

Waste Education Game for 4th Grader of Elementary School

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Abstract— Indonesia is the second world largest sea waste producer after China, where waste can make a lot of problems, such as disease and flood, if not taken care properly. Waste is divided by 3 categories: organic waste, inorganic waste, and B3 waste. Learning about waste can be done through playing game. Trash Hero is one of education game that teaches the player, who is 4th grader of elementary school and above, to be able to distinguish the waste categories, how to recycle organic waste to become compost, and also be more aware of sea and land waste. Kids love Trash Hero game, after playing it several times kids become more understand problems about waste and also kids can distinguish waste by its categories.

Keywords— waste, education game, waste education

I. INTRODUCTION

Waste that is solid is divided into two: organic waste and inorganic waste, which can endanger the environment if it don't get recycled properly. Settlements and commercial area are the biggest waste producer[1]. Usually that waste can be divided again into food waste, garden waste, paper waste, plastic waste, cloth waste, wood waste, metal waste, glass waste, and dust waste[2]. Organic waste has traits such as easily be decomposed like leaf and household waste that comes from kitchen. Meanwhile, inorganic waste is difficult to be decomposed like plastic waste and can waste[3]. B3 waste in general has a flammable nature, and also poisonous. B3 waste comes from household has a corrosive characteristic, flammable and

poisonous like used battery cell and lightbulb. B3 waste is a dangerous type of waste if not recycled properly, where it can spread toxin through the medium of water and air that could enter human body through skin and respiratory organ. The result will be ranging from mild nausea into cancer, which will lead into death[4].

Waste can be recycled and reused to reduce the amount of waste while gaining profits economically. As well as organic waste that can be recycled into compost, inorganic waste can be recycled too to become handicrafts like tapestry and another decoration. There are 4 methods in proper way to recycle waste such as Reduce, Reuse, Recycle, and Recovery. Reduce is a method to lessen the use of mono-use items, Reuse is to use the goods again if it is can be used again, Recycle is recycling the waste into another useful items such as handicrafts, and Recovery is way of converting waste into fuel[5]. The world is putting its attention to plastic waste issue where it will be gathered in a few ocean convergence zones or ocean gyres after being disposed[6]. Indonesia is a world's second largest country in waste producer, behind China[7]. A humpback whale found tangled down by disposed fishing net with about half kilometers long. A bird found dead with plastic bag ensnaring its feet, preventing it to fly. Many reports about plastic waste is responsible for death of marine life such as turtle and seagull[8]. Human society must start to be concern about littering behavior, where it should not be allowed to be done, in land as well as at sea, and also optimizing the plastic recycling process. And because of that, children must be educated early about waste

in a fun way. Using education as a learning medium proved to be effective to teach children about waste.

II. LITERATURE REVIEW

Game is a series of complex activity that has rules and culture in it[9]. According to Joan Freeman and Utami Munandar, game is an activity that can help student to widely develop their ability physically, socially, intellectually, and emotionally[10]. Education is a learning process that has a purpose to develop self-potency and make learning potency become better for student. The purpose of education is to develop student's personality, intelligence, and make student have a noble consciousness and self-control beside skills[11]. Education game is a game that has a purpose to stimulate the power of thinking, improving concentration and also education game has been used as a teaching media to increase thinking, communication, and social ability, also develop personality, and is a unique and attractive media[12]. Waste is a solid material remains which its existence no longer needed and if not recycled properly can endanger the environment. Most of waste comes from settlements and commercial area. At first, waste is divided by 2 categories: organic waste and inorganic waste[13]. Waste education game is a game that is designed to stimulate player's understanding about social dilemma about waste with the purpose to educate or to give knowledge about waste through game as the learning media in a fun way. Construct 2 is a game engine that is used to make the game without writing programming code. This engine is HTML5-based, specialized in 2D game development, which is released by Scirra. Developed game can be built to various platform such as Web Browser, Android, Mac, Windows, Mac OS, and Linux[14]. Android is an open-source Linux Kernel-based mobile operating system, which covers operation system, middleware and application, developed by Google and Open Handset Alliance. Most of smartphone vendor already produced android-based smartphones such as HTC, Motorola, Samsung, LG, Acer,

Nexus, and many more[15].

