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Guessing Number: A Game-Based Mobile Application for Children Learning Numbers

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ABSTRACT

The brains of young kids grow in spurts known as crucial periods. The first happens at the age of two, and the second throughout puberty. Mathematics is one of the most important subjects to study and practice in daily life. Nonetheless, it must be admitted that learning numbers for young kids is difficult, particularly for today's generation. Since it is more interesting and effective than traditional learning, game-based mobile learning applications have recently been used as a learning tool for young kids. Therefore, this paper proposes a learning application for young kids to empower them in learning numbers named "Guessing Number". The objective of this project is to build an application that will help young kids to learn numbers and play games at the same time to stimulate their brains to remember numbers faster. The features focused on this application is to help them recognize numbers, remember numbers by playing games, and stimulate their brain to think fast. This mobile based application is developed using MIT App Inventor along with Canva to design the interface. The proposed educational application has been successfully built, tested, and uploaded into Google Play Store.

Keywords: Android application, children, game-based learning, learning number, guessing number

1 INTRODUCTION

In today's world, the usage of touch screen devices such as smartphones and tablets are developing rapidly. Indeed, smartphone and tablet computing applications are a modern cultural trend that will continue to rise significantly. Capacitive touch technology, which is a screen display device that relies on human finger touch for interaction, is one of the technologies employed in this device. Today's kids especially spend a lot of time in front of screens and use a variety of touch devices like smartphones and tablets. They are frequently exposed to technology since their parents typically allow them to use their smartphone and tablet [1]. There are several advantages for young kids (2 to 8 years old) that learn through touch, gesture, and movement, to use this technology. Instead of the typical desk and chair, smart device mobility and simplicity allow kids to learn in a variety of environments [2]. These capabilities provide kids the freedom to set the devices on their lap, on the

floor, or move it around their house. They can independently operate and interact with the display screen.

Playing is an important element of a kids' existence. Social and cultural engagement among kids while they play can enhance cognitive and personality development [3]. Many researchers have shown that using gamified mobile applications can benefit kids. Based on some studies from Huizenga et al. [4], the usage of mobile games in teaching and learning has a beneficial impact on student learning and motivation to learn. Students reported being more engaged in the game content and to know more about the content of the game upon enjoying the game than before. Incentive from parents to use mobile technology in their kids' education is one of the most remarkable ways to help them to be exposed to learning activities even just by being at home. Kids' focus can easily be shifted from studying to playing [5]. That is why certain mobile games have a terrible image in the eyes of some parents, but of course not all have a negative effect on kids. That is where the educational game takes place. Educational games are those that benefit in the learning of kids. It provides kids with additional education and understanding while they play the game. Kids may study and play while playing educational games [6].

Nowadays, according to the most recent trends in mathematical education research, learners especially kids find it challenging to gain a knowledge of mathematical concepts and construct practical reasoning and approaches to mathematical problems [7]. Kids typically find some subjects more difficult than others. For example, they perform poorly in mathematics [8]. Therefore, one of the solutions to solve the issue is to learn through games. Games are the most powerful motivators for learning and activity. As kids engage in digital gaming such as through mobile application, they learn more than just mathematics. Games may also be used to teach problem-solving, cooperation, and critical thinking skills. These are 21st-Century Skills or essential competency skills that are seen as critical in changing civilizations [9].

This paper proposes an Android application for kids to learn about numbers. The proposed application is aimed at engaging young kids in learning more about numbers and improving their counting abilities. Not only that, it is also to encourage creative thinking in young kids and assist them in brain cell development activities. This application will give a leap to the enhancement of mathematic subject with great cognitive and educational power. By adapting one of the Alexa's skill tutorials in MIT App Inventor [10] into a mobile application, the Guessing Number application is developed. Kids can use this application to learn more about numbers and stimulate their brains on fast thinking. MIT App Inventor is used along with Canva to complete this project. MIT App Inventor is an open source and online tool that provides intuitive mobile applications development and uses block programming [11].

