Interactive mobile games development for children to learn about money

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Abstract. Money notes and coins are used for transactions and are essential in daily human life. Children need to be exposed to enough knowledge about the purposes of money notes, and the most important is to identify the money correctly. Children begin to expose to identifying the money at school in standard one. However, depending on formal education is not enough because the children easily get bored, and they did not fully engage with formal education. The use of mobile games for learning purposes is becoming increasingly popular because they are interactive and able to attract students. Therefore, this research aims to develop mobile games to identify and learn about money. Three main phases have been carried out, and the first phase is preliminary research on the learning approach for children and data collection in money Malaysia Ringgit. The second phase is to design and develop mobile games. Three mini-games have been proposed, and the first game is to identify the money notes and coins. The second game is to learn about counting the money and coins, and the third game is to learn to use the money for purchasing purposes. After these three mini-games have been developed in the second phase, the third phase is the evaluation phase. The usability result shows the users agree the mobile games help them to identify money, calculate the value of money, and to perform basic purchasing activities. Based on the user acceptance results show that the mobile game works more effectively with adult or parental guidance. Overall, this research has successfully produced a mobile game that can help the children to learn to identify, count, and use money.

1. Introduction

Humans are a social species; humans need each other for supply and service needs. This results in the creation of the barter system for it to be benefited by them. In the barter system, one item would be traded for other items, and it's involved between two or more parties. However, this system turns out to be ineffective [1].

Money is defined as a tool of exchange and to calculate the value of something [2]. In modern times, money plays an important role in our economy. This is because money is used for almost all daily things like buying groceries, making online payments, loan payments, transferring them to others, and so on. The proper knowledge of money usage is required to complete the tasks. Various social and economic problems can be experienced if people do not have sufficient knowledge and skills in money management [3].

Therefore, early education for children on the basics of money management is important because it will help them learn skills that will be beneficial as they grow up. This statement is supported by [3] because, in this day and age, children need to be given enough knowledge about money so that they can build good habits, skills, and attitudes in managing their money for the future. Based on the facts, children in Malaysia are exposed to formal education about money starting from first grade in a primary

school in the subject of Mathematics. However, parents need to play an important role in money education as they are responsible for giving money to their children.

2. Problem Background

A study conducted by [3] shows that primary school students in Malaysia have a moderate understanding of money. For example, when shopping at the store or school, most children have difficulty giving the right amount of money or do not know how to receive the balance from the seller. This is because, when children give a larger amount than the original price, the child will only take the goods purchased after giving money to the seller without the balance. Therefore, children need to have basic knowledge about money such as recognizing and distinguishing between types of money, knowing the value of money, and being able to differentiate the value of a product according to its price.

A child's awareness of the function of money starts at the age of three, but a child still does not have a clear understanding of it [4]. At that age, the person closest to the child is their parent or guardian. Thus, education about money begins with their parents. Then, at the age of seven, children were given pocket money by their parents for school expenses. Therefore, they need to know about money management so that they can be responsible for making decisions for themselves in the future [3]. Besides, the way children appreciate and spend their money is directly influenced by how their parents or guardians teach them. This is because at that time parents were the main source of money for children. All matters of financial decisions in the family should be discussed by parents with their children as they are directly affected by these decisions [5].

The rapid growth of technology is affecting the way people live today. The use of technology in education cannot be denied. Some schools have implemented mobile-based education, such as tablets as one of their teaching mechanisms to make the process more fun and interesting compared to traditional teaching consisting of books and papers. Teaching methods in using mobile games have been successful in motivating students compared to book-based methods as students will be more involved in the process of behavioral, intellectual, and emotional learning [6].

Since it is common nowadays for children to be given devices such as smartphones and tablets by their parents, it is appropriate to use mobile games to educate children on certain topics, especially in recognizing money. It turns out that interactivity in mobile games is effective in learning subjects such as mathematics and science because it is quite difficult to imagine and manipulate concepts through real objects [7]. By using mobile games, the user can avoid any damage to the real money or injuries that may occur during learning sessions if using real money. Moreover, mobile games have interactivity, instant feedback, and risk-free nature that can encourage students to explore and try further in a lesson [8]. Thus, the use of mobile games for education has proven to be beneficial.