III. METHOD

A. Population and Sample in Research

As many as 30 4th grader elementary students from SDN 02 Kalongan in Jalan Amarta No. 01, Kalongan Ungaran Timur, Kab. Semarang, become samples for this research.

B. Data Source

There is 2 different data sources used that is divided by 2: primary data source and secondary data source. Primary data source can be obtained directly such as interview and questionnaire, meanwhile secondary data source can be obtained from the data that are already exist such as attendance list, salary and financial report.

C. Development of the Game

1. Game Development

The early stage of Trash Hero game development is drawn into the flowchart in Picture 1. The step of process of Trash Hero game development is many, that is analyzing the needs, game flow design, game art design, programming and testing. Analyzing the needs is the first step, searching the waste issue, such as waste classification, recycling potential waste, to littering issue. The data then can be used to design or develop and evaluate whether the game is effective as a education media or not, and then designing the game flow, this step only will be commenced after knowing the result of the needs analysis. The flow design is made to determine how the game will be made.

Game Design.

The design must be suitable with the corresponding target market. Because Trash Hero is an education game for children, therefore the design of characters, background, graphical feature, color and music will be more child-friendly, and then in the development step, Trash Hero game will be developed using Construct 2 game engine. At this step, many things should be done, such as aligning the game flow with the game

design and sound, so the game will be fit to be played.

Game Testing.

Testing is the final step in game development process. Testing is done to test the game, whether it has bugs or errors. If it has bugs or errors, it should be repaired until it has no bugs or errors.

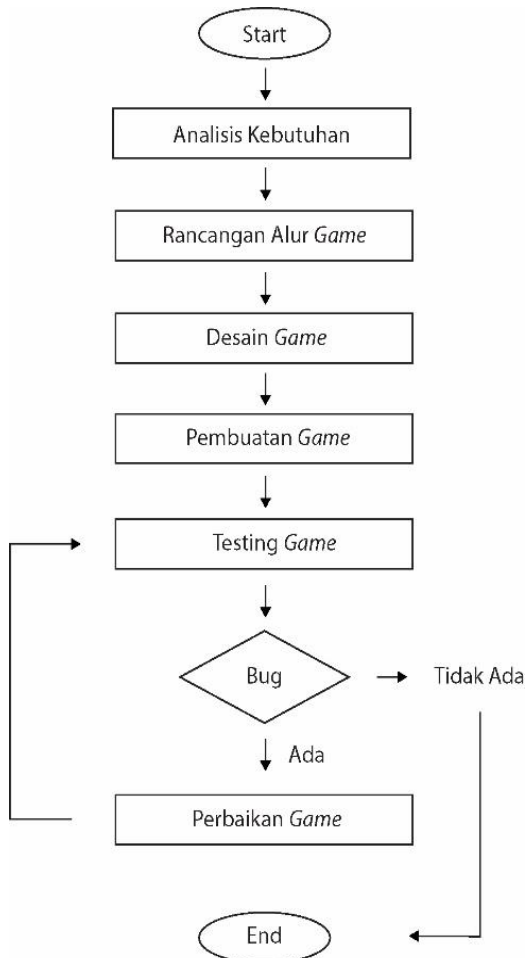


Figure 3.1 Flowchart Game Making Process

2. Game Testing

Trash hero game testing process is drawn in flowchart in Picture 2.2. The process was done firstly by designing questionnaire for 4th grader student of elementary school before distributing it. After distribution and collecting the questionnaire result, the data will be processed using SPSS program. After processing the data using SPSS, the result will be shown whether the game should be developed or not.

