

# DESIGN OF EDUCATIONAL RECYCLING WASTE MANAGEMENT VIDEO GAME FOR CHILDREN

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## Abstract

As time goes by, the earth has undergone many changes, many of which have happened, from natural changes to human lifestyle. Many natural disasters occur as a result of the development of human lifestyles, such as floods caused by littering and piling up. Littering is one of the causes of flooding, therefore it is necessary to build awareness of society, especially children as the next generation.

The purpose of " Design of Educational Recycling Waste Management Video Games For Children " is to provide an understanding of waste and be able to find out the products of reusing inorganic and organic waste to children. The benefits of designing interesting video games can stimulate children's psychology in understanding the cleanliness of the environment and provide education that waste can be used.

The research method in this design uses the Research and Development method which is used to produce a product and test the effectiveness of the product. The results obtained are that there is a significant difference in children's understanding of waste when playing video games and before playing so that the use of games as educational media can be said to be effective.

## INTRODUCTION

Considering the many natural disasters that have occurred around us, such as flash floods that have occurred in several areas and have harmed the situation of victims of these disasters, it makes us more aware to keep the surrounding environment clean, even though the area where we live still feels safe from flood, but if it is not guarded then one day it can hit the settlements where we live. Many things cause this disaster to happen, one of which is the accumulation of garbage around us. This waste is none other than the waste that we often encounter, namely waste from various industries.

In the industrial world, especially in the packaged product industry, many materials have been used, ranging from those that are easily biodegradable to those that are difficult to decompose. Most of the materials that are difficult to decompose are reprocessed into something that can be used and has a selling value like handicrafts from used goods.

Management of waste that is difficult to decompose is very important because if industrial waste is allowed to cause bad things such as contaminating soil and water, killing decomposing animals due to toxins from plastic particles, disrupting waterways that penetrate the soil, reduce soil fertility and flood. Therefore, there needs to be a movement to reduce waste wasted.

This movement can be started in a small environment, namely the family. Parents can provide understanding to children about waste, its impacts, and how it is managed. In giving understanding to children, sometimes this is not easy, but in this digital era using *video games* as a medium for children's learning will be more interesting and help parents make children understand that waste that is usually wasted in vain can become goods of the sale value. Therefore a *video game for the* introduction and management of types of waste that can be found in everyday life and easy to recycle such as inorganic waste will be taken from several types such as plastics, paper, and cans, not only that there is also organic waste, namely dry leaves, rotten fruit, and tree branches. *This video game* also tells the story of a person's life journey by using waste as a source of income to achieve success because it uses waste to become useful items.

Through *video games* that are designed with attractive visuals for children, it is hoped that this *video game* can teach two things to children, namely about waste and entrepreneurship so that with this *video game* children can think creatively and have an entrepreneurial spirit from an early age. With this, it can also make it easier for parents to provide understanding to children about waste and how it is managed into reusable items.

The game or *video game* will be uploaded on *the game.maswebber.com website* because it is easily accessible without the user having to download and *install it*. Besides, the *website* is private property which is used as a portfolio container so that it is easier to use in the processing process

## METHODS

This section includes the type of research or approach used, population and sample (research subjects/respondents), data collection techniques, and data analysis.

The development procedure is carried out using the R&D learning design model according to Sugiyono (2009) with the following procedural steps:

### 1. Potentials and Problems

Based on the background of the data obtained through analysis using interview and observation techniques before the pandemic in February 2020 then referring to previous journal references about the waste problem in Banyumas Regency which is increasingly piling up. Collecting information about things that are the basis for developing multimedia learning.

### 2. Gathering Information

Collecting various information and literature that can be used as material for further research to make a certain product by providing education to children in the early stages of multimedia learning about waste management methods (learning through play) referring to previous reference journals (Endang & Adhi). , Ekanti, namely regarding the Waste Bank through software engineering products based on Android and suggestions for weaknesses so that researchers plan further research.

