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GLOBAL WARMING ISSUE AWARENESS THROUGH VIDEO GAME DESIGN: AN IMPLEMENTATION OF MDA FRAMEWORK

Tony Wibowo, Mega Lispy
Faculty of Computer Science, University Internasional Batam
{ tony.wibowo@uib.ac.id 1831033.mega@uib.edu }

ABSTRACT

The popularity of video games among younger generation today is undeniable. Video games can be used in various purpose beyond mere entertainment value, one of which is delivering message in a more immersive manner than other linier media. Global warming is an issue that are currently becoming very complex and impactful to our daily lives. However, the solution of that problem is rather simple, one of which is forestation. This problem can be turned into video game mechanics to help player understand the urgency of the matter. in this study, we have designed a video game about global warming using the MDA framework method. We produced game design document which consists of mechanics, dynamics and aesthetics. This document then will be used as part of video game development. By designing this video game, we are attempting to spread the message of global warming to younger generation.

INTRODUCTION

Global warming is an increase in the average temperature of the earth or an increase in the average temperature of the atmosphere, sea and land of the earth due to an increase in the amount of greenhouse gas emissions in the atmosphere. The increase in global average temperatures since the mid-20th century according to the Intergovernmental Panel on Climate Change (IPCC) is largely due to increased concentrations of greenhouse gases due to human activities. Global surface temperature will increase by 1.1 to 6.4 °C between 1990 and 2100. This will have many negative impacts on Earth. Some of these impacts are an unstable climate, starting to melt the ice in the north pole, food supplies will be disrupted, the survival of animals and plants will be disrupted, and human health will be susceptible to disease. Global warming can cause climate instability. This instability can lead to extreme weather and can even lead to natural disasters. Then, when the ice at the north pole begins to melt, it will automatically over time the sea level will rise even more. This sea level rise can cause several islands in several countries to sink (Leu, 2021). The latest report released by the American Meteorological Society (AMS) says the warming effect of greenhouse gases has reached 43% since 1990. The report also states that sea level rises for the seventh year in a row and has hit a record high in the 26 years since satellites began recording that data. Sea level rose about 81 millimeters above the 1993 average (Syarifudin, 2019). The problem of global warming needs to be seen as a serious problem and this is one of the biggest challenges to be faced by us human beings, it is not too late for us to be able to avoid and reduce the bad effects of global warming. We should acknowledge this problem and take responsibility and take action (Boudreault et al., 2018). According to research conducted by Letcher (2019), global warming occurs due to an increase in the concentration of carbon dioxide (CO_2) caused by human activities. The solution given is to reduce CO_2 levels by stopping using fossil fuels and replacing them with renewable energy or non-fossil fuels. However, it is highly dependent on governments around the world to enforce policies on the use of non-fossil fuels. Besides that, there is actually another solution that can be a small contribution from us to reduce CO_2 levels, namely by carrying out nature conservation in the form of planting trees and plants, but not just planting trees, but taking care of the trees we have planted (Botahala et al., 2021). Global warming continues to occur

due to lack of knowledge about global warming. Therefore, science education plays an important role in shaping the character of students with knowledge of nature and helping students in efforts to conserve nature (Manda & Saehana, 2021). Materials about global warming are considered difficult to be taught to students directly, as many as 81.25% of students find it difficult to answer questions in the form of problems regarding global warming. Therefore, we need new learning media that can attract the younger generation to learn material about global warming (Guterres et al., 2018). An effective new learning media is to use interactive multimedia media that can attract students' interest and increase the level of student activity in the classroom. One form of interactive multimedia is educational games which allow children to play while learning (Saputri et al., 2018).Video games are one of the entertainment media to fill spare time which is the choice of children today. Along with the development of the game industry in Indonesia, games are becoming very popular among modern society. Video games are fun and entertaining (Wibowo & Vicky, 2021). But apart from being an entertainment medium, video games can also be used as a new learning medium for children to make the learning process more interesting (Pramuditya et al., 2017). Video games as learning media are referred to as Educational Games. Educational games are digital games or digital games designed to facilitate the process of teaching knowledge to users by using interactive multimedia technology that can motivate users to be more interested in the learning process (Borman & Purwanto, 2019). The MDA Framework method is a framework used to design a game. MDA Framework is an acronym for mechanics, dynamics and aesthetics. MDA Framework is divided into three parts, all three of which influence each other. This framework helps us to understand the relationship between working mechanics that will affect the dynamics which will then produce an aesthetic (Laksono et al., 2021). This MDA framework is suitable to be used as a framework in designing an educational game because this framework can create factors related to the learning process in players, namely curiosity, control, fantasy, and challenge (Kusuma et al., 2018). Designing a game means we analyze the goals and problems of the game to be designed and determine the solution. All of that is then written in a document called a game design document and then developed into a prototype form (Gennari et al., 2017).In accordance with the explanation above, it can be concluded that the consequences of global warming are mostly caused by human activities. All this happens due to the lack of human awareness of the surrounding environment and lack of knowledge about global warming. Therefore, it is very important for us to study and pay attention to the environment around us. We hope that "Global Warming Issue Awareness Through Video Game Design: An Implementation of MDA Framework" can attract the attention of the younger generation to study and realize the current state of our Earth and start doing useful things to save our Earth from the effects of global warming that is happening now.

