

# **SALAPIGGY: USABILITY TEST OF THE SIFTEO CUBES AS A GAME INTERFACE FOR THE MONEY COUNTING GAME FOR PRESCHOOLERS**

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## **ABSTRACT**

Kinesthetic learning, one of the VAK learning styles, is now also being adapted by different gaming consoles and platforms. This paper presents Salapiggy, a two-part kinesthetic educational Sifteo game that has both a tutorial on money and sorting game. It is localized in the Philippines and uses Filipino as the User Interface Language and the Philippine peso as Game Objects. Salapiggy is geared to enhance both the player's monetary recognizing skills and basic arithmetic computation skills. The purpose of this research is to determine whether the children who would play the game will be able to do basic computations through money familiarity and eventually play the game, by attaining a certain amount of points. The test results show that players were able to recognize the value of coins and bills displayed and the goal of having them perform arithmetic operations using the cubes were successful.

## **KEYWORDS**

Sifteo, Money Math, Salapiggy, Kinesthetic Games, Localized Game, Filipino, Educational Game, Primary Schooler, Tangible User Interface, Kinesthetic Learning

## **1. INTRODUCTION**

Electronic games, now commonly known as video games, are interactive games operated by the computer circuitry. There is a wide range of platforms that can be used to play these video games. They include personal computers, arcade consoles, video consoles, and hand held devices. [1] These video games involve a player or players that interact with the game platform usually by through a controlling device. The original purpose of the creation of these video games is to be an interactive system that provides the users fun and entertainment. Today, they make up the "biggest industry in terms of turnover".[2]

### **1.1 Background of the Study**

The rapid digital technology advancement today revolutionizes electronic games from the precursor pinball machines introduced during the 1930s to the popular graphically rich and portable games in the late 2000s. Before, given the original purpose of these video games, they were not included in the school curriculum. Some educators feared their negative effects such as bad posture, violence aggression, and bad habits. Numerous dedicated studies, however, proved that games can serve a wide range of advantages in terms of the work performance done by those who play. Expert video game players often outperform non-players on measures of basic attention and performance. Recent research suggests that playing video games, even for a relatively short period of time, improves performance on a number of tasks that measure visual and attention abilities.[3] These good results from the researches, allowed game technology to be slowly integrated into school systems and games related to school subjects that can help students were created. Thus, from the entertaining video games, the educational video games emerged.

### 1.1.1 Kinesthetic Learning and Tangible User Interfaces

Kinesthetic Learning, or the learning style with physical activity, has already been a part of the classroom learning experience, usually in physical education classes. Eventually, as technology advanced, the sense of kinesthetic became a part of the new emerging gaming devices. Consoles like Wii and Kinect cater active play and even include educational games for active learning. These gadgets are called the “tangible user interfaces” and they are used to cater both physically active and enjoyable learning games. Inspired by this, the Sifteo Cubes were created.

### 1.1.2 The Sifteo Cubes

The Sifteo Cubes are flattened square block shaped interfaces with a colour display atop. Each cube can interact with each other when placed in a close proximity. They are connected wirelessly and can be manipulated by shake, press, neighbor, tilt, and flip. The original version of the cubes needs to run with a computer that has the Siftrunner program in order to load the applications and have an audio output. The aim of this research is to explore the unique features these cubes has to offer. Using the developer’s kit provided, the goal is to develop an educational game for the original cubes.

## 2. MONEY MATH AND KINESTHETICS

Paul Richard, executive vice president of the USA National Center for Finance Education (NCFE), showed the importance of teaching money to children at a young age. He suggested that “As soon as children can count, introduce them to money.” [4] This is because children are not born with ‘money sense.’ They learn about money by what they see, hear and experience. [5] This research aims to know whether the Sifteo cubes would be able to cater the money math game and help the children recognize the individual values of the currency and make basic operations with them. The learnability on using the cubes and going through the game will be tested and evaluated.

