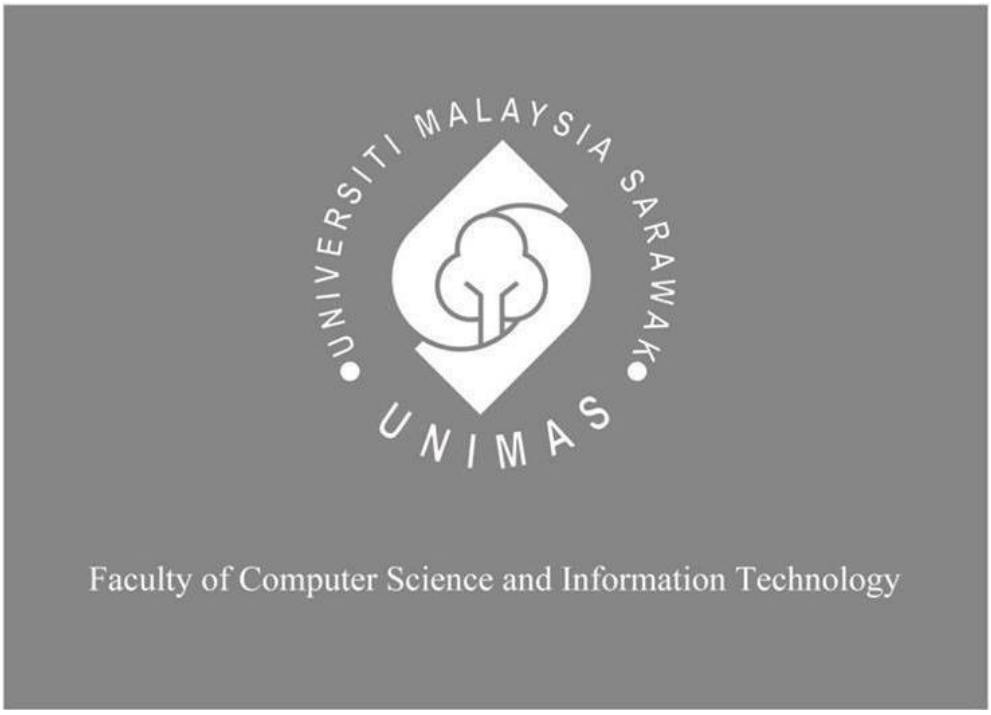

PHYSICS CORNER: INTEGRATING PERFORMANCE INSIGHTS INTO GAMIFIED PHYSICS EDUCATION FOR SECONDARY SCHOOL STUDENTS

Lewis Fung Joon Choi

Bachelor of Computer Science with Honours

(Information Systems)

2025

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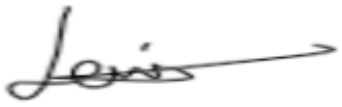

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This project is submitted in partial fulfilment of the
requirements for the degree of
Bachelor of Computer Science and Information Technology

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PHYSICS CORNER: INTEGRASI WAWASAN PERSTASI DALAM PERMAINAN PENDIDIKAN FIZIK UNTUK PELAJAR SEKOLAH MENENGAH

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ABSTRACT

"Physics Corner" is an engaging interactive game designed to address key challenges in Physics learning for secondary school students, particularly those in Form 4 and Form 5 preparing for the SPM examination. The game tackles 2 major issues: the difficulty in visualizing and connecting theoretical concepts to real-world scenarios, and the lack of timely, personalized feedback during the learning process. The project's scope includes integrating a narrative to maintain student engagement, along with hints to aid progression and a scoreboard to offer performance feedback, covering topics from Form 4 Physics syllabus, including Heat, Waves, and Light and Optics, Students will receive optional hints, visual demonstrations, and performance tracking to encourage deeper learning and reflection on their progress. This project follows the Software Development Life Cycle (SDLC) approach, beginning with a requirements analysis using questionnaire survey, which revealed that while students find Physics difficult yet interesting, they preferred interactive, visual learning methods over traditional approach. These insights guided the system design, which includes both logical and physical design elements, such as system architecture diagram, data flow diagrams, and wireframe, serving as a framework for the game's implementation. By incorporating combination of learning styles (Visual, Auditory, Reading, Kinaesthetics/Interactive), narrative storyline and performance insight, "Physics Corner" aims to enhance students' understanding of complex Physics concept in an engaging and accessible manner by acting as an effective and motivating tool.

Keywords: Physics, puzzle-based game, performance insight, SPM, secondary school students

ABSTRAK

"Physics Corner" adalah permainan interaktif yang menarik, direka untuk mengatasi cabaran utama dalam pembelajaran Fizik bagi pelajar sekolah menengah, terutamanya pelajar Tingkatan 4 dan Tingkatan 5 yang sedang membuat persediaan untuk peperiksaan SPM. Permainan ini menangani dua isu utama: kesukaran dalam memvisualisasikan dan menghubungkan konsep teori dengan situasi dunia sebenar, serta kekurangan maklum balas yang tepat pada masanya dan diperibadikan semasa proses pembelajaran. Skop projek ini merangkumi integrasi naratif untuk mengekalkan penglibatan pelajar, bersama dengan petunjuk untuk membantu perkembangan dan papan markah untuk memberikan maklum balas prestasi, yang merangkumi topik dari sukatan Fizik Tingkatan 4, termasuk Haba, Gelombang, dan Cahaya serta Optik. Pelajar akan menerima petunjuk pilihan, demonstrasi visual, dan penjejakan prestasi untuk menggalakkan pembelajaran yang lebih mendalam dan refleksi terhadap kemajuan mereka. Projek ini mengikut pendekatan Kitaran Hayat Pembangunan Perisian (SDLC), bermula dengan analisis keperluan menggunakan soal selidik, yang mendedahkan bahawa walaupun pelajar mendapati Fizik sukar tetapi menarik, mereka lebih mengutamakan kaedah pembelajaran interaktif dan visual berbanding pendekatan tradisional. Penemuan ini memandu reka bentuk sistem, yang merangkumi elemen reka bentuk logikal dan fizikal, seperti diagram seni bina sistem, diagram aliran data, dan wireframe, yang berfungsi sebagai rangka kerja untuk pelaksanaan permainan. Dengan menggabungkan pelbagai gaya pembelajaran (Visual, Auditori, Membaca, Kinestetik/Interaktif), alur cerita naratif dan maklum balas prestasi, "Physics Corner" bertujuan untuk meningkatkan pemahaman pelajar terhadap konsep Fizik yang kompleks dengan cara yang menarik dan mudah diakses, serta berfungsi sebagai alat pembelajaran yang berkesan dan memotivasi.

Kata kunci: Fizik, permainan teka-teki, wawasan prestasi, SPM, pelajar sekolah menengah

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Physics is often seen as one of the most difficult subjects in Science, Technology, Engineering, and Mathematics curriculum. In fact, Physics is perceived challenging even in the university level (Wider & Wider, 2023). The abstract ideas and mathematical concepts that define the subject are one of the reasons many students struggle to understand and solve the given problem, leading them feeling disengaged and unmotivated. Emergence of gamification in education offers a unique opportunity to enhance student engagement and understanding. Gamification can turn traditional learning into a fun experience, promoting active involvement, and create a sense of accomplishment. By integrating Physics concepts into game mechanics, students can engage with complex topics in a dynamic, hands-on way, making the subject more accessible and engaging.

"Physics Corner" is an interactive educational game created to make Physics more accessible and engaging for secondary school students. By aligning with the Form 4 syllabus, the game simplifies learning through immersive experiences that connect theoretical Physics principles to real-world applications. Players explore different settings, interacting with objects to discover the Physics concepts behind them, allowing them to grasp complex ideas in a hands-on, relatable way. After each interaction, journals reinforce understanding and retention, with optional hints to boost engagement and support learning at the student's own pace. Upon completing a set of puzzles or finish interacting with the objects, players receive personalized performance feedback. These insights help students track their progress, understand their strengths and weaknesses, and encourage a proactive approach to learning. By making Physics learning both interactive and student-centred, "Physics Corner" aims to reignite students' enthusiasm for the subject and empower them to take ownership of their educational journey.

1.2 Problem Statement

The way Physics has been taught in Malaysia, especially to SPM students, tends to be more to rote memorization on the formula and application than deep conceptual understanding, while the curriculum and instruction support examination preparation rather than interactive learning. Physics is often viewed as a challenging puzzle for students to piece together, as not only it requires a certain understanding in mathematical knowledge, but also a conceptual understanding on real-world situation, where students may find it difficult to visualise. According to Hamerski (2022), relating physics concepts to real-world scenarios not only increases students' engagement but also promotes deeper comprehension. Furthermore, one of the ways to alleviate student's comfort and enjoyment in learning is through gamification. Findings in Low et al. (2023) illustrate how gamified learning has the potential to encourage knowledge building and problem-solving abilities, as well as positively impacting student perceptions of Physics.

Additionally, students in traditional learning environments frequently experience a lack of timely feedback. When students encounter challenges, they often either need to wait for a teacher's availability to seek explanation, or they may feel afraid of being justified or judged, which might keep them stuck on a problem, preventing them from progressing in their studies. The integration of real-time performance insight can tighten this gap by offering immediate feedback as students' progress through interactive Physics puzzles. Option to receive hints and showcase of performance score allow students to progress without waiting for teacher intervention. Research suggests that integration of scoreboards, which measure student performance in real time, inspire student to actively explore their strength and weakness (De Freitas et al., 2017). This approach allows students to continuously track their progress and

inspires them to stay on task, resulting in improved performance and understanding of challenging concepts.

