LAKBAY: HISTORY THEMED 2D ADVENTURE GAME

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ABSTRACT

The study, LAKBAY: HISTORY-THEMED 2D ADVENTURE GAME, aims to provide its players with a fun, new, and interactive way of learning history through a more modern medium of gaming. Using an interesting story, entertaining gameplay and fun music and art, players are able to learn about history. It features four(4) playable characters and five(5) playable levels, each set in a different point in Philippine history with different enemies, goals, and objectives. The game was developed using Unity Game Development for most of the development, which uses C# for most of the backend code such as the physics of the characters and the enemies inside the game. It was made to be played on machines that run the Windows Operating System from Windows 7 to the latest Windows 11. Test results showed that the game could run successfully and performed as it should without any incompatibility problems. The system was tested by 30 evaluators using the standard criterion of ISO 25010 to check for the quality of the software and was rated with an overall rating of 3.49 with a descriptive rating of "Highly Acceptable".

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THE PROBLEM AND ITS SETTING

Background of the study

In the modern world, video games have been a very large part of our daily entertainment. It developed to a point where different organizations and companies are made for competitions and more. It has now successfully integrated itself into society, especially in communication, market, and even as a source of income. According to the World Economic Forum (2019), games possess more than just the power to connect us emotionally. Today, 63% of adult players play with others, often in squads that get together both online and in person. Brought together by servers and matchmaking algorithms, these strangers quickly learn how to work together to achieve a common goal. Needless to say, video games are inescapable in modern society.

On the other hand, due to the emergence of the COVID-19 pandemic, schools around the world have transitioned into digital learning such as online classes. We found a way to teach and learn from school without the need of face-to-face methods. According to the data from DepEd, 4 million students were not able to enroll for the 2021 school year. This figure will keep growing unless there's an upgrade in the educational system, or the government's action to provide funds for students' mobile learning. But even though the number of students enrolled is dropping, the number of active gamers is rising. This led us, the researchers, to think of a way for the two worlds to intertwine. LAKBAY is a history themed side scrolling adventure game designed to inspire gamers to learn more about the history of the Philippines and teach them while enjoying the game.

Objectives of the Study

The general objective of this study is to develop an educational video game. The story and the environment of the game revolve around historical places, figures, and events.

Specifically, it aims to:

1. Design a 2D side scrolling adventure game with the following features:

    a. Single player game.

    b. Simple and classic 2D-game control settings.

    c. Vintage setup of environment, platforms, structures, items, and sound effects.

    d. Five story levels with different objectives or task inspired by events that happened in Spanish Colonial era of the Philippines.

    e. Acquire power-ups that give player the ability to shoot projectiles at different durations.

    f. Uses A* pathfinding algorithm to the movement of the NPC's in the game for pathfinding.

    g. Save and load system to enable the player to come back to the last level played.

    h. Character selection system to let the player choose the character's looks.

    i. Difficulty selection where the player can choose the difficulty of the game. The higher the difficulty is, the stronger the enemy attacks and the more health they have.

2. Create the game using the following tools:

   a. Hardware:

     • Laptop/Desktop Computer

     • At least Windows 8 OS

     • 4GB RAM

     • AMD Ryzen 3 or Intel i3 equivalent

   b. Software:

     • Unity Game Developer

     • Adobe Photoshop/Illustrator

     • Visual Studio Code

3. Test and improve the application in terms of functionality and performance

efficiency, and portability.

4. Determine the level of acceptability of the application using ISO 25010 criteria for

quality software.

Scope and Limitations of the Study

   LAKBAY is a game that is only available for PC. The engine that the researchers used

is the Unity Game Engine and a full-featured integrated development environment (IDE).

Unity Game Engine will aid us in integrating game coding, asset workflow, scene

building, scripting, networking, and more. Additionally, Unity has a built-in physics

engine that can be used to add a variety of potent features. All the levels developed for the thesis project use this physics engine. For collision detection to occur, at least one of the two colliding objects must be given a rigid body. The game is developed only in 2D, and the arts, sprites, and music that are used are purely original and made through Adobe Photoshop and Illustrator or already available for free in the Unity Asset Store. This game only focuses on the 2D Platformer genre of games. The gamification of learning is also a key point in this study. It tackles the era of the Spanish Occupation on the Philippines focusing on only certain events in Philippine history. The information about history comes from the internet but will be validated by a history teacher for accuracy and legitimacy. Data gathering is conducted through pre-tests before playing the game and post-tests after playing the game to note if new information is retained. The target participants of this study are students and gamers that enjoy playing platformers and are limited to 30 play testers/evaluators by using simple random sampling as a method of selection. This study was conducted by the students of BSCS 4AB of the Technological University of the Philippines – Manila from January to May 2023.

The following features of LAKBAY are as follows:

Main Menu – the section that will serve as the game's main user interface, where players can navigate through the different features of the game: Start Game, Settings, and Exit. If they have an ongoing save file, the menu gives them the option to Resume Last Save.

Settings Menu – a menu where players can configure some options of the game such as audio and user-interface scaling. If accessed while inside the game, it would also allow them the option to resume or exit the current run of the game or exit the game to desktop.

Environment Interaction System – allows the players to interact with various entities inside the game, such as certain buttons in doors or movable boxes, allowing them to move them around or use/apply them to other entities in the game.

Power Up Usage System – allows the players to use power ups, allowing them to unlock new abilities for combat or mobility which can be used to help ease or improve the experience of the player during the level.

Save/Load System – allows the player to save the current level, exit the game, and come back to the start of the saved level.

Character Selection System – allows the player to choose the color scheme and looks of the character.

Difficulty Selection System – allows the players to choose the difficulty of the game. The difficulty of the game controls the strength of the attack and the health points of the enemy. The higher the difficulty is, the stronger the enemy.

Power Up Usage System – allows the players to pick-up power ups, allowing them to unlock new abilities for combat which can be used to help ease or improve the experience of the player during the level

Chapter 2

CONCEPTUAL FRAMEWORK

This chapter includes the research-related to the following topics: 2D Platformer Games, difficulties in teaching history, and incorporating games as a way to teach students different subjects in school.

Review of Related Literature

2D Platformer Games

The researchers covered two subtopics in this section. Themed Platformer games and Types of Platformer Games.

Themed Platformer Games

Since the 1980s, when the genre first began to gain popularity, there have been numerous themed platformer 2D games. Some of these may have been childhood memories for some of us because they were popular forms of entertainment, but others of them are eventually forgotten. Initially, platformers took place on a single screen, with the player facing boss battles and/or obstacles while the map remained static on the screen. The first scrolling levels with the playable character seen from a side viewpoint appeared in 2D platform games with the release of Super Mario Bros. The protagonist usually has the chance to obtain new skills or weapons while fighting enemies while climbing ladders or hopping from platform to level. Later, the term was adopted to describe video games in which hopping on platforms was the key gameplay element rather than shooting.

The difference between platform games with themes and those without themes is that the latter lacks a plot, characters, and other elements that can draw players in. It just concentrates on the gameplay, including the mechanics, basic gameplay, and motions. There are currently countless themed platformer games available, but some of them have stood out to players due of their memorable themes.

Super Mario is one of the most well-known platformers with a theme. It is a video game produced for the Nintendo Entertainment System (NES) in 1985 by the Japanese company Nintendo Company, Ltd., according to Britannica. The game includes Mario and Luigi, two Italian plumbers. They have been sent to the Mushroom Kingdom to rescue Princess Peach from the evil King Bowser. The game consists of a number of side-scrolling levels, each of which contains a variety of foes, from wicked turtles called Koopa Troopas to mushroom-shaped Goombas. Players battle Bowser impersonators in some of the stages, which are set in dungeons and others above ground. After the imposter has been defeated, a citizen of the Mushroom Kingdom informs Mario or Luigi that the princess is in another castle. The game ends once Princess Peach is saved and the real Bowser is vanquished.
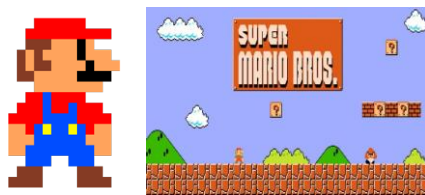
Figure 1. Image of Mario's in-game sprite and the image of the beginning map of Super Mario
Source: FAVPNG.com. (n.d.). Free transparent PNG images. FAVPNG.com.
https://favpng.com/png_view/mario-bros-super-mario-bros-3-new-super-mario-bros-2
png/YxShZ7ar / https://blog.joinknack.com/super-mario-effect

(Hendelmann, 2021) claims that Flappy Bird is another contemporary platformer

game that has generated controversy. It was produced and made available in May 2013 by Vietnamese game developer Dong Nguyen through his company dotGEARS. In this mobile game, you tap the screen to make a pixelated bird fly and dodge obstacles. The bird can fly automatically to the right while still in the air by touching on the screen. If it touches the ground or one of the pipe obstacles, the game is finished. For every ten pipes you successfully clear, you'll get a medal. In December 2013, Flappy Bird began to gain traction as its downloads skyrocketed by 2500%, propelling the game to the top 10 of certain nations' free app charts. On January 17, 2014, Flappy Bird surpassed the popularity of all other free iOS applications. Nguyen also released an Android version of the game on January 24 to kick off the new year. Before it reached the top of the Google Play Store charts, it had been accessible for Android users for a week.
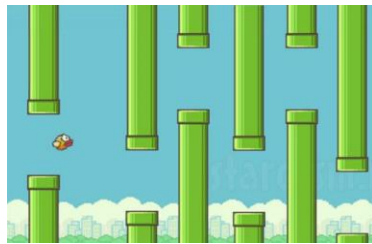
Figure 2. Image of Flappy Bird
Source: Flappy bird - Mini game — Steemit. (n.d.).
https://steemit.com/gaming/@bikalsiwakoti/flappy-bird-mini-game

Types of Platformers Games

According to (Klappenbach, 2021) a platformer, or platform video game, is one in which players control characters who jump or climb through different platforms on the screen. Platformers often have two-dimensional visuals.

Here are some of the basic platform types you'll use when playing or creating games.

- Standard Platform

The common platform serves as the game's framework. There are other variations depending on the game you're playing, but the most common one is that characters can only stand on the top and cannot jump into the bottom. In Super Mario Bros., the default platform can occasionally be destroyed if the character possesses the power up.

- Jump Through Platform

The second most frequent platform (and occasionally the most frequent!) is the jump-through. Because it allows for single-direction bypass, players can jump through the bottom of this platform and stand securely on top. The majority of the games in Icy Tower and Doodle Leap are leap through platformers.

- Slippery / High Resistance Platform

By adding a substance to different platforms, the player's challenge can be altered. The character slides across an icy surface without encountering any resistance. Additionally, these platforms could have a coating of metal, oil, or another substance that suggests low friction. The player's character will move more slowly or have less jumping ability on a different material-based platform, which is an essential control in platform games. This could be caused by high grass, molasses, or any other strange concoction that might increase friction or stickiness.

- Sticky Platform

Some surfaces have enough stickiness to allow a character to defy gravity. Sound Shapes, a fantastic example of this, allows the avatar to roll about upside-down or climb walls on brighter surfaces.

- Conveyer Belt Platform

The goal of altering platform behavior is to place the player in an interesting and

difficult situation. The player relies on reliable character control, therefore adding new factors enhances the experience. The protagonist is automatically pulled in one direction or another, usually in the direction of a hazardous situation. People have used these locations for years to "throw off" overconfident players.

According to Bhosale, T., Kulkarni, S., & Patankar, S. N. (2018), The top-down camera method and 2D front of the scene camera strategy are the two categories of 2D games that are currently available. When using a top-down camera strategy, the player sees the images from the bottom up and can move the camera in all four directions (north, south, east, and west). The player may see the entire level. the. In a 2D front of the scene technique, the camera is positioned in front of the scene. A scene is created by arranging all of the game's pieces to form one. The player only sees the area of the screen that the camera can capture at any given time using this technique.

According to Minkinen (2016), The main feature of games referred to as "platformers" or "platform games" is a player-controlled character who runs and jumps to avoid obstacles and/or to kill enemies. Platformers are regarded as one of the original game genres and are typically labeled as an action game subgenre. Despite being one of the first game genres, platform games have endured in popularity. The two primary types of platformers are single-screen and scrolling ones.

The platformer levels model by Smith et al. is composed of two parts: components and a structural illustration of how these components fit together. They focus more on the internal structure of levels than on how they are represented visually. We classify level elements into five categories based on their purpose: platforms, obstacles, movement

aids, collectibles, and triggers.

Platforms are any obstacles that the player must run across or jump over in order to progress through the level, such as flat surfaces, loops, or the tops of item boxes.

Anything that could injure the avatar is seen as a barrier. Gaps between platforms are likewise recognized as barriers even though they are not actual items in the level.

Any item, such as springs, movable trampolines, or ropes, that facilitates the player's movement across the level is referred to as a **movement aid**.

Objects that grant the player a prize, such as a coin, power-up, or point reward, are known as **collectibles items**.

Any object in the level that changes the state of the level in some way is a **trigger**. A few examples of triggers include switches that turn blocks into currency, buttons that turn on platforms so that players can run across them, and objects that change the behavior of the avatar.

A 2D platform game was created to be used for research investigations on health promotion, according to El Habr et al. (2019). It includes a fundamental aspect of the game and explains how procedurally generated stuff is created. two instances that serve as guidance for suture trials.

According to Khalifa et al. (2019), there are six level design patterns: guidance, foreshadowing, safe zone, layering, branching, and pace breaking. The designs are displayed separately but can be combined or changed to provide a distinctive and fresh

experience. Combining or changing preexisting patterns can commonly result in the creation of new design patterns. These patterns are criteria that might improve player experience rather than requirements for creating a high-quality game. The formalization of these patterns aids in the creation of a developer-wide language and promotes knowledge expansion. Despite the fact that each design is covered individually in this book, combining them together is common.

Difficulties of History teacher in teaching History

The first difficulty is the general one of introducing young minds into the historical study;

the second, the limitations of historical material and the teacher, and third, the previous work in history.

Video Games as Medium of Teaching

According to Brenner-Adams et al. (2017), game-based learning, also known as GBL, has been shown to improve learning in a variety of domains, including critical thinking, problem solving, systems thinking, creativity, and identity development. It refers to the idea of teaching through game-based learning. The fundamental objective of GBL is to give players the knowledge and/or abilities necessary to carry out a task outside of the video game they are currently playing.