Computer programmers and educators team up to create various educational video games that can help a student in different academic subjects. One of the difficult subjects students face in school, Mathematics can be made more engaging by designing challenging tasks that are meaningful for children in which they actively participate. [6] John Edelson suggested that the best way to eliminate math anxiety is to present the exercises in a non-threatening way, that is, instead of opening a math book, try turning to technology to help them conquer fears. That is why educational games such as mathematical educational games should be fun in order to encourage kids to play and learn and at the same time enjoy. [7] And a lot of these mathematical games that cover a wide range of sub topics and have been deployed and implemented using different gaming consoles. Using the computer, there is a long list of online and installable mathematic games that cover a wide range of subtopics can be played. Typing in “math game for kids” in the search bar can lead you to hundreds of games for children that can help them to do basic arithmetic operations such as addition, subtraction, multiplication, fractions, and so on. There are also math games that are designed for gadgets “on the go”. [8] Mathematical game applications have also been designed for smartphones such as Android devices and iPhones. Kids can now play these games in various consoles including the touch screen interfaces. Kinesthetic gadgets or tangible user interface did not escaped the list of the game designers and educators as mathematical games were also designed for them. Mathematical Kinesthetic games like *Scoop* (a movement-based game that is purposed to reduce math anxiety[9]), and *Math Mazing* (a 3D gesture recognition exer-game for arithmetic skills[10]) are designed for Kinect. These games promote active play where users use movement of their hands and feet while learning and it also help students with their math anxiety. Both *Scoop* and *Math Mazing* aims to teach children mathematics in a kinesthetic, fun and effective way[11]. Another tangible user interface is the Sifteo cubes. These digital blocks cater “intelligent play” and kinesthetic games that are classified into different categories and age groups. The alpha version of these cubes was presented at the TED conference last July 2009[12]. There are mathematical games available for download where you can operate with numbers and simple fractions such as *Math Cube*, *Peano’s vault*, and *Mount Braniac*.

The games discussed above have been shown to help students learn in school and their attitude toward learning math. Included in learning elementary mathematics is also doing basic operations in monetary units. There are also a long list of computer games like *Thinklet* that cater doing computations with money or money math. Another web application from that also has a money math game but is quite different from the other games that do money math is mathisfun.com's *Money Master*. Usually, the games that do money math uses the US dollar or Euro (in *Thinklet's* case) as monetary unit values. But with *Money master*, the country may be chosen and the images of the currency of that country will be used as learning objects for performing basic arithmetic operations. However, even though the money images have been localized, the standard language used is still in English. In addition, the user interface that caters this game is only limited with desktop computers or laptops. Gesture-based interaction devices such as Wii, Kinect, X Box, and the Sifteo cubes are more exciting than conventional interaction devices like keyboard, mouse, and joystick. [13] Implementing a money math game that uses the local language of the player with these tangible user interfaces, such as the Sifteo cubes, there would be a bigger benefit in learning.

Pankow and Brotherson discussed ways in talking to children about money and the suggestions they included started with the early years of childhood, 4 to 8 years of age. One of their recommendation is to "discuss basic math concepts with young children and play games that include counting, addition and subtraction." The researchers recommend to start off by having the kids be familiar with the local currency and perform basic operations with them. The skills that are to be developed by the child, such as money value recognition, will be able to aid them to learn other things about money and can help them in the future.[14]

## 2.1 Salapiggy

Salapiggy is an educational money math game designed for primary schoolers. It uses real money images as game objects and aims to help students aged 6 to 8 years old to recognize each denomination of values of the currency, manipulate them, and do basic arithmetic operations with them. Salapiggy has two parts: the lecture or tutorial part and the game proper.



Figure 1. Salapiggy game and tutorial screen shots (Siftulator)

### 2.1.1 Tutorial Part

The tutorial part of the game starts with the introduction of the Filipino terms that usually refer to money. It also briefly explains the use of money, different shapes and sizes and the materials that it is composed of. Afterwards, each kind of the Philippine money is discussed in more detail. Given the target age group of the players of the game, the smallest amount of the money discussed is one peso and largest amount is fifty pesos. For each value, the person seen and the identifying color is introduced. Also, the tutorial also shows some items that the certain amount can buy.