### 3. Product Design

The product is produced from an R & D research. The design stage is the drafting of a multimedia learning product. This draft will be useful for making *flowcharts*. Furthermore, from the *flowchart*, a *storyboard* is made which can be the basis for making learning multimedia products.

### 4. Design Validation

Design validation is an activation process that aims to assess whether the product design, in this case, the new work system will rationally be more effective than the old one or not through testing from other experts and experts. Development of education on special waste for children.

### 5. Design improvements

After the finished product design, it is validated through discussions with experts and other experts so that its weaknesses will be identified. Then try to reduce these weaknesses by improving the design. The task of improving the design is the researcher who will produce the product. The design improvement stage that occurs in each of the four stages above is called formative evaluation because its purpose is for revision needs. Revisions by media experts were carried out twice using a media validation questionnaire and a material validation questionnaire and using a child response questionnaire to determine the child's response to the learning multimedia that had been made.

### 6. Product Trial

The product development trial stage is to make an initial product, then the product is validated by one material expert and one media expert. The products that have been validated are then revised as suggested. Then multimedia learning products are ready to be tested on children. Product designs that have been made cannot be directly tested, right, but must be made first, to produce a product, and that product is tried out. Testing can be carried out through experiments, namely comparing the effectiveness and efficiency of the old work system with the new work system.

### 7. Product Revisions

Product Revision, product testing on a limited sample can show that the performance of the new work system is better than the old system. The difference is very significant so that the new work system can be applied or enforced.

### 8. Trial of Use

After the revision of the resulting product is successful, and there may be revisions that are not so important, then the next step is to test product users in the form of a new work system to be put into effect or applied to real conditions under the scope limitations. In the operation of the new work system, it is still necessary to assess the obstacles or shortcomings that have arisen to carry out further improvements.

Trial stage of product users that have been revised according to the advice of material experts and media experts and are declared eligible to be tested. This trial was carried out into three stages, namely one on one child trials, small group trials, and field trials.

### 9. Product Revisions

This product revision is carried out, if the repair is in real conditions there are advantages and disadvantages. In testing product use, the product maker as a researcher should evaluate how the product is performing, in this case, the work system.

### 10. Mass Product Manufacturing

At this stage of mass product manufacturing, it is carried out if the product that has been tested is declared effective and suitable for mass production. For example, the manufacture of machines that can convert waste into useful materials will be mass-produced if it is based on a feasibility study from both economic, technological, and environmental aspects. So to produce a product, entrepreneurs and researchers must work together.

The technique used to collect data is a non-test technique consisting of interviews, observations, and questionnaires. to obtain qualitative data in the form of accurate information regarding needs analysis and field studies before developing multimedia learning, while a questionnaire was conducted to find out quantitative data about the feasibility of multimedia learning seen from the aspects of learning, material content, display, and programming. There are two types of questionnaires, namely questionnaires submitted to material experts and media experts using a Likert scale and

questionnaires given to children using the Guttman scale. Questionnaire for material experts to get data about the feasibility of the program being developed in terms of learning aspects and aspects of material content. Questionnaires for media experts to obtain data about the feasibility of the developed program in terms of appearance and programming aspects, while the questionnaire given to children aims to determine children's responses to multimedia products produced based on learning points of view and appearance according to children when performing product tests.

### Research and Development (R&D) Method

There are several R & D research models in the field of education, including the Borg and Gall model and the Sugiyono model. In brief, the two models can be described as follows.



Figure 1. Sample image Data analysis table

After going through various game design processes, a product test was carried out through a questionnaire. The questionnaire was distributed to 30 respondents and the following data were obtained. The table below

1. Age table of children of respondents:

Age	total
5	7
6	7
7	16

2. Table Gender child respondents:

Gender	total
Women	13
Male	17

3. Table of questions regarding respondents' knowledge about waste:

Question	Pretest	Post Test
Does your child know about trash?	30	30
Does your child know of inorganic waste?	23	30
Does your child know about organic waste?	24	29