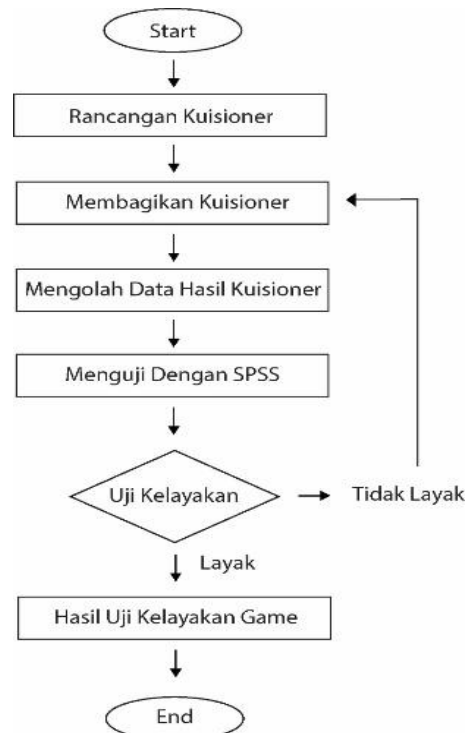


Figure 3.2 Flowchart Testing Game

3. Statistical Testing

The independent variable that are used are Alur Pengalaman Bermain (APB) which used to explain about perceived experience after playing the game, Kenikmatan Yang Dirasakan (KYD) used to determine how much is the perceived enjoyment after playing the game, Harapan Kinerja (HK) used to determine about player’s expectancy about the game. Usaha Yang Diharapkan (UYD), and Keinginan untuk Bermain Game Trash Hero (KuBGTH) are the dependent variable.

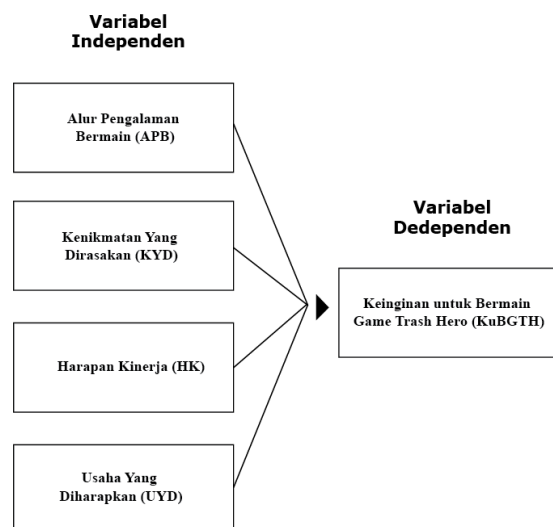


Figure 3.3 Game Testing Model

IV. RESULTS AND DISCUSSION

A. Game Design

Before developing the game, analyzing about waste issue will be useful to be a measuring instrument about waste and be a draft material for the making of waste education game. Due to the target market is 4th grader student of elementary school, the knowledge and theory that will be delivered must be easy to understand for them.

Trash Hero game is an easy-to-play game. On the first level, the player must sort out the trash and put it in the corresponding trash bin. On level 2, the player must pick organic wastes, and then insert it to the chopper machine, that is used to make compost. On level 3, the player must pick the trash from the land as well as the sea. Trash hero is an arcade game, where the player must collect certain coin to continue to the next level. In Picture 3 is the flowchart of Trash Hero game.