1.3 Scope

"Physics Corner" is a game-based learning project tailored for secondary school students, particularly those in Form 4 and Form 5 Physics within the Pure Science Stream. It mainly focuses on providing an engaging and interactive platform that enhance learning through gameplay. The primary goal is to reinforce key physics concepts for students. By doing so, it promotes deeper understanding of physics principles and their real-world applications. Throughout the game, players will be helping various NPCs to solve Physics related problem, allowing them to explore specific concepts and how they apply to everyday situation. Inclusion of hints will be available for students while progressing through the puzzles, as well as performance score at the end of the puzzle. Moreover, time spend on each puzzle will be recorded for feedback purposes, but not time limit for completing the puzzle to avoid enforcing time pressure. The game will align with the Form 4 Physics syllabus, covering certain subtopics from Heat, Waves, and Light and Optics only. To ensure accessibility, "Physics Corner" will be exclusively compatible to Windows desktop systems.

1.4 Aims and Objectives

a. To design and develop an interactive game, "Physics Corner" to enhance Physics learning for SPM students.
b. To evaluate the usability of the game "Physics Corner."

1.5 Brief Methodology

This project will utilize the Waterfall model within the System Development Life Cycle (SDLC). Waterfall model is chosen for this project as it is well-suited for clearly defined project requirements. It provides detailed documentation at each phase, making tracking and maintenance simple. Furthermore, it ensures that each stage is completed before proceeding to the next (Adenowo & Adenowo, 2013). This is advantageous for developing an educational game, as successful implementation depends on having well-defined objectives and a well-designed interface. The methodology consists of 6 phases, Requirement Analysis, System Design, Implementation, Testing, Deployment, and Maintenance as illustrated in Figure 1.1.1 below.

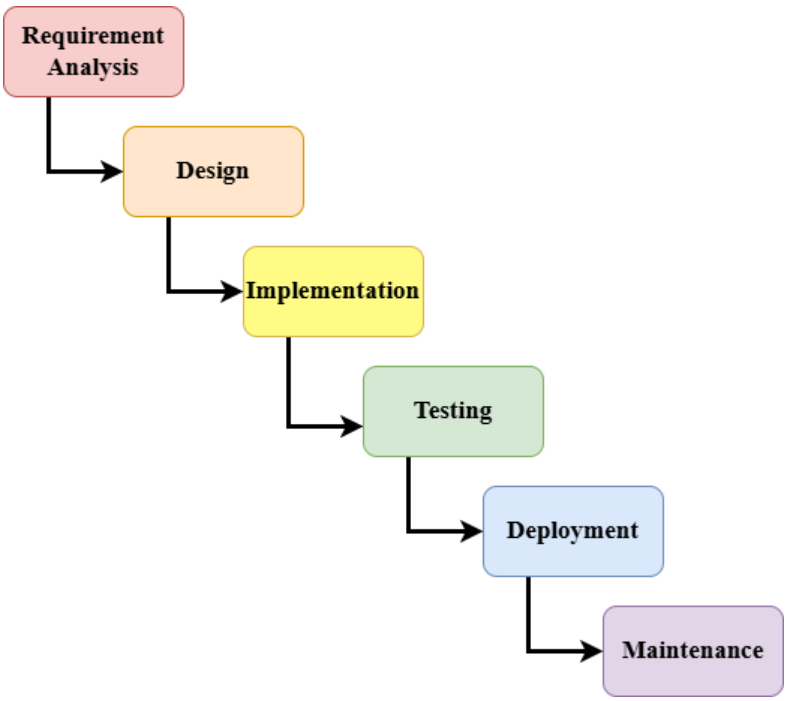

Figure 1.1. 1: 6 Phases of Waterfall Model.

1.5.1 Requirement Analysis Phase

In this phase, collection of project requirements will be conducted and analysed. A variety of techniques and methods, including using Google Form questionnaire survey and research on appropriate sources, such as journal articles and associated materials will be used to collect the requirements. Apart from that, a comparison analysis of similar games will be carried out to make sure that "Physics Corner" offers distinct features that set it apart from its competitors.

1.5.2 Design Phase

This phase involves the planning of overall architecture of the game. This include developing logical designs that describe how various components will interact, as well as physical designs that explain technical aspects like user interface architecture. By acting as a guide for the development process, the system design ensures that every demand is taken into consideration.

1.5.3 Implementation Phase

During the implementation phase, or also can be known as the development phase, the actual development of the game takes place. This involves integrating audio and visual components, developing interactive features, and coding "Physics Corner" in C# within the Unity game engine. Preparation of assets, such as using tools like Adobe Illustrator and Adobe Photoshop, also occurs in this stage.

1.5.4 Testing Phase

The testing phase a crucial phase of game development, essential for guaranteeing the functionality and quality of the game. This stage involves identifying and resolving any issues that could affect the game's performance or player experience. In the first section, functionality testing will be done, where debugging takes place and test cases to be journaled to ensure all functions are fixed and able to run well. Usability testing will be done in the second section to assess user experience and incorporate feedback from testers to balance gameplay mechanics. Both sections will be done thoroughly to optimize the game to operate effectively to meet the project's objectives.

1.5.5 Deployment Phase

After testing is done, the game will be launched online. Players can download the game and share their feedback. The feedback will be then collected to understand their experiences and gathering insights for future enhancements.

1.5.6 Maintenance Phase

The maintenance phase is the last phase, which is done after the deployment to refine and update the game. This phase will be a reoccurring phase when minor updates or requests are identified.

1.6 Significance of Project

"Physics Corner" project expects to accomplish various goals, including transforming traditional physics education into an interactive and engaging experience, making complex concepts more approachable to students. With interactive nature of the game and engagement involved, the project seeks to enhance retention of physics concepts, as students are more likely to remember information when they actively participate in it. Essentially, by illustrating how physics principles apply to real-world situations, the project attempts to assist students grasp the significance of what they are learning, resulting in a better understanding and greater appreciation for the subject.

1.7 Project Schedule

A project schedule is created using a Gantt chart to plan the timeline of the final year project task, as shown in Figure 1.2, spanning from 7th October 2024 to 29th June 2025 as shown in **Appendix A**.

1.8 Expected Outcome

The output of the game "Physics Corner" is to provide an engaging and user-friendly platform for students to learn Physics. By presenting Physics concepts in an enjoyable manner, the game seeks to ignite students' curiosity and sparks their interest towards the subject. Through interactive learning experiences, the game is expected to foster engagement and provide valuable feedback on their learning progress.

1.9 Project Outline

Chapter 1 is the introduction of the project, laying an overview of problem statement, project scope, aims and objectives, brief methodology, significance of the project, project schedule, and expected outcomes.

Moving on to Chapter 2, literature review is divided into three sections. The first section discusses the current situation of Physics learning, the importance of performance insight, and learning styles. The second section portrays the comparison of three existing systems related to Physics learning, evaluating their overall functions. The third section focuses on the tools used to develop the proposed game application.

The in-depth details of methodology of the project are discussed in Chapter 3, particularly requirement analysis phase and system design phase. This chapter showcases the data collection and analysis, visualization of logical design such as system architecture design, data flow diagrams, and physical design like wireframe.

In Chapter 4, implementation phase of the project is discussed thoroughly, offering a glimpse into each designing detail of the game application.

After that, Chapter 5 is used for testing the application through functional testing using test cases, and usability testing to evaluate the user interface.

Lastly, Chapter 6 wraps up the project with a conclusion and achievement. This chapter also outlines the limitations and constraints faced while doing this project, as well as the possible future works to further refine the game application.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter will shed light on the current scenario of Physics learning in Malaysia, Serious Games (SG), performance insight, types of learning style, comparison of existing similar games that has educational Physics incorporation and evaluation on the features of each game, as well as tools needed to develop an educational game that is engaging and educational.

2.2 Physics Learning in Malaysia

Physics is commonly perceived by students as a challenging subject. A study conducted in 2014 found that Malaysian students showed moderate motivations towards learning Physics, yet still found the subject boring and less interesting compared to Biology or Chemistry (Saleh, 2014). A decade later, similar challenges still afloat on Physics education in Malaysia, as seen in more recent studies. One of the studies said that significant factor contributing to this perception is the abstract nature of Physics (Zulkiffli et al., 2024). Many students find it difficult to relate the complex theories and Physics concept to their everyday experiences, as these abstract concepts involve phenomena that are not directly observable or intuitive. For example, in topics about heat, understanding the microscopic activity of molecules in a wave, or the concept of waves in light and sound, which often operate on scales or under conditions outside our sensory perception, making abstract ideas seem distant and difficult to conprehend between theory and real-world experience. Another study done by Mat Karim and Karim (2024) showcase the perception from teachers, as most of them mentioned that students face difficulties in visualizing the idea of certain concepts and tend to just memorise the formula. This statement is also supported by Bunyamin et al.'s (2020) findings, where importance of real-world application should also be emphasized in teaching, rather than just problem-solving. This

evidently depicts that Physics truly hold its reputation as being a hard subject to grasp, and have created a mental block for students, feeling that the subject is inherently beyond their abilities. However, with the rise of technology in recent years, several pedagogical approaches have been used, such as e-learning platform like DELIMa (Digital Educational Learning Initiative Malaysia) introduced by the Ministry of Education Malaysia in 2020, the submerge of interactive simulation like PhET Interactive Simulation (Physical Interactive Technology) as well as gamifying tools like Kahoot or Quizziz. For instance, the *Sijil Peperiksaan Malaysia* (SPM) or Malaysian Certificate of Education results shows an increment from 2022 to 2023, indicating adoption of digital tools and resources can have positive impact on learning outcomes (Ministry of Education Malaysia, 2023). There has been a lot of gamified platform and game-based learning introduced over the years to increase the engagement of Physics learning, but the use of serious game in education, particularly related to secondary school Physics is has yet to reach widespread adoption in the market (Achour et al., 2023; Kara, 2021).

