the rapid evolution of mobile technology and gaming trends [4]. These factors necessitate a flexible and comprehensive approach to UX evaluation to ensure that mobile game-based learning platforms effectively meet users' learning and usability expectations.

Evaluating the user experience of mobile game-based learning is pivotal for ensuring the effective and efficient delivery of educational content. Employing a mix of different evaluation methods such as surveys, interviews, and observations can provide comprehensive insights into users' experiences, ultimately leading to the enhancement of mobile game-based learning platforms. A multifaceted approach to UX evaluation, considering the unique challenges in this domain, is essential for optimizing the learning experience and meeting the diverse needs of learners. This research aimed to measure the significant User Experience (UX) elements of the Kenali Semai application and to propose design recommendations for improving the UX. The UX elements of the application were proposed for future improvement.

2. Methodology

This research is conducted using the User Experience Questionnaire (UEQ) framework. The research methodology begins with designing the survey questionnaire, which can be broken down into two parts: the respondent demographic profile and the adoption of the standard questions provided by the User Experience Questionnaire (UEQ) framework, tool, and analysis [5-7].

Mobile applications have become an effective tool for education and learning [8] and mobile game-based learning has become predominant in various research [9,10]. Thus, Mobile Game-Based Learning (Kenali Semai) was used as the case used in the research. Then, the questionnaire was distributed through Google Forms starting from October 19 until November 18, 2022, for the data gathering process. The sample collected is 200 sample. The questionnaire is designed in English and is distributed to students at a public university in Malaysia by using e-mails. The questionnaire is divided into two parts. Part 1 is the respondent profile and their experiences using mobile game applications. The second part is the main questionnaire about the Kenali Semai application. All the data that has been gathered has undergone a validity and reliability test to measure the internal consistency and reliability of the questionnaire dataset. The data is then extracted and analysed using the User Experience Questionnaire (UEQ) Analysis Tool. The cluster column graph is used to show the first objective of this study, which is to measure the significant user experience (UX) elements of the Kenali Semai mobile application.

3. Results

3.1 Demographic Profile

This research has successfully gathered 200 respondents. 55% of those polled are men, while 45% are women.

3.2 Validity and Reliability Test

The results of the validity and reliability tests on the User Experience Questionnaire (UEQ) are displayed in Table 1. With an average above 0.60, the alpha values offer good validity and dependability overall. In that circumstance, it is possible to describe the total User Experience Questionnaire (UEQ) result as valid and reliable.

Table 1
Validity and Reliability

UEQ scale	Cronbach's Alpha	Validity and Reliability
Attractiveness	0.94	Reliable
Perspicuity	0.84	Reliable
Efficiency	0.86	Reliable
Dependability	0.71	Reliable
Stimulation	0.88	Reliable
Novelty	0.60	Reliable