3. Background Study

A study has been conducted by [9] to find out the experiences of children learning about money at home and school. While, as agree by [10], young children often have difficulty with understanding money in a traditional formal school learning. Without proper financial education, [11] has claimed that children can be very vulnerable and defenseless; the study agreed that children with poor financial skills often result in delayed financial responsibilities.

The use of mobile games in learning has been widely used nowadays. Most schools are already beginning to implement the use of devices such as tablets in their learning sessions. This is because several advantages can be seen by using mobile games for learning. Among them, the cognitive ability of a child who plays video games at seven years is better compared to children who do not play video games [12].

Also, the use of mobile games in learning has proven successful in motivating students when compared to using the traditional way of learning based on books. At the same time, games like this have a persuasive nature due to their interactive way of use as well as the exciting use of technology [13].

Studies on existing games should be conducted to compare the features of the game and the concept of the game to be used in this research. The concept and pattern of the game are based on learning to know money. Table 1 shows a comparison of each of the existing games that have been developed

previously, namely Peter's Pig Money Counter, Freefall Money, Renegades Buggies, and MON€¥$! - Money Match Puzzle. Figure 1 shows the existing game interfaces.

(a) Peter's Pig Money Counter [14]   (b) Money Match Puzzle [15]   (c) Freefall Money [16]

Figure 1. Existing game to learn about money.

Table 1. Comparison of Existing Game Features.

Application	Features		
	Getting to Know Money	Game Patterns	Interactions
Peter's Pig Money Counter [14]	Some know US coins	Put money in a jar based on the value	Touch, drag, and drop
Freefall Money [16]	Get to know coins using the concept of paper exercises	Write the value of the coin based on the designated coin model	Touch
Renegade Buggies [17]	Learning to collect and save money	Collect money and items you want to buy along the way.	Touch and swipe
MONEY! - Money Match Puzzle [14]	Recognize coins and paper by matching based on design.	Match money with the same shape and value.	Touch and swipe

4. Methodology
To build a mobile game and store children with a basic knowledge of identifying money, the chosen platform is Android. The research has several planned phases, namely Phase 1: Preliminary Research and Data Collection, Phase 2: Design and Implementation, and Phase 3: Testing and Evaluation.

4.1. Phase 1: Preliminary Research and Data Collection
In this phase, the focus of the research is to explore past approaches to money-based learning, including how games are used to achieve interactive learning for children. The activities involve, to find out what syllabus is used and what is the learning methods used in primary school about the basics of money. Data is collected from the textbooks provided.

4.2. Phase 2: Design and Implementation
Based on the information found in the previous phase, the design phase for money base learning games has been implemented to assist children in basic money learning and interactively test their knowledge. The main challenge in this research is to illustrate the syllabus available from books to mobile games. As mentioned above, the target users for this game are students around the age of 7 to 9 years, so mobile games based on touch and finger gestures are appropriate because it makes it easier for children to play this game. The design phase begins when all the requirements have been identified and properly understood. It also involves how the game is viewed by the end-user. From the information obtained from the research phase, it is then used as a design guide for this game. As such, this money-learning mobile game targets consumers seven to nine years. The content for this application is in line with the sub-topics of money for the subject of Primary school syllabus Mathematics. It includes questions about

knowing money, knowing the value of money, and basic purchase simulations. Thus, the design is divided into sections, as presented in Figure 2.
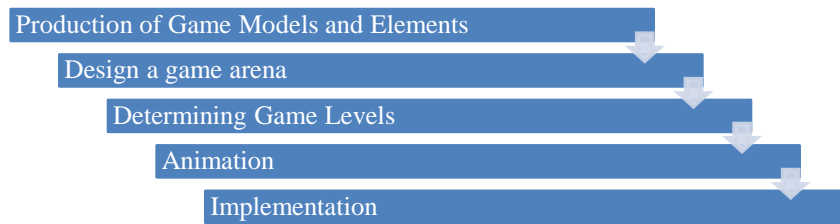

Figure 2. Design process.

After the design phase is complete, a mobile game framework on basic money learning is carried out. A prototype for a 3D puzzle game was developed for this phase. After a complete development phase, this mobile game has been implemented on Android platforms using the Unity IDE.