### 2.1.2 Game Mechanics

In order to gain a score, the player should sum up the values shown in each cube, and then arrange it in ascending order. The player can:

- **Neighbor** the cubes to arrange it in ascending order
- **Shake** the cubes to change the money displayed
- **Press** the cubes to display a hint(the total amount of the coins)
- **Flip** all the cubes to go back to the menu

Whenever the player arranges the cube in correct ascending order, the score is incremented and displayed along with an image that says the player answered correctly. In the case that wrong answers are made, instead of telling the player that an incorrect sorting was done, the game prompts the player to try again.

## 3. DISCUSSION

The main objective of the test is to determine whether the children to play the game would be able to recognize the money images displayed on cubes, to be able to do basic computations, play the game, and attain a certain amount of points. It is evaluated in the following main criteria: Learnability, and User Satisfaction. Learnability is based on the ability to perform during an initial task, improve performance over the entire usage history, and eventually achieve a specific performance.[15,16] Satisfaction refers to the user's perceptions, feelings and opinions[15]

Each student is given a maximum of 30 minutes to play with the cubes and become familiarized with the gesture. They are observed, and guided if needed. The start of the game involves forming the word "salapi" that is divided into "sa", "la", "pi". Each syllable is displayed per cube.

The moment that they are able to form the word and neighbor the cubes would be the start of their familiarization and learning on how to operate the cubes. They would then go through the tutorial part of the game. Each instruction is displayed separately per cube. After this, they would go to the game instructions module. This is where the players are taught on how to play the game. Once the players are able to follow the instructions, score a point and use the hints in the game, it will be the mark of learnability.

Evaluation of the application follows after playing the game. Questions on the ease of use and following the game instructions were asked. The players were also asked to give their opinion on the game and rate it having 1 as the highest score and 5 as the lowest.

### 3.1 Game User Interface

The game objects used for recognizing money are scanned images of the real Philippine Currency. The characters and other game backgrounds were designed to look child-friendly and attractive so that the target users would be able to appreciate it more. There are also human characters drawn in cartoon that do the lectures and instruct the player on what to actions to execute. In order to cater localization of the game, the background music used is an instrumental version of the Philippine Folk Song entitled *Bahay Kubo* (Nipa Hut). It is a short mp3 file that is looped throughout the life cycle of the application.

In e-learning, as in classroom-based courses, "courses that accommodate the ...cultural preferences ... will offer the best – and fastest - learning outcomes"[17] To maximize the educational purpose of the game, the instructions and tutorials of Salapiggy is designed with the target players' native language, Filipino. Simple terms are used in order to suit the age group of the players.

### 3.2 Flexibility

The game is designed to cater software localization. That is, to adapt to the other countries' currency and local language. There is an advantage for countries whose currency breakdown is the same as that of the Philippines'. Just by customizing the tutorial language and currency images of the game sprites, Salapiggy could be utilized to one's local learning environment

### 3.3 Test Methodology

The testing involves a total of 10 students with ages ranging from 6 years old to 8 years old. They are composed of two 6 year olds, four 7 year olds, and also four 8 year old elementary students. All 10 students know how to read and do basic arithmetic operations. All of the students who went through the testing were first time Sifteo cube users. The individual software testing had three parts, first was the lecture or tutorial part, then the game demo or the game instructions, and lastly, the sorting game. Each player is timed from the moment they started the game until they reach 10 piggy points. After the player has finished playing, an interview was conducted to learn the insights of the students who played the game. After everyone has already played the game, we gave them a chance to play again.