According to Boom et al. (2020), video games' historical themes, locales, or narrative components provide excellent opportunities for experiential learning. Their inherently interactive qualities allow for an immersive experience, which promotes a deeper and more thorough understanding of the historical period being shown.

Choi et al.'s (2020) research suggests that playing video games can improve cognitive abilities. It has been found that various video game genres are connected to a range of cognitive processes, including working memory, attention, probabilistic learning, problem-solving abilities, and visuo-spatial function. Examples include the fact that gamers of many genres who play video games frequently were better at maintaining attention. It has been found that FPS players use the top-down attention method to efficiently distribute their attention.

According to Zirawaga (2017), given the nature of history as a subject, it is crucial to provide more modern and developing technology to supplement the main way of instruction. History deals with facts that must be remembered exactly as they are, unlike subjects like math and science that seem to be more important. If history is viewed as a subject with little significance in the world, students may not feel the need to learn in order to comprehend terminology and concepts, instead feeling the need to learn in order to perform well on the exam and forget about the course. It is becoming more and more obvious that enrolling students in such a course is essential to guaranteeing that they retain the information even for future usage. Students will be able to view the course differently if game theories are applied in light of the fact that history provides more than a summary of the past.

According to Tian (2020), the visual effects that complemented the gameplay's main elements led to more positive feedback. More immersive play experiences are likely to be produced when visual effects and game mechanics are combined. They got to the conclusion that fusing visual effects with game mechanics is a good design approach because the visual effects in the game did boost play testers' understanding of the game.

On the other hand, unless the designers wish to convey a specific tone to players, using visual effects for optional game components or purely for decoration should be avoided.

Students are more enthusiastic and motivated to participate in games than they are with a range of exercises, claim Cam et al. (2017). According to the authors, when students use educational games to supplement their studies, they not only learn more but also apply it to their studies. Ersoz (2000) also demonstrates the high level of motivation that comes from playing tough and enjoyable games. When teachers announced that it was time for games, students were excited. In reality, teachers can use games to promote classroom camaraderie or to push and amuse children through competition.

Gamification can be applied in education at all levels, including primary, higher education, and lifelong learning, according to Nand (2019). The authors of a practitioner's guide to gamifying education (Huang and Soman, 2013) outline a five-step procedure:

1) Understanding the target audience and the context

2) Defining the learning objectives

3) Studying the experience

4) Identifying the resources

5) Applying gamification elements.

The length of the learning program, the location of the learning, the type of the learning program, and the size of the class are some important factors to take into account when gamifying learning. Olsson et al. (2015) noted that users frequently experience

loneliness and perplexity while learning in a virtual environment; as a result, visualization and gamification may be used as solutions, however the former performed better than the latter.

Using a videogame to teach a student cannot guarantee learning or engagement on its own, according to Harris, C.A., Mong, & Watson (2011); the teacher must be involved as well. For instance, the teacher must comprehend how the game works, present the learning objectives in advance, choose a game that is appropriate for the curriculum, get permission from the school administration to buy the game, have the game's hardware implemented, and justify its use. The teacher must also be aware of the main purpose for using a videogame.

Games have entertained people for hundreds of years and will continue to do so (Sailer, Hense, Mayr, & Mandl, 2017). The potential of games can be fully realized by applying gamification concepts. The main objective of gamification is to increase engagement (Kapp, 2012; Villagrasa et al., 2014). Low student involvement and a lack of desire are the two major issues that teachers in schools face (Lee & Hammer, 2011). Another aspect of gamification is the intentional use of games to further educational objectives. Video games are used in educational contexts to further learning objectives through a process known as game-based learning (Wiggins, 2016). Game-based learning has been shown to boost student engagement (Wiggins, 2016). A form of game-based learning known as serious games (SGs) has been utilized to instruct material such biology, computer science, commerce, and science.

Gamification, which is referred to as a "growing trend," comprises optimizing and utilizing game principles and elements in contexts other than games, as opposed to just creating a simple game to satisfy players' need for pleasure. To boost the user's motivation and engagement, it takes a lot of effort to combine fun components with the non-game aim. The purpose of this activity is to demonstrate how non-game apps can benefit from the fun and amusement that video games provide (Flatla, Gutwin, Nacke, Bateman, & Mandryk, 2011). Gamification is believed to have the potential to improve user experience by including game aspects while also incorporating the context and lesson provided by the game.

Gamification is an engaging and pleasant method of assisting teaching and learning. It does this by incorporating game elements like points, levels, badges, and leaderboards. With the use of educational opportunities and unprompted feedback, a well-designed gamified lesson gives students a fun experience that reinforces their learning (Bouchrika et al., 2019). This allows students to gradually expand their knowledge. Gamification is thought to enhance all aspects of learning because it has been demonstrated to boost and improve student engagement, motivation, social impact, and academic performance (Zainuddin et al., 2020). Motivation, which is closely associated to learning, is essential to the teaching-learning process' success (Gopalan et al., 2017). It sparks students' interest in the material and encourages them to participate actively in learning activities, both of which boost their motivation to study. Students who reported enjoying school and being satisfied with their learning experiences also had higher levels of academic success and general life satisfaction, according to studies by Huebner Gilman et al. (2009), Martirosyan et al. (2014), and others (Suldo et al., 2014).

An educational simulation is a series of technologies that enable highly engaging, typically two-dimensional, interactive virtual worlds with few variables (Lamb et al., p. 160). These simulations are made to look as real as possible and allow the player to experiment and change the world on the screen. Education simulators are made with learning in a real-world setting in mind, not merely for entertainment. In particular, digital educational games provide a novel method of learning through play and experimentation with diverse ideas and concepts.

Games can be utilized as a teaching tool in addition to being a source of amusement. Particularly in learning complex or overly theoretical material, appealing learning tools can improve the interest of young people or members of the millennial generation. Games can boost student engagement when they are made with learning principles in mind. Learning, engagement, and inspiration. Game-based learning encompasses more than just making games for students to play. Creating learning activities can gradually present the ideas and direct users toward the desired outcome. According to Hamari Research, instructional video games can successfully engage students in the learning process and can be triggered by stepping up the difficulty and inventiveness requirements while playing the game. For game-based learning, there are 11 essential game design elements, including game goals, game mechanisms, game fantasy, and game value, interaction, liberty, story, sensation, difficulties, sociality, and mystique.

Digital games have dominated the world and ingrained themselves in our social and cultural landscape as a result of the rapid growth of technology and life's digitalization. Digital games offer interesting experiences, interactive learning environments, and cooperative learning activities; as a result, their popularity has exploded in recent years.

Digital games are today seen by industries, businesses, governmental agencies, and academic groups as a potent social, technological, and cultural force that cannot be disregarded. The learning of academic subjects might become more student-centered, absorbing, fun, and interesting through games designed to contain educational objectives and subject matter. This would increase learning effectiveness and efficiency. Games are "an engaging, voluntary, and entertaining activity in which a demanding goal is pursued according to agreed-upon rules," according to Kinzie and Joseph (2008).

The relationship between game design and student learning is complex, despite mounting evidence that GBLEs can be an effective teaching tool during the past decade (Clark et al., 2016; Mayer, 2014; Wouters et al., 2013). If a GBLE is designed in a way that provides students the sense they can perform some action in the virtual environment, such as using a virtual object, even while they are unable to do so in reality, they may still believe they have a high level of student agency. According to research (Sawyer et al., 2017; Rowe, Shores, Mott, & Lester, 2011; Snow, Allen, Jacovina, & McNamara, 2015), greater student agency is associated with higher levels of involvement and better learning outcomes in GBLEs, albeit the relationship is not always obvious. It's critical to ensure that gaming mechanisms that provide greater levels of freedom and control, such allowing students to explore an open world environment, still complement the activity's primary learning objectives.

Although COVID-19 has grown, higher education has seen substantial challenges in correctly adopting educational solutions (Sutton & Jorge, 2020; Toquero, 2020; Strielkowski, 2020). As a result, students will continue their education via distant learning (Bozkurt, 2019). the improvement of learning and teaching through the use of

computers, cellphones, and other technologies. To be relevant in the present world, every school must follow the methodology (Barrera, Jaminal, and Arcilla Jr., 2020). Studies have shown that teaching students through the use of games may improve their learning results (Brezovsky, 2019; Wardoyo, DwiSatrio, and Ma'rufm, 2020). Digital games had certain advantages. Memory-based cognitive learning's underlying concepts (Wu et al., 2020). In particular, students who are more internally motivated and have a positive outlook on GBL are more likely to achieve learning goals and feel more satisfaction from participating in GBL (Vlachopoulos and Makri, 2017), which suggests increased motivation for learning students (Auman, 2011).

The use of games as a teaching tool can undoubtedly help to enhance learning and development. Contextual learning aid for in-person instruction. The relationship between game-based learning and social learning theory in the classroom should be explained in professional development (Polin, 2018). Apps that include elements from mobile video games to provide interesting, immersive learning experiences with predetermined objectives are referred to as educational games. These games' designers propose challenges, promote multiple levels of engagement, provide entertaining multimedia, and invite feedback (Denden, Essalmi, & Tlili, 2017). Given how much education has changed society, video games have a significant instructional potential.

According to a study by Chang W. (2009), by using virtual game-based learning, or V-GBL, learning resources, students can gain from efficient learning activities and interesting learning content with problem-solving skills. Both the utility rate of this learning system and the learning capacity of the students can be enhanced. Because of the

V-GBL environment's efforts to embrace a number of gaming subsystems, the interaction models used in the learning activities are improved.

In reference to the effects of various learning methodologies on students with diverse prior learning attitudes, Hooshyar (2021) notes that their findings suggest that an adaptive game may be more effective in improving students' learning attitudes than a standard method. More specifically, when compared to students with lower prior learning attitudes, the adaptive game was able to more effectively raise those students' prior learning attitudes, while students in the control and experimental groups who had lower prior learning attitudes also showed similar improvements in learning attitude.

This study used a qualitative case study approach to comprehend instructor and student perspectives (Stake, 1994). Cases are "specific, unique, bounded systems. [in which researchers] gather comprehensive, systematic, and in-depth information," according to Patton (2002) (p. 447). The research team's specific unit of interest in this study was the high school history course. A group of three with experience in educational technology—two graduate students and a professor—conducted the study. The graduate students were from various professional backgrounds and had previous work experience in K–12, higher education, and corporate environments. Constructivist grounded theory (Charmaz, 2000) served as the methodological guide. According to this theory, research techniques are evaluated by the researchers as they do the study, and emergent questions are chosen to guide and change the research procedures to better match the context of the phenomenon being investigated.

As was previously said, information was gathered through student focus groups, interviews with Mr. Irvine, the teacher, and collection of assignments, field notes, and video recordings of the classes. Student engagement and teaching methods and classroom integration emerged as the two main topics from the data analysis. All of the student focus groups show a consistent level of student engagement and participation.

According to Mr. Irvine, he integrated the game into his classroom through these several key factors.

    1. Teachable moments and focus on learning,

    2. goal orientation, reflection, and position taking

    3. learning to play the game

The case study nature of this study limits the generalizability of its findings. The usage of video games in educational settings can still be guided by these findings, though. Undoubtedly, more investigation is required to pinpoint the ideal methods for integrating video games into the classroom.

A literature review was done before the game was created to determine which gamification model is best for teaching history. Choosing the historical lesson that will be included in the game is the second step. There aren't many papers that cover this lesson, so the tale of General Sudirman was picked. During the Second Dutch Military Aggression, Sudirman was also the first commander of the Indonesian National Army to use guerilla warfare to combat invaders. The final process entails creating the game

screenplay, which covers Sudirman's history, by compiling data from Sudirman biographies. The terms and game elements are listed below.

Table 1

Game Elements of the Study

Game Element	Brief Description
Missions/quests	As the plot progresses, the game will assign missions to the player, who may see them in the top right corner of the screen. The missions can involve meeting a certain character, finding objects, or eliminating adversaries.
Scores	Reflects the player's performance in all quizzes. At the conclusion of the game, the score will be shown and recorded in the leaderboard.
Map	To investigate the area surrounding Sudirman's location, the player might move around the map. The route taken by Sudirman during the conflict against the Dutch was taken into account when creating the map.
Mini games	For each chapter, there are short tests regarding Sudirman or the events that surround him. The final chapter of the game must be repeated if the quiz question is incorrect.
Background Story	The story of the game will detail Sudirman's early years as well as the occasions that led to his appointment as a general in the Indonesian Army.
Characters	Historical figures who interacted with Sudirman, such as Dutch commanders, Indonesian government officials, or soldiers who fought alongside Sudirman.
Enemies	The player will eventually have to engage the Dutch army in combat in order to advance. Enemies could also be necessary in order to complete a mission.
Items	Items may aid players in moving forward or triumphing in combat. Items could also be necessary in order to complete a quest.
Leaderboard	after the game is over, shows the player's top 12 individual scores.

Note. From "Enhancing Historical Learning Using Role-Playing Game on Mobile Platform" by Kusuma, et al, 2021, (https://www.sciencedirect.com/science/article/pii/S1877050921001083?ref=pdf_download&fr=RR-2&rr=7cc1fffc7abd045f)

The game is created with RPG Pro Maker MV and written in JavaScript. After completion and testing, it is released for installation on Android smartphones. The game-based learning is then evaluated by a quasi-experimental. This study also suggests a methodology for measuring how the suggested learning model affects students' motivation for learning and academic success.

63 people took part in the experiment, with 34 university students and 297th grade junior high school students making up the majority of the participants. Each participant received a random assignment to use a game or the web as a learning tool. Following the random assignment procedure, 31 individuals accessed the internet and 32 used the game.

Before performing the necessary tests to establish the hypothesis, we used Cronbach's Alpha to conduct a validity and reliability test to see if the data we had collected were indeed usable. There are 63 participants in this test, as was previously announced. Following the randomization process, 31 people used the internet and 32 people played the game. We utilized Cronbach's Alpha to conduct a validity and reliability test to see whether the data we had obtained were truly useful before carrying out the necessary tests to prove the hypothesis. As previously reported, this exam has 63 participants.

The data are not normally distributed according to the Shapiro-Wilk test since several of their Shapiro-Wilk scores (Sig.) were higher than 0.05. In order to examine their hypothesis, the researchers must utilize the non-parametric test.

To analyze all data, we use Ranked Analysis of Covariance (ANCOVA) to test hypotheses set 1 and 2.

Games, according to Sharritt (2008), have the capacity to alter how children view learning, transforming it from a job to something enjoyable. To be ready, teachers and game creators must have a solid understanding of the actual learning process.