Serious Games (SG) are not like traditional games where it is just purely for entertainment, instead it is developed to help achieve a certain goal. While exact objectives and situations may differ depends on context, the underlying principle is that Serious Games are intended to have a significant impact on the player, whether through skill acquisition, engagement enhancement, knowledge transfer or behavioural modification (Kowert & Quandt, 2020). Games that require players to solve puzzles can help develop problem-solving skills and critical thinking, while providing an interactive world for players to immerse into, receiving feedback at the same time makes games a more digestible format for learning. In the context of education, several studies have shown that Serious Games can enhance students' understanding and enthusiasm for a subject when it is contextualized (Alotaibi, 2024; Cornito, 2023; Reddy et al., 2021; Yadav & Oyelere, 2021). This is helpful when it comes to subject like Physics,

which often involves abstract concepts and complex phenomena, allowing students to visualize and manipulate it in ways that are difficult to achieve in conventional classroom. For instance, games like “Kerbal Space Program” allows players to design and launch spacecraft, applying Physics principles such as orbital mechanics and aerodynamics. Although primarily designed for entertainment, it has been recognized and used for its educational potential in teaching space science and Physics (Rosenthal & Ratan, 2022). Application like this let students immerse themselves in the game environment, solving game quests without going too in-depth of the topics like the textbook format, enhancing their ability in drawing connections between real-life applications and theoretical knowledge. Furthermore, games can provide direct evaluation like students’ action and consequences as well as adding extra context compared to consulting teachers in a 1-to-40 classroom scenario (Willert, 2021).

2.3 The Importance of Performance Insight

Performance insight provides preview of player’s progress, understanding, skills and behaviours as they progress with the game. Performance insight is commonly referred as feedback in educational games domain, which is a significant in-game feature addition to ensure an effective learning journey (Kickmeier et al., 2008). As Crookall (2010) points out, serious games can easily integrate data collection tools to provide real-time feedback during gameplay or summative feedback at the end, offering valuable insights into player performance. Such metrics like time spent on tasks, decision made during gameplay and scores on completing certain challenges can act as a reference for players to make decisions. This informative feedback can also motivate players to continually advance the game, further increasing in-game retention and exposure to more in-game content, as shown in Liu et al.’s (2021) study. However,

the amount of insight should be balanced as too little feedback can lead to frustration or confusion, while too much can overwhelm the player (Zheyu et al., 2021).

On top of that, features like tips or hints, rewards or badges, achievements, and leaderboard can act as feedback mechanisms as well to help improve player's engagement. Garcia-Iruela & Hijon-Neira (2020) found that feedback systems like points and badges are favourable among students, as they make students feel rewarded and seeing the accumulation of their achievements give them a sense of accomplishment. This result is supported by the insights gathered in Zeng et al.'s (2020), showing that tips and hints are beneficial and valuable for students in educational game, as learning through game is more to self-regulated learning, without intervention like teacher's guidance. At the same time, it gives students the ability to choose whether to use the hints options or to challenge themselves while encountering obstacles. Conversely, more conflicts are seen in implementing leaderboards in game compared to other features. Do et al. (2024) and Lopez et al. (2023) note that leaderboards are not an optimal gamification design, as the aim to achieve better performance than others invoke anxiety and stress, which leads to poorer performance overall. Chen & Huang's findings (2024) indicate that leaderboards although can boost engagement and motivation due to encouragement of peer competitiveness, more of it are done by replaying easier levels to achieve higher in ranks. This result aligns with Philpott & Son's (2022) findings, where leaderboards as an external rewarding system has tip the balance of internal satisfaction and external recognition, straying further away from the initial goal.

2.4 Learning Styles

Certain aspects need to be taken into consideration when developing an educational game, and one of it is learning style. Every individual has their own unique learning style, such as visual, auditory, reading or writing, and kinesthetics otherwise known as the VARK model

(Flemming, 1995, as cited in Tomić et al., 2023). Visual learners absorb information most effectively when they can see it. These people often use diagrams or highlight important notes to improve knowledge retention. In the context of video games, visuals play an important role in enhancing learning by providing clear and engaging representation of concepts. For instance, colours and animations can provide more detail visuals when players navigate the game world (Sastradika et al., 2021). Auditory learners excel when they can hear information. This group of learners often speaks out when studying and listens to what is being recited. Verbal instructions such as in-game dialogues or sound effects can aid these learners to better grasp information (Budiansyah et al., 2024). Other than that, Reading or Writing learners tend to read and take notes to process information. In gaming context, text-based instructions or in-game journals works well with these people as they can associate the storyline and objective better while scouring through the narratives (Tuli et al., 2022). Kinaesthetic learners are prone to active involvement, where they learn best when hands-on interaction is involved. Experimentation and manipulation of in-game elements, like moving objects with mouse or making the character jump across the platform, using buttons to navigate and solve puzzles aid well for these types of learners (Warburton et al., 2023). In fact, visual, auditory, reading or writing and kinaesthetic are intertwined in game to simulate real-life experience and stimulates all senses to maximize engagement, as well as maintaining consistency in game narration and design to not overwhelm the learners (Zeng, et al., 2020). Hence wise, a good game should incorporate these multimodal presentations to enrich learning journey and provide an interactive experience.

2.5 Review on Existing Games

This section reviews three existing games that incorporate educational physics elements, namely “Phys 1”, “Kirchhoff’s Revenge”, and “Game of Physics”. All three games are downloaded and reviewed thoroughly.

2.5.1 Phys 1

Figure 2.1. 1: Displacement tool to measure the distance to be applied for the equation

“Phys 1” is a 2D physics puzzle game developed by Osmosis Games where the objective is to navigate through platforms filled with obstacles that can harm the players, as well as collect coins and tackle stimulating kinematic problems. Players are to use tools like the displacement tool to measure distance and direction (as shown in Figure 2.1.1), the velocity tool to track speed and direction of rocket launching, and the time tool to measure the rocket's travel time between points. The UI is simple and user-friendly, with a drag-and-drop interface that makes it easy for players to interact with the tools directly on the screen. However, several downsides arise as players progress through the games. The player starts with 3 hearts, with a maximum of 5 hearts when traversing from levels to levels without failing. If the player makes an incorrect measurement and apply the wrong value, they face a penalty of losing 1 heart. Furthermore, there are no hints available during puzzle-solving, limiting players to only three mistakes before

the game ends (as depicted in Figure 2.1.2), requiring them to replay the level. Alternatively, no time limit on solving puzzles provide a more lenient and methodical approach for players to think carefully and double check before executing the plan. Apart from that, the scoreboard (see Figure 2.3) is relatively simple, reflecting only the completion of the level with 3-star rating. The stars are awarded based on the player's ability to collect all the coins, avoid losing hearts from mistakes in solving physics problems and minimize health loss from obstacles harm. It lacks meaningful feedback as it does not provide insights into player's performance, such as the number of attempts taken, trial and error patterns, or the time spent on solving each puzzle. Moreover, the absence of motivational elements or encouragements may hinder the player's sense of accomplishment and drive to improve.

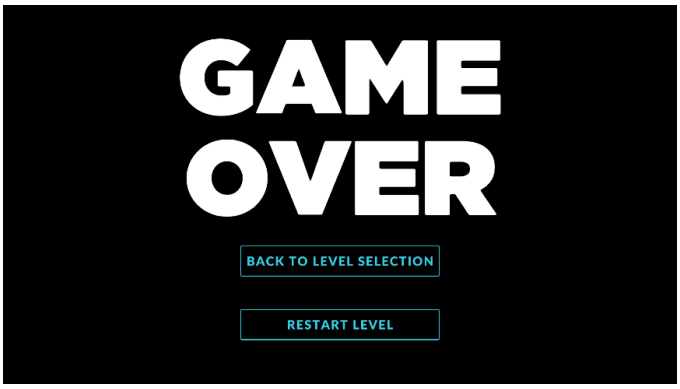

Figure 2.1. 2: Game over scene when a player fails a challenge

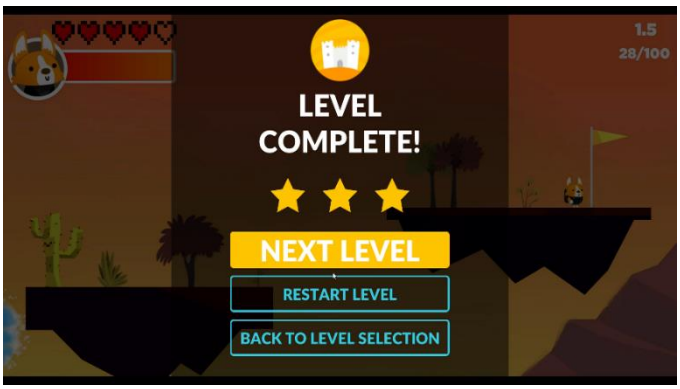

Figure 2.1. 3: Three-stars completion of the level

There is no storyline in this game, but 6 sections of playable levels, “First Gear” to “Fourth Gear”, “Falling Free”, and “Projectiles”. The first 5 sections are related to linear motion, which aligns with the Malaysian Secondary School Form 4 syllabus, as it uses linear motion equations, tinkering between the relationships of velocity, time, acceleration, and displacement (Kementerian Pendidikan Malaysia, 2019). The "Falling Free" section covers free fall, assuming gravitational acceleration ($g = 9.8\ ms^{-2}$) and initial velocity, $v = 0\ ms^{-1}$. Meanwhile, the "Projectiles" section (refer to Figure 2.1.4), despite its title, still applies linear motion principles to introduce projectile motion concept, combining both horizontal and vertical motion to present an ultimate trial for players. With the application of kinematics, this game closely mirrors real-world scenarios like ballistics or space exploration, where understanding velocity, acceleration and trajectory are essential for predicting the motion of the object. The game is free to download from the Microsoft Store or Google Play, as well as available offline on both mobile and desktop devices after installation.