PROPOSED INNOVATION

Based on the background that has been mentioned, namely global warming that is happening today, the occurrence of global warming is mostly caused by human activities. Therefore, we conducted research which aims to create a video game that provides education about one solution to handling global warming, namely reforestation activities.The aims of this research is to find out how to design a video game about global warming with the “Simulation Video Game & Role-Playing Game” genre, using the MDA Framework method and using the Game Design Document (GDD).

RESEARCH METHODOLOGY

This research is an applied research type that aims to design a video game with the theme of global warming using the Mechanics Dynamics Aesthetics Framework (MDA) method. The following is the research flow of this research:

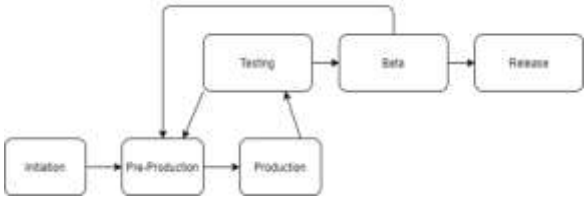

Figure 1. Research Flowchart
Source: (Amani & Yuly, 2019)

At the initiation stage, the development team would gather to discuss the video game about global warming that will be made. The discussion is in the form of game ideas, game titles, game genres, game patterns, and game mechanics that will be made. Then at the pre-production stage, we started designing video games with the MDA framework method approach where at the design stage there were several stages such as game design document, market research and market validation. The Production stage is the stage of applying what has been designed at the design stage into a prototype form including assets and programs in video games. This prototype will be used for testing to players After the production stage is complete, the prototype that has been made by the developer team will be tested by internal testers. This test aims to obtain subjective feedback and objective analytical data, where the feedback and analytical data will be taken into consideration for further development and improvement. The Beta Testing stage is different from the previous stage, at this stage the prototype will be tested to external tester. This test aims to detect errors in video games and feedback from external testers. If the results of the Beta External Testing do not match the standards of the game designer, it will return to the pre-production stage. After the video game made has passed the production cycle, which means that the video game is completely finished and ready to be played by players, the video game created will begin to be released to the play store.In this stage of designing a video game with the theme of global warming, the design will be carried out by making a Game Design Document (GDD) using the MDA Framework method. MDA Framework is a method consisting of mechanics, dynamics and aesthetics. The following is a Game Design Document (GDD) design diagram using the MDA method:

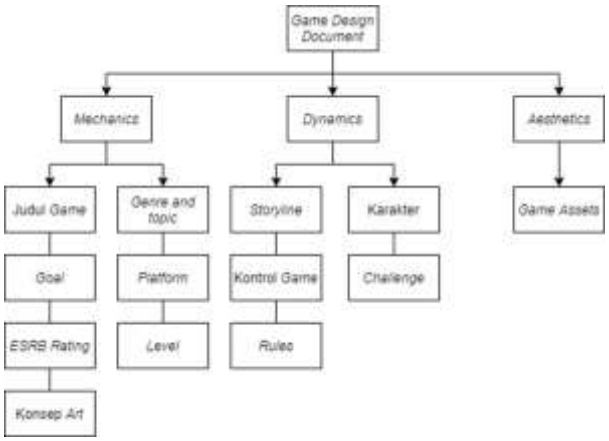

Figure 2. Game Design Document Design Diagram using the MDA Framework method
Source: (Afrilia et al., 2019)