The commonly accepted notion that interactivity is a crucial element of media-based learning is emphasized by Carriazo (2007). Their research clearly shows that teaching through games is much more effective than teaching from textbooks, despite the fact that their findings do not support this theory. This is because learning through games is more fun than learning in a traditional way, like by reading textbooks.

In reference to the effects of various learning methodologies on students with diverse prior learning attitudes, Hooshyar (2021) notes that their findings suggest that an adaptive game may be more effective in improving students' learning attitudes than a standard method. More specifically, when compared to students with lower prior learning attitudes, the adaptive game was able to more effectively raise those students' prior learning attitudes, while students in the control and experimental groups who had lower prior learning attitudes also showed similar improvements in learning attitude.

The information provided is based on data from Bourgonjon (2013) and highlights several important issues that impact teachers' willingness to use games as teaching tools. The most important thing to note is that change appears to be largely driven by teachers' assessments of how applicable video games are to their teaching methods. As a result, it may be argued that a model designed to describe and forecast the adoption of commercial

games by secondary school teachers should consider both utility and learning potential. Such a model should allay teachers' concerns over the challenge of using games in the classroom, even though its relevance to the other features is still unknown.

Using Games/Entertainment as a way to teach History.

The data used to support the information comes from Bourgonjon (2013) and reveals several significant concerns that affect teachers' willingness to employ games as teaching aids. The most crucial point to make is that instructors' assessments of how video games fit into their teaching strategies appear to be substantially responsible for the change. It might be claimed that a model created to characterize and predict the uptake of commercial video games by secondary school instructors should take into account both usefulness and learning potential. Even though its applicability to the other elements is still unclear, such a model should ease instructors' worries about the difficulties associated with using games in the classroom. According to Admiraal, pupils were more interested when given assignments that required competition and activity as opposed to simply walking around the entire city and learning things that way.

Games can be an effective teaching and learning technique, according to Ardito. According to him, a game must be fun for the children to remember the material because learning something fun makes it remembered. He continued by saying that playing games often calls for multiple talents to be used at once, which can aid in skill improvement. He concluded by saying that a game should promote relational activity that promotes group engagement, encourages collaboration, and helps resolve conflicts.

Manas claims that strategy games provide great teaching tools for history due to their

various advantages. The main idea behind these games isn't the realism of the pictures they show, but rather the game rules, which regulate how far a player may proceed in the game and aid in the learning process.

According to Barr (2018), it's important to make the game enjoyable for the students so they would engage with it fully. This is because, when it comes to educational games, kids tend to know they are playing for learning and not enjoyment, which often stops them from engaging with the learning.

According to Admiraal (2011), digital games, whether or not they use location-aware technology and mobile devices, have the potential to revolutionize education and challenge the generally held belief that games are nothing more than "mere entertainment.' The majority of young people today have completely different attitudes toward education that they do toward their video and computer games. On the other hand, that is precisely the mindset we want all of our students to have: one that is interested, competitive, cooperative, results-oriented, and actively seeking knowledge and answers. Therefore, it makes a lot of sense to attempt and combine the educational material with the fun and inspiring qualities of games. A motivated student demonstrates a strong interest in and enjoyment for what they are doing.

Based on Waninger, others believe that traditional education should be able to adapt to technology and maximize the way gamers think, but aside from this, the educator themselves should be aware of whether using video games to teach their students would be the most effective method and whether they would fit into their curricula.

Ritterfeld (2005) implied that the enjoyable nature of game play offers sufficient

internal incentive for persistence and, ultimately, learning. By allowing for explicit

education goals, purposeful and incidental learning – which may include complicated

problem solving – can be facilitated. Additionally, including a reward system implies that

learning must be intentional, and that the education aim must be clear. As was already

mentioned, playing games for reinforcement can help with practice, but cannot help

someone overcome problems.

   According to Squire, simulations instructional value is often found in the simulation

experience rather than in the program itself. The generation of the kinds of

understandings that educators might want is not guaranteed by simply deploying a

simulation. Instead, instructors should provide students the chance of reflect and debrief,

and the amount of time spent doing so should be equal to the time spent playing games or

participating in simulations. Instructors play a significant part in the process by

encouraging collaboration, encouraging reflection, and organizing extension activities.

Unity as the platform used for Game Development

According to (Dave A., 2022), there are 11 key benefits for using Unity in Game

Development. Those 11 key benefits are the following.

Table 2

Key Benefits and Description

Key Benefits	Description
1. User Friendliness	It is simpler to use Unity than other technologies. Other problematic technologies become more challenging when used.
2. Compatibility with Several Platforms	Unity is compatible with a variety of operating systems, including Steam, iOS, PCs, Macs, Android, and gaming consoles. Because of this, Unity makes it simple to design a wide range of games for different platforms and a variety of game levels.
3. Online Tutorials	The abundance of tutorials and training videos available online for every student is the best feature about Unity. With enough practice, Unity may be used to construct even small and straightforward games.
4. Availability of the Rich Asset Store	A vast variety of textures, pre-made 3D models, original animations, sounds, programming languages, and object modeling, such as a picturesque backdrop, a well-known character, a building, etc., are available to game creators through the Unity Asset Store.
5. Multiplayer Gaming	Some of the most popular multiplayer games are made with the Unity engine. The platform's many features encourage developers to produce top-tier games for online users.
6. 2D Game Development	Despite being mostly used to create 3D games, Unity also provides capabilities for creating 2D games. A plethora of assets and a built-in 2D engine in Unity's most current version make it simpler for developers to produce 2D games.
7. Community Assistance	Help is always available from the Unity developer team. More than 2.5 million developers currently use the Unity programming language, and use is rising quickly.
8. Access to both Free and Pro Version	Both the commercial and free editions of Unity offer a wide range of functionality. You can select the free edition to showcase the most important features.
9. Top-Notch Graphics	For its outstanding, cutting-edge graphics, Unity is recognized. In order to enable the development of beautiful games, the game engine provides a wide variety of interesting tools and rendering technology that is very versatile.
10. Less Coding	Beginners who want to start game creation as a hobby or job can do it with Unity. Even though it employs Boo, JavaScript, and C#, you can still create games without writing any code.
11. Debugging	During gameplay, every game variable is visible.

Note. From "Why choose Unity 3D for your next game development project?. What

Makes Unity the Best Game Development Platform?" by Dave, A., 2023

(12https://www.mindinventory.com/blog/unity-3d-game-development/)

Design and Implementation Visual Environment of 2D Puzzle Platformer Computer

Game: ASCENDER

The researchers created the single-player, 2D puzzle-platformer PC game ASCENDER based on literature, using the Unity game development engine. Ocean, a teenage girl born without arms or legs, the professor, and Sky, the main playable character, are on a quest to gather resources that will be required to outfit Ocean with artificial arms and legs in the exploration mode of the Ascender video game, which is set in a large underground cave that the Indonesians called "Goa." Sky is a canine-sized, bipedal robot helper.

Making a focal ground based on the design curve level plan that the game designer had provided was the first step in the process of producing their storyboard. The creator of the game was using a drawing. In order for the artist to comprehend and create the set environment appropriately, the game designer used a sketch of the fundamental components that was as straightforward as feasible.
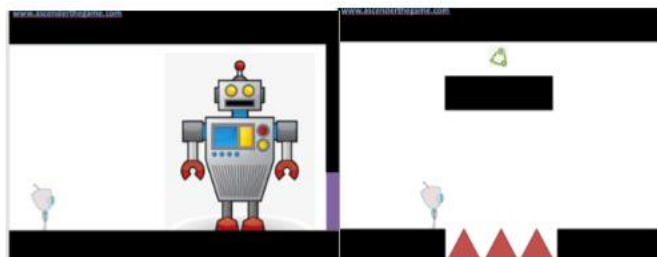
Figure 3. Simple Level Design Drawing by Game

Designer

source: https://www.jstage.jst.go.jp/article/adada/21/1/21_73/_pdf

The main robot character is the little robot on the left in Figure X above, while the huge robot is depicted in the image on the right as a non-playable character (NPC). A mission may start as a result of dialogue between the main character and an NPC. AIR, a large workshop in a warehouse where all the artificial intelligence robots receive their operational license after finishing the assignments, is where this scene is set. The Warehouse is a huge space filled with rusted high-tech components. An environment artist made a storyboard that concentrates on the main ground (focus ground) to help viewers visualize this setting. The most crucial tool for visualizing recreation on any project, including a game, is the storyboard. Making the game storyboard enables the entire game production team to organize and develop all of the game design's components, in addition to assisting the visual artist in organizing and improving game assets. Scene each scene, a pencil was used to draw the game's storyboard on an A4-sized piece of paper. The developers of the game use this A4 size, which corresponds to one block map area in Microsoft Office Excel Format, to estimate the length of the overall area for each district and the points where they connect to one another. Each district has a different duration depending on the concept. The visual artist connected those storyboards on A4 paper using Excel maps, where each district was separated by a different color, and tacked them to the wall so that the storyboard's visual flow could be viewed and enhanced.
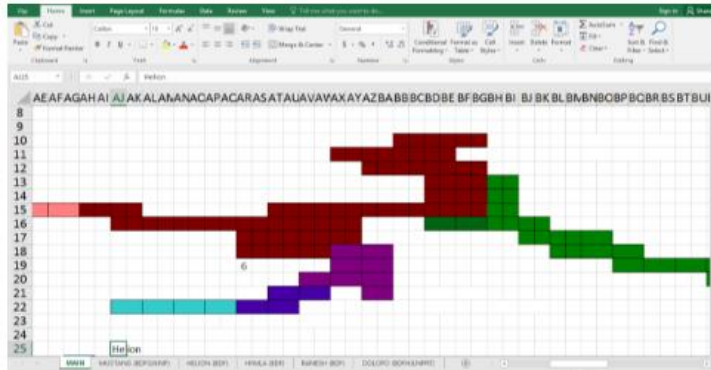
Figure 4. Microsoft Excel Map Format

source: Design and implementation visual environment of 2D puzzle platformer ... (n.d.).
https://www.jstage.jst.go.jp/article/adada/21/1/21_73/_pdf

Each storyboard is approved by the art director before the primary ground is colored

using the concept art's predetermined color scheme. After tidying the storyboard, artists

used grayscale blocking to indicate which areas are dark and light. The major ground

(focus ground) was colored using digital coloring with a resolution of 1600 x 900 dpi in

Adobe Photoshop. On the basis of the grayscale mapping, the artist can start coloring.
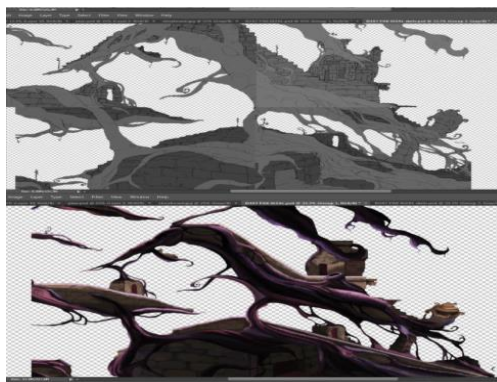
Figure 5. Coloring Process of the Game's Setting

source: https://www.jstage.jst.go.jp/article/adada/21/1/21_73/_pdf

Figure 5 depicts the coloring stage on the primary ground in Everest District. The holy area of Everest is situated in the cold zone, where enormous tree roots predominate the landscape. As a result, cold color was dominant in that area's equivalent color. In addition, to accommodate magical and spiritual feel in the said district, the main color used was cool pallets as purple, reddish brown, and a slight blue and green as complementary colors. The tension of color relationships.

Additionally, a sophisticated coloring process recognizes each object and provides information about the environment's state, such as the presence of rust on steel, grass, plantations, ice, and lava. By incorporating different color tones and color schemes that complement each district's distinctive Goan feature, it is feasible to give each district a distinct personality and enhance the visual experience of the game. For instance, the Mustang District in Goa, which is primarily a rural area and the most productive for growing plantations for food sources, is styled in a brown and greenish color scheme. In games, parallax scrolling is a comprehensive coloring technique that incorporates the main ground as well as the backdrop, foreground, and each parallel layer with variable depths.
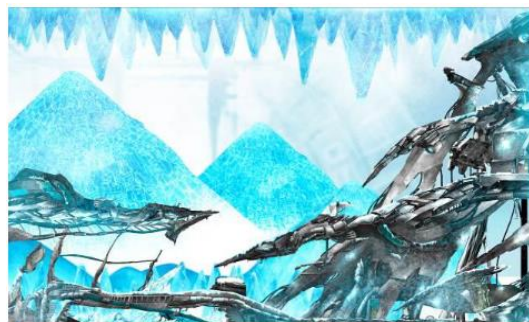
Figure 6. Helion District Final Layout

source: https://www.jstage.jst.go.jp/article/adada/21/1/21_73/_pdf

With the help of the programmer, the entire picture was composed as a visual implementation in the game, where all of the components were joined in each layer to produce a stunning setting with parallax scrolling. The artist needed to make a few minor modifications and adjustments to close the visual parallax gap or just to make the visual environment similar throughout each area in Goa. The environment layout of Helion District, as displayed in Figure 6 above, serves as an illustration of the outcome.

The Development Process of Awang Sains 2D Digital Mobile Game

The development of the 2D mobile video game Awang Sains is covered in this article. The game was played, tested, and evaluated by 15 specialists. The game will be evaluated for its usability, mobility, playability, learning content, local content, language, and aesthetics. The game was created using the features that have been identified. The purpose of this game is to teach and study science in year 4 courses. This article discusses the creation of the 2D mobile video game Awang Sains. 15 experts played, examined, and reviewed the game. The usability, portability, gameplay, educational value, regional value, language, and aesthetics of the game will all be assessed. The features that have been identified were used to develop the game. This game's objective is to promote science education in year 4 courses. This character is designed with Malay looks and is wearing "baju Melayu and songkok". Shown in Figure 7.

Figure 7. Character Sprite of Awang

source: https://www.jstage.jst.go.jp/article/adada/21/1/21_73/_pdf

At this step, an actual game is created by including all the media and technological components that were selected based on the research. The development process for generating software or digital games includes storyboarding, visual design, and programming (Nisa, 2004). During this phase of development, critical teaching and media techniques will be used, and students will also review the papers (Umar, Abdul Rahman, Mokhtar, & Alias, 2011).

