Waste Sorting and Processing Education for Children through Game Applications that Use Loud Sound Levels

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Abstract— Garbage is one of the big problems in society.lack of awareness of throwing garbage in its place worsen the situation. Waste processing has also become more difficult because waste is not sorted. lack of knowledge of sorting waste does not make matters better. To deal with this problem, the government launched a bank sampah program to reduce waste problems. But garbage banks don't accept all types of waste. The waste bank only accepts waste that can be recycled. Therefore a game was created to teach sorting garbage and not to litter. It was made with a sound sensor to give a unique impression in the game. The game development is designed with a reward and punishment system to tell players if they do the right thing. After the game is finished, tests are conducted on several elementary school children and the results are that EE, PE, and HM have an influence on the BI variable.

Keywords— Trash, Games, Sound Sensor,litter, garbage sorting

I. INTRODUCTION

The Ministry of Life and Forestry noted that the amount of waste produced a day reaches 175,000 tons per day if one person produces 0.7 kg of waste per day[1]. data from the American Association for the Advancement of Science (AAAS). In 2015, Indonesia was listed as one of the 10 largest countries in terms of pollution of plastic waste into the sea, which ranked second at 1.2 tons in a year after China, which dumped 3.5 million tons of plastic waste a year.[2]. According to Taj Yasin, the construction of the TPA and the TPA development plan are still considered ineffective. Because what really matters is the culture of sorting waste starting from the household sector.[3]. It is not only waste sorting that must be considered, but disposing of the waste in its proper place must also be considered. Sorting waste that is not disposed of or given to a place where it should be will still make garbage pile up if not disposed of in its place. It can be seen that in 2019 the city of Jakarta got money from a fine of littering Rp. 19,000,000 out of 210 offenders and from the previous year amounting to Rp. 128,000,000 from 649 offenders.[4]. in addressing this problem the government has launched a bank sampah program. This program aims to reduce waste and improve waste management [5]This program produces quite good results in reducing waste. The potential of waste banks in Yogyakarta has the potential to reduce waste by up to 97%.[6]Bank sampah has proven to be helpful in handling waste. Bank sampah is not a bank that accepts all types of waste. Bank sampah accepts certain waste that has been sorted in advance. With this program ,knowledge is needed to sort waste. [7]. Garbage is part of goods that are not used, items that must be thrown away, or unwanted goods that usually come from human activities, but are not waste that comes from humans and are usually solid .[8]. According to law number 18 of 2008 Garbage is a solid residue of human daily activities and / or natural processes.[9]. Kodoatie defining trash is a waste byproduct of the activities or life cycle of living things, whether humans, animals, and plants that are solid or semi-solid.

Broadly speaking, waste can be divided into 2 parts, namely:

1. Organic trash

This garbage is usually called wet garbage, this garbage usually comes from living things. Organic trash is garbage that does not last long and usually decomposes quickly. Because this waste is easily broken down, this waste can be processed into compost which can be used as fertilizer for other plants. Examples of organic waste are vegetable remains, fruit remains (inedible parts of fruit), leaves and so on

2. Inorganic trash

Garbage which can also be called dry waste is rubbish that cannot decompose naturally or rot. Not being biodegradable or decomposing naturally doesn't mean we can't use this trash. We can make these waste into handicrafts or can be recycled using special tools This garbage can pollute the environment if it is disposed of carelessly. Examples of inorganic trash are waste containing materials that are difficult to decompose such as glass, metal, plastic, rubber, cans, and so on.[10].

According to the Regulation of the Minister of Communication and Information Technology Number 11 of 2016 games are also referred to as Electronic Interactive Games. Electronic interactive games are activities that take the form of play and have goals (objective) and rules that must be followed and are based on electronics in the form of software or in the form of applications used in electronic devices.[11]Education can also be called an effort to guide children to do the tasks that must be done, so that they can be independent and responsible morally. Education. Education is an effort to achieve self-determination and responsibility.[12] Educational games can be interpreted as changing people's attitudes and behavior in an effort to mature humans in a more entertaining and creative way by using interactive multimedia technology[13].