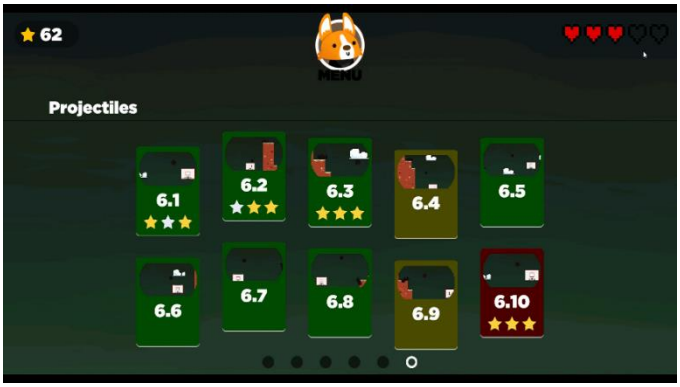

Figure 2.1. 4: Level layout of Projectiles section

2.5.2 Kirchhoff's Revenge

Figure 2.2. 1: Home page of Kirchhoff's Revenge

"Kirchhoff's Revenge" (Figure 2.2.1), developed by Gerd Kortemeyer and a team of educators at Michigan State University, is a first-person puzzle game designed to teach the fundamental principles of electrical circuits. In contrast to commercially driven games, "Kirchhoff's Revenge" was built for educational reasons, adopting research-based design approaches to address frequent challenges students face when learning about electricity and circuits (Kortemeyer, 2020). The game is both entertaining and educational, featuring a storyline where players must escape the Gustav Kirchhoff's lair. As they progress, players not only engage with increasingly complex circuit puzzles but also learn key concepts about electricity, current, resistance and potential. Educational contents are integrated in such a unique way where blackboards (as shown in Figure 2.2.2) and informational display (as shown in Figure 2.2.3) are used to provide insights into the historical background and the scientific theories behind the puzzles. This combination of gameplay and academic content creates an immersive experience, where players can deepen their understanding of electrical circuits while solving interactive challenges.

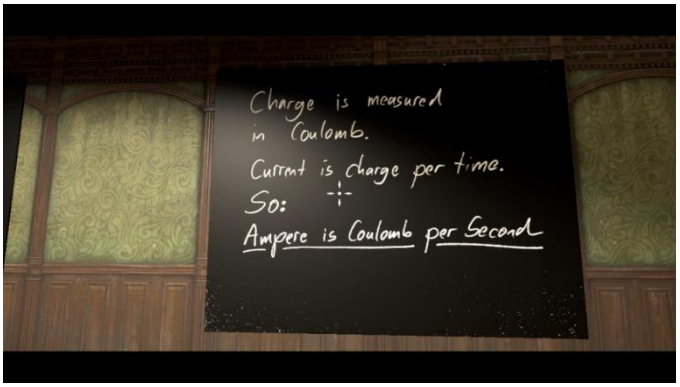

Figure 2.2. 2: Explanation of relationship between charge, current and unit of Ampere

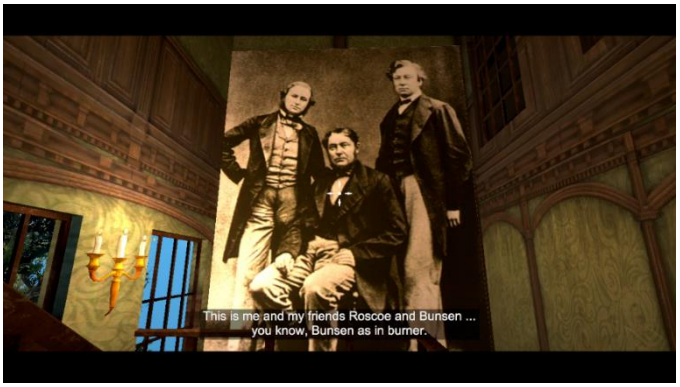

Figure 2.2. 3: Portrait of Kirchhoff (left) with Bunsen (middle) and Roscoe (right)

Similarly to "Phys 1", this game also has no timed challenge, allowing players to experiment at their own pace without the pressure of time or penalties. If a current overload occurs, the game triggers a short explosion, allowing players to reconnect immediately without restarting the level, though Kirchhoff may add a sarcastic remark (see Figure 2.2.4). As the game provides instructions through dialogue with Kirchhoff or via the blackboard, if the players are to forget the instruction, or stuck in a puzzle, they can refer to the blackboard for recall or hints. Upon solving all the puzzles, they are rewarded with a "*Schwarzwälderkirschtorte*", or Black Forest Cake and a certificate by Kirchhoff (as illustrated in Figure 2.2.5).

Figure 2.2. 4: Kirchhoff making a sarcastic comment on player's mistake

Figure 2.2. 5: The player is awarded a certificate and Black Forest cake for winning the game

Having instant reset on puzzles, hints and achievement are beneficial for players engagement. However, no performance feedback on overall actions limits a potential valuable feature to provide insights or aid student evaluation. The game is highly relevant to real-world applications, particularly in fields like electrical engineering and daily task like planning ceiling bulb circuits. Based on Kirchhoff's laws, it aligns with concepts taught in higher education, particularly in chapters like Form 6's Second Semester of STPM (Malaysia Higher School Certificate Examination) Electricity and Magnetism (Malaysian Examinations Council, 2020), rather than a secondary school syllabus (Kementerian Pendidikan Malaysia, 2019). The interface is straightforward and intuitive, where players can easily grab, rotate, and connect circuit elements. Used in high school and college physics courses, in Western countries, the game is available on Steam and required an Internet connection.

2.5.3 Game of Physics

Figure 2.3. 1: Home screen of Game of Physics

The third game is called “Game of Physics” (Figure 2.3.1), a 3D Android game developed by Mind Design Marketing Communication Pvt. Ltd, which can be play for free on mobile devices. Set in the medieval era, players take on the role of a soldier tasked to reclaim their castle. The gameplay blends role-playing games elements and strategic mechanic, where players control the soldier to perform actions such as attacking, moving, and dodging in real-time combat (as shown in Figure 2.3.2). As the player marches further into the castle, the gameplay introduces a unique mechanic, where the player must collect "formulas" that enhance the soldier's abilities (see Figure 2.3.3). These formulas grant the player the power to deal long-range, one-turn-kill (OTK) damage. To activate these abilities, players need to solve physics-based puzzles involving concepts of projectile motion. Unlike “Phys 1” where it combines linear motion to expose players on projectile motion concept, this game directly applies the projectile motion principles which are not covered in the secondary school syllabus, but rather in the second chapter of STPM Form 6’s First Semester (Kementerian Pendidikan Malaysia, 2019; Malaysian Examinations Council, 2020). However, in terms of real-world relevance, this game shares similarities with “Phys 1” with the use of cannons, while also introducing the concept of archery.

Figure 2.3. 2: Player encountering enemies at the front gate of the castle

Figure 2.3. 3: The first formula in the game available to be collected

To use the formula, correct calculation is crucial to successfully deploy the attack. The user interface as shown in Figure 2.3.4, layout neatly the formula of the projectile motion along with corresponding variables, with a number-pad underneath for player to key in the correct value. If the player inputs an incorrect value, they will lose one of their three available attempts (refer to Figure 2.3.5), where losing all three attempts will prompt the player to replay, adding an additional layer of difficulty and strategy. At the same time, if the player takes too long to think and does not act quickly, the enemies will periodically deal damage on the soldier. This two features hand-in-hand form a pressured-based challenge onto the players, which may instil stress onto the players. The constant pressure from enemies may heighten anxiety and make it more difficult for players to perform optimally. Likewise, the hint system in the game is limited, appearing only after a wrong attempt, such as selecting the wrong cannonball size. This restricts players from freely assessing or choosing when to use hints, unlike in “Kirchhoff’s Revenge”, where hints are available all the time, potentially causing frustration in this game, especially

since the feature is unlocked only in the final stage. After the player triumphantly reclaimed the castle, a congratulatory message appears at the end scene, as can be seen in Figure 2.3.6. Since "Game of Physics" is an educational puzzle game, the lack of performance insight on how well the player performed, along with no-achievement integration to motivate and reward player's fast action under pressure throughout the course sufficiently highlights the flaws of this game.

Figure 2.3. 4: User interface for calculating the range of the projectile

Figure 2.3. 5: User interface showing the player's remaining attempt

Figure 2.3. 6: A congratulatory message for the player finishing the game

2.6 Comparison of Reviewed Games

Table 1. 1: Comparison of features across reviewed games

Games / Features	Phys 1	Kirchhoff's Revenge	Game of Physics
Storyline	✗	✓	✓
Easy to navigate UI	✓	✓	✓
Pressured-based challenge	✗	✗	✓
Penalties for trial and error	✓	✗	✓
Hints available	✗	✓	✗
Achievement	✓	✓	✗
Performance feedback on scoreboard	✗	✗	✗
Relation to secondary school syllabus	✓	✗	✗
Real-world relevance	✓	✓	✓
Need Internet access to play	✗	✓	✗

Table 1.1 tabulates the comparison of reviewed game based on 10 features. The first feature is storyline, as strong narrative can significantly enhance player engagement, making learning more immersive and memorable. Despite all 3 games are puzzle-level based, only "Phys 1" has no narrative element in it, limiting its ability in terms of audience retention. Additionally, UI that is easy to navigate is essential when developing an educational game as

players should not be concerned about complex controls, but instead should aid players quickly emerge into the core of the game elements. All 3 reviewed games have different UI, but all of them are easy to use and do not hinder the player's capabilities to proceed with the game mission.