The software for this game should be created with the characteristics of a teaching tool that blends enjoyment and learning. Kassim, Nicholas, and Ng (2014) contend that multimedia-based learning must be adapted to meet the needs of the students. For digital video games to be entertaining and instructive, they need to have mechanical elements such graphics, plots, prizes, appropriate music, and obvious academic content and abilities (Plass et al., 2015). The game's software should be developed with the qualities of a teaching tool that combines fun and education. According to Kassim, Nicholas, and Ng (2014), multimedia-based learning must be customized to the needs of the learners. Digital video games need to contain mechanical components such images, plots, prizes, appropriate music, and obvious academic content and talents in order to be enjoyable and educational (Plass et al., 2015).

Pathfinding Algorithms in Game Development

Pathfinding is a plotting node used by computer programs to identify the shortest or simplest path between two points or from source to destination. Pathfinding is essential to several important applications in the fields of video games, robotics, crowd simulation, and GPS. The use of pathfinding algorithms in video game creation is highlighted in this article. Pathfinding techniques are used to help the agent or non-player character find a

way from the starting point to the goal destination. One of the key elements in creating a more realistic non-player character in a video game is pathfinding. When the non-player character in a video game is sufficiently lifelike, the experience can be enjoyable and enjoyable. However, the primary problem with video games is the need for the best non-player character pathfinding. Finding appropriate pathfinding for agent movement in a video game is a typical issue, according to Garham, who supports this claim. Pathfinding can be applied in static, dynamic, or real-time environments. The procedures or methods used to select a path in a video game are known as pathfinding algorithms.

Pathfinding algorithms were developed to handle pathfinding challenges, such as those brought on by the Dijkstra, A*, genetic, and ant colony optimization methods. In order to discover the shortest path between two nodes, pathfinding algorithms are employed to solve the shortest path issue and the best path. The A* algorithm has been applied to a variety of video game genres, including turn-based strategy games, racing games, and real-time strategy games. One of the problems that Hart, Nilsson, and Raphael's A* algorithm was created to answer in 1967 was pathfinding in a video game. The Non-Player Character (NPC) uses pathfinding to guide between two node sites in order to capture the player character.
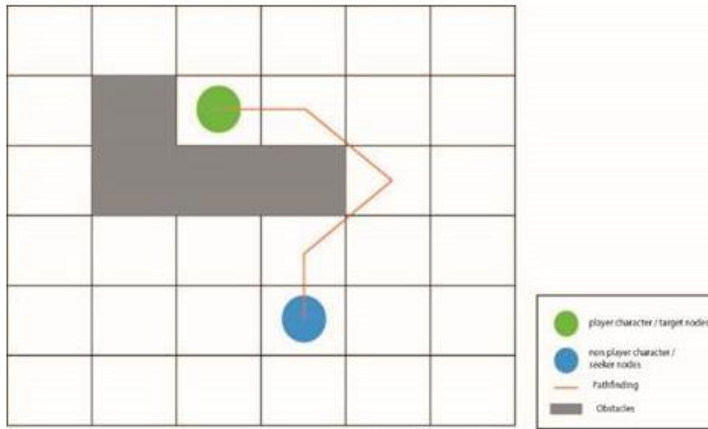
Figure 8. A* Algorithm

source: https://iopscience.iop.org/article/10.1088/1757-899X/769/1/012021/pdf?fbclid=IwAR22k9w2sl1gTICSV4i12J6az4BhgiuFCSreyo57qU8GxEtHqFnn9y1-_Mk

The A* algorithm always tries to do pathfinding by looking into the lowest value or path in order to discover the best minimum response. A heuristic function is used by the A* algorithm to determine the lowest path. The algorithm can estimate the path rapidly and precisely thanks to the heuristic function. The A* algorithm's advantage is that its logic and flow are relatively simple to comprehend. The A* algorithm has long been preferred by programmers to resolve pathfinding issues due to its simplicity. This is so that the A* algorithm can identify the shortest path to the minimal solution. f(n), a heuristic function, is used by A* to identify the node. The value of the function $f(n)$ is:

$f(n) = g(n) + h(n)$

Equation X: Function $f(n)$

The price needed to go from a beginning node to a target node is called g(n). The cost to get to the target node will be calculated by g(n). Heuristic value h(n) is an estimate from source node to target node. f(n) will estimate and choose the least expensive option to produce a good outcome if the grid contains barriers. When h(n) is zero, the A* algorithm transforms into Dijkstra's algorithm, which will always discover the shortest path.

Side-Scrollers refers to 2-dimensional games where the characters or objects progress sideways, generally seen through a side-view camera angle, thus, the term "side"-scrollers. Some examples of famous side-scrollers are Metal Slug, Super Mario Bros., and Castlevania.

Game mechanics refers to the set of rules in which the game is played. This includes player movement like jump height, sprinting speed, and gravity. This can also include object interactions such as collision type, collision model, friction, and more.

Assets are premade objects that can be used to create prefabs in the developer. These are simple objects like texture, shapes, animations, and more.

Prefabs are objects made in the developer that will be used repeatedly as a preset. Prefabs are used to avoid repetition of work and to standardize the design and mechanics of the objects in the game. For example, a rock, platform, box, enemy model, etc.

Skyblock refers to the outermost background of the visuals in the game. Skyblocks are most of the time, pictures of the sky, space, indoor venue, cave, and more.

Mobs/NPC's (Non-Playable Characters) are characters in the game aside from the one that the user controls. Mobs are usually background characters that the player interacts with in the game to progress the story.

Conceptual Model of the Study

Based on the information gathered from related studies and literature, a conceptual model was formed, as illustrated in Figure X.
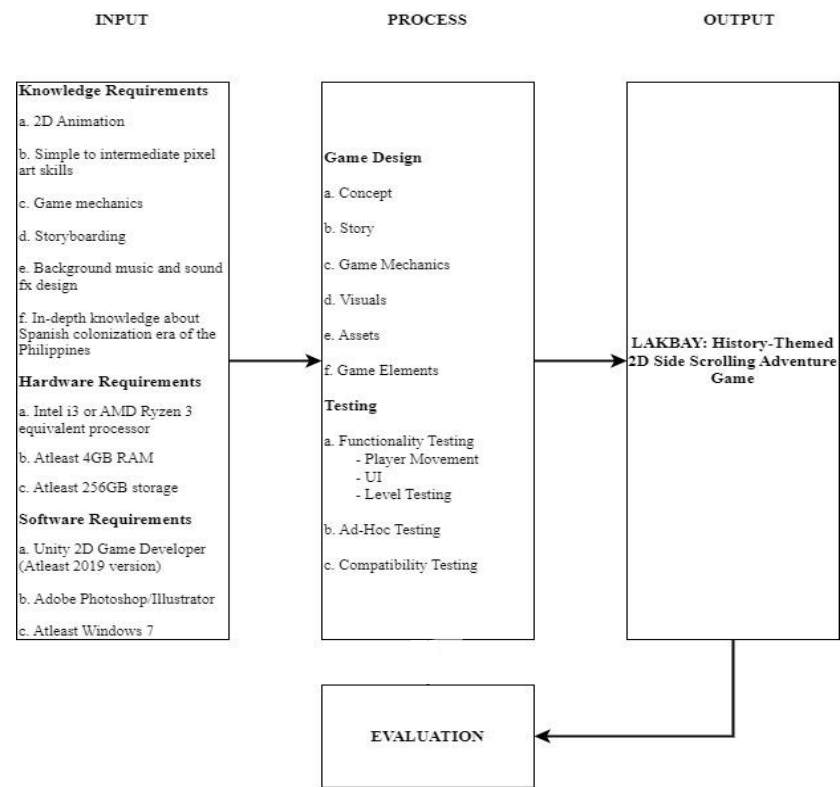
Figure 9. Conceptual Model of the Study

Input

The input section consists of three requirements: Knowledge, Hardware, and Software Requirements. Knowledge requirements features basic C# and Unity programming, basic pixel art skills, knowledge about game mechanics specifically on 2D side scrollers, storyboarding, and lastly, knowledge about the Philippine history from the Spanish occupation. Hardware requirements on the other hand consist of only two things, a capable laptop or desktop and a proper internet connection. Lastly, software requirements consist of Unity Game Developer for making the game, Adobe Photoshop, or Illustrator for editing the visuals, and at least Windows 7 OS needed for both programs to run.

Process

The process section defines the stages of system development for the study. The first part of the process is Game Design, which is divided in five parts, namely: Concept, Story, Game Mechanics, Visuals, Assets, and Game Elements. Which then leads to the Testing procedure, which features three phases: Functionality Testing, Ad-Hoc Testing, and Compatibility Testing. All of the processes are discussed further in Chapter III Methodology.

Output

With the input and process stated above, the output of the model is "LAKBAY: 2D Adventure Side Scrolling Game", which is put through evaluation involving volunteer respondents. The game is evaluated based on its functions, playability, and general performance.

Operational Definition of Terms

The following terms are defined operationally to better understand the system and the game.

Obstacles are intentionally placed on game terrain that makes it harder for the player to continue forward. Obstacles are usually placed strategically to push the limits of the player's movement, sometimes requiring power-ups to complete.

Power-ups are items that give a temporary competitive advantage or new skills to the player. It is used to help defeat enemies or get across a difficult obstacle that usually cannot be completed without such boosts.

Projectiles refers to the damaging objects the enemies shoot out. Projectiles are meant to harm the player and is to be avoided, but there is a power-up in the game that allows the player to shoot, damaging enemies instead.

Objective is an item or destination that is needed to retrieve, reach, protect, or destroy in order to accomplish the mission. Objectives differ from stage to stage, and there can be multiple objectives in a single level.

Interactable Objects are objects that the player is meant to interact with. Examples include opening a chest, acquiring a key to open the door, destroying a crate or a vase, and more.

Chapter 3

METHODOLOGY

This chapter presents the project design, project development, operation and testing procedures and evaluation procedure. This section of the study demonstrates how the application was designed and developed, as well as how the researchers executed and tested the program.

Project Design

This section discusses the system functionality, game design, and how the game was made. As said in the objectives of the study, the game was made using Unity Game Development which generally uses C# programming for the back end. The back end is generally used to tweak game mechanics such as player movement, collision, object interaction, customization of assets, and overall functionalities. The front-end on the other hand includes level design, text/speech prompts, customization of menu, and addition of sound effects and background music.
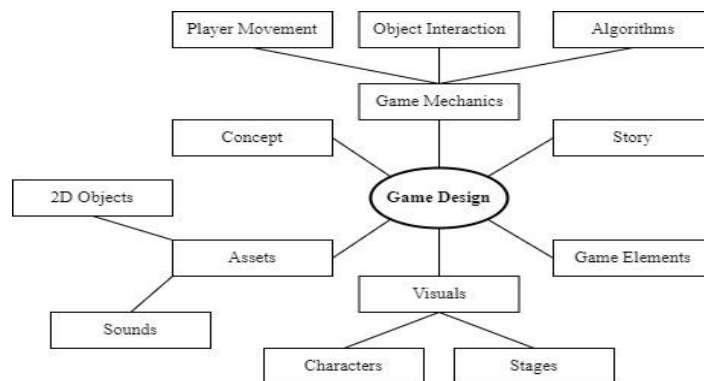
Figure 10. Game Design

Concept

A. Type of Gameplay – There are many types of 2D game genres. Specifically, LAKBAY is a side-scrolling platformer. The game is played solely from a side-view camera angle, in which the player can move left, right, up, and down. The camera follows the character in the frame as it progresses through the map.

B. Objective – The objective of the game, generally, is to move the player from point A to point B, point A being the starting spot where the mission is given, and point B being the end point where the mission is completed. Specifically, LAKBAY gives users specific missions (Ex. finding an object/character, defeating specific boss, maneuvering through an obstacle, etc.) to accomplish in order to progress the story while avoiding or destroying enemies in the way, and searching the end point to move on to the next chapter.

Story and Game Elements

The story of the game features five chapters/levels, each with its own different stories and missions to accomplish. The player must complete the preceding level before continuing to the next one, otherwise, the level will not be unlocked.

Setting – The main setting of the story is the 18th-19th century era of the Philippines where the Spaniards colonized the country. Each chapter of the story features different significant places and events that existed in real-life (Ex. Battle of Tirad Pass, Declaration of Freedom in Kawit, etc).

Table 3.

Story and Game Elements

Level Title	Stage 1: Ferdinand Magellan's Voyage		
Location and Description	Ferdinand Magellan's Ship (Trinidad), Year 1519, F. Magellan was on his way to the Philippines unknowingly thinking it was Spice Island.		
Plot Device	Magellan's Compass - This is what drives the course of the voyage.		
Characters	Main Character		
Background Music/Sound FX	Smooth sailing music with the sounds of the sea.		
Mobs and Abilities	Evil Drones - Melee Attack	**Role**	Main Villain's henchmen.
Objective	The Villain is trying to steal Magellan's compass, his only tool to navigate in the unknown waters of the Pacific in order to get to the "Spice Island". Destroy the enemy drones on the way to secure the compass before they get to it.		
Level Title	Stage 2: Sandugo		
Location and Desciption	Tagbilaran, Bohol, Year 1565, Legazpi and Sikatuna are on their way to meet to perform the blood pact to "seal their friendship" as a form of tradition.		
Plot Device	Sandugo Cup and Knife - The cup and knife that they used to share their blood for sandugo.		
Characters	Main Character		
Background Music/Sound FX	Tribal music with the sounds of the jungle.		
Mobs and Abilities	Minions - Bash/Melee Attack	**Role**	Main Villain's henchmen.
Objective	The Villain is trying to change the course of history by preventing Sandugo to happen. He already stole the knife and is on the way to steal the cup. Destroy his minions to make sure the cup is secured and retrieve the stolen knife.		
Level Title	Stage 3: First Print of Jose Rizal's Noli Me Tangere		
Location and Description	Berlin, Germany, Europe, Year 1886, Rizal finally tries to have Noli Me Tangere printed in Berliner Buchdruckerei-Aktiengesellschaft at Berlin		

Plot Device	The first ever papers of Noli Me Tangere, Jose Rizal's book that criticizes the Spanish Government officials and the priests that abuses their powers.		
Characters	Main Character		
Background Music/Sound FX	European inspired instrumentals.		
Mobs and Abilities	Evil Drones Mk.2 - Shoot homing fire balls.	**Role**	Main Villain's henchmen.
Objective	The Villain is trying to reduce Jose Rizal's significance in the chain of events by destroying his most prized work, Noli Me Tangere. Defeat all the enemy drones that are trying to burn the manuscript.		
Level Title	Stage 4: Execution of Rizal		
Location and Description	Fort Santiago/Bagumbayan, Year 1896, Jose Rizal was set to be executed in Bagumbayan.		
Plot Device	Jose Rizal's Death was one of the key events that led to the eventual Himagsikan.		
Characters	Main Character		
Background Music/Sound FX	Tense, marching music that invokes climax.		
Mobs and Abilities	Evil Drones, Minions, and Evil Drones Mk. 2 Shoot/Bash	**Role**	Main Villain's henchmen.
Objective	After failing to make Jose Rizal insignificant to the Revolution, the Villain now will try to abduct Rizal and prevent his assassination in Bagumbayan to change the course of history. The main character has to make the hard decision to let things happen as they did in history and prevent the Villain from interfering.		
Level Title	Stage 5: The Treaty of Paris		
Location and Description	Hôtel d'York, Paris, France, Year 1898, The Treaty of Paris was held, giving the United States in control of the Spanish Colonies in the West Indies, and ending their long war.		
Plot Device	The Treaty Papers, this is what drives the course of the current events.		
Characters	Main Character		
Background Music/Sound FX	8-bit futuristic and high paced music.		
Mobs and Abilities	The Villain - Slash	**Role**	Main Villain

Objective	As a last ditch of effort to change the course of history, the Villain tries to alter the events of the 1898 Treaty of Paris by destroying the paper and preventing the agreement. To make sure the history stays where it is supposed to be, the player needs to defeat the boss, the Villain, himself, and prevent the destruction of the papers.