The game was made with unity. Unity is a real-time 3D platform that allows designers, artists and developers to work as a team to work on a project. [14] Unity can be used to create animation games and simulation tools in 2-dimensional, 3-dimensional, Virtual Reality, Augmented reality, or other forms. [15]. Program made by C# language with Visual studio .NET, a Microsoft integrated development program. [16] Can be used to manage the Console, a GUI (Graphical User Interface) design tool, Windows forms. Web services and web applications. These applications can be used for free or can pay a certain amount of money for features that can be used by Premium Users. [17].

II. METHOD

2.1 Primary Data Source

This primary data source is obtained through data obtained from a questionnaire which will be distributed to several people.

2.2 Secondary Data Source

Secondary Data Sources are obtained through several journal books, and several articles related to this game

2.3 Method of Collecting data

1. Literature study

The technique of collecting data is by searching for sources of written information obtained in person or online.

2. Questionnaire

Data collection techniques by providing several statements to respondents who have tried the provided application.

2.4 Game Development Method

First game development is done by making a game design and then giving the design to the lecturer. The design is given for approval by the lecturer.

After the game design given to the lecturer is approved then it will start creating the required assets first such as image objects and code. Pictures are taken from several websites and some are self-made. After the image is completed, an animation will be made from some of the images provided, such as animation when walking, picking up trash, and so on. After the animation and image have been completed, code is generated to regulate movement and rules in the game. After the game finished then the game was tested. This has to be done to find the bug in the game

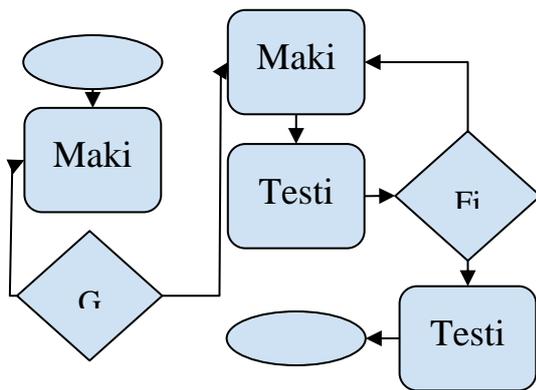figure 1 illustrates the game development design

Figure 1 Game development design

2.5 Testing Method

There were 3 type of testing performed namely validity,reliability and correlation test. By using these 3 types of test, it can be ascertained that the data to be generated from the questionnaire is valid and can be accounted for. Connection between variables can be seen in figure 2 below.
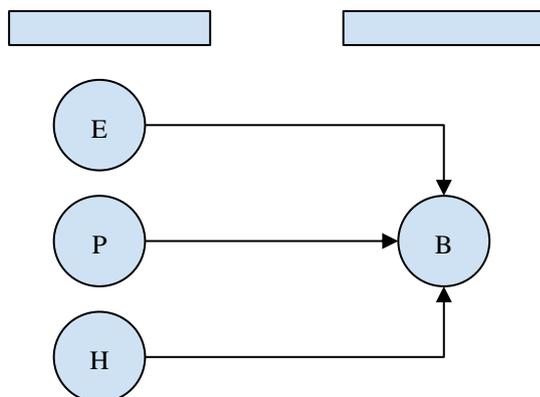

Figure 2 Connection between variable

The figure above shows the connection between variables , this means variable EE (*Effort Expectancy* = convenience), Variable PE (*Performance Expectancy* = usability), dan Variable HM (*Hedonic Motivation* = enjoyment) predicted to have an influence on the variable BI (*Behavioral Intention* = desire to continuously use) which makes the variable BI the dependent variable

III. RESULT AND DISCUSSION

3.1 Game Design

"nyampah!" The game was created with the aim of increasing awareness not to litter and to be able to differentiate (sort) waste. Made with unity this game is made without sound because one of the inputs for this game is sound. The sound is used so that there is a unique impression of this game.

