Conceptual Framework for a Video Game as an Educational Tool for Waste Sorting and Management

Rahma Kholisa[1]*, Dwi Mutia Sari[2]

[1,2] Department of Fine Arts, Faculty of Languages and Arts, Padang State University, Indonesia
*Corresponding Author
 Email: rkholisa2706@gmail.com

ABSTRACT

Waste has become an environmental issue that grows in line with the increasing activities of society. One of the causes of this problem is the lack of awareness about the importance of waste sorting and processing among the younger generation, which can lead to negative impacts on health and the environment. Therefore, there is a need for an engaging and effective medium to deliver educational messages about the proper way to sort and process waste to the youth. One such medium that can be used to convey this message is a video game. The goal of designing this game is to deliver educational content in a fun and engaging way that resonates with the younger generation. In the development of the game, the method used is the Game Development Life Cycle (GDLC), which includes the stages of initiation, pre-production, production, testing, beta testing, and release. This method is used to ensure that the game is tailored to its target audience based on feedback received by the developers. The methods used to collect data during this research include observation and surveys for primary data, as well as secondary data from e-books, e-journals, the internet, and other sources. The game development is guided by a creative concept that serves as a foundation for the next stages of development. This creative concept includes verbal, non-verbal, and visual messages that provide an overall picture of the game to be developed. This game can serve as both an educational and entertaining tool that increases knowledge and fosters awareness among the target audience about the importance of proper waste sorting and processing. It is expected that this research can serve as a foundation for developing other educational games related to waste management.

INTRODUCTION

Recently, urbanization has been developing rapidly, contributing to changes in people's consumption patterns. The lifestyle changes brought about by urbanization have significantly impacted the younger generation. This is due to the fact that many young people grow up in urban areas or migrate to more developed regions in search of better facilities and education. According to Law No. 18 of 2008 concerning Waste Management, "population growth and changes in consumption patterns result in an increase in the volume, types, and characteristics of increasingly diverse waste" (Waste Management Law, 2008). These changes in consumption behavior among the younger generation lead to an increase in the waste they produce. However, many young individuals still lack awareness regarding the importance of sorting and managing waste.

According to Ramadhan et al. (2024), one of the factors influencing a person's environmental awareness is a lack of knowledge. Based on the author's observation of waste bins that apply a sorting system in a university area, it was found that much of the waste was still not being sorted properly. An initial survey conducted with 17 respondents, 100% of whom were aged 19–25, revealed that 70.6% of them do not sort their waste, and 52.9% are still unaware of the impact of improperly sorted waste.

According to Katmawati et al. (2016), the rapid advancement of technology has led to the

widespread availability of fast food, which caters to daily consumer needs. Instant, attractive, and affordable food products have become a popular choice, particularly among young people. These products are often packaged to preserve and extend shelf life, but the packaging significantly contributes to the increase in waste. Therefore, the rising volume, type, and characteristics of waste must be accompanied by knowledge and awareness about the importance of sorting and processing waste. Waste sorting is the process of separating waste into homogeneous categories. When waste is sorted from the beginning, it can help prevent a decrease in the quality of recycled products and reduce the chance of recycling failure. Improperly recycled waste will ultimately accumulate in landfills. Hence, it is essential to contribute to waste sorting and processing from the early stage, even before the waste is discarded.

As a result, there is a need for a medium that can educate and raise awareness among the younger generation about the importance of sorting and managing waste. Media serves as a tool to convey information, education, and messages to specific audiences. It is designed to be engaging and to facilitate the reception of information by its target audience.

With recent technological developments, new forms of media have emerged, one of which is video games. Video games are no longer just a form of entertainment, they can also be used as educational and informational media. According to Computer Technology Research (CTR), people remember only 20% of what they see and 30% of what they hear. However, they can remember 50% of what they see and hear, and 80% of what they see, hear, and do simultaneously (Munir, 2012). Video games are capable of delivering educational content in a fun and engaging manner. In addition to having appealing visuals, video games allow players to be actively involved in the gameplay.

In this final project, the author utilizes video games as a medium. By embedding information and messages within engaging interactions and storylines, video games can capture the interest of the younger generation and serve as an effective educational medium.

From several research articles reviewed, very few have implemented the concept of waste sorting and processing into video games that are visually styled to suit younger audiences. This indicates a gap in the use of interactive media, particularly video games as an engaging and educational tool for teaching young people how to properly sort and manage waste.

The purpose of this study is to develop a video game as a medium to increase knowledge and raise awareness among young people about the importance of proper waste sorting and processing.

METHOD
Design Method

The method used in the creation of the Final Project "Video Game as an Educational Medium on Waste Sorting and Processing" is the Game Development Life Cycle (GDLC) design method. According to Krisdiawan et al. (2019), the Game Development Life Cycle (GDLC) is a game development method that covers the process from the initial idea to the final release. It starts from the ideation and concept phase of the game and continues through to the release stage. The GDLC method consists of six stages:

1. Initiation

In this stage, the author conducts brainstorming sessions to determine the type of game to be developed. The game is designed around the topic of waste sorting and processing. The gameplay mechanics, game genre, theme, art style, and other foundational elements are decided in this phase.

2. Pre-Production

Pre-production is the next step following the prototype phase. During this stage, the author creates rough drafts of the game, including essential elements such as the game genre, mechanics, storyline, characters, and other components that facilitate the production stage.