Game Mechanics

LAKBAY is a game focused more on movement and the player working his way through the obstacles set in the level. There is optional combat in which the player can just dodge projectiles without destroying obstacles and enemies. The game also features keys and a chest system that holds most of the objectives, enabling the player to move on to the next one.

A. **Player Movement** – The most crucial mechanic in a 2D side scroller is player movement since most of the gameplay is about moving past through obstacles. The parameters used in the game developer are as follows: Player speed = 4, Jump height = 13.6, Gravity Coefficient = 4.5, and the Collision box of the player spans from head to toe vertically, and elbow to elbow horizontally.

Table 4.

List of Controls and its Functions

Function	Key	Description
Move Right	D	Player will move to the right.
Move Left	A	Player will move to the left.
Jump	W	Player will jump.
Interact	G	Player will interact with the nearest object (chest, door, etc.)
Fire/Shoot	G	Player will shoot projectile forwards.
Pause/Menu/Back	P	Pause the game and open the pause menu. In menu selection, pressing this key will make the selection go back
Navigate/Select	WASD & Space Bar	While in the menu, the user is shown options that direct them to selected choice. Navigating is done by pressing directional keys which are the "WASD" keys; W for up, A for left, S for down, and D for right. To lock-in a choice, the user is to press the "Space Bar".

B. **Object Interaction** – Objects, such as crates and more, can be pushed in order to
   create platforms to get past obstacles. There are also objects that need to be picked
   up in order to progress the story or open chests that hold important items in the
   game.

C. **Algorithms** – To randomize the experience of the user and not make the gameplay
   repetitive, the game uses two algorithms: A* algorithm for pathfinding and
   Procedural Generation. Power-ups and lesser stationery or hovering enemies are
   placed randomly all through-out a stage map using procedural generation. A*
   Pathfinding Algorithm is a popular and commonly used search algorithm in video
   games. A* finds the shortest route to the target location one node at a time.
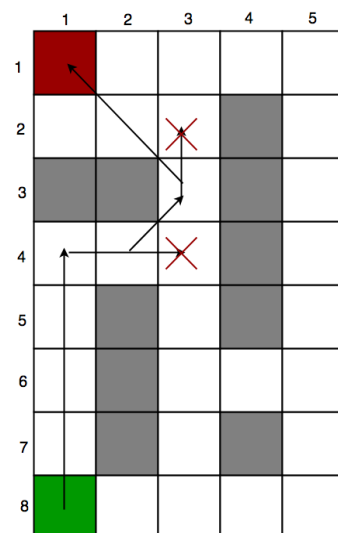
Figure 11. Visualization of A* Algorithm.

Each step it picks the node according to a value - 'f' which is a parameter equal to the
sum of two other parameters – 'g' and 'h'. At each step it picks the node/cell having the

lowest 'f', and processes that node/cell. We define 'g' and 'h' as simply as possible below:

g = the movement cost to move from the starting point to a given square on the grid, following the path generated to get there.

h = the estimated movement cost to move from that given square on the grid to the final destination. This is often referred to as heuristic, which is nothing but a kind of smart guess. The algorithm doesn't know the actual distance until it finds the path, because all sorts of things can be in the way (walls, water, etc.).
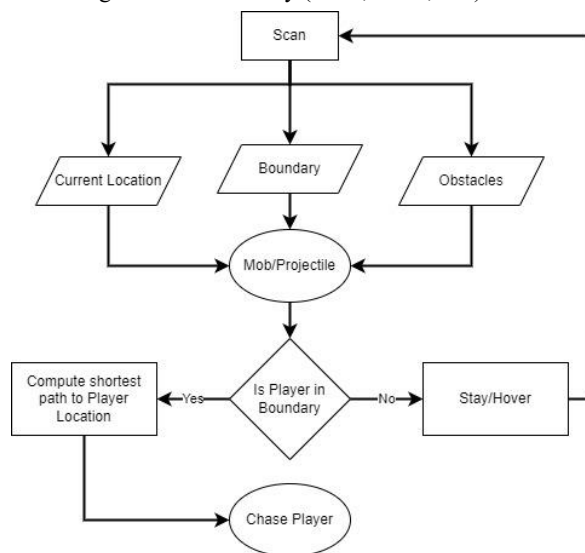
Figure 12. Application of Pathfinding.

As shown in Figure 15, the program will scan for the starting location, the movement boundary (to make sure that the movement will be localized to the designated area), and obstacles. If the player enters the vicinity of the boundary, the program will now start to find the shortest path to the target (the player) which will prompt the chase. If the player

leaves the boundary, or is not present inside the boundary, the mob will either hover

around or be stationary depending on its type, which will reset the process.

Visual

As the game is inspired by the 18th – 19th century era inspired, the buildings, objects,

and characters in the game mostly sport a vintage look, in exception to the main character

and its contemporary enemies.
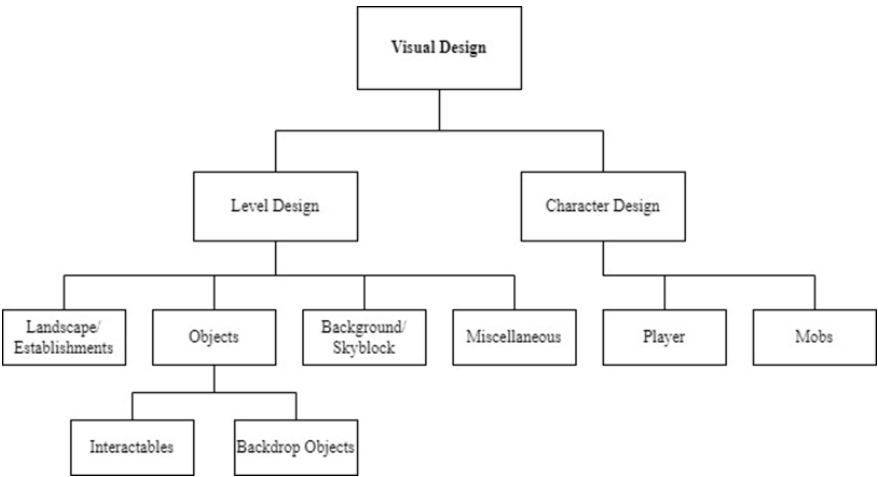
Figure 13. Visual Table of Content Design

A. **Level Design** – The buildings in the game are wooden and stone establishments. The ground is mostly unpaved roads and the background sports a lot of greeneries. The objects and obstacles present in the game are also vintage, mostly wooden things such as crates, carts, boats, furniture, etc.

Figure 14. Escolta St., Manila in the 19th century.

B. **Character Design** – With the exception of the main character and its adversaries, all the other characters/mobs seen in the game are dressed like people in the 18th-19th century. They generally wear vintage suits and dress for Spaniards, *barong tagalog* and *baro't saya* for Filipino men and women, and appropriate vintage military attire for soldiers.

Figure 15. 19th century European clothing (left), Barong at Saya (right)

Assets

Almost of the assets that are used in the game came from the Unity Asset Store, the majority of which are free. There are also assets that are made originally, specifically for certain levels that heavily features Filipino look to the setting and characters. The assets can be edited and created using Adobe Photoshop and Adobe Illustrator, since they are usually still images and illustrations.

Figure 16. Some of the assets used in the game.
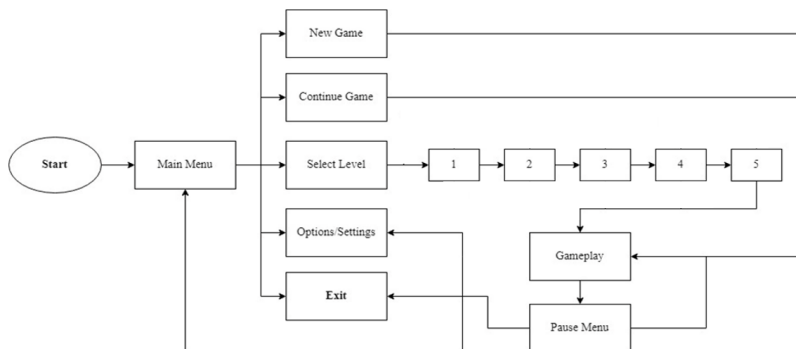
Figure 17. LAKBAY High-Level Interface Diagram

When the game boots up, the player will be greeted by a landing screen, prompting the user to press any key to continue to the Main Menu. The main menu will then feature five

main options: New Game, Continue Game (if save game is available), Select Level,

Settings, and lastly Exit. The new game option will overwrite any saved game

progression and will start the game back to level 1. On the other hand, the continue game

option will move the player to the last checkpoint/level played (if save game is available).

Next is select level in which the user can choose what specific level he/she wants to play.

This will also overwrite any saved game progression and will start the game on the

selected level. Then, the settings, where the user can customize the game experience. The

user can adjust music volume, FX volume, resolution, and more. And lastly, the exit

which will terminate the program and close the window. When the gameplay is ongoing,

the user can prompt the pause menu, in which he/she can access the settings and exit, and

can also go back to the Main Menu, saving the current progression of the game.

Project Development
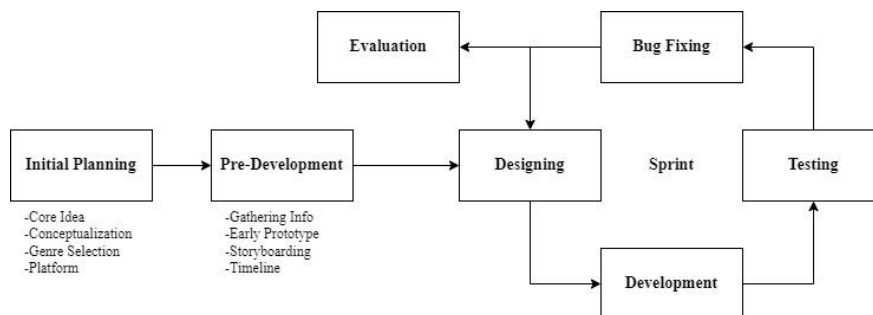
Figure 18. Agile Development Model of LAKBAY

The researchers utilized a method called agile methodology, in which the researchers

have a goal set to finish in a specific timeframe. This allows the researchers to finish the

divided tasks efficiently without losing quality, as the model specializes in incremental

changes, in which every iteration is tested.

Process

- Initial Planning – In this phase, the researchers start brainstorming different ideas to form the core idea of the game. This includes the selection of concept, genre, and platform.

- Pre-Development – After the initial planning, the researchers gathered information based on the concept that has been decided. Which was then used to make an early prototype that contains basic mechanics.

- Sprint – Here the researchers divided the tasks and cycle into four phases: designing, developing, testing, and bug fixing. First, the researchers tackled game mechanics, which includes player movement, object interaction, and more. Next is modeling, where prefabs and assets are designed in order to make level designing easier. When all the models are finished, the researchers moved on to level designing, where five levels are designed individually. And lastly, for the finishing touches, are audio and visual assets that are added to the game to improve the overall aesthetic. Each task will be tested for bugs, and overall playability.

- Evaluation – After the sprint is done, the last part of the process is the evaluation, where the game is evaluated by the respondents.

Operation and Testing Procedure
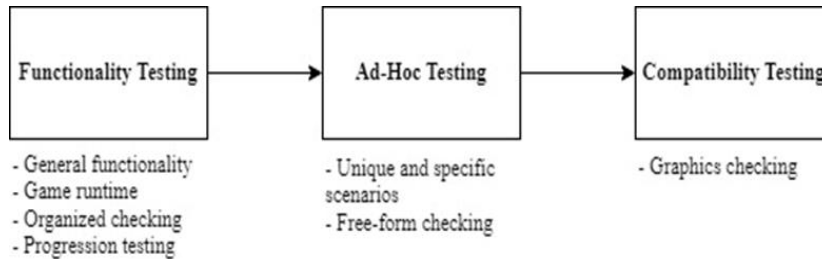
Figure 19. Three-phase testing process

The operation and testing procedure was split into three phases, functionality testing, ad-hoc testing, and compatibility testing. First is functionality testing, where the general functionality of the game is tested. Here the game is tested to see if it works according to the initial specifications, and the emphasis was on the basic elements that must be functional. Generally, the general graphics, UI, sound, and mechanical problems are checked. The game was also checked if it runs from start to finish without break. Second is the Ad-Hoc testing, where the game is tested with the sole purpose of finding bugs and errors. It is a free-form testing, meaning there are no checklists to follow. The difference in this testing is that the player intentionally did things that are not usually done in a normal gameplay in order to catch bugs that are not obvious but still game breaking. Lastly, the final phase, compatibility testing. In this testing, the game is played in various screen sizes. This is to check if the game meets the essential requirements of the software, hardware, and graphics.

Functionality Testing is performed to test the functionality of the features of the created game. It is done to ensure that each feature would function as expected. The following procedures are the steps that were taken to test the functionality of the game.