Sound is used for some in-game inputs. In the provided stage (two stage) sound is used as input in interacting in the game.the use of sound in stage 1 and 2 is different. On stage 1 sound is used as input to shout and at stage 2 sound is used to determine whether a statement is true or not.

3.2 Game Concept

There are 2 types of play in this game, the first is picking up trash (also called stage 1).on stage 1 players will be able to walk in 4 directions and will see rubbish scattered around the trip. Players can pick up trash or not. If the trash is taken, the score will increase by 1 if not taken the score does not decrease at all. Players can Pick up trash with the button provided on the right side of the screen.

At this stage players will also encounter npc in the form of children who are in charge of disposing of trash. The player can stop the child's npc from taking out the trash by making a sound. When a screaming sign appears on the player's head, the player will make a sound so that the child's NPC doesn't litter. If the player screams too late then the score will be reduced by one if the player manages to stop the child's NPC then the score will not be reduced.

In the second stage, the game will be like a quiz. At this stage before playing the player will choose the type of trash that will be selected to the provided trash can. There are 4 types of waste to choose from, namely glass, plastic, metal and paper waste. Although there are 4 types of trash to choose from, there is 1 type of trash that cannot be selected that does not match any of the bins provided. This garbage is called hazardous waste.

When the game starts, the player will choose the same type of trash as the existing

trash. When the player sees a different type of trash from the trash can, the player will make a sound before the time runs out. If the trash given is the same then the player just waits for the time to run out without making a sound.

3.3 Flowchart

Before making a game, what must be done first is to create a workflow for the game to be made. This is done to facilitate the game creation process because there are detailed notes about the creation flow so that there is an outline that will be followed in making the game.. The game flow is made in the form of a flowchart. Figure 3 will show the flow of the game "nyampah!"
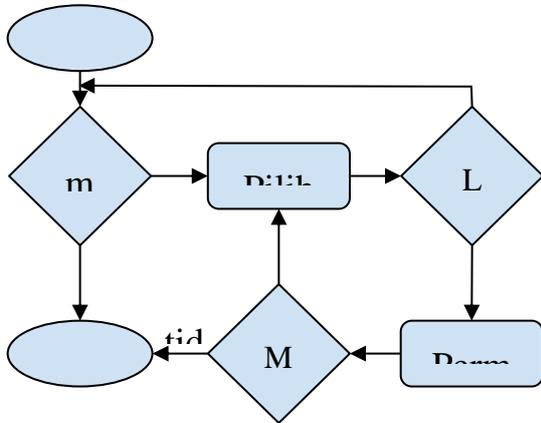

Figure 3 Nyampah! Flowchart

3.4 Respondent Data Analysis

After the game is over and there are no more problems in the game, a game experiment is conducted and data collection is carried out by distributing questionnaires to 73 people who are still in the elementary school education stage. The following results were obtained:

3.4.1 Profile of Respondents
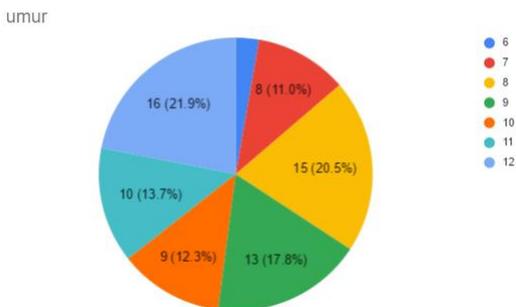- Respondents were aged from 6 to 12 years

Figure 4 Participant age pie chart

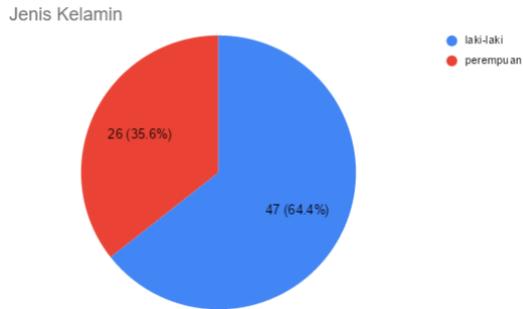- Respondents were male and female from 73 respondents from 26 women and 47 men