Mechanics is a component that can be referred to as "rules" in video games. Mechanics is divided into several other components in the form of:

1. Game title

The gameplay in the video game that will be designed in this research is to allow players to do the action of planting trees and plants with a background in the forest. So for the initial stage of designing this video game, we plan to give the name "Forestor" to the video game that will be designed and made in this research.

2. Genre and topic

We plan to make a video game “Forestor” with a combined game genre, which is a combination of the simulation genre and the Role-playing game (RPG) genre. Where in this video game the player will be led to start the game with a conversation and a story, and the player can simulate the action of planting trees and plants.

3. Goal

The goal of the video game "Forestor" is for the player to plant as many trees and plants as possible and keep the surroundings clean in order to earn coins or money to buy seeds from

these trees and plants. Planting trees and plants will increase the health rating of the village. When the tree rating is full, the player is declared to have successfully completed the game.

4. Platform

We plan to use the windows operating system on a personal computer (PC) as a platform that will be centralized and used for research and development of the video game “Forestor”.

5. ESRB Rating

In this study, we plan to design the video game "Forestor" as a video game that is suitable for players of all ages to play. So this video game is designed as a game with an E (Everyone) rating on the ESRB Rating.

6. Level

The game level planned in the "Forestor" video game in this study is that players must be able to fulfill all planting slots for every available land and clean up the surrounding environment and earn money through proper waste recycling. The money was then used to buy land and seeds to plant further trees and crops.

7. Concept art

We chose the concept of 2D pixel art as the concept art for the video game “Forestor” that will be designed in this research. The asset design is planned in the form of 2D pixel art using some art from a video game called “Stardew Valley” and we will design our own assets by following the art style of the game “Stardew Valley”. These assets are designed using Adobe Photoshop CS6. The tools used are in the form of a pencil tool in Adobe Photoshop CS6, the brush used is a Hard Mechanical 1 pixel. Each asset uses a combination of different colors according to the color of the respective asset. Next is the dynamics section. Dynamics is the result of player interaction with mechanics in the game. Dynamics is divided into several other components which are:

1. Storyline

The background story of the video game "Forestor" is in a city full of pollution, the main character wants to return to the village to get fresh air. But when he got to the village, pollution was everywhere, the situation in the village was very chaotic. The main character talks with the village head there and learns that there have been forest fires and floods in the village due to climate change which is the impact of global warming. So the main character is determined to make the village healthy again by rebuilding the forest by planting trees.

2. Character

We plan to use only 2 characters in the video game “Forestor” in this study. The main character in the form of a character that will be played by the player, the character played is in the form of a male character. The last character is a village head who acts as a guide and as a side character in the video game “Forestor”.

3. Game control

At this initial design stage, we plan to centralize this “Forestor” video game on the Personal Computer (PC) platform, so the main control of the gameplay of the “Forestor” game is by using a mouse click.

4. Challenge

In every video game, of course, there are difficult obstacles that players must face. Here are some details about the challenges in the video game "Forestor" at the initial design stage:

a) The rarer the status of the tree or plant, the more difficult it is for players to get these seeds in the shop.
b) Players must be good at maintaining the cleanliness of the environment around the village, maintaining cleanliness in the sense of being able to understand waste recycling properly so that players can collect coins / money to buy tree seeds and land.
c) In the video game there is a collection book, players can collect money to buy tree and plant seeds in order to collect all types of trees and plants in the "Forestor" game.

5. Rules

The rules established at the early design stage in the video game “Forestor” consist of:

a) Players will only earn money through proper waste sorting/recycling and watering trees and plants.
b) Players must be careful when using an ax, because even a healthy tree will be

cut down if the player cuts it down, this action will result in the village's health rating being reduced.

c) If the land is full, players can buy new land available in the shop in the game.
d) Character view 2D top down.
e) Players cannot plant trees in areas where there are dead trees unless the tree has been cut down.
f) The status of trees and plants will decrease if the player does not water the trees and plants for a certain period of time.