    1. Identified the functions of each feature.

    2. Checked the input and output required for each specified feature.

    3. Ran the test cases.

    4. Compared the test results with the expected results.

    5. Evaluated the test results to see if it passed or failed.

Table 5

Test Case Form (Sample)

Test Case ID	TCFT-01	UC Reference	
Objective	Press **Directional** keys set by the user in the game ie.(W = Jump, A = Left, D = Right).		
Assumptions/ Preconditions	The game is running, and the player's character is on the field ready for user input.		
Actions	Expected Results		
1. Press W	Player will jump.		
2. Press A	Player will move to the left.		
3.Press D	Player will move to the right		
Status	Passed	Severity		Priority	

The table includes the following information:

1. Test Case ID, a number that uniquely identifies the test case.

2. UC Reference which indicates the required document reference that served as the case's basis.

3. Objective which specifies the test scenario.

4. Assumptions/Preconditions, which are the requirements that must be met prior to executing the test procedure.

5. Actions indicating the required steps to execute the test case.

6. Expected Output which outlines the anticipated outcome of the test; and

7. Actual Results that demonstrate if the application succeeded or failed the test case with the proper severity and priority marks.

Table 6

Functionality Testing Case

Test ID	Objective	Expected Results
TCFT-01	Select Play Game in main menu	Player will proceed to level 1.
TCFT-02	Select Level Select and choose a level in main menu	Player will proceed to corresponding selected level.
TCFT-03	Press D, A, and W in keyboard	Player will move accordingly to the directional representation of pressed keys.
TCFT-04	Press G in keyboard	If player is touching a chest, open, else, player fires projectile.
TCFT-05	Press P in keyboard while in-game	Pause menu will appear and game timer will be paused.
TCFT-06	Deplete all the player's health points	Game Over screen will appear.
TCFT-07	Select Retry in game over screen	The level that the player is currently on will reload.
TCFT-08	Select Main Menu in game over screen	The player will be sent back to the main menu.
TCFT-09	Reach the endpoint/end goal of a level	The game will load the next level.
TCFT-10	Select Exit Game in main and pause menu	The game window will close.

Portability Testing

After the functionality test, the game's compatibility with different screen sizes. This testing is done in order to check if the game has the essential requirements to run in different devices with different screen resolutions and different Windows OS versions. The game is tested in the following resolutions and OS versions:

Table 7

Portability Testing

Test ID	Screen Resolution
TCCT-01	1920x1080 (16:9)
TCCT-02	1366x768 (16:9)
TCCT-03	1280x720 (16:9)
TCCT-04	1024x768 (4:3)
TCCT-05	800x600 (4:3)

Test ID	Windows OS Version
TCCT-06	Windows 7 (64-bit)
TCCT-07	Windows 8 (64-bit)
TCCT-08	Windows 10 (64-bit)
TCCT-09	Windows 11 (64-bit)

Evaluation Procedure

The developed game is evaluated using the criteria of ISO 25010 for Software Product Quality. LAKBAY is evaluated by 30(?) randomly selected respondents composed of students. The evaluation procedure is as follows:

1. Each respondent is provided an assessment form that is used to evaluate the game.
2. The researchers held a short demonstration of how the system works, and discuss the functions, features, and objectives of the game.
3. The respondents are asked to play the game.
4. After playing the game, the respondents are asked to evaluate the game through the assessment form according to ISO 25010.
5. The overall mean rating for each criterion is calculated based on the collected data.
6. The results are evaluated using the mean values in table X and the qualitative interpretation corresponding to that value.

Table 8

Four-Point Likert Scale

Numerical Rating	Adjectival Interpretation
4	Highly Acceptable
3	Very Acceptable
2	Acceptable
1	Not Acceptable

Table 9

The Range of Weighted Mean Ratings and its Qualitative Representation

Numerical Rating	Qualitative Interpretation
3.4 - 4.0	Highly Acceptable
2.6 - 3.39	Very Acceptable
1.8 - 2.59	Acceptable
1.0 - 1.79	Not Acceptable

Chapter 4

RESULTS AND DISCUSSION

This chapter presents the project description, project structure, project test results, project capabilities and limitations, and project evaluation results of the study.

Project Description

LAKBAY is a 2D platform game for PC that offers an entertaining and educational experience of Philippine history. With 5 levels, a captivating plot, interactive item chests, power-ups, and enemies to conquer, players can learn about Philippine history while having fun.

The PC game currently supports computers running at least Windows 7 or above. The application was developed using Unity Game Development for most of the development, which uses C# for most of the backend code such as the physics of the characters within the game.

Project Structure
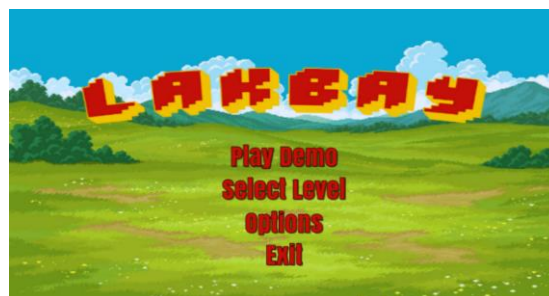
Figure 20. LAKBAY Main Menu

Figure 20 shows the landing screen. This is the first thing the player sees when the player opens the game. The player is greeted by a Main Menu with four options: Play Game – which will automatically load the player into the very first scene and stage; Select Level – where the player can choose which level/stage they want to play; Options – where the sound effects and music settings are found; and lastly Exit – which exits the game and closes the program.

Figure 21. Select Level Screen

Figure 21 shows the Select Level screen, this screen allows the player to select which level they want to play without having to start from the beginning all the time. Once the player picks, the game will load the corresponding level bypassing the ones before it.
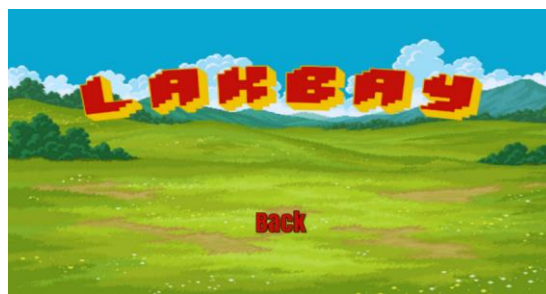
Figure 22. Options Screen

Figure 22 presents the Options screen to the user. This screen allows the user to fix aspects of the game to their liking. The option menu features sound effects and music switch, which they can turn on/off.
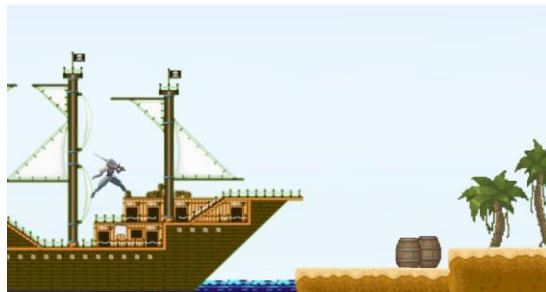
Figure 23. Level 1

Figure 23 shows the landing spot of the first level of the game. The player is spawned on a big wooden ship, representing Trinidad, one of Magellan's Ships. The level is mostly set on an island and coastline setting, where the ground is sand, and the trees are exclusively palm.

Figure 24. Level 2

Figure 24 shows the Second playable level: Level 2 – Sandugo. The level is set on the
inside the island of Bohol. Here, vegetation is noticeably greater than the previous level,
the reason being this is inside of the island. The level also features lots of wooden
furniture, houses and other Spanish Era things as decoration.

Figure 25. Level 3

Figure 25 shows the third playable level: Level 3 – First Print of Jose Rizal's Noli Me
Tangere. Unlike the earlier two, the story of Level 3 is set on the city of Berlin, Germany.
The environment is noticeably much more different than the first two because of the fact
that at the time, Berlin is much more advanced than the Visayas islands, showcasing brick
houses, stone infrastructure, and paved roads. Overall, the level sports a more industrial
look.
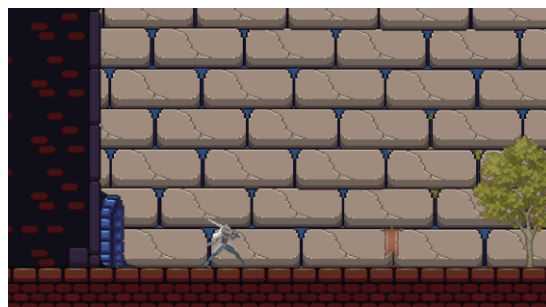
Figure 26. Level 4

Figure 26 shows the 4th level in our game, the Execution of Rizal set in Intramuros. The objective of this level is to make sure that the Execution of Rizal happens on the day and time as history has it. The entirety of the level is covered by a massive wall in the background, similar to the aesthetic of the Walled City of Intramuros.
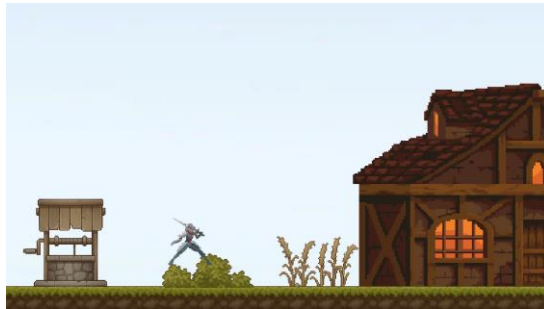
Figure 27. Level 5

Figure 27 shows the starting point for the last level in LAKBAY: Level 5 - The Treaty of Paris. The story is set on the countryside of France, showcased by the unpaved roads, almost farmland looking setting, and presence of wheat in the background. The objective of this final level is to stop the Villain from keeping the Treaty Papers into reaching the capital, Paris.

Figure 28. Example of the Instruction/Objective Panel

Figure 28 shows an example of an instruction or objective panel, which is always shown at the start of every level. Inside the panel are clues about the objective, the story behind the objective, and other important details about the level or mission.

Figure 29. Pause Menu

Figure 29 shows the Pause Menu in the game. The pause menu features three options; Resume – which resumes the game timer and the user's gameplay; Main Menu – which sends the player back into the main menu; and lastly, Exit – which exits the current level, and closes the program.

Project Test Results

This section summarizes the test results executed and the data collected based on the functionality, reliability, portability, and usability testing.

Table 10

Functionality Test Summary

Test Execution	Expected Results	First Test Results	Second Test Results
No. of Test Cases Executed	10	10	10
Passed	10	9	10
Failed	0	1	0
Success Rate	100%	90%	100%

Table 10 summarizes the conducted functionality test results. The table shows that out of 10 test cases (see chapter 3 - page 69 for reference), all 10 were run. In the first test, out of the 10 test cases ran by the researchers, 9 were successful, and 1 failed, resulting into 90% success rate. After some bug fixing and cleaning up, the second test was run. Out of the 10 test cases ran by the researchers, 10 were successful, and none failed, resulting into 100% success rate.

Table 11

Portability Test for Screen Resolution Adaptability Summary

Test Case ID	Aspect Ratio	Screen Resolution	Result
TCCT-01	16:9	1920x1080	Success
TCCT-02	16:9	1366x768	Success
TCCT-03	16:9	1280x720	Success
TCCT-04	4:3	1024x768	Success
TCCT-05	4:3	800x600	Success
	Resolutions Tested	Failure Count	Success Count
Total	5	0	5

Table 11 summarizes the conducted compatibility test results. The table shows all the screen resolutions tested in the procedure alongside its corresponding aspect ratio. The result shows that the game is compatible to all five of the screen sizes and aspect ratios tested, resulting in a 100% success rate.

Table 12

Portability Test for Install Ability Summary

Test Case ID	Type	Windows OS Version	Result
TCCT-06	64-bit	Windows 7	Success
TCCT-07	64-bit	Windows 8	Success
TCCT-08	64-bit	Windows 10	Success
TCCT-09	64-bit	Windows 11	Success
	Versions Tested	**Failure Count**	**Success Count**
Total	4	0	4

Table 12 summarizes the conducted portability test results for the game's install ability within different versions of Windows OS. The table shows all the versions tested in the procedure alongside its corresponding bit type. The result shows that the game is compatible to all four of the versions tested, resulting in a 100% success rate.

Project Capabilities and Limitations

The following are the capabilities of the system:

1. The game is capable of running in machines and Windows operating

   systems that are not as recent or up to date.

2. The game can showcase how a simple 2D game can bring entertainment

   and joy to its players.

3. This game lets the user learn about history in a new and more

   entertaining way, through a video game.

4. This game can be played offline and does not need an internet

   connection to save progress.

The following are the limitations of the system:

1. The game only has 5 playable levels due to the time constraint of this

   project.

2. This game has limited room for customizability as it is a story game and

   does not have a need for different cosmetics.

3. This game only has one playable character throughout the entire game.

4. The application can only be run on Windows systems from Windows 7

   to the most recent Windows 11.

Project Evaluation Results

    The evaluation procedure was conducted using the standard criterion of ISO 25010 to
check for the quality of the software. The following are the results of the evaluation on
the LAKBAY PC game:

Table 13

Overall Evaluation Results Summary

Criteria	Mean Average	Qualitative Interpretation
Functional Stability	3.37	Acceptable
Performance Efficiency	3.43	Very Acceptable
Portability	3.5	Very Acceptable
Compatibility	3.5	Very Acceptable
Usability	3.46	Very Acceptable
Reliability	3.4	Very Acceptable
Total	**3.44**	**Very Acceptable**

    Table 13 summarizes the overall evaluation results based on the ISO 25010 standards.
It shows the weighted mean per criterion and its equivalent qualitative interpretation. The
table shows that the game's score for functional stability is 3.46, performance efficiency
score of 3.48, and portability score of 3.52, all of which translates to a qualitative
interpretation of very good. The overall mean average score of the game is 3.49, which is
a very good qualitative interpretation. The specifics and scores of each criterion questions
showed are further discussed in the figures below.

A. Functional Suitability

I. FUNCTIONAL SUITABILITY This attribute indicates the extent to which a product or system offers features that fulfill explicit and implicit requirements when utilized within defined circumstances.
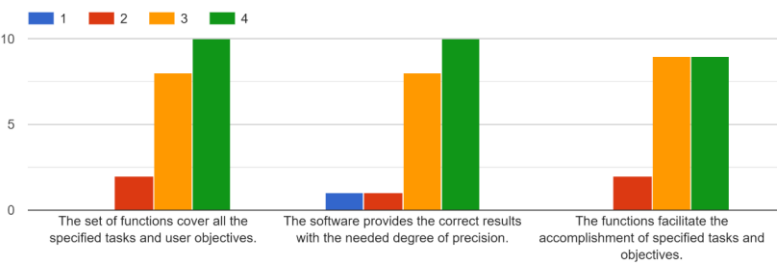
Figure 30. Functional Suitability Scores

Figure 30 shows the graph for the evaluation results of functional suitability. The game was evaluated good by the respondents, with an overall mean score of 3.37, which implies that the application meets the functions stated and needs implied under specification conditions. The table below shows the questions, and mean score for each, and the total mean score for the criterion functional suitability.