2 RELATED WORKS ON EDUCATIONAL APPLICATION

This section includes a literature review related to educational application as shown in Table 1. It is not new to involve kids in games throughout the active learning process learning, since the use of games in teaching has grown in recent years. Creating an interesting and enjoyable atmosphere stimulates and encourages kids to learn. The game's enjoyable atmosphere captures the kids' attention and works as a stimulant for them to be active and desire to learn more in the approach of combining games in teaching. For an example, [12] created a Clinic Vitals application to be an acceptable substitute for in person vital signs instruction and their results showed that no significant

difference was found between the two groups (mobile application and in-person teaching) based on skills assessments. In addition, [7] proposed an augmented reality application called Mathify as an effective solution to overcome the fear in kids in learning the basic of math. Their results showed that Mathify is a well-designed learning application with equal elements of education and entertainment.

Table 1: Summary of research on educational application

Author	Research Title	Name of Application	Platform Available	Module
[12]	Using an educational mobile application to teach students to take vital signs	Clinic Vitals	Mobile Application	Instructional video & article
[7]	Augmented Reality Application for Basic Mathematics: Teaching and Assessing Kids' Learning Efficiency	Mathify	Mobile Application	Learning & Assessment
[6]	Empowering Elementary Schools on Learning Math: A Development of Gamified Educational Mobile Application for Grade 3 Students	Math's Going On	Website and Mobile Application (Android)	Practice, Quiz & Help
[13]	Kiddy Manner: A Game-Based Mobile Application for Children Learning Thai Social Etiquette	Kiddy Manner	Mobile Application (Android)	Account management, simulated situation, jigsaw, scoreboard, quiz, items management, daily reward & setting
[14]	User Experience Study on Folktales Mobile Application for Children's Education	Mfolktales	Mobile Application (Android)	Animation story & Game

Furthermore, [6] created Math's Going On, an educational gaming application designed to help elementary students, particularly third graders to understand math. They obtained an overall excellent rating and the students who used their game also got significant scores in Math. Likewise, [13] proposed an application to teach kids about Thai Social etiquette called Kiddy Manner. They evaluated their application based on children and parent's satisfaction. The average score of post-test is higher compared to the average score of pre-test for children evaluation while for parent evaluation, they obtained average satisfaction for six different aspects including content, UI design, functions, usability, practicality and benefits. Moreover, [14] presented research on the evaluation of user experience for the folktales mobile application called MFolktales. The aim of their application is to promote Malay folk stories to the children and they got positive impression in user perception and good product in relative quality.

Based on Table 1, most of the researchers focused on the benefits that kids will get by using the educational application. They also developed an effective mobile application by combining both learning and assessment module. The application built is great for parents to educate their children into becoming a better person and lead up to a generation that will help the country development

[15]. The application is mostly available on Android for mobile application. Therefore, this paper proposes a game-based Android application for children to learn numbers called Guessing Number. This application combines both module for learning and interactive games on number.

3 MATERIAL AND METHODS

This section consists of information related to the methodology for this research which are hardware and software requirements, development of the application, testing of the application along with upload the application into Google Play Store.

3.1 Hardware and Software Requirements

It is necessary to employ particular hardware and software to develop an Android application for the Guessing Number. This project used a laptop computer with the specification as shown in Table 2. In term of software, MIT App Inventor was used to create the Android application. It is a simple, visual programming program that enables anybody to create a highly optimized application for Android phones, iPhones, and Android/IOS tablets [11]. It is user-friendly software with a graphical user interface (GUI) that allows users to simply drag and drop the specified components. Moreover, Canva is also widely used in this project for the development of the application such as create image for text label and icons. Canva is a creative design tool that can be used in many fields including education to help students create great projects and learn the basics of digital design [16].

Table 2: Specification of hardware

Operating System	**Processor**	**RAM**
Windows 11	Intel(R) Core(TM) i5-10300H CPU @ 2.50GHz 2.50 GHz	8.00 GB (7.81 GB usable)

3.2 Development of the Application

3.2.1 Architecture

Figure 1 shows the summary of the architecture of the Guessing Number application. The application has eight visible components and six non-visible components. It uses fourteen variables to save the specific data related to the application. It also applied six for both event handlers and procedures.