4.3. Phase3: Evaluation and Testing
This phase discusses the game evaluation of basic money learning for Android platforms. This includes comparisons between existing games and shows improvements if needed. The evaluation process is carried out for the usability and functionality of the game developed. Also, the test phase in this is to identify the complications or errors found in the built game. The game will be tested using a black box testing technique or known as a behavior test and then a user acceptance test. Figure 3 shows the Research Methodology.
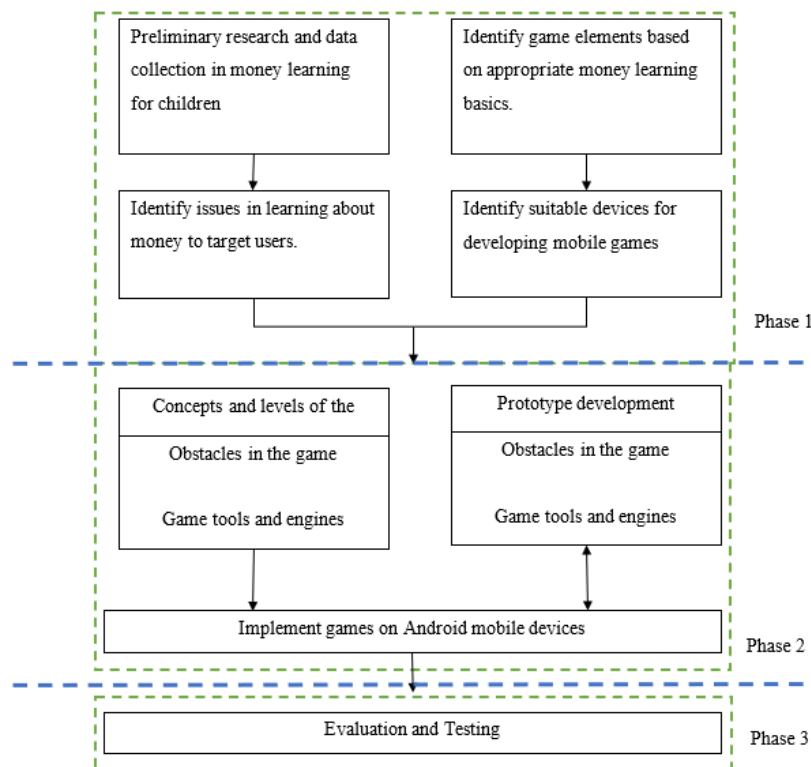

Figure 3. Research Methodology.

5. Game Design

The concept of this game is a 2-Dimensional puzzle; questions about the basics of money were asked to the player. The game has three different types of games, namely recognizing money by matching the front and back of the money, calculating the value of money by choosing the correct answer, and also the purchase of items by paying the right amount. Figure 4 shows the framework of this game.
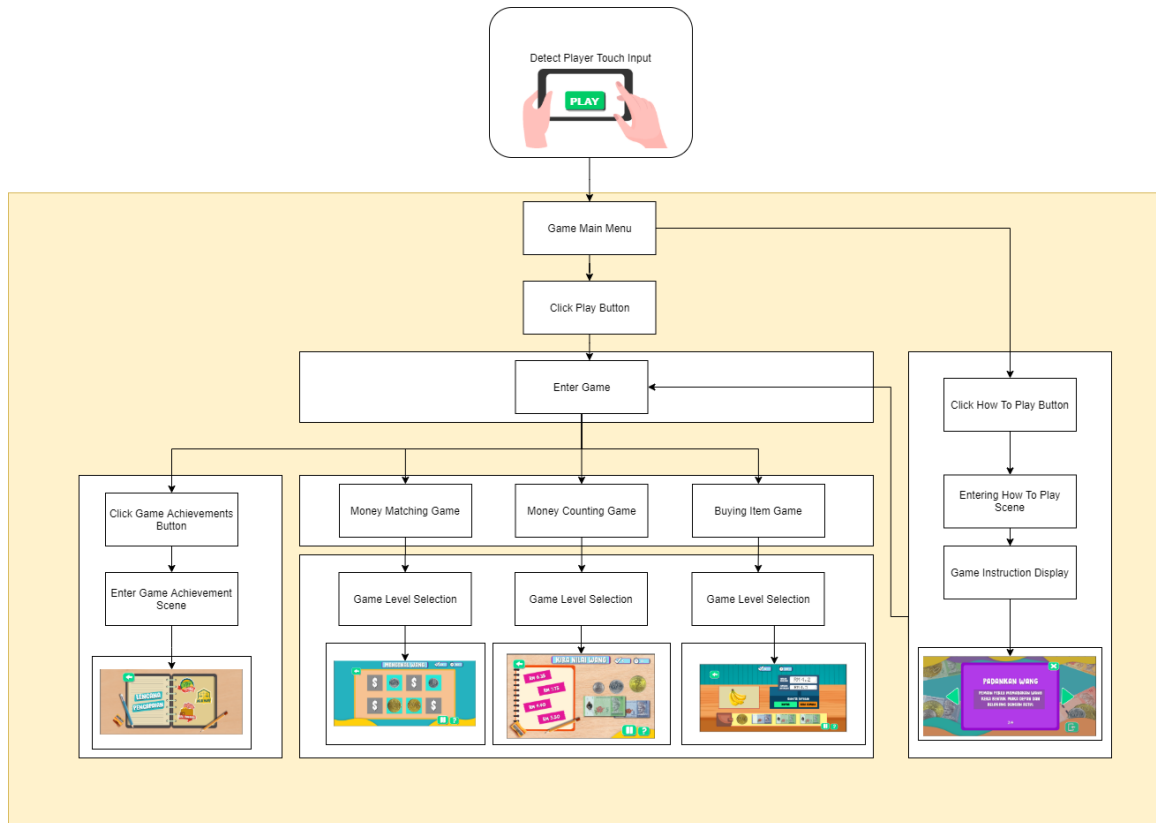