Figure 5 Participant gender pie chart

3.5 List of Questionnaire Questions

The result of the questionnaire data are based on 4 variable from EE (Effort), PE (Performance), HM(Enjoyment), and BI(continuous use)

EE1	EE2
1. Learn how to play the game "Nyampah!" it's easy for me	2. My interaction with game "Nyampah!" clear and understandable
EE3	EE4
3. I feel the game "Nyampah!" easy to use	4. It's easy for me to be good at playing the game "Nyampah!"
PE1	PE2
5. I feel the game "Nyampah!" useful for my daily life	6. I feel the game "Nyampah!" helps me learn to differentiate trash
PE3	HM1
7. I feel the game "Nyampah!" makes it easy for me to sort trash quickly	8. Playing game "Nyampah!" is fun
HM2	HM3
9. Playing game "Nyampah!" is exhilarating	10. Playing game "Nyampah!" is very entertaining
BI1	BI2
11. I plan to continue using the game "Nyampah!" as often as possible in the future	12. I intend to use the game "Nyampah!" in my daily life

BI3	
13.. I would suggest other people to use the game "Nyampah!" in the future	

3.6 Validity Test

The validity test table can be seen from the table below. the variable value is above 0.7. Valid variables have a number above 0.7 and will be marked in green and invalid variables will be marked red. In the BI variable, all variables are in the numbers between 0.7 - 0.9 and are colored green, in the EE variable it is in the numbers between 0.81 - 0.87 and is given a green color, in the HM variable it is at 0.8 and 0.9 and is given a green color, and in the PE variable it is already between 0.7 - 0.8 and colored green

	BI	EE	HM	PE
BI1	0.7200			
BI2	0.9061			
BI3	0.7800			
EE1		0.8168		
EE2		0.8512		
EE3		0.8250		
EE4		0.8792		
HM1			0.9126	
HM2			0.8866	
HM3			0.8731	
PE1				0.7782
PE2				0.7880
PE3				0.8797

Figure 6 Validity test table

3.7 Reliability Test

It can be seen from the table below that the variables EE, PE, HM and BI have acceptable values. The variable EE has a value, 8648 which indicates good. The PE variable has a value of 7539 which indicates acceptable. HM variable has a value, 8734 which indicates good. And the BI variable has a value of, 7257 which is acceptable

	Cronbach's ...	rho_A	Composite ...	Average Va...
BI	0.7257	0.7485	0.8462	0.6493
EE	0.8648	0.8736	0.9078	0.7113
HM	0.8734	0.9241	0.9203	0.7938
PE	0.7539	0.7952	0.8568	0.6668

Figure 7 Reliability test table

3.8 Hypothesis testing

The table below shows the P Values of the EE PE and HM variables with the BI variable. in the table below it can be seen that P Values EE, PE. HM, with BI is below the 0.05 which says that the EE, PE, and HM variables have an influence on the BI variable

	Original Sa...	Sample Me...	Standard D...	T Statistics (...	P Values
EE -> BI	0.6493	0.6503	0.0729	8.9068	0.0000
HM -> BI	-0.1418	-0.1392	0.0550	2.5772	0.0102
PE -> BI	0.3753	0.3790	0.0705	5.3272	0.0000

Figure 8 Correlation test table.

IV. CONCLUSION

The conclusion from the research results of the game "Nyampah!" is :

1. The game "Nyampah!" was designed using a leveling system. This leveling system is used to differentiate the game modes in this game. With this leveling system, players can choose existing game modes. This game is also designed to use a scoring system which is useful for giving the player direction when the player is doing the right thing in the game.

2. The game's integration with sound sensors is designed to turn on automatically during the game so that players will be able to immediately issue a sound to activate the sound sensor without having to press certain buttons.

3. the effect of making "Nyampah!" It can be seen from the results of the questionnaire which shows a significant correlation between the results of EE (Effort Expectancy), PE (Performance Expectancy) and HM (Hedonic Motivation) to BI (Behavioral Intent)

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