3. Production

The production stage is the continuation of the pre-production phase. In this stage, the author collects game assets and implements them using programming within the game engine.

4. Testing

In this phase, the author conducts prototype testing involving third parties to evaluate the game's

functionality. This testing aims to identify bugs, assess difficulty levels, and evaluate the effectiveness of the educational elements. The results are used to improve the game before moving to the next stage.

5. Beta

   After completing the initial testing phase, the game undergoes user testing. Testers provide feedback, which is then used to revisit the pre-production phase for refinements. This stage results in valuable feedback to improve and optimize game elements to better meet the needs of the target audience.

6. Release

   In this final stage, the game that has passed the beta phase is declared ready for public release. The final build is officially distributed through predetermined platforms. Additionally, promotional strategies are implemented to introduce the game to a broader target audience.

Data Collection Method

   In the game development process, the author collected both primary and secondary data, which were obtained through the following methods:

1. Primary Data

   Primary data is information obtained directly from its source. In this study, primary data was collected through the following methods:

   ● Observation

   The author conducted observations of waste bins located in the campus area and examined the sorting of waste contained within them.

   ● Survey

   The author distributed questionnaires to respondents who belong to the younger generation, specifically those aged 19–25, both from the surrounding environment and through social media platforms.

2. Secondary Data

   Secondary data refers to information obtained through literature studies, including e-books, e-journals, the internet, and other sources related to the development of video games with the theme of waste sorting and processing.

RESULT AND DISCUSSION
Creative Concept

   The creative concept serves as the foundation that supports the process of developing ideas and creative strategies. It focuses on delivering messages and information effectively to the target audience. It is important to consider how the message can be conveyed clearly and engagingly without disrupting the gameplay experience. In this process, three main approaches are used:

1. Verbal Messages

   The verbal message delivered in the game focuses on the importance of properly sorting and processing waste. This message is conveyed through character dialogues, informational pop-ups, and mentor NPC guidance. The strategy aims to deliver educational messages in a persuasive manner without sounding patronizing, using language that feels more relatable to younger audiences to ensure the message is effectively received. According to Heikkonen (2018), some games use dialogue as part of the gameplay to deliver narratives and core ideas. This approach allows players not only to engage with the storyline but also to gradually gain insights into waste sorting and processing as the story progresses.

2. Non-Verbal Messages

   Non-verbal messages in this game design are conveyed through gameplay mechanics that encourage players to correctly sort waste and learn about simple waste processing techniques that individuals can apply. The game mechanics are designed to have players actively participate in the sorting process, which indirectly educates them about waste classification. Sound effects are also

carefully selected to enhance atmosphere and mood. for example, celebratory sounds when players correctly sort waste and gloomy sounds when mistakes are made. These effects strengthen the emotional impact of player actions and reinforce the game's educational objectives.

3. Visual Messages

Several visual elements are designed to attract players' attention, including character designs, objects, shapes, colors, and animations (Khadafi et al., 2023). In this game, visual messages are conveyed through various design elements, including:

- Character Design

    Characters are designed to reflect specific roles within the game. Each character not only has an appealing appearance but also a unique background and personality that align with the game's theme, helping to strengthen the narrative.

- *Game World Design*

    The game world is designed to show environmental changes, such as a dirty environment becoming clean after the player finishes sorting waste. This reinforces the message about the importance of maintaining a clean environment.

- Color

    Color plays an important role in delivering visual messages. Bright and fresh colors are used to depict clean and healthy environments, while dull and dirty colors represent polluted areas. According to Wirania (in Yasa, 2022), there are three types of colors:

    - Primary Colors, Basic colors that are not mixed with others, such as red, blue, and yellow.
    - Secondary Colors, Created by mixing two primary colors, such as purple (red + blue), orange (red + yellow), and green (blue + yellow).
    - Tertiary Colors: Formed by mixing a primary color with a secondary color, such as bluish-purple (blue + purple).

- Icons and Symbols

    Icons and symbols related to waste sorting and processing, such as waste type icons and recycling symbols are used to help players understand different types of waste without relying heavily on textual instructions. According to Budiman & Anwar (2020), in video game visualizations, signs such as symbols, indexes, and icons are constructed to deliver meaningful value to the player. Thus, icons and symbols are not only used in UI/UX but also contribute to character and world design.

- *Cutscene*

    According to Wibowo et al. (2024), cutscenes are combinations of animation, visual effects, and audio used to present narratives that align with the game's storyline—for instance, showing the transformation of a dirty environment into a cleaner one. Cutscenes also help strengthen the game's message and provide a deeper emotional impact.

    Through these elements, visual messages not only enhance the game's aesthetics but also function as a medium to convey the core message and goals of the game development.

CONCLUSIONS

The design of this educational game on waste sorting and processing focuses on applying a creative concept to deliver educational messages to the younger generation in an engaging and interactive way. Using the Game Development Life Cycle (GDLC) method, the game is developed based on verbal, non-verbal, and visual messages.

Verbal messages are conveyed through character dialogues and informational pop-ups written in a language style that resonates with young audiences. Non-verbal messages are embedded in the gameplay mechanics that encourage players to actively participate in sorting and processing waste. Visual messages are presented through character design, environmental changes within the game world, and the use of colors to create an attractive visual experience.

This creative concept approach helps align various game elements so that educational messages can be effectively delivered without compromising entertainment value. However, further development is needed to optimize both the game elements and gameplay mechanics.

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