Table 14

Functional Suitability Results Summary

Criteria	Mean Average	Qualitative Interpretation
Question 1	3.4	Very Acceptable
Question 2	3.35	Acceptable
Question 3	3.35	Acceptable
Total	**3.37**	**Acceptable**

B. Performance Efficiency

II. PERFORMANCE EFFICIENCY This attribute refers to the efficiency of the performance of the system in relation to the resources utilized when operating within specified conditions.

Figure 31. Performance Efficiency Scores

Figure 31 shows the graph for the evaluation results of performance efficiency. The game was evaluated very good by the respondents, with an overall mean score of 3.43, which implies that the game quickly responds and executes its function within acceptable response time. The table below shows the questions, and mean score for each, and the total mean score for the criterion performance efficiency.

Table 15

Performance Efficiency Results Summary

Criteria	Mean Average	Qualitative Interpretation
Question 1	3.35	Acceptable
Question 2	3.5	Very Acceptable
Question 3	3.45	Very Acceptable
Total	**3.43**	**Very Acceptable**

C. Portability

III. PORTABILITY This attribute refers to the ease and efficacy with which a system, product, or component can be adapted to a different hardware, software, or operating environment.

Figure 32. Portability Scores

Figure 32 shows the graph for the evaluation results of performance efficiency. The game was evaluated very good by the respondents, with an overall mean score of 3.5, which implies that the game quickly responds and executes its function within acceptable response time. The table below shows the questions, and mean score for each, and the total mean score for the criterion portability.

Table 16

Portability Results Summary

Criteria	Mean Average	Qualitative Interpretation
Question 1	3.5	Very Acceptable
Question 2	3.5	Very Acceptable
Question 3	3.5	Very Acceptable
Total	**3.5**	**Very Acceptable**

D. Compatibility

IV. Compatibility This attribute refers to the versatility and adaptability with which a system, product or a component can be adapted to a different hardware, software, or operating environment.

Figure 33. Compatibility Scores

Figure 33 shows the graph for the evaluation results of performance efficiency. The game was evaluated very good by the respondents, with an overall mean score of 3.5, which implies that the game can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product. The table below shows the questions, and mean score for each, and the total mean score for the criterion compatibility.

Table 17

Compatibility Results Summary

Criteria	Mean Average	Qualitative Interpretation
Question 1	3.5	Very Acceptable
Total	**3.5**	**Very Acceptable**

E. Usability

V. Usability   This attribute refers to the being appropriately recognizable, learnability and being operable with which a system, product or a compone... hardware, software, or operating environment.
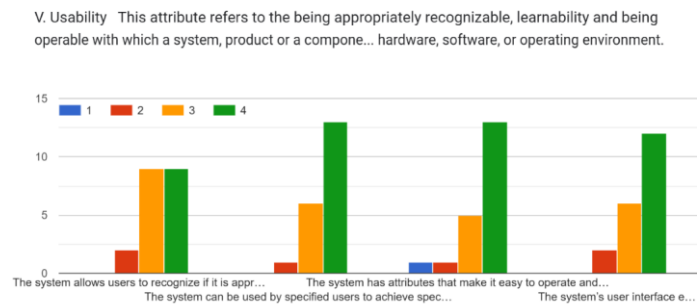
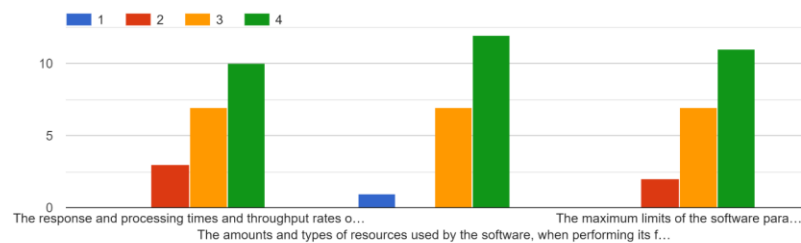*Figure 34.* Usability Scores

Figure 34 shows the graph for the evaluation results of performance efficiency. The game was evaluated very good by the respondents, with an overall mean score of 3.46, which implies that the game can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use. The table below shows the questions, and mean score for each, and the total mean score for the criterion usability.

Table 17

Usability Results Summary

Criteria	Mean Average	Qualitative Interpretation
Question 1	3.35	Acceptable
Question 2	3.6	Very Acceptable
Question 3	3.5	Very Acceptable
Question 4	3.4	Very Acceptable
Total	**3.46**	**Very Acceptable**

F. Reliability

VI. Reliability   This attribute refers to the maturity, availability and fault tolerance with which a system, product or a component can be adapted to a... hardware, software, or operating environment.
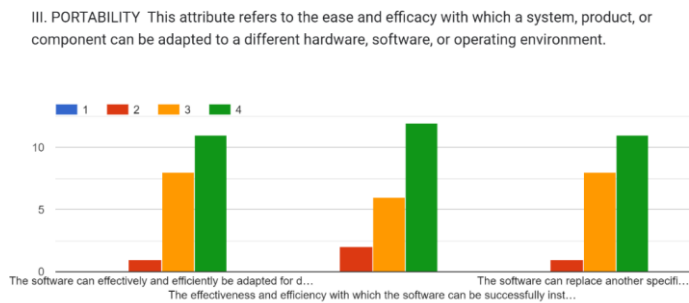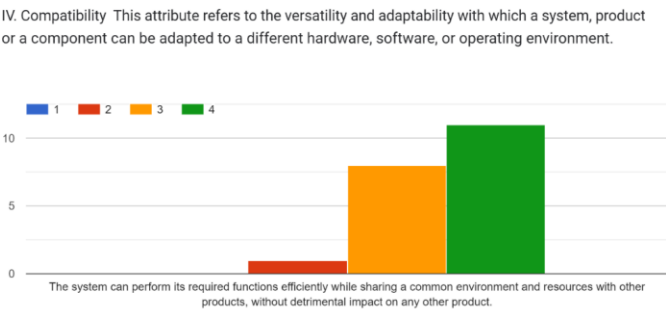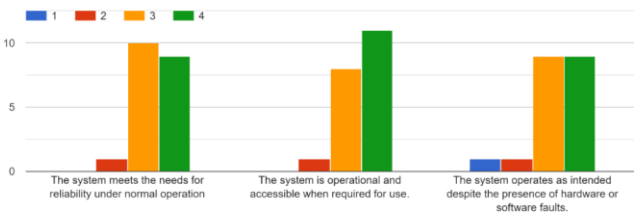
Figure 35. Reliability Scores

Figure 35 shows the graph for the evaluation results of performance efficiency. The game was evaluated very good by the respondents, with an overall mean score of 3.4, which implies that the game performs and can be used in face of normal and abnormal situations such as hardware faults, other software faults, and more. The table below shows the questions, and mean score for each, and the total mean score for the criterion reliability.

Table 18

Reliability Results Summary

Criteria	Mean Average	Qualitative Interpretation
Question 1	3.4	Very Acceptable
Question 2	3.5	Very Acceptable
Question 3	3.3	Acceptable
Total	**3.4**	**Very Acceptable**

Chapter 5

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

This chapter presents the summary of findings, conclusions, and recommendations based on the results of the evaluation, comments, and suggestions.

Summary of Findings

Based on tests and evaluations conducted on the performance capability of the application, the following were the findings of the study:

The game was developed according to the planned design and specifications, including the story, game elements, visual design, and game mechanics. The game gives the users a learning experience as a part of playing the game that can help ignite their thirst for learning more about the intricacies of what really happened outside of the story presented in the game. The game also gives a good balance of difficulty and fun in its gameplay that is suitable for any range of age. The application also underwent testing and passed using the criteria or principles of ISO 25010. This implies that users can easily use, adapt, and install the application.

Based on the data gathered during the project evaluation, the study got an overall rating of 3.44 with a corresponding overall qualitative interpretation of very good. Particularly the study obtained:

- In terms of functionality and suitability, the software was rated good which means that the objectives had been accomplished to its intended purpose and

function.

- In terms of performance efficiency, the software was rated very good which

- proves that the application quickly responds and execute its function within

   acceptable response time.

- In terms of portability, the software was rated very good which proves that the

   application can be installed and run on Windows 7/8/10/11 devices.

- In terms of compatibility, the software was rated very good which proves that

   the game can perform its required functions efficiently while sharing a

   common environment and resources with other products, without detrimental

   impact on any other product.

- In terms of usability, the software was rated very good which proves that the

   game can be used by specified users to achieve specified goals with

   effectiveness, efficiency and satisfaction in a specified context of use

- In terms of reliability, the software was rated very good which proves that the

   game performs and can be used in face of normal and abnormal situations

   such as hardware faults, other software faults, and more.

Conclusions

In consideration of the objectives of the study and the results of the testing and evaluation undertaken, the following conclusions were derived:

1. The LAKBAY: History Themed 2D Adventure Game was successfully designed with the following features:

a. Single player game.

b. Simple and classic 2D-game control settings.

c. Vintage setup of environment, platforms, structures, items, and sound effects.

d. Five story levels with different objectives or task inspired by events that happened in Spanish Colonial era of the Philippines.

e. Acquire power-ups that give player the ability to shoot projectiles at different durations.

f. Uses A* pathfinding algorithm to the movement of the NPCs in the game for pathfinding.

2. The game was created using the following tools:

a. Hardware:

- Laptop/Desktop Computer

- At least Windows 8 OS

- At least 4GB RAM

- AMD Ryzen 3 or Intel i3 equivalent

b. Software:

- Unity Game Developer

- Adobe Photoshop/Illustrator

- Visual Studio Code

3. The functionality, performance efficiency, and portability of the game were tested and successfully improved.

4. The application acceptability was completely evaluated using ISO 25010 criteria and yielded an overall mean of 3.49, which has a corresponding descriptive rating of "Highly Acceptable".

Recommendations

Considering the findings and conclusions made in the study, the following recommendations for the improvement of the application are hereby presented for future enhancement:

1. Develop a mobile version for better availability.

2. Improvisation of sounds, visuals and user interface for better user experience.

3. Creation of more diverse options for mobs/enemies and in-game features like moving platforms or terrains.

4. Addition of more levels and storyline from other eras in the past.

5. Add a randomized mob/enemy spawner to avoid repetitiveness of each gameplay and provide a different experience for everytime a player plays the game.

6. Add better animations for the enemies and other objects.

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Appendix A

SAMPLE EVALUATION INSTRUMENT

LAKBAY: HISTORY THEMED 2D ADVENTURE GAME

Greetings!

We are a group of fourth year *Bachelor of Science in Computer Science (BSCS)* students from the *Technological University of the Philippines – Manila Campus (TUP-M)* and we would like to request your assistance in evaluating our Research Project, *"LAKBAY: History Themed 2D Adventure Game"*.

LAKBAY is a simple history themed 2D side scrolling adventure game designed to inspire gamers to learn more about the history of the Philippines and teach them while enjoying the game.

Download our game's demo here: LAKBAY Adventure Game Demo

To install the game, extract the .rar file. To run the game, open the resulting folder and double click the file "LAKBAY Adventure Game.exe".

In order to guarantee the respondents' privacy, all information gathered will be maintained in strict confidence. Should you have any questions regarding the survey and the game, please contact us at:

- dylan.jabla@tup.edu.ph
- frankyle.ledesma@tup.edu.ph
- laillealdrich.rodil@tup.edu.ph
- nicholeandrea.rosario@tup.edu.ph

Full Name: _____

Email: _____

Device Processor: _____   Device Memory (RAM): _____

Device OS: _____   Device Resolution: _____

Instruction: Please evaluate the software by using the given scale and selecting the

corresponding numerical rating.

Numerical Rating and Qualitative Equivalent

1 – Poor   **2** – Fair   **3** – Good   **4** – Very Good

A. Functional Suitability				
Questions	**1**	**2**	**3**	**4**
The set of functions cover all the specified tasks and user objectives.				
The software provides the correct results with the needed degree of precision.				
The functions facilitate the accomplishment of specified tasks and objectives.				

B. Performance Efficiency				
Questions	**1**	**2**	**3**	**4**
The response and processing times and throughput rates of the software, when performing its functions, meet the requirements.				
The amounts and types of resources used by the software, when performing its functions, meet the requirements.				
The maximum limits of the software parameter meet the requirements.				

C. Portability				
Questions	**1**	**2**	**3**	**4**
The software can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments.				
The effectiveness and efficiency with which the software can be successfully installed and/or uninstalled in a specified environment.				
The software can replace another specified software product for the same purpose in the same environment.				

D. Compatibility				
Questions	**1**	**2**	**3**	**4**

The system can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product.				

E. Usability

Questions	1	2	3	4
The system allows users to recognize if it is appropriate for their needs.				
The system can be used by specified users to achieve specified goals of learning to use the application with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use.				
The system has attributes that make it easy to operate and control.				
The system's user interface enables pleasing and satisfying interaction for the user.				

F. Reliability

Questions	1	2	3	4
The system meets the needs for reliability under normal operation				
The system is operational and accessible when required for use.				
The system operates as intended despite the presence of hardware or software faults.				