Figure 4. Game Framework.

Before playing, players can also enter the screen of how to play where it will explain about this game. When players press the start button, they will enter a game type selection menu where they can choose between the three desired game types. In this menu as well, they can go to the awards list view to see the awards won if they complete each type of game by completing each level. Next, the first game is to match the money according to the same design. There are two designs for coins, the front design, and the back design. Next, players also need to match the front design of the banknote and the back design of the banknote. The last stage is a combination of these two designs. Each level has its time limit.

The next game is to determine the value of the money displayed. A combination of banknotes and coins will be displayed, and players are required to calculate the value of the money. Choices of answers will be given to the player.

Finally, a game was developed for the purchasing items. Players will be given items at a certain price, and they will have to pay according to the total price of the item stated. A list of money will be given to the players so that they can add up each money to make the desired amount.

5.1. User Interface Example

There are three buttons, namely the Start button to start the game, the How to Play button where it will give a little description about this game, and the Exit button to exit the game. Figure 5 shows the main interface of the first view once the player enters the BijakWang game.

Figure 5. Main Menu Interface.

6. Implementation

There are three mini-games, namely matching money, counting money, and purchasing the items. Each game has a different way of programming and game elements.

6.1. Matching Game

Players need to match the money front design to the right money back design. Correct answers will be given marks. There is also a time count for this game. Figure 6 shows a game for matching money.
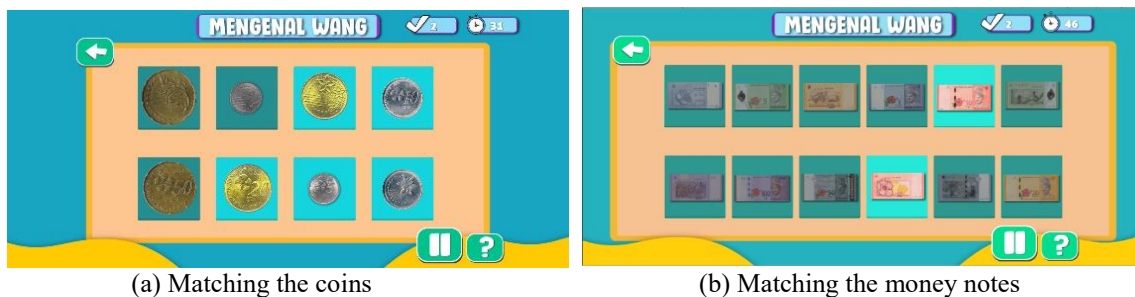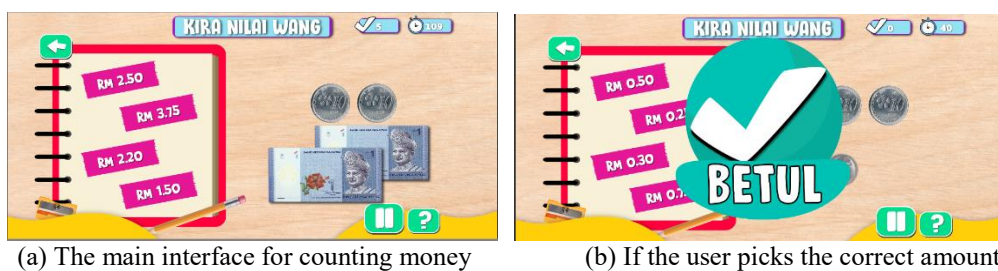