Lastly is the Aesthetics section. Player aesthetics will be achieved through game assets when a player plays the created video game. Game assets in the video game "Forestor" will be designed using the concept of pixel art. The following are the planned assets for the video game “Forestor”:

1. Tools: shovels, watering can, recycle bins, axes.
2. Trees and plants: sunflower, bodhi tree, coconut tree, banana tree, apple tree, oak tree, cypress tree, green bean plant, blueberry plant, coffee plant, corn plant, pepper plant, tomato plant, orange tree and bamboo tree.
3. Items: seeds.
4. Character: male character and village head character.
5. Collectable item: crops (apples, corn, bananas, etc.), coins, trash
6. UI/UX: main menu, shop, dialog menu, gameplay menu, pause menu, health bar menu, collection book menu, tutorial menu.

RESULT AND DISCUSSION

This study aims to design a video game about global warming. Designing a video game requires several initial stages. The initial stage in designing a game is to determine the concept of the video game that will be made and finally all ideas are mentioned in a document which is a game design document (GDD) with detailed explanations. The following is an explanation of the stages that will be carried out in the process of designing a video game about global warming in this study.

The game concept of the video game “Forestor” that will be designed and made in this research is that players are asked to take care of trees and plants by meeting all the needs of these trees and plants. The concept comes from the video game "Plants VS Zombie" mode "Zen Garden". The visuals of the video game “Forestor” follow the art style and concept of the game “Stardew Valley”. The two video games have little in common, namely the gameplay part of planting and caring for plants. We take the concept of the video game "Stardew Valley" that players can get coins through the sale of fruit produced from certain trees and plants and also the collection book system in the video game "Stardew Valley". Game Design Document (GDD) is a collection of documents that contain a concept designed by game designers in order to be prepared for game developers to get an idea in developing video games that have been designed (Rahayu & Fujiati, 2019). In this study, GDD was made based on the structure of the MDA Framework method. MDA is divided into mechanics, dynamics and aesthetics. Mechanics contains video game titles, genres and topics, video game goals, platforms, ESRB ratings, levels, and concept art. Dynamics contains storyline, characters, game controls, rules, and challenges. Aesthetics are the components (game assets) that produce player responses to the video games we make.

The following is the implementation of mechanics in the video game "Forestor":

1. The video game title

The title for the video game that will be made in this research is in accordance with the plan at the previous planning stage, namely "Forestor". The name “Forestor” will appear in the video game at the start of the main menu (See Fig. 3).

Figure 3. The main menu

2. Video game genres and topics

The genre of the video game "Forestor" that will be created in this research is a combination of the simulation genre and the Role-playing game (RPG) genre, which means that the genre of this video game is in accordance with what was previously planned at the design stage of this video game. While the topic of the video game "Forestor" is the main character who has the determination to help a village so that the village returns to being healthy, healthy in the sense of a green environment free from pollution.

3. Goal

The final goal of the video game "Forestor" underwent a slight change from what was previously planned at the initial design stage, namely the player planting as many trees and plants as possible and keeping the planted trees and plants healthy and not wilting while paying attention to the village's health rating. Trees and plants that are healthy and well cared for will generate money that can be used to buy tree seedlings and other plants. Withered and dead trees and plants will affect the village's health rating, if the health rating reaches zero (0), the game will display a "game over" display.

4. Platform

The platform that will be centered and used by the video game "Forestor" in this game development research is in accordance with the previous plan at the design stage, namely the Windows operating system on a Personal Computer (PC).

5. The ESRB rating

The video game "Forestor" in this study was designed as a game for a rating of E (Everyone) which means the video game "Forestor" is designed to be suitable for players of all ages. The content in the video game "Forestor" does not contain violence and other content that is not suitable for children, so the video game "Forestor" is suitable for players of all ages to play. However, because the "Forestor" video game has not been rated or has not been rated by the ESRB Rating, the rating status is still at RP (Rating Pending) rating.

6. Level

At the game level there is a slight change from the previous plan at the design stage. The game level in the video game "Forestor" in this study is that players must be able to fulfill all planting slots for every available land in order to collect money, the collected money can be used to buy materials needed in the process of keeping trees and plants healthy, as well as to buy the next piece of land in the shop.