### 3.4 Testing Observations



Figure 2. Children playing Salapiggy with the Sifteo cubes

The Sifteo cubes were new devices for the children, since it is their first time to use it, they have no idea on how to manipulate it at first. Also, due to the popularity and commonality of the touch screen devices, the users thought that the press feature is just soft touch. During the tutorial part, since all the instructions and lectures are in Filipino, they all read it out loudly and comfortably and were able to comprehend the text well. With the help of comments like "Tama!" (Correct), the player is clapping and smiling and is motivated to play more and score higher. After playing the game, the child becomes more confident of doing it the second time. Everyone is excited to have their second turn. During the group play, the players were observed to coordinate and help each other to achieve the correct answer.

### 3.5 Test Results

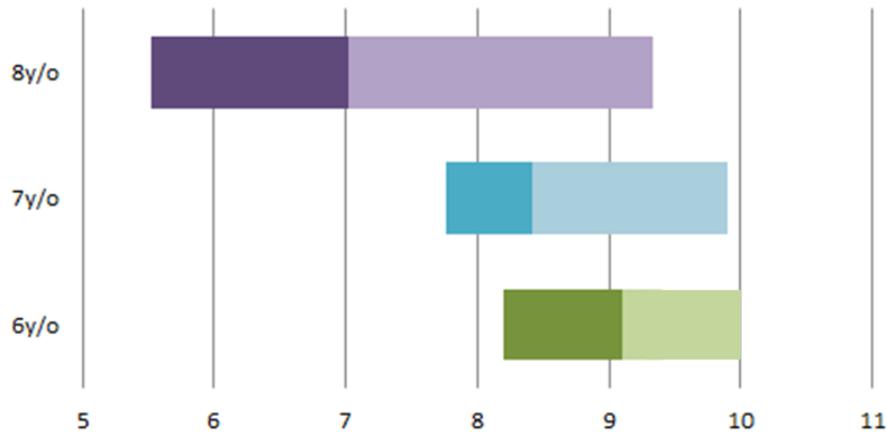


Figure 3. Gantt Chart. Represents the least, average, longest time of the players to reach 10 piggy points. The X-axis represents the time and the Y-axis represents the age of the players.

Each student was timed as they played the game. After consulting a statistics major, he suggested that given the same goal score they are to reach, their time can be graphed by using the Gantt chart where the left end of each bar shows the fastest time the player was able to attain 10 points while the right end of the bar shows the slowest time the player attains 10 points. The divider of the color shows the average time of the children per age. On the graph displayed, the x axis represents the time while the y axis is the age group of the players. The graph shows that the least time for the 6 year old test cases (green bar) to reach 10 points is 8.2 minutes and 10 minutes maximum. Their average time is 9.1. For the 7 year old test cases (blue bar), the least time is 7.45 minutes, maximum is 9.15 minutes, and yielding an average of 8.11 for the four players. For the their fastest time is 5.53, slowest time is 9.33, and average time of 7.025.

### 3.6 Challenges Faced

A week was spent for testing because there is only one set of sifteo cubes used and we have to test the players individually for 30 minutes, plus the interview, second time playing, and the group playing. Even though the players want to score more, we had to limit the goal to be achieved to only 10 piggy points due to time constraints.

## 4. CONCLUSION

The test results show good software learnability of the players using the money sorting game using the Sifteo cubes. Even though at first, the players were not familiar with the tangible user interface and its basic functionalities, with the help of the instructions from the game and also continued use, they were able to familiarize the usage and gestures of the Sifteo cubes and play the game. In a reasonable amount of time, they were able to reach the goal and gain 10 piggy points. Despite the limited number of testers, the test results suggest that the money images are recognizable through the LCD display of the Sifteo cubes. Also, the goal of having them perform arithmetic operations using the cubes was successfully attained.

## 5. RECOMMENDATIONS

The researchers recommend that the player performance improvement and effectivity of the game to the players be evaluated with the help of experts. Moreover, we recommend that game be implemented in other localized languages in different countries. From this, a potential new line of research topics related to the Software Localization of Children's educational games can be done using Salapiggy.

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