(a) Matching the coins   (b) Matching the money notes

Figure 6. Matching Money.

6.2. Counting Money

The game of calculating the value of money is for the player to choose the value of the correct answer based on the pieces of money given. Figure 7 shows the game to calculate the total value of money.

(a) The main interface for counting money   (b) If the user picks the correct amount

Figure 7. Main Menu Counting Money.

6.3. Purchasing Items

In this game, the player must pay the correct amount of money based on the price of goods spawned at random. The method of payment is by tapping at any of the money shown on the screen and the value in the Total Payment Amount will increase based on the value of money. Players will add up the value of money until they get a sufficient amount for payment. When a player presses the Pay button, the player will know whether the answer is correct or incorrect. Figure 8 shows the purchasing items or goods gameplay where the player can spend money to buy the item shown. In Figure 8 (a), a random item was spawned on the left-hand side of the screen while the right-hand side shows the cash register

machine with the price of the item, and at the bottom of the screen are the choices of money for the player to tap. Figure 8 (b) shows the correct answer feedback once the player answers the right amount of money. The player will receive points and proceed to the next question. However, Figure 8 (c) shows the incorrect answer feedback once the player answers an incorrect amount of money. The player will not gain any point and will answer the question again until it is correct.

(a) The main interface for purchasing items

(b) If the user correctly purchases the items

(c) If the user provides an incorrect amount to purchases the items

Figure 8. Purchasing the items.

7. Evaluation

The evaluation has been performed to observe usability testing. User satisfaction while using this research is also assessed to see whether the game is accepted by the user [18]. Target users will be asked to play the game and complete the same requested task to see if they will have any problems. Figure 9 shows the ongoing test to one of the target users of this game, namely children between the ages of seven (7) to (9) years.
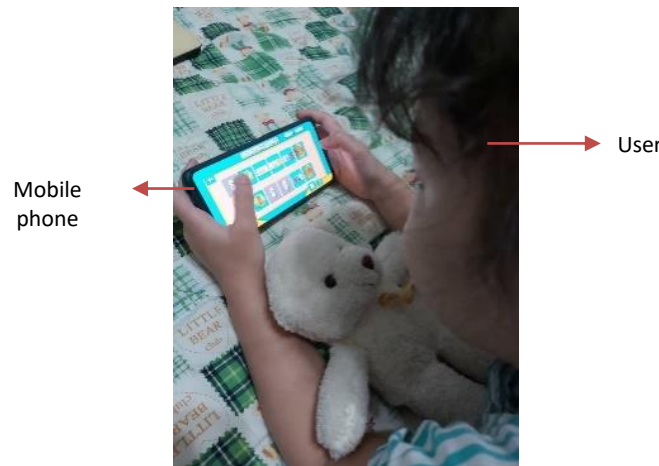
Figure 9. Mobile games with the user.