Speaking of progression, pressure-based challenges, penalties, hints, and achievements are often used in educational games to foster competitiveness and motivation. However, these elements can be double-edged swords, as time-based may increase anxiety, leading to avoidance, excessive penalties can discourage risk-taking, while overly forgiving hints and easy achievements may undermine the game's educational goals, distracting from the primary objective of learning. "Phys 1" and "Game of Physics" has penalties for trial and error, both using 3 attempts on physics-based puzzles. "Phys 1" and "Kirchhoff's Revenge" have achievement in their game, but the latter is the only game with hints available. "Game of Physics" is the only game with pressured-based challenge where it adds additional weights on player's problem-solving time with enemies periodically attacking on the player.

The 7th feature to be compared across the reviewed games is performance feedback on scoreboard, where it is absent in all the 3 reviewed games. Performance feedback is crucial especially when it comes to educational game as it provides insights for players to know how they performed and what are the alternatives to approach the puzzles. In relation to secondary school syllabus, only "Phys 1" is related in terms of linear motions. All reviewed games are relevant to real-world scenarios, where linking physics concepts and real-world applications are crucial in motivating players' perceptions towards the stigma of physics. Lastly, "Phys 1" and "Game of Physics" have offline accessibility to play the game, making it efficient for learning, especially for those who lived in a rural area.

2.7 Tools

To develop an engaging game for physics learning, a combination of tools is required, such as game engine to handle game logic, physics simulations, and user interaction, as well as designing program for creating appealing visual assets to enhance the user experience.

2.7.1 Unity Game Engine

Unity is a popular game development engine that has essential features for creating interactive learning experiences, particularly in physics simulations. One of Unity's most notable characteristics is its scripting environment, which is designed to be user-friendly even for beginners while simultaneously providing sufficient depth for more experienced developers. Unity's scripting API, which uses C# as its primary programming language, enables developers to design and handle sophisticated interactions, simulations, and game logic without requiring a steep learning curve (Unity Technologies, 2023). It also has a user-friendly “drag-and-drop” interface to simplify the process of integrating game assets. Other than that, Unity has offers various resources such as tutorials and active community that can help streamline the learning process. Additionally, Unity has built-in engine that simplifies physical phenomena simulation like “RigidBody” to have weight or mass, which is beneficial to apply real-world physics properties to game objects.

2.7.2 Adobe Illustrator

Adobe Illustrator is a vector-based design tool mainly for creating 2D visual elements. Serious games may incorporate game icons, user interface components, and educational illustration, where Illustrator is a good fit for it as one of its strength lies in producing clean, scalable vector graphics that can be easily integrated into Unity. For instance, physics learning games necessitate the use of UI elements such as buttons for interactions, levers or sliders for

controlling variables, and motion illustration to convey concepts. These elements can be designed in Illustrator and then export to Unity without losing its resolution and clarity, regardless of screen size or resolution. This seamless integration between Illustrator and Unity enables developers to maintain visual consistency throughout the game, ensuring that all graphical elements, from interfaces to instructional assets, align with the overall design and educational goals.

2.8 Summary

The persistent perception on physics as a difficult subject has led to the exploration of alternative teaching methods, including the development of serious games to engage students more effectively. A comprehensive review of existing educational games, namely “Phys 1”, “Kirchhoff’s Revenge”, and “Game of Physics” is conducted to gather insights on their design, educational value, and engagement strategies. Through comparing these games, key elements that enhance engagement and learning outcomes including narrative storyline, easy to navigate UI, integration of hints and achievement to ease progression, performance feedback to give insights for players, offline accessibility and real-world application are identified. In terms of game development tools, platforms such as Unity, along with design software like Adobe Illustrator, are reviewed for their potential in supporting the game development process. Building on this analysis, the proposed “Physics Corner” should incorporate all these features and will be developed using the tools reviewed.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter focus into each phase of Waterfall Model, as illustrated in Figure 3.1.1. The first phase is Requirement Analysis Phase, which consists of 2 subsections, data analysis and system analysis. The data analysis section investigates the perception of Physics learning and how an interactive game can help improve engagement towards learning Physics, whereas system analysis section inspects the hardware and software requirement for the game. The second phase is System Design Phase, which includes the system's architecture diagram, data flow diagram, entity relationship diagram, data dictionary, and wireframe. The subsequent phases are Implementation Phase, Testing Phase, Development Phase, and Maintenance Phase, are then discussed before closing the chapter.

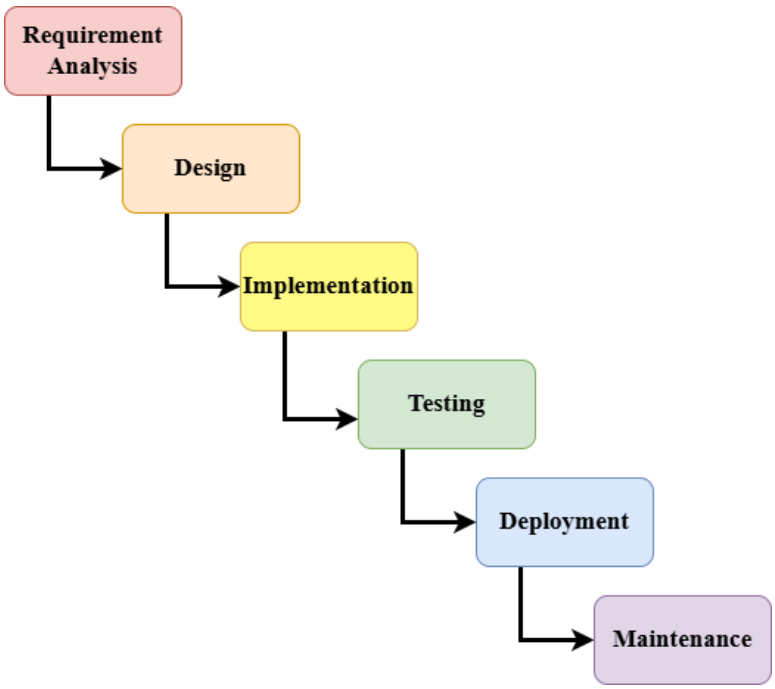

Figure 3.1. 1: Six phases of Waterfall model

3.2 Requirement Analysis Phase

3.2.1 Data Analysis

This section analyses and visualizes the survey gathered from a Google Form questionnaire survey conducted on 33 current and former higher secondary form students. The questionnaire, as presented in **Appendix B**, consists of 4 sections to collect and understand respondents' insight on learning Physics as well as their perspective on games in enhancing engagement towards learning Physics. The questionnaire starts with a brief introduction and the purpose of conducting the survey, following with Section A, "Demographic Profile", aiming to understand respondents' background which might influence their views on Physics education and learning through games. The next section, Section B is "Current View on Learning Physics", exploring the respondents' way of learning Physics and the attitudes towards Physics. Section C is "Perception on the Concept of Physics Learning Game", assessing the respondents' perspective on the idea of using game for Physics education. The last section of the questionnaire is Section D, "Opinions on Features for Physics Learning Game", focused to understand which features the respondents believe are the most important for a Physics learning game.

