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Learning Number Game with Interactive Projection For Students of Sepuluh Nopember Surabaya Kindergarten

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ABSTRAK

4 Based on the 2017 survey by the Indonesian Internet Service Providers Association (APJII), a total of 143.26 million Indonesians have used the internet. This situation was exacerbated by the online learning process during the pandemic, which forced children to be exposed to digital devices more than they should, for more than 2 hours a day. However, digital devices can influence children's behavior. It is proven that 66 out of 100 children suffer from high levels of digital addiction. One of the reasons for the negative impact of digital devices on children is their one-way communication nature. This means that instructions come only from the device, while children absorb them without meaningful responses. In response to this issue, the service provider has created an interactive two-way game as an alternative form of entertainment for children. The game called "Numberpedia" is played using a projector aimed at a surface, allowing children to interact by touching the projected images. This Numberpedia game device was then donated and played at TK 10 Nopember in Surabaya as part of a community service project. The response from the children after playing the Numberpedia game showed that it has clear and engaging audiovisual elements and it sparked enthusiasm among the children to play it.



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1. INTRODUCTION

Technology has been widely used in various aspects of life today. For instance, mobile phones are a simple example of how technology has been utilized. However, technology is just a tool that can have a positive impact if used properly and a negative impact if not used properly. During the pandemic, various problems have arisen and influenced each other, including economic problems and the problem of gadget exposure for children.

3 According to the 2017 survey by the Indonesian Internet Service Providers Association (APJII), 143.26 million people or 54.68 percent of the Indonesian population use the internet. The age group with the highest internet usage is 13-18 years old (75.5%). Devices are the most widely used tools to access the internet, which is as much as 44.16% [1]. In a study conducted by Dwi Wulandari and Dilfera Hermiati, it showed that out of 100 children, 66 of them experienced high-level device addiction [2].

The situation was worsened by the Covid-19 pandemic that forced the teaching and learning process to be done online [3]. As a result, the exposure of devices to children, which ideally should be less than 2 hours per day, had to increase to more than 2 hours per day [3]. Whereas it has been proven that device exposure can

affect children's behavior [4]. Some efforts have been made by various parties to overcome this problem, for example by facilitating internet access in public facilities in villages for children's online learning needs [5], the use of e-learning [6], creating study group for children, and others.

Several innovations have been made in the field of learning, such as the Gempytha Game Software as an innovation in Mathematics learning media [7], the Android-Based Mathematical Education Game "GESIT" [8]. These various game software were made to help learning during a pandemic, because it is proven that students and teachers have positive perceptions [9]. However, the interaction in the game does not involve the player's motor movements. This could actually have an impact in the form of gadget addiction.

One of the reasons for the negative impact of electronic devices on children is their one-way communication and lack of interaction. This results in the child's skills being underdeveloped and slow. To address this issue, the author initiated the creation of an Interactive Projection Number Game called Numberpedia. Numberpedia is played with a projector aimed at a surface, allowing the child to interact by touching the numbers with their hands. It is hoped that Numberpedia will provide an alternative game with good interaction for children, thereby reducing the negative impact of electronic devices.

As a form of concern for the community, and to see the response of children to the game Numberpedia, a community service activity was carried out together with the students of 10 Nopember Surabaya Kindergarten, some of whom are gadget addicts. The result was that the participants played the game with great enthusiasm and joy.

The selection of digital game media Numberpedia for this service activity was carried out considering its good effectiveness. The method of counseling using interactive videos accompanied by demonstrations has been proven to increase knowledge and change behavior [10]. In addition, the use of interactive media has also been proven successful in community service activities such as dental health counseling using interactive video media [11]. Other servants have also used game media as a means of educating children about climate change [12].

2. METHOD

Introduction of the player's hand in the game Numberpedia is done using Python. The player's hand image is captured by the camera, then the pattern or shape of the hand and its movement are detected. This hand movement is used as a controller in the game. There are many alternative methods for hand recognition, for example, using the Color Sorting method [13], Naive Bayes method [14], Deep Learning method [15] and other method.

In this community service activity, the game used is Numberpedia that has been developed. The Numberpedia game is then directly implemented to the target users, they are students of 10 Nopember Surabaya Kindergarten. Their responses then observed to see the level of acceptance of this Numberpedia game.

As shown in Figure 1, the process of conducting this community service activity begins with the planning phase, followed by project implementation, and finally the execution of the community service.