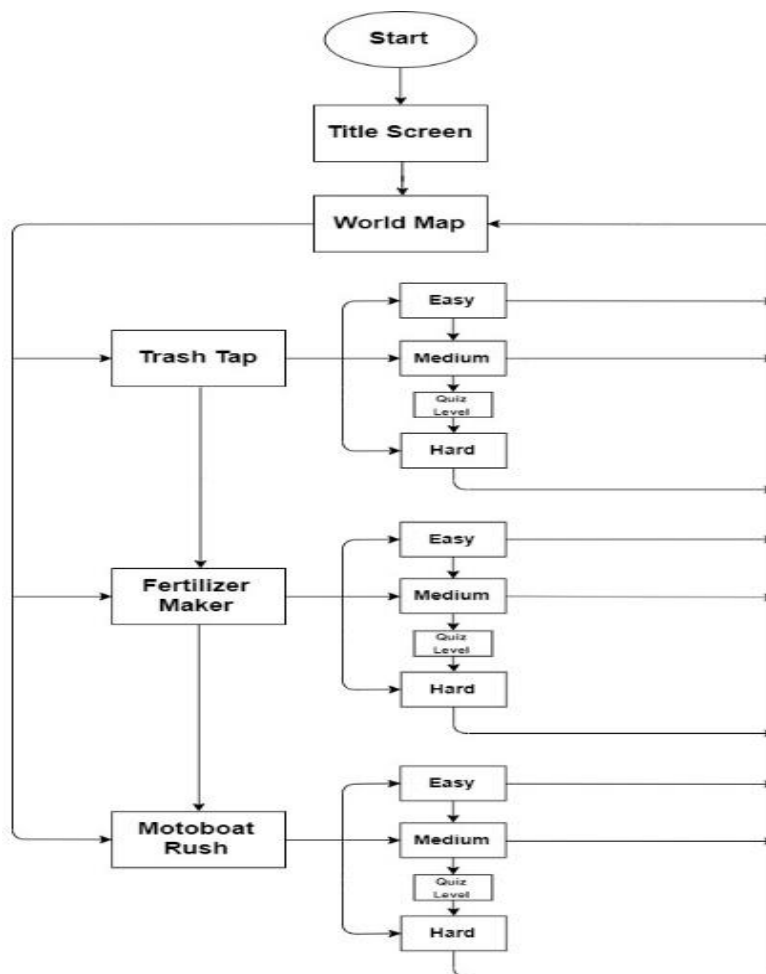


Figure 4.1 Flowchart Game Trash Hero

B. Game General Description

Trash hero has a purpose to educate about waste issue. The game was made to educate children about waste issue from an early age. Not only about waste education, the game expected to be able to encourage the player to be more aware to the earth environment from an early age. The game is expected to be interactive as well to the player, because in the game there are questions that must be

answered by the player, so the player will gain more knowledge about waste. There are 3 levels in the game. The first one is Trash Tap, where the player must put the trash into its corresponding trash bin. The second level is Fertilizer Maker, where the player must put the organic wastes into the chopper machine in order to make compost. The third level is Motoboat Rush where the player must pick the trash by colliding them from land and sea.



Figure 4.2 Tittle Screen Display

On the title screen in Picture 4.2, the player must tap the play button in order to start the game.



Figure 4.3 Tampilan Layout Fertilizer Maker

Picture 4.3 is a Fertilizer Maker layout. The player must choose the organic waste and put it into the chopper machine in order to make compost.



Figure 4.2 TrashTap Display

Picture 4.2 is a Trash Tap level layout. The trash will be fallen down and the player must make sure that the trash that falls into the trash bin is in correct category.



Figure 4.4 Moto Boat Rush Display

Picture 4.5 is a Motoboat Rush layout. On this level, the player must pick the trash in order to gain score from the picked trash. There is a score threshold which determines the score is eligible enough to make the player can go through past this level or not.

C. Game Research Results

To know whether the game is success and gives positive impact to the player or not, questionnaire is made and then distributed to the student who are already played Trash Hero game. The questions in the questionnaire are

according to the research variable. Every independent variable is very affective to the dependent variable intention.