3.2.1.1 Section A: Demographic Profile

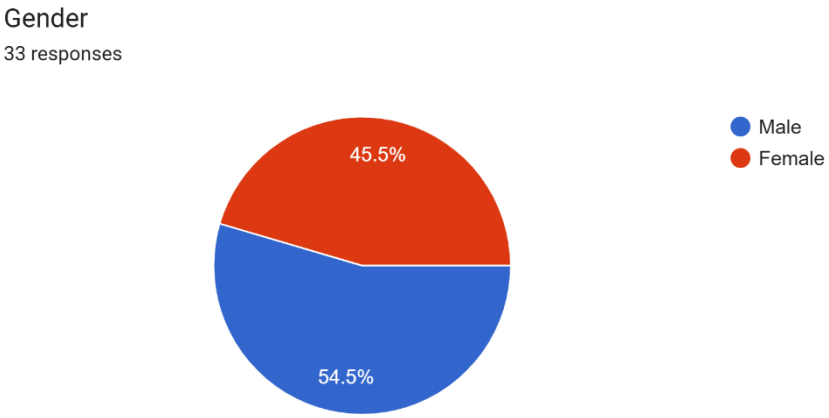

Figure 3.2. 1: Respondents' gender distribution

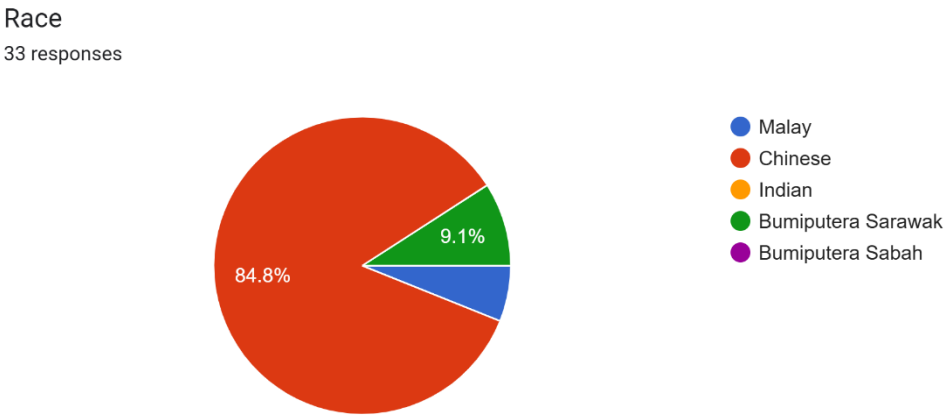

Figure 3.2. 2: Respondents' race distribution

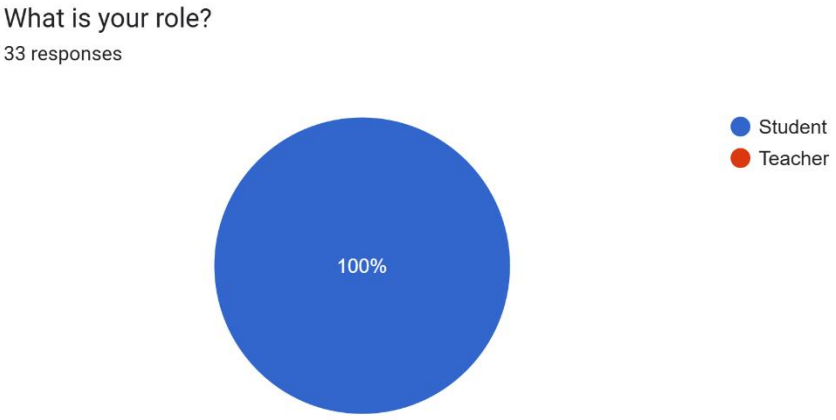

Figure 3.2. 3: Respondents' role distribution

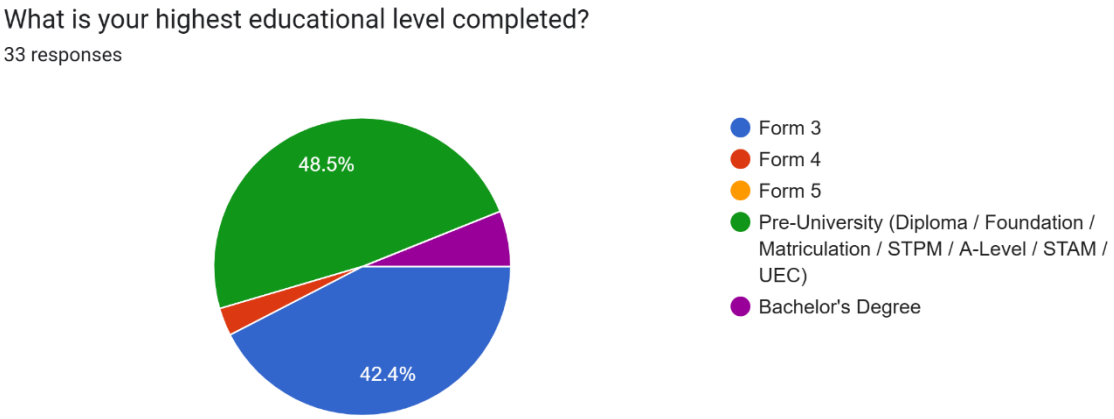

Figure 3.2. 4: Respondents' highest educational level completed

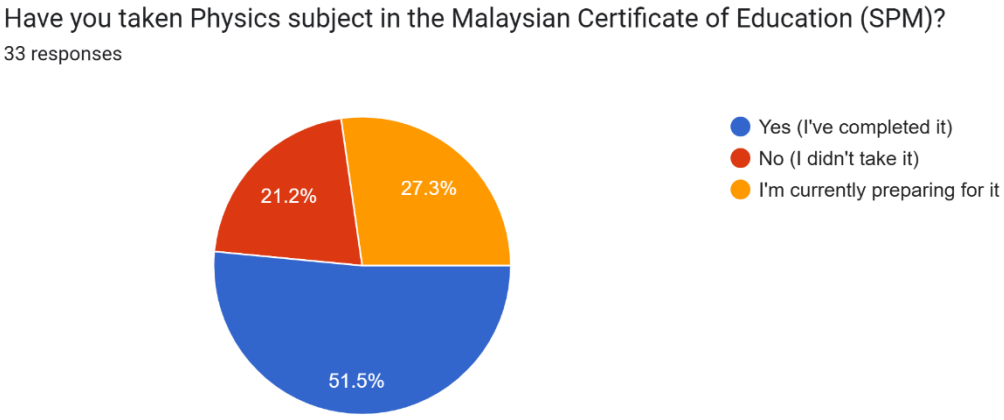

Figure 3.2. 5: Respondents' participation in Physics subject in the Malaysian Certificate of Education (SPM)

In Figure 3.2.1, the demographic profile of the respondents indicates that 54.5% are male and 45.5% are female. The respondents come from different races (as shown in Figure 3.2.2), with Chinese making up the largest group at 84.8%, while Bumiputera Sarawak comprises 9.1% and the remaining 6.1% are Malay. All the respondents are students (as depicted in Figure 3.3.3), with majority of having completed secondary school. Among them, 48.5% completed pre-university education (indicating they are now university students), and 6.1% have completed a bachelor's degree (indicating they are currently postgraduate students). The remaining respondents are still in secondary school, with 42.4% having completed Form 3 (now in Form 4) and 3% having completed Form 4 (now in Form 5), as shown in Figure 3.2.4. Regarding their Physics education (see Figure 3.2.5), most of the respondents (51.5%) have taken Physics as part of their Malaysian Certificate of Education (SPM), with 27.3% currently preparing for it, and 21.2% have not taken the subject.

3.2.1.2 Section B: Current View on Learning Physics

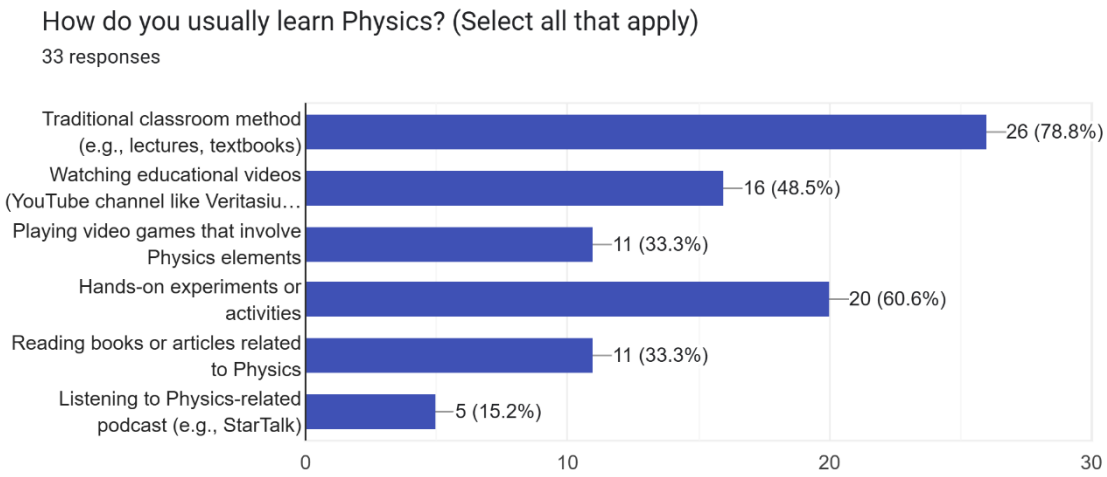

Figure 3.2. 6: Respondents' usual method for learning Physics

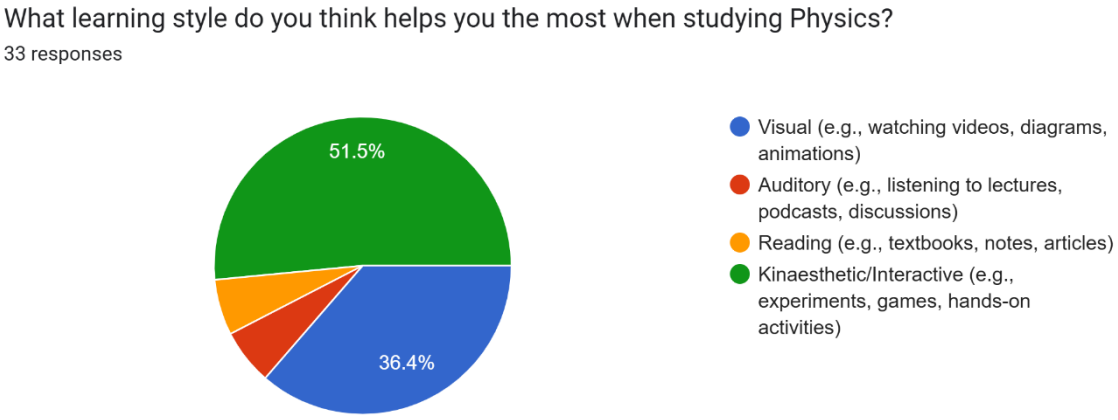

Figure 3.2. 7: Respondents' preferred learning styles for learning Physics

Figure 3.2.6 shows the learning methods respondents currently use to learn Physics. Most respondents (78.8%) rely on traditional classroom method, followed by 60.6% who engage in hands-on experiments or activities, and 48.5% who watch educational videos. 33.3% uses video games related to Physics, and read books or articles on the subject, respectively. Only 15.2% listen to Physics-related podcasts. On the other hand, Figure 3.2.7 illustrates the

respondents' preferred learning styles. The largest group (51.5%) prefers kinaesthetic or interactive learning, while 36.4% prefer visual learning. Auditory and reading-based learning styles are less common, with both at 6.1%. These data reveal an interesting contrast, while most of the respondents currently use traditional classroom method to learn Physics, there is a clear preference for more interactive and visual learning experiences. This suggests that while classroom learning remains the most common method, respondents are more inclined towards a more engaging, hands-on approach with visuals on learning Physics, which should be incorporated into the proposed game.