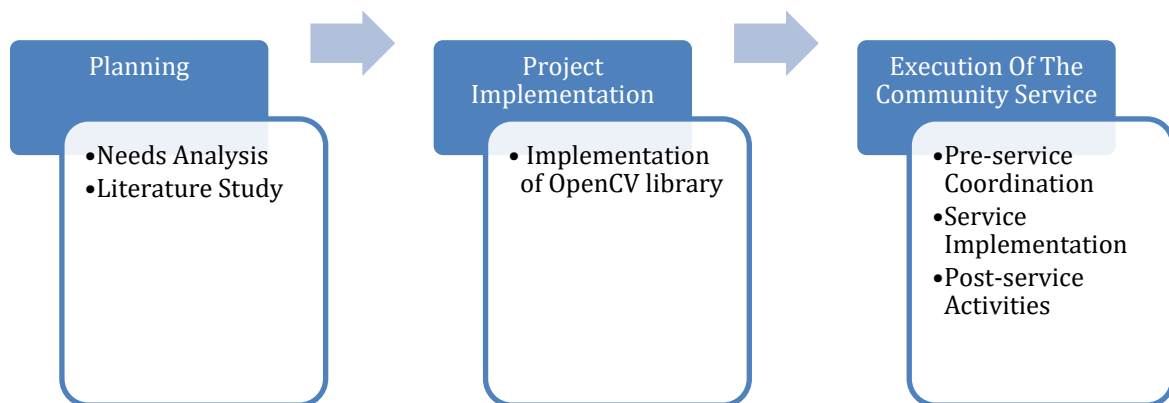


Figure 1. The process of conducting community service

The service provider starts this community service activity by carrying out planning, which consists of analyzing needs and conducting a literature study. This is done because interactive projection projects are still relatively new and few people are doing them. The needs analysis stage is carried out to clarify ideas, user

targets, target platforms, and other games that are used as references.

The main idea of the Numberpedia Game is to create an educational game for children with a two-way interaction approach, providing an alternative game for children with low negative impact. The interaction in Numberpedia is designed using interactive projection methods, displaying images using a projector that is aimed at a screen or wall, while players interact using their hands, which are detected through a camera. This will enable two-way interaction in the Numberpedia Game.

The target users of Numberpedia are kindergarten-aged children who are in the process of learning numbers. In this community service activity, the Numberpedia game is played by students of 10 Nopember Surabaya Kindergarten. Meanwhile, the target platform for Numberpedia is Windows.

Some game references for creating Numberpedia include Main Bersama Rupi: Mengenal Angka, Pinkfong Numbers Zoo, and Endless 123. Main Bersama Rupi: Mengenal Angka game has three modes of play. The first mode is learning numbers by giving players an audio-visual display of the numbers. The second mode presents players with two numbers with one audio, then the player chooses which number corresponds to the audio explanation. The third mode challenges players to match the visuals of several number cards.

Pinkfong Numbers Zoo game introduces numbers in a fairly large range, namely from number 1 to 100. However, those numbers are broken down by level, for example, level 1 introduces only numbers 1 to 5. While the next level introduces larger numbers.

The Endless 123 game uses video games to introduce, match, and teach addition of numbers. However, this game appears to highlight more on the visual and attractive animations.

After completing the needs analysis and obtaining game references, the development of this Numberpedia game was carried out. One thing that distinguishes Numberpedia from the other games is the interaction device used. Other games are generally based on mobile devices with touch screens as the interaction device, but Numberpedia uses hand gestures as the interaction device. These hand gestures are used to enhance two-way interaction during gameplay. The hand gesture interaction device in the Numberpedia game is created by implementing the OpenCV library.

After the Numberpedia game was completed, the next phase is the community service implementation activity. The chosen community service partner is 10 Nopember Surabaya Kindergarten. The activity begins with a survey as well as coordination related to the community service activities with the partner. Next is the implementation of the community service, followed by post-service activities. Post-service activities include the handover of game device grants and the creation of a memorandum of understanding between the service provider and the partner.

3. RESULTS AND DISCUSSION

Numberpedia has two main menus, namely learning and playing. The Learning menu will display numerical learning for users, introducing numbers from 0 to 10, divided into four stages as shown in [Figure 2](#).



Figure 2. The process of community service implementation

The introduction of numbers on the Learning menu consists of three ways. Firstly, the user is presented with a display in the form of a number, then asked to follow the writing flow of the number according to the given instructions ([Figure 3](#)). The second way is that the user will be given a visual of the number, as well as characters in the amount corresponding to the number. Users will be asked to count the number of characters by touching them (directing their fingers to the characters) one by one as shown in [Figure 4](#). The third way is to match characters with numbers. Users will be presented with a number, as well as a number of characters that contain the number. Users will be asked to match the number with the corresponding character as shown in [Figure 5](#). In the field implementation, the number recognition menu is not often conducted due to time constraints and the number of participants.