## 4. Table of questions regarding the respondent's interest or interest in the design:

Question	Pretest	Post Test
What color does your child prefer?	Blue: 9 Yellow: 4 Orange: 3 Red: 9 Purple: 4    Black: 1 Green:	Blue: 5 Yellow: 6 Orange: 3 Red: 9 Purple: 4 Black: 1 Green: 2
Which character does your child like?	1:18 2: 5 3: 7	1:21 2: 0 3: 9
Which sound does your child like?	Children: 25 Men: 2 Women: 3	Children: 26 Men: 4 Female: 0
Which music does your child like?	A Children's Song: 21 Lullaby: 9	A Children's Song: 22 Lullaby: 8

5. Question table about *gadget* usage :

Question	Pretest	Post Test
What does your child frequently access when using <i>gadgets</i> ?	Youtube: 7 Games: 12 Both: 11 Others: -	Youtube: 7 Games: 15 Both: 8 Others: -
How long does your child use <i>gadgets</i> ?	<1 Hours: 9    1 - 2 hours: 21 Others:	<1 hour: 5    1 - 2 hours: 25 Others:
What games/videos do your kids often enjoy on <i>gadgets</i> ?	Learning: 2 Entertainment: 28	Learning: 2 Entertainment: 28

## RESULTS AND DISCUSSION

In achieving the results of the research with the title " Designing Educational Video Games About Recycled Waste Management For Children " which is the aim of the design to provide solutions for how to provide learning to children while playing, it takes a process consisting of a design process and a game development process so that it can achieve the final result. that fits the purpose.

### Designs

The following are 4 stages of design:

#### 1. Story

In the title "Designing Educational *Video Games* About Recycled Waste Management For Children", a short story is used which becomes the basis for making the game. *This video game* tells the journey of a character who is down due to flash floods that hit his shop so that he falls into poverty. To stay alive, he makes use of the objects around him such as organic and inorganic waste. He also manages waste and used goods into items that have a selling value such as making decorations, containers, and so on. This story is expected to inspire children to care for the environment and to be creative in using waste to help the environment enjoy a more prosperous life.

## 2. Storyboard

This storyboard serves as a combination in designing the game to match the results to be achieved. *The storyboard is kept simple with descriptions of audio, action, and animation in each game layout.* The following is a *storyboard on video game design.*

### 3. Design

At this stage, the rough sketch that has been made is *scanned* into an *image file* so that it is easily edited and formed into a neater *digital* image using the CorelDRAW X7 vector manager application. All the image needs in the game such as character designs, buttons, HUD, *Pop-Up*, *Enemy*, and others are designed in this application and *exported* in PNG format. In addition to pictures, audio to *back sound* and *sound effects* are also needed so that in this design used audio manager LMMS.

### 4. Game Production

After all the necessary materials have been found, the next design is carried out using the Construct 2 *software*.

## Results

### 1. Logo Design

In this game, there is a game name which is then used as a *logotype* for the game which functions to make it better known by the *player*. The game called Picky Trash is designed to introduce a type of recycled trash that is often found in everyday life wrapped in the story of the Dhamar character who is the character in this game.

### 2. The meaning of the logo



Figure 1. The Picky Trash logo

This game is called Picky Trash which is meant to "pick out the trash", which is a game that provides information to players about recyclable waste. The logo is only dominated by brown and green which means nature. There is also a *recycle* symbol that replaces the letter A which means recycling, while on Huruh H there is a trash can lid that symbolizes the trash can. The typeface used is taken from the decorative and bold type because this game is intended for children.

### 3. HUD

*Head-Up Display* (HUD) is a display that functions to show data visually in a digital game interface, HUD is used to make it easier for players to find out their data such as lives, coins, missions, items, and keys. Each HUD uses a *sprite font* To Japan 48 pt as a number that visualizes player data.



Figure 2. Lives HUD



Figure 3. Coins HUD



Figure 4. Missions HUD



#### 4. Ground and Tile

*Ground* and *Chesnut* serves as a pedestal base or footing on *the platform* can run and jump (*jump through*) on it. There are 4 *ground* and *tile* designs in this game, namely wood, asphalt, floor, and ground.