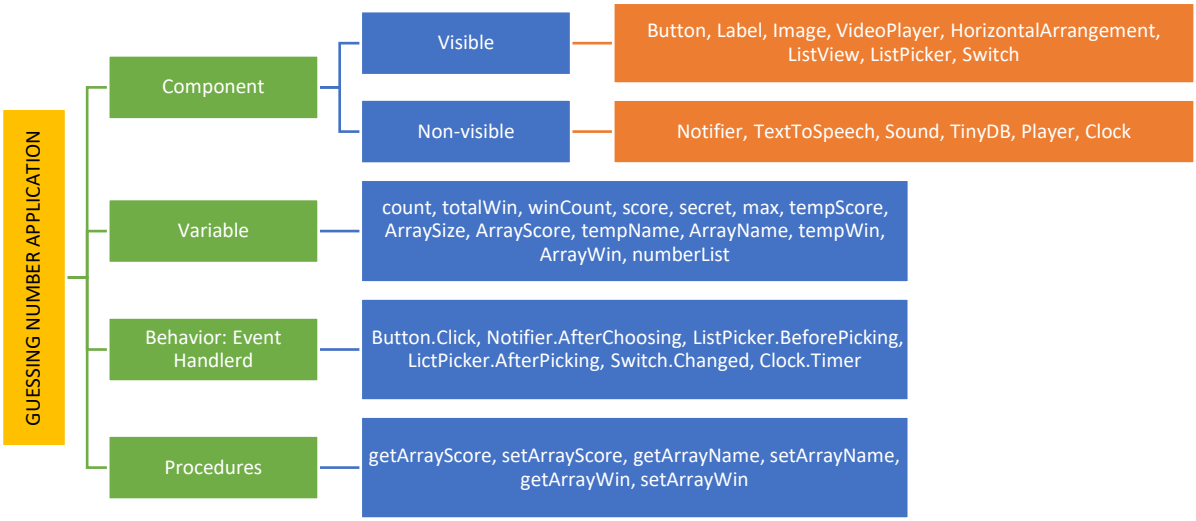


Figure 1 : Architecture of Guessing Number application

3.2.2 Interface Design

The interface design for this application uses designer tab or menu in MIT App Inventor. The design of the application is based on portrait view and it only specific to the Android phone, not the tablet and monitor. In general, the application consists of four main modules which are learning, game, manage player and scoreboard. There are ten screens in total for the application which are splash screen, main menu, learn number, games menu, four screen for games, manage player, and finally for the scoreboard as shown in Figure 2.

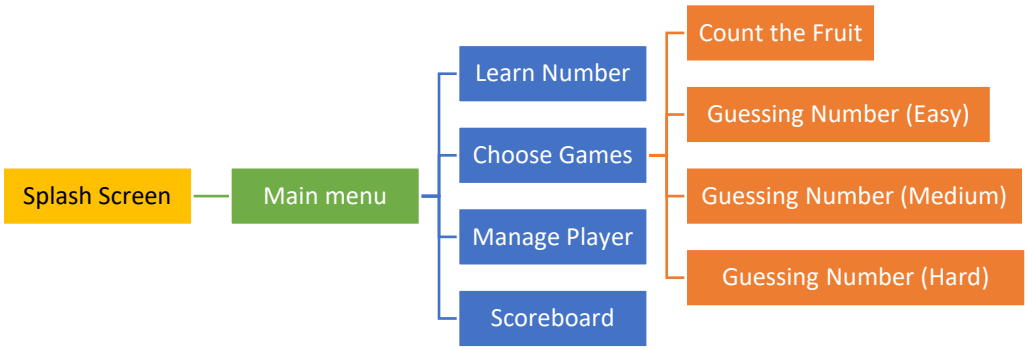
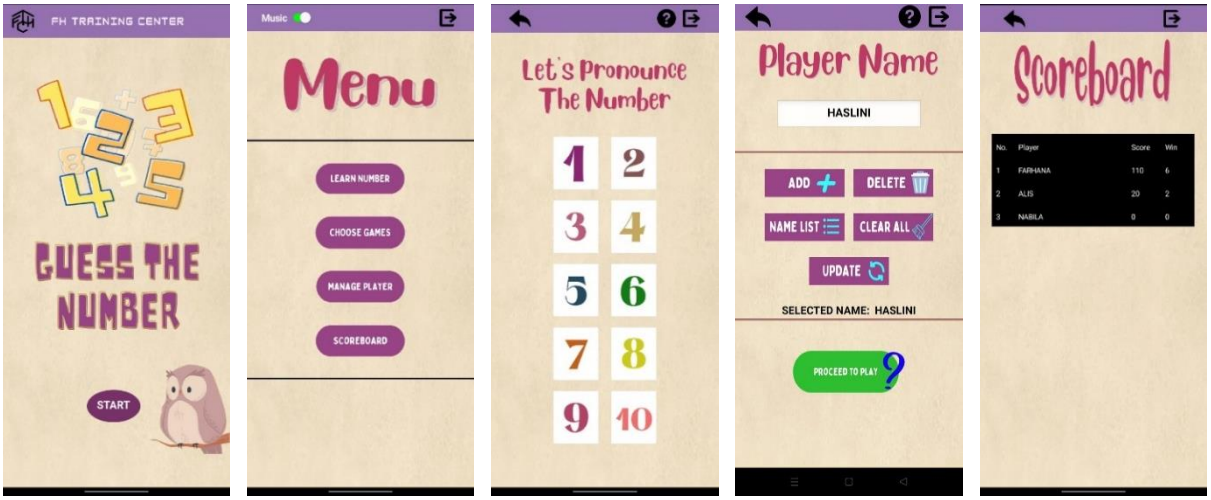