Comments / Suggestions:

_____

_____

_____

Appendix B

GANTT CHART

January	Week 1	Week 2	Week 3	Week 4
Sprite Design	🟩	🟩	🟩	🟩
Demo Level	🟦	🟦		
Demo AI	⬛	⬛		
Demo UI Design	🟥	🟥		
Story	🟧	🟧	🟧	🟧

February	Week 1	Week 2	Week 3	Week 4
Sprite Design	🟩		🟩	🟩
Level Design			🟦	🟦
AI				
UI Design				
Story	🟧			

March	Week 1	Week 2	Week 3	Week 4
Sprite Design	🟩	🟩	🟩	🟩
Level Design	🟦	🟦	🟦	🟦
AI		⬛	⬛	⬛
UI Design				🟥
Story				

April	Week 1	Week 2	Week 3	Week 4
Sprite Design	🟩			
Level Design	🟦	🟦	🟦	🟦
AI	⬛	⬛	⬛	⬛
UI Design	🟥	🟥	🟥	🟥
Story			🟫	🟫

May	Week 1	Week 2	Week 3	Week 4
Sprite Design				
Level Design	🟦			
AI	⬛	⬛		
UI Design	🟥	🟥		
Story	🟫			
Testing/Evaluation	🟪	🟪		

Appendix C

PROFILE OF RESPONDENTS

No.	Full Name	School Level
1	John Christian Nacebo	College
2	Diane Natcher	College
3	Shaina Camille Macaranas	College
4	Alliah Zaki Mendoza	High School
5	Samantha Egar	High School
6	Dirk Andrei Tuibeo	College
7	James Marshall Agpalo	High School
8	John Edward Complido	College
9	Delia Mendoza	High School
10	Justine Dumasig	High School
11	Shirley Sabus	College
12	Rica Mae Bobadilla	College
13	Joman De Vera	College
14	Joel Manaog	College
15	John Edison Famisaran	College
16	Ericka Amante	College
17	Joseph Poblacion	College
18	Benjamin Joshua C. Clavo	High School
19	Aldrich Gerard Gatbunton	College
20	Sean Wayne Cesa	High School

Appendix D

FUNCTIONALITY TEST CASES

Test Case ID	TCFT-01		
Objective	Select **Play Game** in main menu		
Assumptions/ Preconditions	The game is running and the player is in the main menu page.		
Actions	**Expected Results**		
1. Select Play Game	Player will proceed to the first level of the game.		
Status	Passed	**Tested by:**	Dylan R. Jabla

Test Case ID	TCFT-02		
Objective	Select **Level Select** and choose a level in main menu		
Assumptions/ Preconditions	The game is running and the player is in the main menu page.		
Actions	**Expected Results**		
1. Select Level Select	Player will proceed to level select menu		
2. Select Level 1	Player will proceed to the first level		
3. Repeat for each level	Player will proceed to the corresponding level		
Status	Passed	**Tested by:**	Dylan R. Jabla

Test Case ID	TCFT-03		
Objective	Press **Directional** keys set by the user in the game ie.(W = Jump, A = Left, D = Right).		
Assumptions/ Preconditions	The game is running and the player's character is on the field ready for user input.		
Actions	**Expected Results**		
1. Press W	Player will jump.		
2. Press A	Player will move to the left.		
3.Press D	Player will move to the right		
Status	Passed	**Tested by:**	Dylan R. Jabla

Test Case ID	TCFT-04		
Objective	Press **G** in keyboard		
Assumptions/ Preconditions	The game is running and the player's character is on the field ready for user input.		
Actions	**Expected Results**		
1. Press G	If player is touching a chest, open, else, player fires projectile.		
Status	Passed	**Tested by:**	Dylan R. Jabla

Test Case ID	TCFT-05		
Objective	Press **B** in keyboard while in-game		
Assumptions/ Preconditions	The game is running and the player's character is on the field ready for user input.		
Actions	**Expected Results**		
1. Press P	Pause menu will appear and game timer will be paused		
Status	Passed	**Tested by:**	Dylan R. Jabla

Test Case ID	TCFT-06		
Objective	Deplete all the player's health points		
Assumptions/ Preconditions	The game is running and the player's character is on the field ready for user input.		
Actions	**Expected Results**		
1. Navigate your way to a nearby enemy	The enemy will chase the player if in range.		
2. Purposely get hit until all HP is depleted	Game Over screen will appear.		
Status	Passed	**Tested by:**	Dylan R. Jabla

Test Case ID	TCFT-07		
Objective	Select **Retry** in game over screen		
Assumptions/ Preconditions	The game is running and the player is dead, prompting a game over screen.		
Actions	**Expected Results**		
1. Select Retry	The level that the player is currently on will reload.		
Status	Passed	**Tested by:**	Dylan R. Jabla

| Test Case ID	TCFT-08		
Objective	Select **Main Menu** in game over screen		
Assumptions/ Preconditions	The game is running and the player is dead, prompting a game over screen.		
Actions	**Expected Results**		
1. Select Main Menu	The player will be sent back to the main menu.		
Status	Passed	**Tested by:**	Dylan R. Jabla

Test Case ID	TCFT-09		
Objective	Reach the endpoint/end goal of a level.		
Assumptions/ Preconditions	The game is running and the player's character is on the field ready for user input.		
Actions	**Expected Results**		
1. Go to the endpoint of the map	The game will load the next level.		
Status	Passed	**Tested by:**	Dylan R. Jabla

Test Case ID	TCFT-10		
Objective	Select **Exit Game** in main and pause menu		
Assumptions/ Preconditions	The game is running and the player is in the main menu and later, the pause menu.		
Actions	**Expected Results**		
1. Select Exit in main menu	The game window will close.		
2. Press P while the game is running and the player is playing a level	The pause menu will appear		
3. Select Exit in pause menu	The game window will close.		
Status	Passed	**Tested by:**	Dylan R. Jabla

Appendix E

UNITY 2D STORE FREE ASSETS USED IN THE GAME
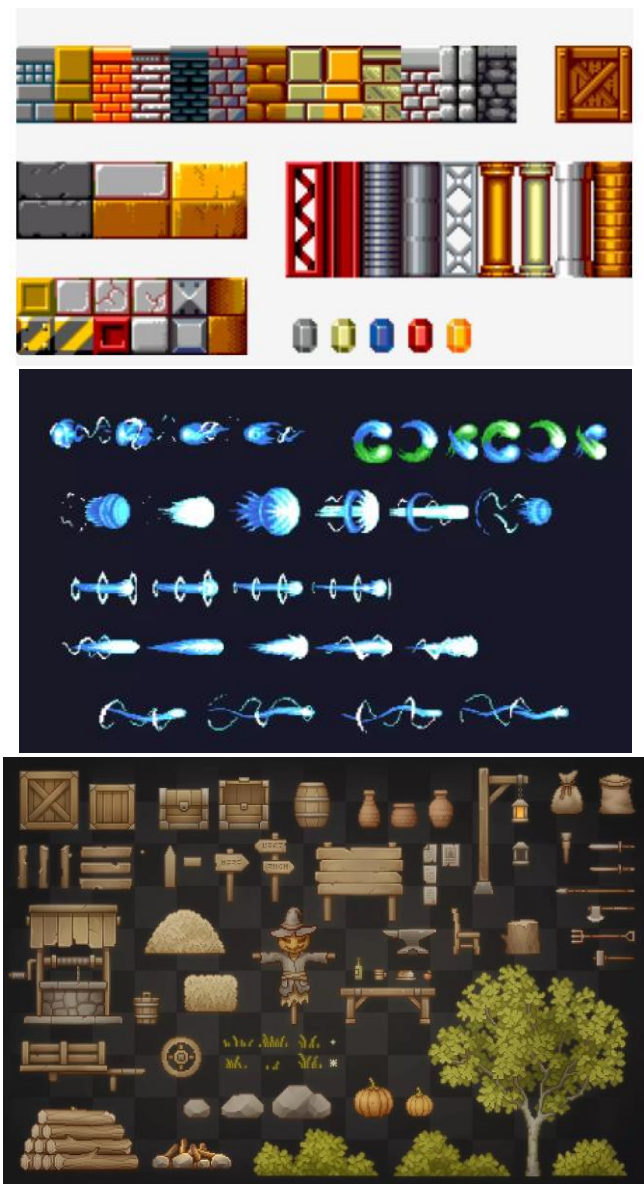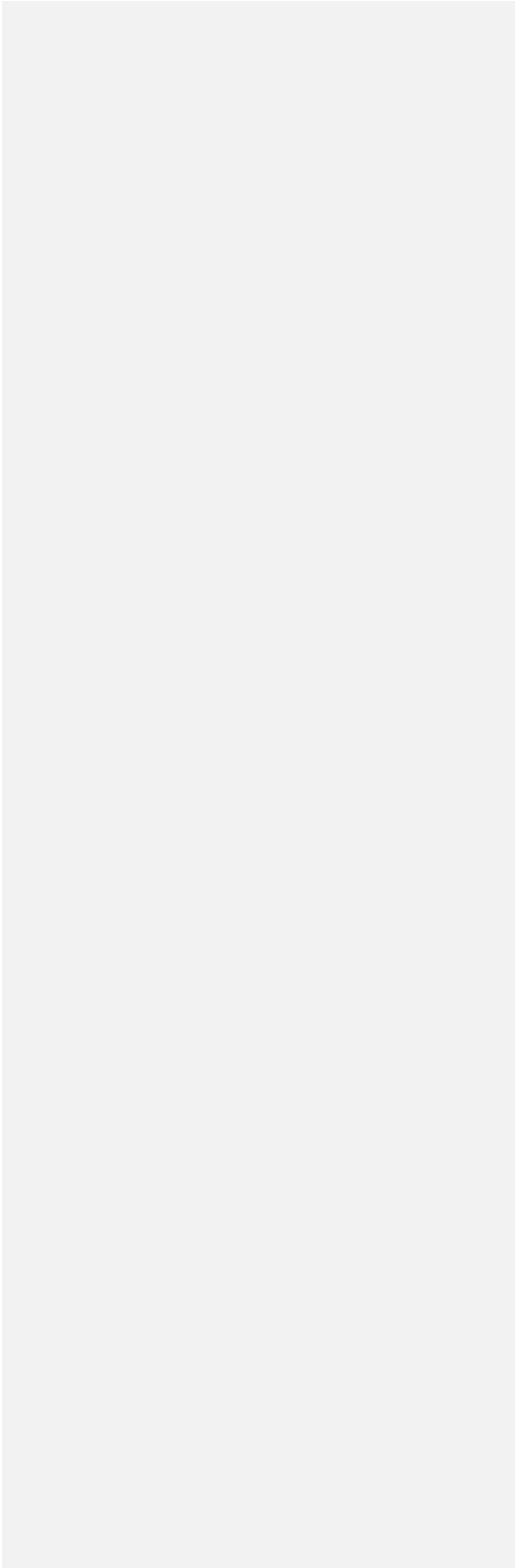
APPENDIX F

Thesis Grammarian Certification

APPENDIX G

Certificate of Similarity and Authenticity

Researcher's Profile

Personal Information:
Name: Dylan R. Jabla
E-mail: dylanjabla07@gmail.com
Date of Birth: 07 July 2001
Nationality: Filipino
Marital Status: Single

<u>**Education:**</u>
2007 – 2013	: Mayor Calixto D. Enriquez Elementary School
2013 – 2017 (Junior High School)	: Cavite State University Rosario – Science
Education Laboratory School	
2017 – 2019 (Senior High School)	: St. Mary Magdalene School Kawit
2019 – Present	: Technological University of the Philippines

<u>**Training and Courses Attended:**</u>
- Computer Networking 1 & 2
- Business Intelligence
- Computer Programming 1 & 2
- Discrete Structures
- Probability and Statistics
- Computer Architecture and Organization
- Object Oriented Programming
- Data Analytics
- Human Computer Interaction
- Data Structures and Algorithms
- Information Management
- Programming Language (Design and Implementation)
- Web Development
- Computer Networking 1 & 2

<u>**Skills Profile:**</u>
- Html
- CSS
- Bootstrap
- JavaScript
- C Programming
- MySQL
- Web Design
- GitHub
- PHP
- Photo Editing
- Video Editing

Personal Information:
Name: Fran Kyle A. Ledesma
E-mail: ledesmafrankyle@gmail.com
Date of Birth: 24 May 2001
Nationality: Filipino
Marital Status: Single

Education:

2007 – 2010, 2011-2013	: Shekinah Christian Training Center
2003 – 2011	: Academy of Jesus
2013 - 2017 (Junior High School)	: Shekinah Christian Training Center
2017 - 2019 (Senior High School)	: Shekinah Christian Training Center
2019 – Present	: Technological University of the Philippines

Training and Courses Attended:
• Computer Networking 1 & 2
• Business Intelligence
• Computer Programming 1 & 2
• Discrete Structures
• Probability and Statistics
• Computer Architecture and Organization
• Object Oriented Programming
• Data Analytics
• Human Computer Interaction
• Data Structures and Algorithms
• Information Management
• Programming Language (Design and Implementation)
• Web Development
• Computer Networking 1 & 2

Skills Profile:
• Html
• CSS
• Bootstrap
• JavaScript
• C Programming
• MySQL
• Web Design
• GitHub
• PHP
• Photo Editing
• Video Editing

Personal Information:
Name: Laille Aldrich Imperial Rodil
E-mail: laillealdrich.rodil@tup.edu.ph
Date of Birth: 10 December 1999
Nationality: Filipino
Marital Status: Single

Education:

2007 – 2013	: Tambo Elementary School - Main
2013 – 2017 (Junior High School)	: Pasay City Science National High School
2017 - 2019 (Senior High School)	: Pasay City Science National High School
2019 – Present	: Technological University of the Philippines

Training and Courses Attended:

• Computer Networking 1 & 2
• Business Intelligence
• Computer Programming 1 & 2
• Discrete Structures
• Probability and Statistics
• Computer Architecture and Organization
• Object Oriented Programming
• Data Analytics

• Human Computer Interaction
• Data Structures and Algorithms
• Information Management
• Programming Language (Design and Implementation)
• Web Development
• Computer Networking 1 & 2

Skills Profile:

• Html
• CSS
• Bootstrap
• JavaScript
• C Programming
• MySQL

• Web Design
• GitHub
• PHP
• Photo Editing
• Video Editing

Personal Information:
Name: Nichole Andrea P. Rosario
E-mail: nicholeandrea.p.rosario@gmail.com
Date of Birth: 11 November 2000
Nationality: Filipino
Marital Status: Single

Education:

2007 – 2013	: Sinag-Tala Elementary School
2013 – 2017 (Junior High School)	: Judge Juan Luna Highschool
2017 - 2018 (Senior High School)	: Lucrecia R. Kasilag Senior High School
2018 - 2019 (Senior High School)	: San Francisco High School
2019 – Present	: Technological University of the Philippines

Training and Courses Attended:

- Computer Networking 1 & 2
- Business Intelligence
- Computer Programming 1 & 2
- Discrete Structures
- Probability and Statistics
- Computer Architecture and Organization
- Object Oriented Programming
- Data Analytics
- Human Computer Interaction
- Data Structures and Algorithms
- Information Management
- Programming Language (Design and Implementation)
- Web Development
- Computer Networking 1 & 2

Skills Profile:

- Html
- CSS
- Bootstrap
- JavaScript
- C Programming
- MySQL
- Web Design
- GitHub
- PHP
- Photo Editing
- Video Editing