7. Concept art

The concept art used in the video game "Forestor" in this study is 2-dimensional (2D) pixel art. Pixel art consists of 2 syllables, namely the word pixel and art. Pixel which means the smallest unit of image on a computer. Pixel art is one of the digital illustrations used in the visual use of a video game, animation, and others (Wijaya et al., 2017). These assets were created using Adobe Photoshop CS6 using the pencil tool. Next is the implementation of dynamics. Here is the implementation of the dynamics in the video game "Forestor":

1. Storyline

As previously planned at the initial design stage, the background story of the video game “Forestor” is In a city full of pollution, the main character wants to return to the village to get some fresh air. But when he got to the village, pollution was everywhere, the situation in the village was very chaotic. The main character talks with the village head there and learns that there have been forest fires and floods in the village due to climate change which is the impact of global warming. So the main character is determined to make the village healthy again by rebuilding the forest by planting trees.

2. Character

The characters in the video game "Forestor" in this study are divided into main characters and side characters. The main character is the character that will be played by the player. At the initial design stage, We planned that the player would only play one main character, namely a male character, but in the end we added an option for the player to be able to choose a character according to the player's wishes, namely in the form of a male character and a female character. A side

character is a character who will support the storyline of the video game, a side character in the video game “Forestor” is a village head character (See Fig. 4).

Figure 4. Character image in video game forestor

3. Game control

As previously planned at the initial design stage, the main gameplay control of the video game “Forestor” is by using a mouse click.

4. Challenge

In this part of the Challenge, there are slight changes from the initial design stage. The main challenge or challenge in the video game "Forestor" is to see how players can manage their own finances in the video game so that they can be used to buy tree and plant seeds, buy further land, buy the necessary tools so that the trees and plants planted do not wither. or die. Here are the details about the challenges in the video game "Forestor":

a) The rarer the tree or plant, the more difficult it is for players to take care of. Difficult to care for in the sense that the needs needed by these trees and plants are more than regular trees and plants.
b) The more land the player handles, the more skill players need in managing in-game money so they don't run out of money to buy tree and plant needs.
c) In the video game there is a collection book, players can collect money to buy seeds to get all types of trees and plants in the "Forestor" video game.

5. Rules

The following are the details of the rules that apply in the video game "Forestor" in this study:

a) Players will not get gold if they do not give according to the tree's request.
b) Players must be careful in using an ax, because even healthy trees will be cut down if the player cuts them down and will result in the village's healthy rating being reduced.
c) If the player does not meet the tree's needs for 5 minutes, the tree's status will slowly enter the unhealthy and unhealthy stage.
d) If the land is full, players must buy new land in the shop to open new land.
e) If pests have appeared on the trees, players must immediately eradicate pests using pesticides.
f) View 2D characters top down.
g) Players cannot plant trees in areas where there are dead trees unless the tree has been cut down.
h) Players will only earn money by meeting the needs of these trees.
i) Trees will only grow if the player has watered 50-100 times depending on the type of tree itself.
j) If the status reaches minus, then the stage will be declared failed and the player will start from the beginning of the game.
k) Players can earn additional gold by selling fruitful plants.
l) Pesticides and fertilizers will only be obtained from quest rewards and purchased through the shop.

Aesthetics which are the components that produce the player's response to the video game that we make. The player response here is generated through the assets in the video game that we created. The following are the assets in the video game "Forestor":