3.3 Survey Analysis: Distribution of Answers Per Item

This section provided the distribution of answers per item for the survey analysis. This part contributes to offering a more in-depth understanding of some aspects of the Kenali Semai application that are felt by the user. The Kenali Semai application's key user experience (UX) components are measured by the survey that was done. The final product included 26 items broken down into six user experience (UX) components from the User Experience Questionnaire (UEQ) framework. In Figure 1, users' responses to 26 survey questions about their opinions of the Kenali Semai application's user experience (UX), whether favourable or unfavourable, are represented.
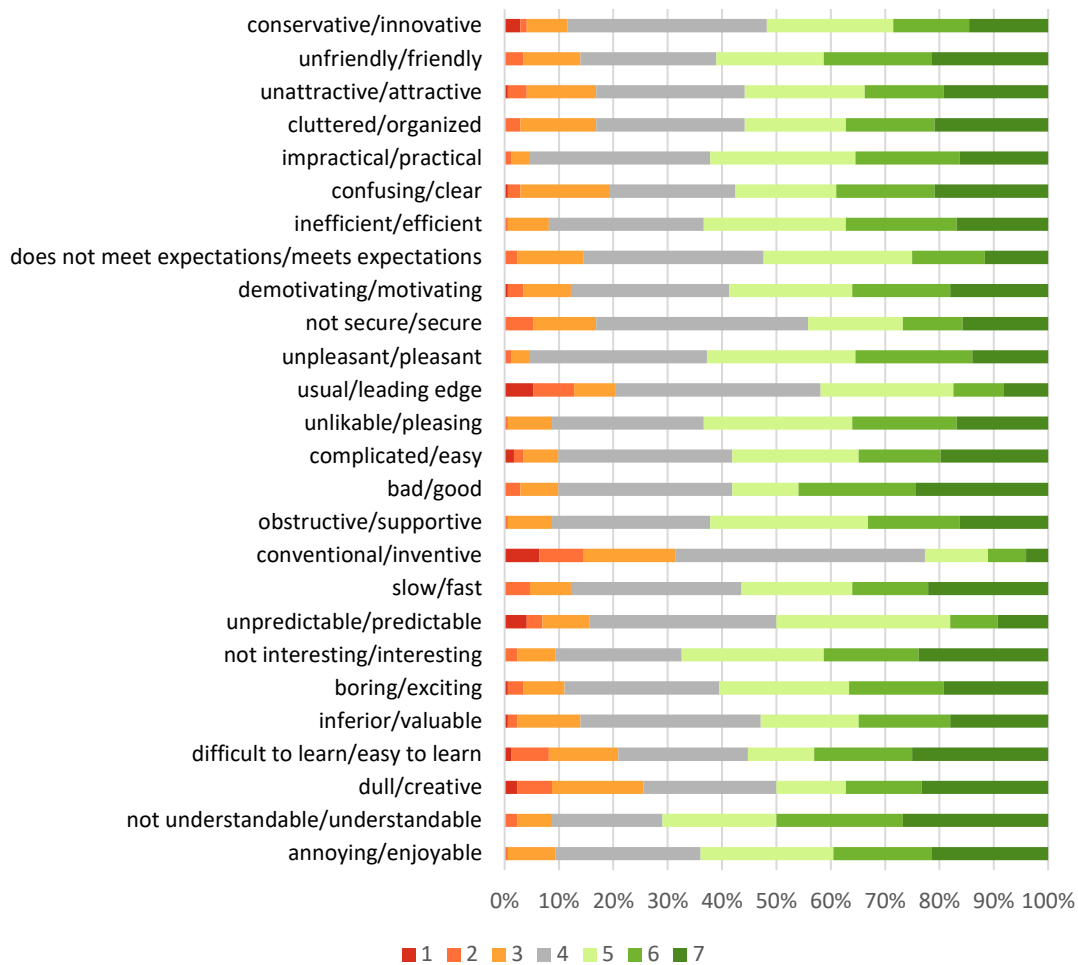
Fig. 1. Answer distribution by item

The percentage of respondents who agree or disagree with each item is shown to the right or left of the neutral bar. The percentage of respondents who neither agree nor disagree is split down the middle and is shown in a neutral colour. The items on the y-axis are arranged according to the proportion, with the highest and lowest items having, respectively, the most and least, agreement. The details of Figure 1 above can be further broken down in more depth as shown in Table 2.

Table 2
Answer Distribution by Item in Detail Answer Distribution by Item in Detail