#### 5. Dhamar Character Design

In this game, players can control a character named Dhamar, a household head who has to work hard to earn money for his family by utilizing the items around him. The name Dhamar itself has a meaning that illuminates his family. Here are some images used in the game.



Figure 5. The Dhamar character runs

In making the movement or animation of the Dhamar character that is running it takes 5 frames like the picture above with *speed* 11. Each image has a size of 5.41 cm x 9.846 cm and the same color, along with the dominant color used in the character design of the Dhamar walking character. Not only *the running frame* but in this game there is also a Dhamar image that illustrates several situations, here are some of these images.



Figure 6. Dhamar characters

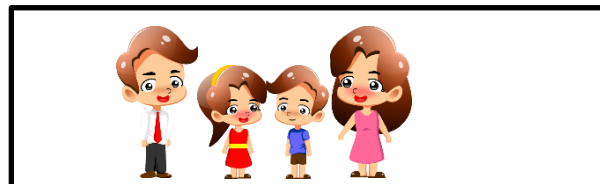


Figure 7. The character of the Dhamar Family

Apart from the characters of Dhamar and his family, there are enemy characters designed in two images

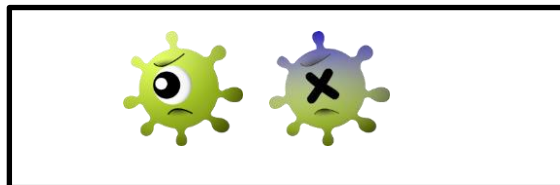


Figure 8. Enemy characters

The first image when still active in the arena and the second image when the player has defeated the *enemy*. If the player is defeated by an enemy, it will reduce 1 life, but if the player manages to defeat the enemy, the player will get 100 coins. *Enemy* characters are designed at the size 14.291 cm x 13.571 cm.

## 6. Background

In this game, various background designs are also used, such as a house wall for a playground inside the house, a clear sky for a playground that describes an *outdoor* atmosphere, and a school wall that describes a school atmosphere. The size of the background made is 26.98 cm x 15.173 cm.

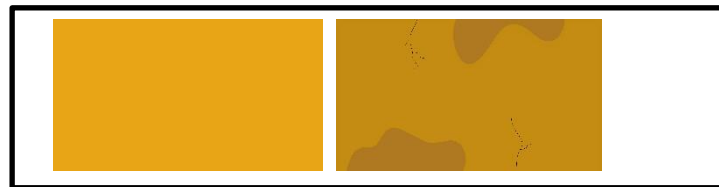
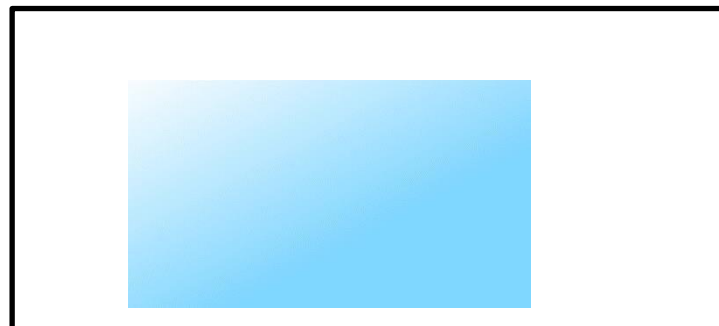


Figure 9. Clean and Dirty Home Walls



## 7. Object Design

The object designs in this game include organic waste designs consisting of paper (newspapers, books, and origami), plants (twigs, leaves, and wood), and fruit (banana peels, rotten fruit). Apart from organic waste, there is also inorganic waste consisting of metal waste (cans and metal scraps), plastic (plastic bags, bottles), and glass. There are also recycled object designs consisting of paper pulp dolls, wooden figures, fertilizer, piggy banks, plastic flowers, and glass.