1. Plants and Trees

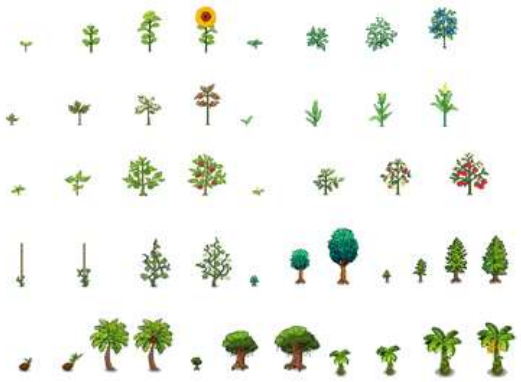

Figure 5. All of the Plants and Trees in the video game

2. Items for sale in the shop

Figure 6. All of the Items in the shop

3. User Interface

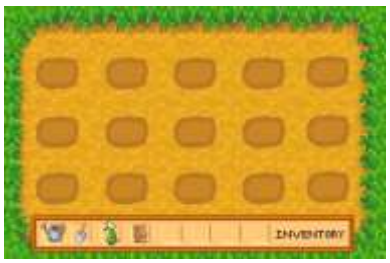

Figure 7. The UI

Some of the assets in the video game "Forestor" were created directly by us and some were taken through the official website of Stardew Valley, namely stardewvalleywiki.com. These assets were created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The following is a breakdown of the use of color for each asset that has been created:

1. Trees and Plants
   a) Bodhi Tree
      This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used for the leaves are #8cc23a, #71ae23, #5e8e21,#4b6e1b, #3d5419, #698333, #26511e, #152d0e, #2a5626 and #34441c. The colors used for the trunk are #7e3f25, #602b19, #a66d41, #cf966a and #3d1e0d. The outline color used is #142e0d.
   b) Palm Tree
      This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used on the leaves are #104f1a, #277027, #5e841d, #7d9d16, #a4b006 and #bfcc1a. The colors used for the trunk are #442417, #664532, #7c5232 and #85634a. The outline color used is #243f29.
   c) Cypress Tree
      This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used on the leaves are #104f1a, #5e841d, #7d9d16, #a4b006 and #bfcc1a. The colors used for the trunk are #442417, #664532, #7c5232 and #85634a. The outline colors used are #000601 and #1c0d07.
   d) Banana Tree
      This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used for the leaves are #2e5914, #4e7e18, #acc84f, #7eab4e, #65951d, #427025, #93c025, #c6e065, #54742b and #7c9635. The colors used for the trunk are #3e4c0a, #3d6c1e, #586b10 and #94ad33. The outline color used is #083401.
   e) Oak Tree
      This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used for the leaves are #0a2c12, #0f5812, #19662c, #29ad51, #ddee9e, #b7eeb9 and #63876a. The colors used for the trunk are #1c1202, #21180a, #3b2d18, #a57942, #ba9669, #907958, #ddee9e and #5f5341. The outline color used is #010b04.
   f) Sunflower
      This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used for the leaves are #316800, #114800, #487910, #66961e, #8ab435, #a0c844. The colors used for the flower parts are

#87a41d, #a2bd18, #d4ea5c, #f29a0f, #feda0f, #e07b0e, #fce400, #6e1905, #a22111, #c54916, #f17d2a, #670e01, #401407 and #57220b.

g) Blueberry Plant
This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used for the leaves are #152c11, #154922, #1e5a2d, #3e9151, #6dc67a and #1c5029. The colors used for the flowers are #f8f3e0, #71615d and #a99e8e. The colors used for the fruit parts are #124362, #18509c, #2c6bbb and #88baf0.

h) Coffee Plant
This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used for the leaves are #485022, #88993d, #647122 and #6d7439. The colors used for the flowers are #f5f2d2 and #b5b07f. The colors used for the fruit are #76231d, #c5535a, #f29a85 and #ffdbb9.

i) Pepper Plant
This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used on the leaves are #487910, #a0c844, #8ab435, #66961e, #4e5b1a and #677330. The colors used for the fruit section are #3f690f, #5c861d, #468738, #9acd71, #2a5228, #82403a, #a11b1c, #ae3626 and #cd8d6d.

j) Tomato Plant
This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used for the leaves are #68892c, #7ca139, #344e1e, #4f6b30 and #446424. The colors used for the fruit are #1e561d, #2a7528, #9c3233, #dd1a21, #ffa485, #b1b459, #d3db63 and #e3ef81.

k) Corn Plant
This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used for the leaves are #257c34, #359045, #61ab47, #9cc659, #81a636 and #c7dd5f. The colors used for the fruit parts are #257c34, #359045, #61ab47, #9cc659, #f2b745, #efdf31 and #f6ed6d.

l) Green Bean Plant
This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used for the plant parts are #3a4e36, #445929, #4b832d, #81ad62, #6c9f42, #435d3e and #374b33. The colors used for the green peas are #89a469, #bbe086 and #abcc65. The colors used for the stick parts are #76613f, #976943 and #a17b51.