Figure 3. The first learning method, following the flow of writing numbers

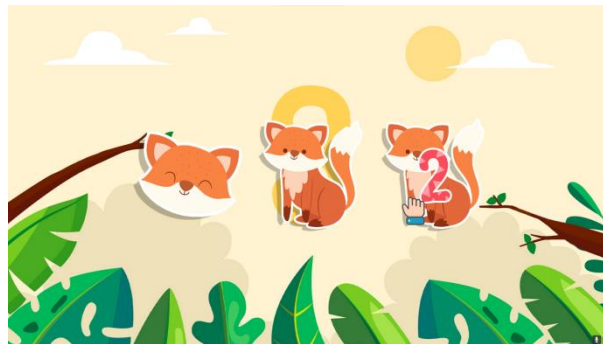


Figure 4. The second learning method, counting the number of characters

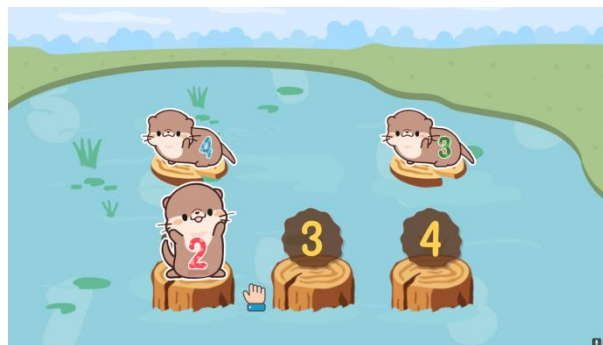


Figure 5. The third learning method, matching characters with numbers

The second menu is the Play Menu. In this Play Menu, users will be presented with bubbles containing numbers that continuously move randomly. Users are then asked to choose a number according to what is mentioned in the game. If the selected number is correct, the number bubble will burst and continue to search for the next number. The appearance of the Play Menu is as shown in [Figure 6](#).



Figure 6. Play menu interfaces

At the beginning of the community service activities, the game was played together by several children. This was done because the Numberpedia game was created to be playable by more than one person, thus increasing the togetherness of the players. However, some of the younger players did not yet understand and were unwilling to obey the rules of the game, resulting in them blocking each other during gameplay, as shown in [Figure 7](#).



Figure 7. Children play Numberpedia together, but they cover each other

The issue of children covering each other while playing Numberpedia in groups led the service provider to decide that Numberpedia should be played one child at a time, taking turns. This decision was made considering that the children were quite enthusiastic and patiently waiting for their turn.



Figure 8. One child plays the Numberpedia game

To observe the children's response as players, the service provider then distributed a simple questionnaire to them after playing the Numberpedia game. The questionnaire consisted of six simple questions for the audience with yes or no answers. The results of the questionnaire were then summarized in [Table 1](#) below.

Table 1. Questionnaire Questions and Answers

No	Question	Answer (Number of Respondents)	
		Yes	No
1	Is the game easy to play?	45 Children	5 Children
2	Can all images displayed by the game be seen clearly?	50 Children	0 Children
3	Can all audio in the game be heard clearly?	47 Children	3 Children
4	Can all text in the game be read clearly?	50 Children	0 Children
5	Do you like the game?	48 Children	2 Children
6	Are you interested in playing a game that uses similar technology?	50 Children	0 Children

Based on the questionnaire data given to the players, it is evident that the majority gave positive responses to the Numberpedia game. Thus, according to the questionnaire provided, it can be said that the Numberpedia game has clear images, clear audible audio, clear visible text/fonts, and can generate interest among children.

4. CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis and discussion in the previous section of this article, several conclusions can be drawn. First, the community service participants, namely the students of 10 Nopember Surabaya Kindergarten, were enthusiastic about playing the Numberpedia game. The Numberpedia game can be played easily, with clear images, audio, and text, and the majority of players liked the Numberpedia game.

The suggestion for next community service activities related to Game Numberpedia is to collaborate with more schools so that more children can try this game, and the impact can be observed.

As for suggestions for the future development of the Numberpedia game, there are two main aspects: improving system stability and system development. The first improvement in system stability is related to the highly sensitive lighting for the hand recognition process. One possible method to address this issue could be improving the detected hand image quality [16] before proceeding with the recognition process. The second system improvement can be achieved by measuring the functionality level of the Numberpedia game to ensure it works well. One of the system testing methods that can be used is black box testing [17] [18], which has proven to be effective in testing a system. Lastly, it is recommended to evaluate the user interface of the Numberpedia game. User interface testing for games is commonly conducted and aims to improve the system, as has been done with other games [19].

The next development suggestion could be to implement IoT to control the camera for better user hand detection. Based on previous research, the implementation of IoT on cameras has been proven to be feasible [20], and can even be controlled through specific applications such as Telegram [21] and ThingSpeak [22]. If IoT is utilized, it is important to maintain the quality of the internet connection, which is one of the essential components of IoT. This can be done by analyzing the connectivity [23] for the appropriate network type to use or by automatically adjusting network settings [24].

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