This test is conducted to see if this research can meet the needs of the target users. Eight respondents have filled out the form with the help of their parents. The first question is, the children were asked to answer Q1: I can learn to identify money with this game and the result as in Figure 10. Six respondents have successfully managed to match the money correctly.
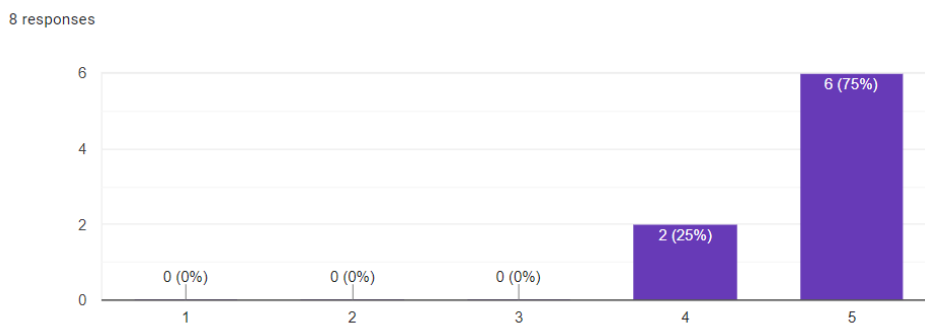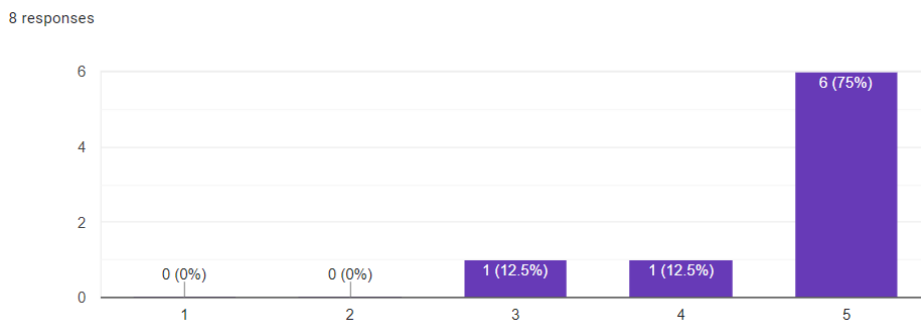

Figure 10. The user responds to the matching game.

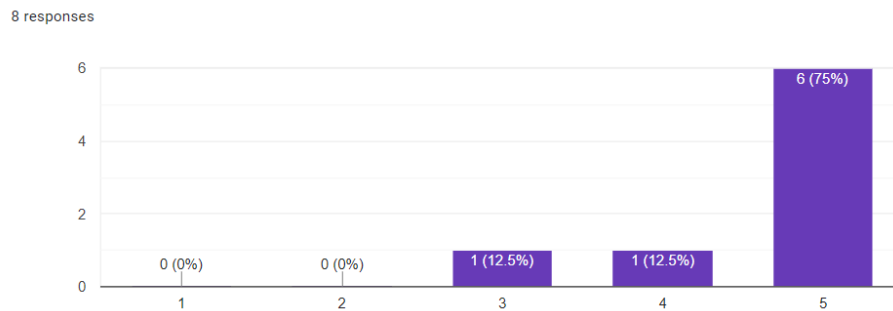**Figure 11.** The user responds to the game for counting money.

Figure 12. The user responds to the game for purchasing the item.

The second question is, the children were asked to answer Q2: I can learn to count the money with this game and the result as in Figure 11. Six respondents have successfully learned to count the money adequately. As in Figure 12, the result for Q3. The third question the children were asked to answer Q3: I can use the money to purchase the items. Six respondents have used the money to purchase the items and found themselves able to purchase the item with the exact amount of money.

8. Conclusion

A research is complete when it has achieved the goals and objectives of the research. The goal of developing mobile games to get to know money, knowing the types of money, and basic purchasing skills for children aged seven to nine years has been achieved. Apart from that, the three stated objectives can also be achieved. They are starting with the first objective, which is to analyze the needs in the development of mobile games for learning to know money for children. Next, to develop mobile games for children aged seven to nine years that can help them learn the basic knowledge of money is also successful.

This research will only be implemented on Android platforms. This is because smartphones that use the Android platform are accessible to get by users. Also, this research is only for single players because it focuses on education. Next, lacking in-game animation to engage players more effectively. Finally, this research has only three stages which include easy, medium, and difficult due to time constraints.

For future work, there are some plans to improve this Smart Money mobile game research. The first is to add more animation so that it can attract players more effectively. Also, to add elements of 3-Dimensional (3D) objects, especially in displaying the purchase of items because the application only in 2D. The rewards can be revealed, besides the games can be converted into Augmented Reality (AR) application.

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