Figure 2: Flowchart of application

The first screen that users will see as soon as they open up the application is the splash screen (Figure 3a), where it has a start button. When users click on the start button, it will bring them to the main menu (Figure 3b). The main menu screen has four different buttons to go to learn numbers (Figure 3c), games menu, manage players (Figure 3d), and scoreboard screen (Figure 3e). The purpose of Learn Number screen is to help users, kids especially to learn how to pronounce each number. The pronunciation of each number will be heard every time users click on the numbers. For example, a voice will pronounce the number 6 if users click on the button for number 6. On the other hand, the

purpose of Manage Player screen is to manage player or user information such as display all list of players, add new player, delete and update selected player as well as clear all of the players' names on the game. In addition, the purpose of the Scoreboard screen is to display the ranking of all the players based on their scores. Section 4 will explain in detail about game module.



(a) Splash screen (b) Main Menu (c) Learn Number (d) Manage Player (e) Scoreboard

Figure 3: Example of interface design

3.2.3 Program Algorithm

This section explains some algorithms used in the application. For the guessing number games, users need to choose a player name before starting the game and their latest score and total win will be automatically displayed as illustrated in Figure 4. A random number that will be generated is limited to only a certain number depending on the level of the games. For an example for Easy level, a random number is generated between 1 to 10.

```
If PlayerName is empty
        Display message "Choose a player first!"
Else
        Display total score for the selected player
        Display total win for the selected player
EndIf
Set RandomNumber to generate random integer from 1 to 10
Set guess count to 1
```

Figure 4: Algorithm to display player information and generate a random number (Easy level)

The number entered by users will be checked whether it is within the range of the number set for the level as depicted in Figure 5. If the guessed number is too big then a voice and a text will be displayed to tell users, the information. Similarly, if the guessed number is too small. However, if guessed number entered by user is correct, a text would appear, and a sound will be played to inform them

that the answer is correct. A calculation for total score and total win for the selected player will be conducted and automatically saved into a storage called TinyDB in MIT App Inventor. Every update of the latest score and total win will also be displayed on the screen to inform the users.

```
If guessed number is between 1 to 10
        If guess count less than 4
                If Guessed number is greater than Random number
                        Display message  and phone say "Your guess is too big"
                        If guess count equal to 3
                        Display message “Refresh the number”
                                Notifier print “You failed to guess the number within 3 attempts!”
                        EndIf
                ElseIf Guessed number is greater than Random number
                        Display message and phone say "Your guess is too small"
                        If guess count equal to 3
                        Display message “Refresh the number”
                                Notifier print “You failed to guess the number within 3 attempts!”
                        EndIf
                ElseIf Guessed number is equal to Random number
                        Display message and phone say "Your guess is correct!"
                        Calculate and Save latest total score by adding current total score plus 10
                        Calculate and Save latest total win by adding current total win plus 1
                EndIf
        EndIf
        Display latest total score and total win for the selected player
Else
        Display message “Please enter a number from 1 to 10”
EndIf
```