## 8. Decoration Design

In addition to object design, there are also decorative designs that contain images that are used to decorate the background. The decorations include buildings, plants, and other equipment.

## 9. Button Design

The buttons function to control the objects in the game and also control what can be arranged in them. In this game, many buttons are made and all use audio with a "click" sound that is more "heavy". The following is an explanation of the buttons used in this game. For each button with text except the level button use Kids Rock DEMO font.



Figure 8. Control Button Design

In addition to the control buttons, there are also buttons for start, exit, audio settings, profile, back, settings, next, previous, skip, tutorial, start, reset, level, buy a key, home, close, level is empty, the level is locked, OK, retry, next level, paid off, get items, play again, iron, glass, plastic, fruit, paper, plants, sell, sell items, continue, inorganic, and organic buttons.

## 10. Audio and Backsound

The audio in the game serves to make the game feel livelier and less boring. In this game, the audio used is not too much, some of it is managed with the LMMS audio management application to



create a *sound effect* like coins when it is obtained by the characters, and here are some of the audio used in this game. This game uses *back sound* with music from Dee Yan-Key of A Children's Song. From the title, it is known that this music was created for children so that is why this music is used in games.

## 11. Sprite Fonts

*Sprite font* is an image that consists of a string of characters in a font. In Construct 2 sprite fonts are used so that the resulting text is tidier and can be used on all devices that do not have the type of font used. *The font sprites* used in this game are To Japan, Candy Beans, Futura Hand, and Quicksand. All of these *fonts* are used for non-commercial educational purposes only.



Figure 9 . Futura Hand Font Sprite

## 12. Layout Design

The game display design is made with a resolution of 1280 px x 720 px consisting of Home, Introduction 1, Introduction 2, Introduction 3, Level, Tutorial, Level 1, Level 2, Level 3, Level 4, Level 5, Locked Pages, Create Items, Selling Barags, and The End's Pages.



Figure 10. Home Layout Design



Figure 11. Introductory Page Views



Figure 12. Introduction Page Views 2



Figure 13. Layout Design Introduction 3



Figure 14. Level Layout Design



Figure 15. Layout Design The End

## Discussion

From the results and discussion with a product with the title "Designing Educational Video Games About Management of Recycled Waste for Children" using the R&D method through Hypothesis testing of 25 respondents Interpretation of proven results H<sub>1</sub> is accepted and H<sub>0</sub> is counted with the assumptions as below

H<sub>0</sub>: There is no significant difference in children's understanding of waste when playing *video games* and before playing.

H<sub>1</sub>: There is a significant difference in the child's understanding of the garbage at the time playing *video games*, and before playing.

From the data that has been processed with *paired sample t-test*, it can be concluded that H<sub>1</sub> is accepted because the significant value is  $<0.05$ , with the conclusion that the correlation between *pretest* and *posttest* :

1. Based on the significance value (2-tailed) the *pretest value* is  $0.000 > 0.05$ , which means that there is a significant correlation between the *pretest* and *posttest* variables.
2. Based on the calculated *r* value (Pearson Correlation), it is known that the *r* value for the *pretest* and *posttest* relationship is  $0.927 > r$  table  $0.505$  (1% of 25 (N) types of questions) which can be concluded that the relationship between the two is positive and play can provide an understanding of knowledge child regarding trash.
3. Based on the asterisk (\*) in SPSS, in the table above the star shown, is (\*\*), which means the variable above is associated with a significance level of 1%.

## CONCLUSION

Conclusions from the results of studies or research in designing this *video game* are expected to have an impact on children in this digital era. With the advancement of technology, children's learning methods will also develop and change. Because gadgets are a basic requirement nowadays, even in the learning process, choosing *video games* as a learning medium can help children learn in a fun way. This game is designed to convey to children about waste so that they can care more about the environment and be creative in managing goods, especially the waste around them through information about recycled waste products conveyed in this *video game* so that one day it can grow a more aware society. to the environment. Based on the test results of this game, the *video game* can provide understanding to children about waste, and is easy to use and effective.

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