2. Tools

a) Shovel
This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used are #c5832d, #e1983a, #e0b378, #db9b48, #6e6d6d, #ffffff, #c2c2c2, #9c9c9c and #d7d7d7.

b) Pesticide
This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used are #3a611d, #82b852, #50842c, #cfe7bf, #f3f7f1, #50842c, #497a27, #bbe290, #6d9f41 and #5b8f34.

c) Fertilizer
This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used are #925033, #a97c3b, #d69b4f, #eac99e, #c5a670, #ebc484, #ffe6c1, #d48354 and 9fc378.

d) Watering Can
This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used

are #2e2e2e, #404040, #58595b, #a6a7a9, #ffffff, #bbbcbe, #d0d2d1, #c8cac9, #8f9092, #95d9f9 and #79caf0.

e) Random Seed (Plant)
This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used are #002f26, #297938, #529b31, #70c725, #1e6144, #004c3c, #173123, #36610a and #7fa12f.

f) Random Seed (Tree)
This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used are #002f26, #297938, #529b31, #70c725, #1e6144, #004c3c, #173123, #36610a and #7fa12f.

3. Collectable items
   a) Gold Coin
   This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used are #f5da48, #fefda2, #94531a, #c17333, #f0c92e, #d69522 and #db9e24.
   b) Silver Coin
   This asset was created using Adobe Photoshop CS6 using pencil tools and a brush used in the form of Hard Mechanical 1 pixel. The colors used are #a8a4a4, #d8d7d5, #e5e5e5, #edeef0, #f9f9f9, #dbdcde and #cecdd3.

DISCUSSION

Video games are currently very popular and are played by people of all ages. More and more people are interested in learning about video game development. When we want to make a video game, of course we have to think in advance what kind of video game we want to make. Starting from ideas, video game genres, gameplay, and others. It's all referred to as part of game design In the game development team, the person in charge of game design is the game designer. Game designer is a person who takes a role in terms of creativity, creativity in designing a game. These ideas are then put into a document called the Game Design Document (GDD). Why is a game design important? That's because the goal of this game design is to determine what kind of game the team wants to make. With game design, all the details of a video game that will be designed are recorded in it. This will be a benchmark for other members of the development team in carrying out their respective roles. Among them are the content of gameplay or logic and the rules that apply in video games that will become a benchmark for game programmers to apply them to programming the video game. In designing a video game, we usually take a number of video game references that are well known and played by many people. That will help us in giving an idea in terms of designing games with the same genre. In this study, we take gameplay references from the game "Plants Vs Zombies" in "Zen Garden" mode. In the video game "Forestor" there will be a conversation between players and NPCs containing information about global warming. The video game "Forestor" which was designed in this research is aimed at education, namely providing information about global warming and providing one of the solutions to overcome it.

LIMITATIONS

Because this research was conducted during the covid-19 pandemic, we experienced several difficulties, including communication problems with the development team and the difficulty of finding samples as player respondents.

FUTURE WORK

We hope that this research can be continued by other prospective researchers with other scopes. The scope can be in the form of making video games that teach other solutions in overcoming the problem of global warming. It can also be in the form of making video games as an educational medium that teaches world issues other than global warming. There are still many problems in this world that we need to be aware of and respond to. Therefore,

we hopes that further research can examine how to make video games that can provide new education for the younger generations.

CONCLUSION

Based on the results of this study, the following are some conclusions that can be drawn, namely:

1. Global warming has brought several negative impacts that affect our daily lives, but we still lack knowledge about global warming and how to overcome it, therefore we have to start taking this global warming problem seriously.
2. In this research, we use the MDA framework method which consists of mechanics, dynamics and aesthetics to create a game design document (GDD).
3. The video game designed in this study aims to provide information messages about global warming. The video game is called "Forestor", with the gameplay of planting trees which is one of the solutions in overcoming the problem of global warming.
4. The video game "Forestor" is expected to attract the interest of the younger generation to play while learning material about global warming and solutions to global warming problems.
5. The result of this research is a game design document (GDD).

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