Figure 5: Algorithm to check the guessed number and update current player information (Easy level)

3.3 Live Testing and Application Testing

To evaluate the developed application, two methods have been applied which are Live Testing and Application Testing. There are three types of live testing in MIT App Inventor which are using AI Companion, USB and emulator. In this project, AI Companion is selected because it is the easiest way for live testing. By using AI Companion method, it requires both the computer or laptop and the Android device (phone or tablet) to be connected to the same Wi-Fi network. During the Live Testing, there are a few restrictions that may cause the application to malfunction. For example, the application's exit or close function cannot be evaluated during Live Testing. As a result, it is essential to do Application Testing where an Android application file (.apk) must be created. Many criteria were considered for both types of testing such as functionality and user interface design. Four persons have involved during the testing process.

3.4 Upload Application into Google Play Store

The Guessing Number application has been successfully built and uploaded into Google Play Store. It can be accessed and downloaded into Android phones and tablets by searching “FHTC Guessing

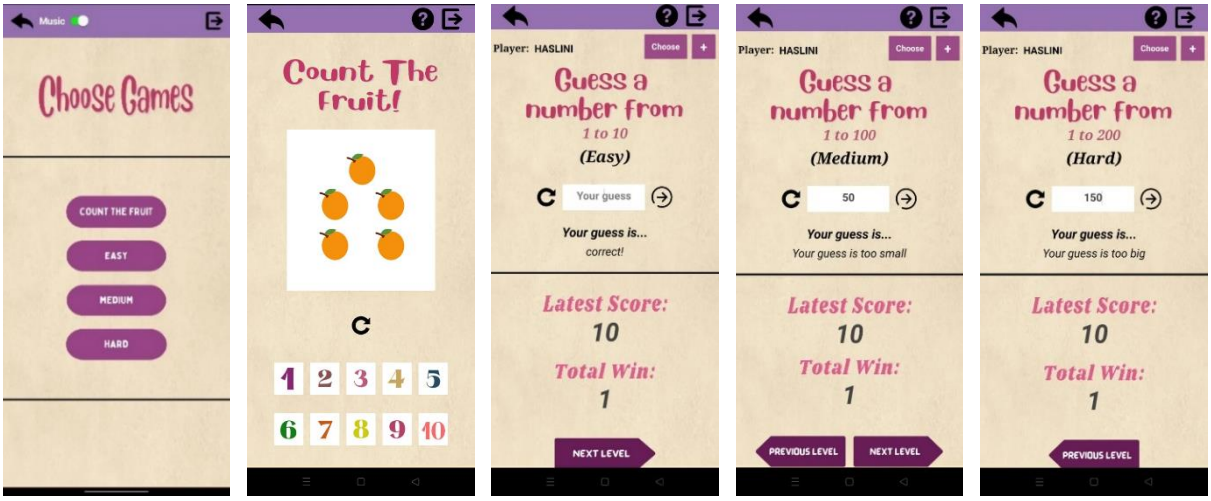
Number" directly from Google Play Store or using the URL below: https://play.google.com/store/apps/details?id=appinventor.ai_fhtrainingctr.FHTC_GuessingNumber [17].

4 RESULTS AND DISCUSSION

This section discusses the outcome of the developed Guessing Number application together with testing result.

4.1 Result for Game Module

The games menu as shown in Figure 6a consists of four buttons that will lead users to count the fruit and guessing number games. The guessing number games are divided into three different levels start from easy, medium, and lastly, hard. As users click on the count the fruit button, a screen-like Figure 6b will be displayed. They have to click on the refresh button to start the game which will display a random picture and calculate the total of fruits shown in the picture. The answer can be submitted by clicking on the number buttons. The result will display correct or wrong answer.