Scale	Item no.	Item		Negative eval. (%)	Neutral eval. (%)	Positive eval. (%)
Attractiveness	25	(1)	Unfriendly/friendly	13.95	25.00	55.82
	24	(2)	Unattractive/attractive	16.86	27.32	55.82
	16	(3)	Unpleasant/pleasant	4.65	32.56	62.79
	14	(4)	Unlikeable/pleasing	8.72	27.91	63.37
	12	(5)	Bad/good	9.88	31.98	58.14
	1	(6)	Annoying/enjoyable	9.30	26.74	63.96
Perspicuity	21	(1)	Confusing/clear	19.19	23.26	57.55
	13	(2)	Confusing/clear	9.88	31.98	33.80
	4	(3)	Difficulty to learn/easy to learn	20.93	23.84	55.23
	2	(4)	Not understandable/understandable	8.72	20.34	70.94
Efficiency	23	(5)	Cluttered/organized	16.86	27.33	55.81
	22	(6)	Impractical/practical	4.65	33.14	62.21
	20	(7)	Inefficient/efficient	8.14	28.49	63.37
	9	(8)	Slow/fast	12.21	31.40	56.40
Dependability	8	(1)	Does not meet expectations/Meets expectation	14.54	33.14	52.32
	11	(2)	Not secure/secure	16.86	38.95	44.19
	17	(3)	Obstructive/supportive	8.72	29.07	62.66
	19	(4)	Unpredictable/predictable	15.70	34.30	50.00
Stimulation	18	(1)	Demotivating/motivating	12.21	29.07	58.72
	7	(2)	Not interesting/interesting	9.30	23.26	67.44
	6	(3)	Boring/exciting	11.05	28.49	60.46
	5	(4)	Inferior/valuable	13.95	33.14	52.91
Novelty	26	(5)	Conservative/innovative	11.63	33.63	54.74
	15	(6)	Usual/leading edge	20.35	37.80	41.85
	10	(7)	Conventional/ inventive	31.40	45.93	22.67
	3	(8)	Dull/creative	25.58	24.42	50.00

Based on Figure 1 and Table 2, the highest item that receives a positive evaluation (70.94%) is item number 2 (understandable/not understandable), which indicates that the user is remarkably familiar with the application. Moreover, the survey analysis also shows a high neutral and negative evaluation, in item number 10 (conventional/inventive), with a total of 45.93% (neutral evaluation) and 31.40% (negative evaluation). Thus, it can be concluded that item number 10 has a higher assessment on a neutral evaluation compared to a negative assessment. This indicates that the user feels the application is neutrally inventive. The overall result of this section also shows that positive evaluation is more polarized than neutral and negative evaluation. This indicates that the overall survey analysis of the Kenali Semai application received an average positive evaluation for all 26-item scales.

3.4 Objective: To Measure the Significant User Experience (UX) Elements of the Kenali Semai Mobile Application

This section discusses the objective of this research, which is to identify the significant user experience (UX) elements of the Kenali Mobile Semai application. The results are displayed in a cluster bar graph as shown in Figure 2 according to the groups of attractiveness, perspicuity efficiency, dependability, stimulation, and novelty. The data from the online questionnaire is entered and processed using the User Experience Questionnaire (UEQ) Analysis Tool.
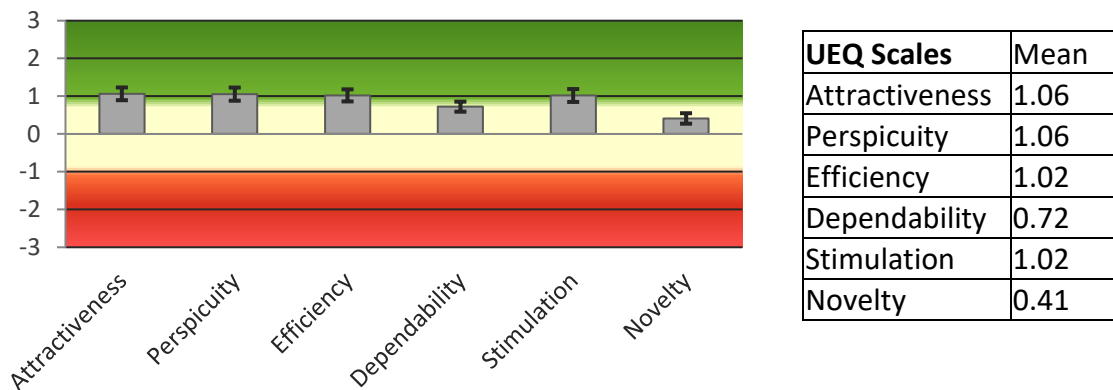
UEQ Scales	Mean
Attractiveness	1.06
Perspicuity	1.06
Efficiency	1.02
Dependability	0.72
Stimulation	1.02
Novelty	0.41