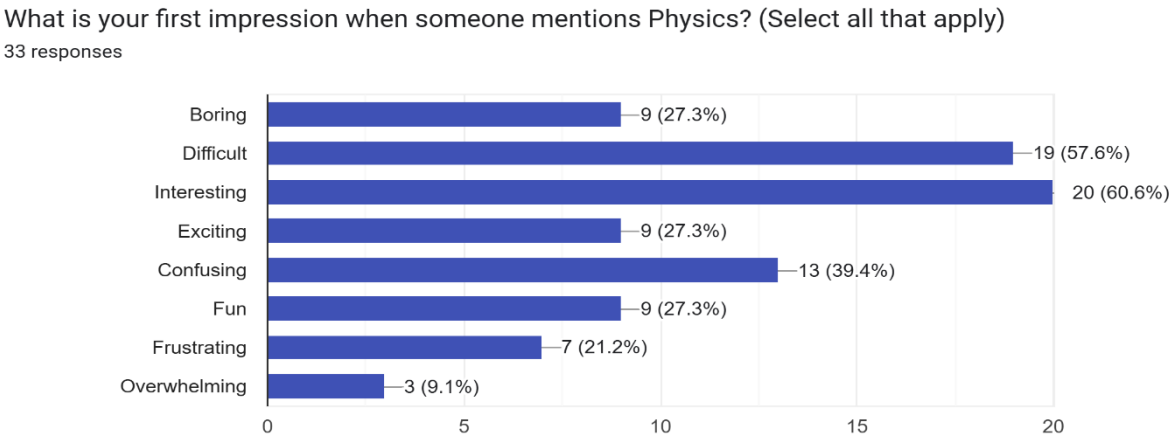

Figure 3.2. 8: Respondents' first impression on Physics

The data in Figure 3.2.8 highlights the respondents' first impression when Physics is mentioned. The majority of respondents find Physics interesting (60.6%) and difficult (57.6%). A significant portion of respondents also view Physics as confusing (39.4%) and boring (27.3%). Interestingly, 27.3% describe Physics as exciting, while fewer respondents find it frustrating (21.2%) or overwhelming (9.1%). This implies that while Physics is generally seen as an

intriguing subject, it also elicits mixed feelings, with substantial number finding it difficult and confusing.

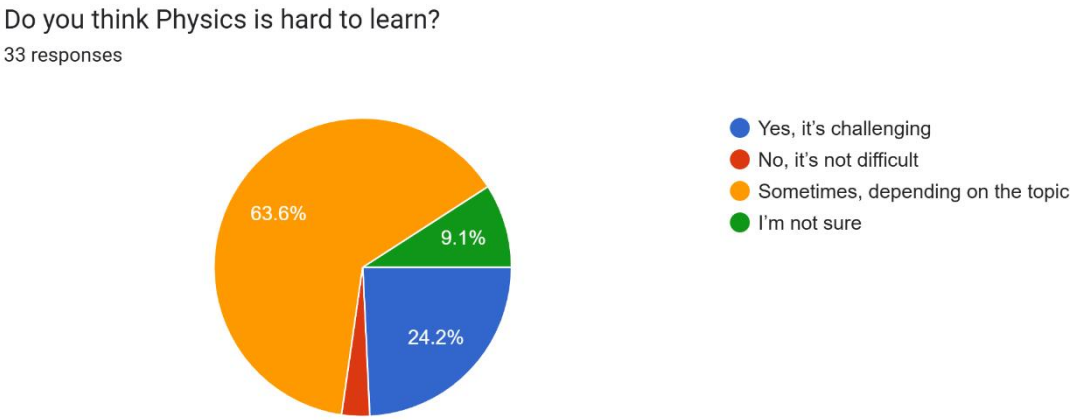

Figure 3.2. 9: Respondents' perceptions of the difficulty of learning Physics

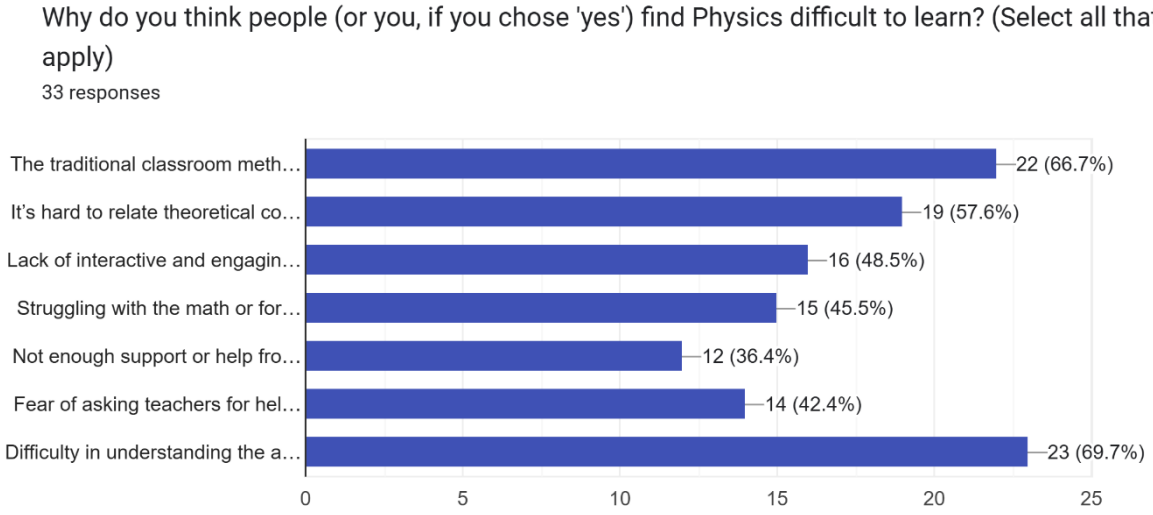

Figure 3.2. 10: Reasons why respondents find Physics difficult to learn

In Figure 3.2.9, we see that when asked whether Physics is hard to learn, 63.6% respondents infer that it can be challenging depending on topics, while 24.2% agree that it is generally difficult. Only a small percentage (3%) feel that Physics is not difficult to learn, and

9.1% are unsure. This suggests that many students perceived Physics as a subject that varies in difficulty depending on the specific content being covered. Moreover, Figure 3.2.10 provides insight into why respondents find Physics difficult to learn. The most cited reasons, cited by 66.7%, is the traditional classroom method feeling boring and unengaging. Furthermore, 57.6% struggle with relating theoretical concepts to real-world situations or visualizing them. Other significant factors are lack of interacting learning aids (48.5%), struggles with maths and formulas (45.5%), fear of asking for help (42.4%), and insufficient support from teachers. Additionally, 69.7% of respondents feel that the abstract nature of Physics concepts contributes significantly to the difficulty of the subject. The findings indicate that many students' difficulties with Physics stem from traditional teaching methods, abstract content, and a lack of interactive and supportive learning tools, which aligns with the problem statement of this study, highlighting the need for more engaging, interactive learning approaches to improve Physics learning engagement.

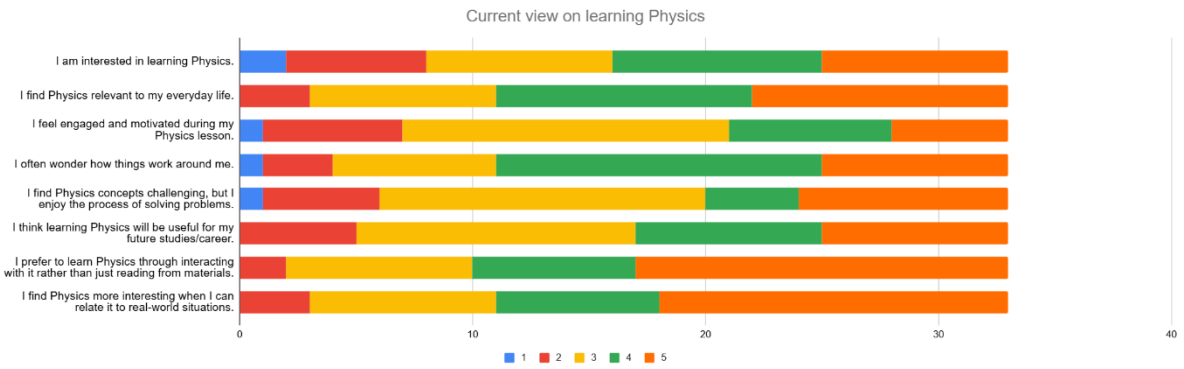

Figure 3.2. 11: Current view on respondents' thoughts and experiences with learning Physics

Figure 3.2.11 shows the respondents' level of agreement about their thoughts and experiences while learning Physics. Most respondents (51.5%) expressed interest in learning Physics, with 9 agreeing and 8 strongly agreeing that they are interested. However, a smaller

portion (6.06%) strongly disagrees, suggesting that while many students have a positive attitude towards Physics, there are still some who find it unappealing. Next, respondents largely agree (66.7%) that Physics is relevant to their daily lives, with 11 agreeing and strongly agreeing with the statement respectively, while only 9.09% disagree. This result reveals that students do find Physics relatable, even though it is a complex and abstract subject. In terms of engagement and motivation in learning Physics, only 36.4% agree with the statement, while 21.2% disagree with it. This result supports the initiative aimed to make Physics learning more engaging should be implemented, making students more motivated to learn Physics. When it comes to curiosity on how things work, 66.7% respondents expressed curiosity, while 18.2% respondents show less interest in exploring how things work around them. 39.4% find that although Physics is challenging, they enjoy solving problems. This is evidenced by 4 respondents agreeing and 9 strongly agreeing, while a total of 6 disagreeing. This indicates that although the subject can be difficult, students still derive enjoyment from problem-solving process. This component should be considered when implementing the proposed game. 48.5% respondents view Physics as beneficial for their academic or professional future. Respondents strongly prefer interactive learning experiences over traditional reading-based methods, with 48.5% strongly agreeing and 21.2% agreeing the statement and only 6.06% disagreeing it. The high agreement also correlates with statement on finding Physics more interesting when it is related to real-world situations, with a total of 66.7% respondents agreeing, indicating interactive environment and linking Physics concepts to practical examples make the subject more engaging and relatable for students.