(a) Games menu (b) Count the Fruit (c) Guessing Number by level (easy, medium & hard)

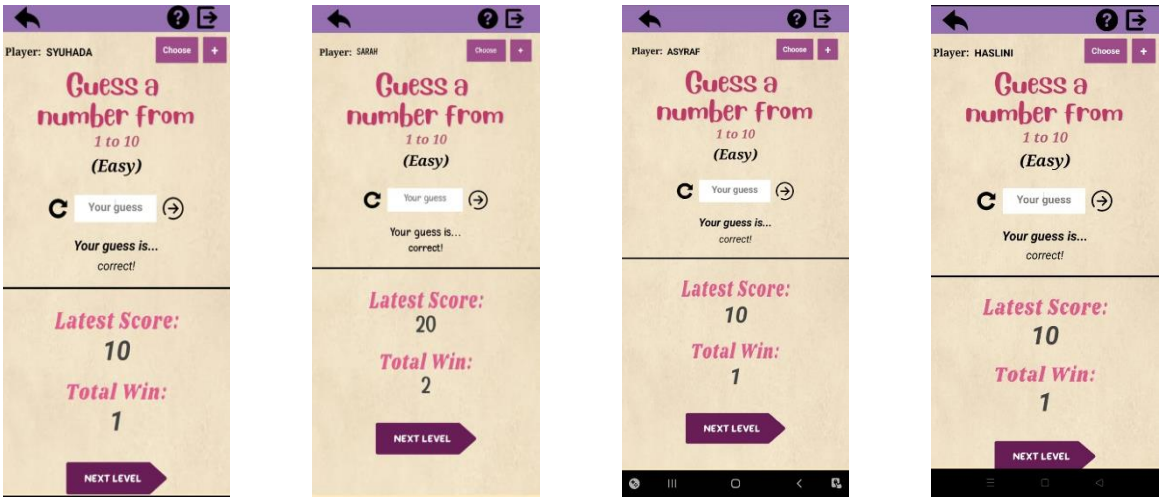
Figure 6: Interface for Game Module

Furthermore, the easy, medium, and hard level buttons that are shown in the games menu will lead users to the guessing number games as depicted in Figure 6c. Users must select a player name before they can begin playing guessing number game. Each of these levels will have its own difficulty. The first level is the easiest level where they only need to guess a number from 1 to 10 and the second level is the medium level, the range of the number expanded to 100. On top of that, the largest range of the game where users have to guess the number from 1 to 200 is the hardest level of all guessing number game that is available in the application. The score that will be rewarded for every correct

answer for easy, medium, and hard levels are 10, 20, and 30 correspondingly. Every correct answer will be saved into a storage.

4.2 Result for Live Testing & Application Testing

Based on testing as mentioned in section 3.3, it was found that the display of application interface is slightly different on various tested phone models. It may be due to different phone size and display settings on the phone. To overcome the issue, setting for responsive user interface has been applied in the development. Figure 7 shows the example of display for screen game guessing number (easy) played on various phone models. In terms of functionality, all the functions available on the application worked well for all tested phones.



(a) Infinix note 30 pro (b) Redmi note 10 5g (c) Samsung Galaxy A71 (d) Realme 6

Figure 7: Display of application interface based on various phone models

5 CONCLUSION

This project has successfully developed an interactive Android application for learning number and guessing number games that is suitable for various types of users, kids especially to encourage creative thinking in young kids and assist them in brain cell development activities. The main features of the developed application are:

a) Can learn number & how to pronounce the numbers

b) Can play the count fruit game and the guessing number game in different levels which are easy, medium and hard

c) Support multiple players in a single application.

d) Provide an informative scoreboard to see the ranking of the players.

This application is now only can be played offline which limits the enjoyment if users want to play the games with their online friends. However, some enhancements for this application are being taken into consideration to make it available online which is also part of the strategy to broaden its reach. Other than that, the researchers are also on a plan to make some new functions for both young and older kids (6-12 years old) such as mathematical operator where users can make easy mathematical operations.

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REFERENCES

[1] L. F. M. Ibharim, N. Borhan, and M. H. M. Yatim, "A field study of understanding child's knowledge, skills and interaction towards capacitive touch technology (iPad)," 2013 8th Int. Conf. Inf. Technol. Asia - Smart Devices Trend Technol. Futur. Lifestyle, Proc. CITA 2013, pp. 6–10, 2013, doi: 10.1109/CITA.2013.6637571.

[2] K. Ellingson, "Interactive Technology Use in Early Childhood Programs to Enhance Literacy Development & Early Literacy Development for Children with Cochlear Implants," p. 3, 2016.