Rotated Component Matrix^a

	Component					
	1	2	3	4	5	6
APB1	-.029	.196	.187	.809	-.074	.140
APB2	-.068	-.124	-.020	.740	.162	.361
KYD1	.002	.035	.019	.058	-.037	.927
KYD2	.078	.003	-.124	.322	.050	.847
HK1	.118	.171	.005	-.118	.799	.188
HK2	.173	.077	-.043	.210	.846	-.169
HK3	-.174	.017	.751	-.017	.439	.063
HK4	.106	.141	.634	.260	-.325	-.312
HK5	.401	.174	.556	-.164	.141	.023
HK6	.238	-.037	.775	.102	-.237	-.062
HK7	.408	.496	.300	-.466	.063	-.057
HK8	.480	.465	.317	.287	-.133	.017
HU1	.087	.868	-.038	-.224	.063	.116
UYH2	.123	.718	.210	.307	.218	-.064
UYH3	.223	.660	-.193	.471	.382	-.082
KuBGTH1	.788	.147	.040	-.134	.163	-.013
KuBGTH2	.845	.182	.154	.162	.065	-.099
KuBGTH3	.775	.138	.161	-.155	.213	.280

Figure 4.5 Validity tes

Table 4.5 is the validity test result before erasing the Harapan Kinerja (HK1, HK2, HK7, HK8) variable.

Rotated Component Matrix^a

	Component				
	1	2	3	4	5
APB1	-.041	.196	.184	.105	.817
APB2	-.092	-.045	-.056	.375	.752
KYD1	.033	.006	.053	.908	.092
KYD2	.076	.003	-.119	.838	.338
HK3	-.128	.156	.744	.139	-.049
HK4	.132	.002	.636	-.403	.321
HK5	.467	.210	.568	.017	-.144
HK6	.234	-.194	.748	-.122	.149
UYH1	.130	.801	.012	.087	-.234
UYH2	.177	.794	.243	-.069	.282
UYH3	.220	.766	-.196	-.036	.424
KuBGTH1	.818	.186	.023	-.001	-.111
KuBGTH2	.847	.143	.101	-.135	.206
KuBGTH3	.811	.166	.146	.283	-.152

Figure 4.6 Validity tes

Table 4.6 is a validity test result after erasing the Harapan Kinerja (HK1, HK2, HK7, HK8) variable.

Variabel	Cronbach's Alpha Based on Standardized Items	Keterangan
Alur Pengalaman Bermain (APB)	.695	Questionable
Kenikmatan Yang Dirasakan (KYD)	.849	Good
Harapan Kinerja (HK)	.674	Questionable
Usaha Yang Diharapkan (UYD)	.774	Acceptable
Keinginan untuk Bermain Game Trash Hero (KuBGTH)	.823	Good

Figure 4.7 Reliability cronbach's alpha

Table 4.7 is used to make sure whether the questionnaire that has been made to do the research is reliable or not.

Correlations

	AAPB	AKYD	AHK	AUYD	AKuBGTH
AAPB Pearson Correlation	1	.408*	.093	.214	-.051
AKYD Pearson Correlation	.408*	1	-.111	.072	.094
AHK Pearson Correlation	.093	-.111	1	.150	.353
AUYD Pearson Correlation	.214	.072	.150	1	.374*
AKuBGTH Pearson Correlation	-.051	.094	.353	.374*	1

Figure 4.8 Correlation test

Correlation test is a test that is used to measure or to find out about the proximity of the 2 variables. The result of the correlation test can be seen in Table 4.6 below, that Usaha Yang Diharapkan (UYD) has close connection with Keinginan untuk Bermain Game Trash Hero (KuBGTH), and Alur Pengalaman Bermain (APB) has close connection with Kenikmatan Yang Dirasakan (KYD).

V. CONCLUSION

Trash Hero game is an education game for 4th grader student of elementary school. Trash Hero game can give the student the understanding and knowledge about waste issue with attractive and easy-to-learn method. Trash Hero game is a game made using Construct 2 as a game engine, and also Adobe Illustrator and Adobe Photoshop as a game art designing application.

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