Fig. 2. User Experience Questionnaire Results

Figure 2 shows the mean of the six scales of the significant user experience (UX) of the Kenali Semai application that is used for plotting the graph. As a result, any scale that falls in the range of -0.8 and 0.8 is regarded as neutral. Finally, any scale with a value of below -0.8 is thought to be a negative evaluation. Any scale with a value greater than 0.8 is considered a good assessment. Based on Figure 2, four scales are given a positive evaluation, with the highest being the attractiveness scale (1.06), which represents a good impression of the application, and the perspicuity scale (1.06), which indicates that the user is quite familiar with the application. This is followed by the efficiency scale (1.02), where the user can use the application to complete the intended set of tasks within the application, and the stimulation scale (1.02), where users feel motivated to use the product.

Finally, even though the application has a positive evaluation, two scales are given a neutral evaluation, the lowest of which is the novelty scale (0.41), which indicates that users may feel the application is neutrally creative or innovative. This is followed by the dependability scale (0.72), where the users feel neutral control while using the application. The UEQ scales can also be viewed as a group, which consists of pragmatic quality (perspicuity, efficiency, and dependability) that shows task-related quality aspects of the Kenali Semai application and hedonic quality (stimulation and novelty) that shows non-task-related quality aspects. Figure 3 below shows the mean of the attractiveness, pragmatics, and hedonic qualities of the application.
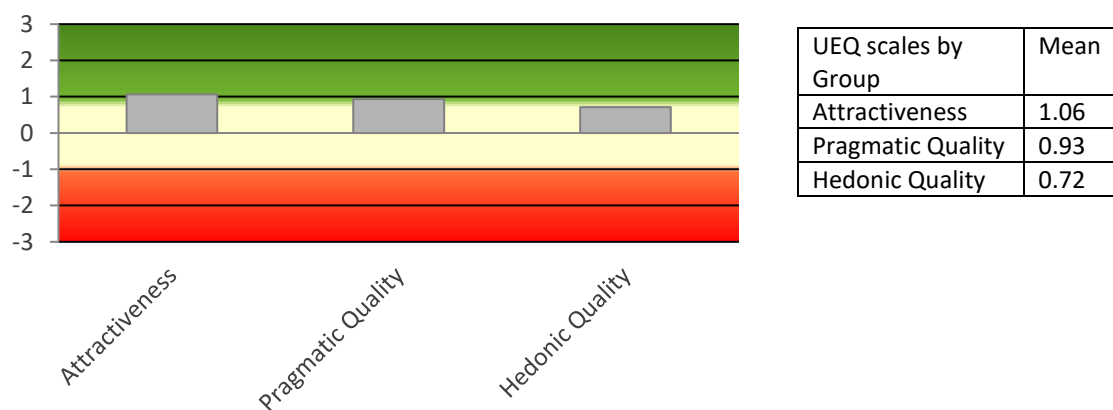

UEQ scales by Group	Mean
Attractiveness	1.06
Pragmatic Quality	0.93
Hedonic Quality	0.72

Fig. 3. Groups Results Graph

According to Figure 3 above, the pragmatic (0.93) and attractiveness scale (1.06) qualities are rated positively, while the hedonic (0.72) quality is rated neutrally. This demonstrates that respondents believe the Kenali Semai application offers them a positive user experience (UX) and is

free of significant problems when carrying out its intended functions. In conclusion, the analysis's findings allowed for the identification of the key user experience (UX) components of the Kenali Semai application. Even though all six scales individually receive positive evaluation, attractiveness, and perspicuity receive the highest score of 1.06. The attractiveness scale scores the highest at 1.06. This demonstrates that the attractiveness scale is an important user experience (UX) element to consider when evaluating the Kenali Semai application.