[3] T. Yang, Q. Mok, I. K. W. Lai, K. K. Ng, and L. Luk, "Research on the Satisfaction of Kid's English Education Application Based on Importance-Performance Analysis (IPA)," Proc. - 2020 Int. Symp. Educ. Technol. ISET 2020, pp. 206–209, 2020, doi: 10.1109/ISET49818.2020.00052.

[4] J. Huizenga, W. Admiraal, and J. Voogt, "Computers in Human Behavior Mobile game-based learning in secondary education : Students ' immersion , game activities , team performance and learning outcomes," Comput. Human Behav., vol. 99, no. November 2018, pp. 137–143, 2019, doi: 10.1016/j.chb.2019.05.020.

[5] S. Papadakis and M. Kalogiannakis, "Mobile educational applications for children. What educators and parents need to know.," Int. J. Mob. Learn. Organ., vol. 11, no. 2, p. 1, 2017, doi: 10.1504/ijmlo.2017.10003925.

[6] E. R. Yabut, M. N. Jamis, R. E. Manuel, and B. S. Fabito, "Empowering Elementary Schools on

Learning Math : A Development of Gamified Educational Mobile Application for Grade 3 Students," 2019, doi: 10.1109/HNICEM48295.2019.9073428.

[7] Manisha and A. Mantri, "An augmented reality application for basic mathematics: Teaching and assessing kids' learning efficiency," Proc. - 2019 5th Int. Conf. Comput. Commun. Control Autom. ICCUBEA 2019, pp. 21–24, 2019, doi: 10.1109/ICCUBEA47591.2019.9129083.

[8] E. S. Chukwuemeka, "Why Students Hate Maths: 14 Reasons," BSCHOLARLY, 2022. https://bscholarly.com/why-students-hate-maths/ (accessed Feb. 01, 2023).

[9] K. J. M. Kiili, K. Devlin, and J. Multisilta, "Editorial: is Game-Based Math Learning Finally Coming of Age?," Int. J. Serious Games, vol. 2, no. 4, pp. 3–6, 2015, doi: 10.17083/ijsg.v2i4.109.

[10] "Alexa Number Guessing Game," MIT App Inventor. https://appinventor.mit.edu/explore/resources/ai/alexa-number-guessing-game (accessed Nov. 01, 2022).

[11] "About Us," MIT App Inventor. https://appinventor.mit.edu/about-us (accessed Nov. 01, 2022).

[12] L. Hester, B. Reed, W. Bohannan, M. Box, M. Wells, and B. O'Neal, "Using an educational mobile application to teach students to take vital signs," Nurse Educ. Today, vol. 107, no. March, p. 105154, 2021, doi: 10.1016/j.nedt.2021.105154.

[13] S. Tangsripairoj, M. Sukkhet, J. Sumanotham, and B. Yusuk, "Kiddy Manner: A Game-Based Mobile Application for Children Learning Thai Social Etiquette," JCSSE 2019 - 16th Int. Jt. Conf. Comput. Sci. Softw. Eng. Knowl. Evol. Towar. Singul. Man-Machine Intell., pp. 109–114, 2019, doi: 10.1109/JCSSE.2019.8864177.

[14] N. Ibrahim, W. Fatimah, W. Ahmad, and A. Shafie, "User Experience Study on Folktales Mobile Application for Children's Education," Proc. - NGMAST 2015 9th Int. Conf. Next Gener. Mob. Appl. Serv. Technol., pp. 353–358, 2016, doi: 10.1109/NGMAST.2015.73.

[15] K. Miyamoto, "What are the social benefits of education?," Education Indicators in Focus, vol. 01. pp. 1–4, 2013.

[16] L. Edwards, "What Is Canva And How Does It Work? Tips & Tricks," Tech & Learning, 2022. https://www.techlearning.com/how-to/what-is-canva-and-how-does-it-work-for-education (accessed Feb. 01, 2023).

[17] "FHTC Guessing Number." https://play.google.com/store/apps/details?id=appinventor.ai_fhtrainingctr.FHTC_Guessing Number (accessed Aug. 11, 2023).

APPENDIX A : CODING TO CHECK THE GUESSED NUMBER