3.5 Suggestions to Improve User Experience (UX)

To increase the attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty of the Kenali Semai mobile application, various design elements and user experience (UX) considerations should be considered.

i.   Attractiveness: Visuals, animations, and sound effects enhance engagement in mobile learning games [3]. Immersive elements may increase attractiveness and user engagement in educational games [3]. By creating a comprehensive user experience (UX) framework for mobile educational games, designers and developers can ensure that these games are not only effective but also engaging in students' learning [14]. Research indicates that immersive elements play a crucial role in enhancing attractiveness and user engagement in educational games. Various methodologies and models have been proposed to design and evaluate immersive game mechanics for specific content standards, emphasizing the importance of engagement for effective learning [15].

ii. Perspicuity: To increase the clarity and understandability of the content, the game can incorporate clear instructions and explanations, as well as interactive elements that help the player understand complex concepts [11]. Using multimedia, such as images and videos, can also help make the information more accessible and memorable [11], making it easier for users to assimilate and control new technologies [16]. Clear instructions enhance content clarity and understandability in games and incorporating explanations aids in increasing content perspicuity in games [17].

iii. Efficiency: Adaptive learning algorithms adjust content difficulty based on player performance [3]. Personalized algorithms can increase learning efficiency by adjusting content difficulty [3]. Personalized learning path recommendations also address cognitive overload and learning disorientation by generating optimal learning strategies that adapt to the learner's changing abilities, thus enhancing learning efficiency [18,19].

iv. Dependability: Thorough testing and quality assurance processes enhance mobile game dependability [12]. The design with robust security features is important to protect player's data [12]. Dependability in mobile games is a multifaceted attribute that encompasses reliability, availability, security, and maintainability, among other factors [20]. Additionally, the integration of robust security features is vital to protect players' data, ensuring that the game is resilient against abuse and maintains user trust [21].

v.   Stimulation: Diverse tasks like puzzles enhance user engagement in mobile applications [13]. Challenging activities like mini-games increase stimulation for user experience [13]. Gamification elements enhance user engagement and challenging activities in mobile apps increase stimulation for user experience [22]. Mobile learning software includes diverse interactive activities for engagement and challenging activities like mini-games enhance user stimulation in mobile apps [23].

vi.   Novelty: To maintain the player's interest, it is important to continually update the game with new content and features [3]. This can include adding new levels, challenges, and storylines, and improves novelty in user experience [3]. New levels, challenges, and storylines maintain player interest in the game and continual updates improve novelty and user experience in the game [24]. Novelty is crucial for user engagement in updating game content and new levels, challenges, and storylines enhance user experience novelty [25].

By considering these UX elements and making design decisions that reflect their importance, the mobile game-based learning application of the cultural heritage of the indigenous Semai can be made more appealing, effective, and enjoyable for users.

4. Conclusions

Kenali Semai is one of the game-based learning applications about the cultural heritage of the indigenous Semai, which functioned to preserve the culture from extinction. This research aimed to measure the significant UX elements of the Kenali Semai application and to propose design recommendations for improving its UX. A quantitative research approach was adopted by using the UEQ framework. The UEQ had six (6) UX scales: novelty, stimulation, dependability, efficiency, perspicuity, and attractiveness. This research is conducted using the User Experience Questionnaire (UEQ) framework, tool, and analysis [5-7]. The research methodology begins with designing the survey questionnaire, which can be broken down into two parts: the respondent demographic profile and the adoption of the standard questions provided by the User Experience Questionnaire (UEQ) framework. Then, the questionnaire was provided through Google Forms. The data is then extracted and analysed using the User Experience Questionnaire (UEQ) Analysis Tool. The UX elements of the application were proposed for future improvement.

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