3.2.1.3 Section C: Perception on the Concept of Physics Learning Game

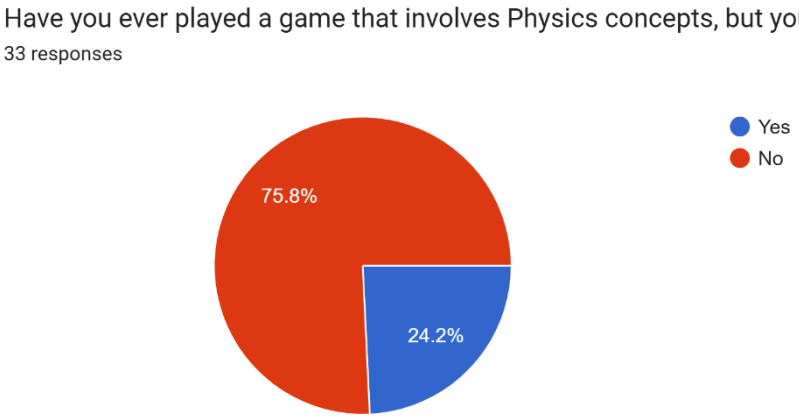

Figure 3.2. 12: Respondents' experience with games involving Physics concepts without prior awareness

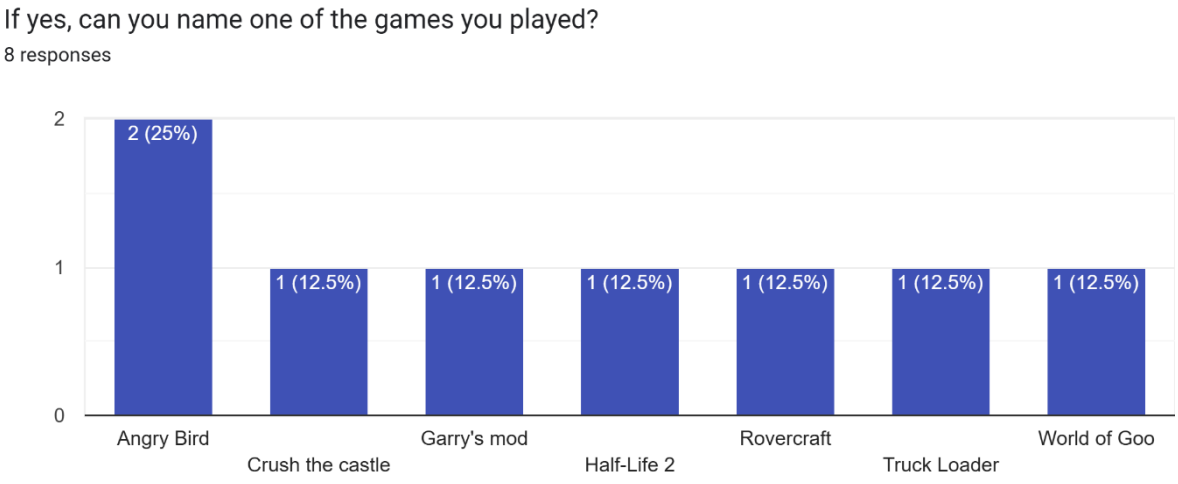

Figure 3.2. 13: Games played by respondents involving Physics concepts (initially unaware)

75.8% respondents have not played a game involving Physics concepts unknowingly, while 24.2% acknowledge that they have done so, as shown in Figure 3.2.12. With 8 respondents saying 'Yes' as illustrated in Figure 3.2.13, most frequently mentioned game is 'Angry Birds' (2), followed by a range of other games, including 'Crush the Castle', 'Garry's Mod', 'Half-Life 2', 'Rovercraft', 'Truck Loader', and 'World of Goo'.

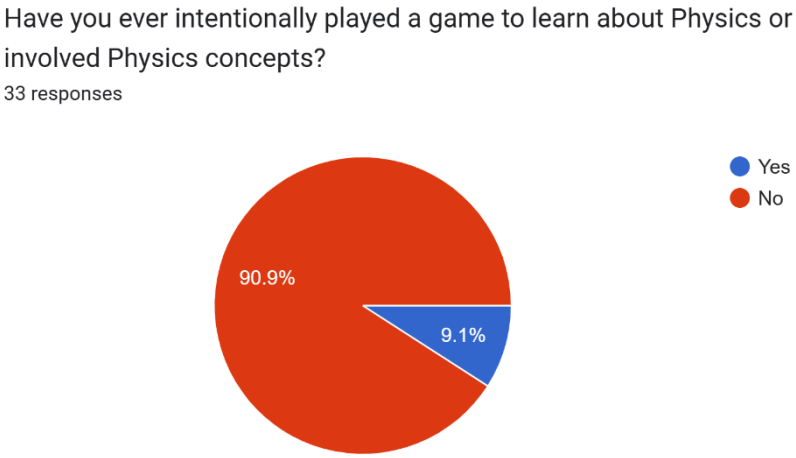

Figure 3.2. 14: Respondents' intentional play of games that involve Physics concept

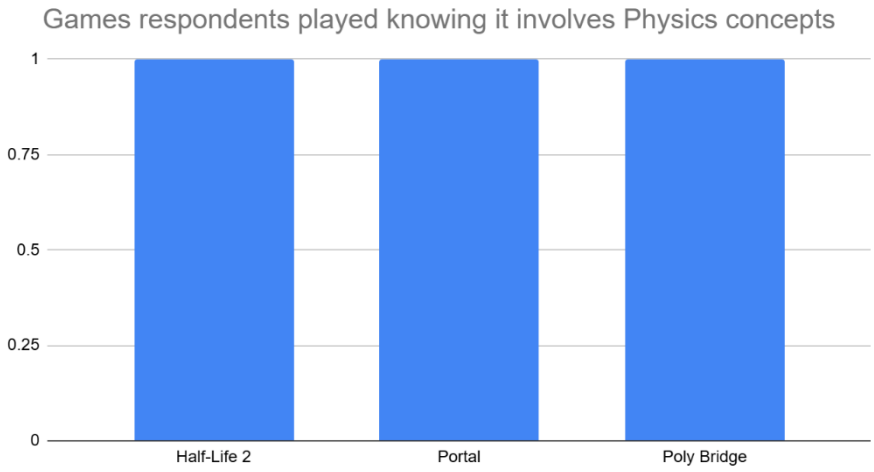

Figure 3.2. 15: Games respondents played intentionally knowing it involves Physics concept

Figure 3.2.14 shows that only 9.1% respondents have played a game to learn Physics or knowing it has Physics elements, while 90.9% have not done so. With 3 respondents who answers 'Yes' as illustrated in Figure 3.2.15, the games mentioned are 'Half-Life 2', 'Portal', and 'Poly Bridge'.

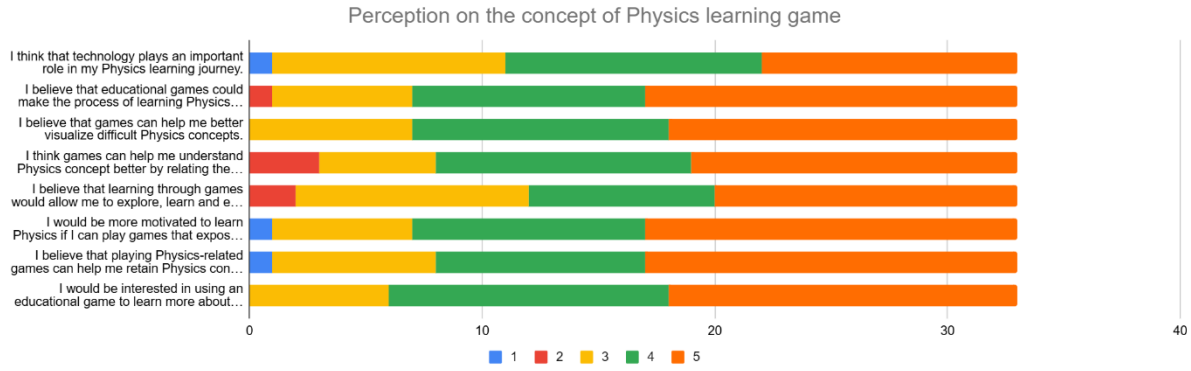

Figure 3.2. 16: Respondents' perception on the concept of Physics learning game

Figure 3.2.16 shows the respondents' perception on the concept of Physics learning game. Above average (66.7%) agrees that technology plays an important role in their learning process. A large majority (78.8%) agrees (30.3% agreeing and 48.5% strongly agreeing) that educational games could make learning Physics more enjoyable, reflecting strong support for the potential of educational games in enhancing the learning experience. The same percentage (78.8%) also agree that games could help them visualize difficult Physics concepts (33.3% agreeing and 45.5% strongly agreeing), indicating most respondents see games as a useful tool to improve their ability to visualize and understand complex concepts. This aligns with the responses on using games to relate Physics concepts to real-world applications, with a majority (75.8%) agreeing (33.3% agreeing and 42.4% strongly agreeing) the statement. In terms of self-paced learning and self-exploration through games, 63.6% favour (24.2% agreeing and 39.4% strongly agreeing) the statement. 78.8% show that they are motivated to learn Physics if they could play games related to the subject, (30.3% agree and 48.5% strongly agree), showing a strong inclination towards using games as a motivational tool for learning. Relating to concept retention, 75.8% agree that games will perform better than traditional method. Lastly, the highest percentage of all (81.8%) express interest in using games for learning Physics, indicating a strong interest in incorporating educational games into Physics learning.

3.2.1.4 Section D: Opinions on Features for Physics Learning Game

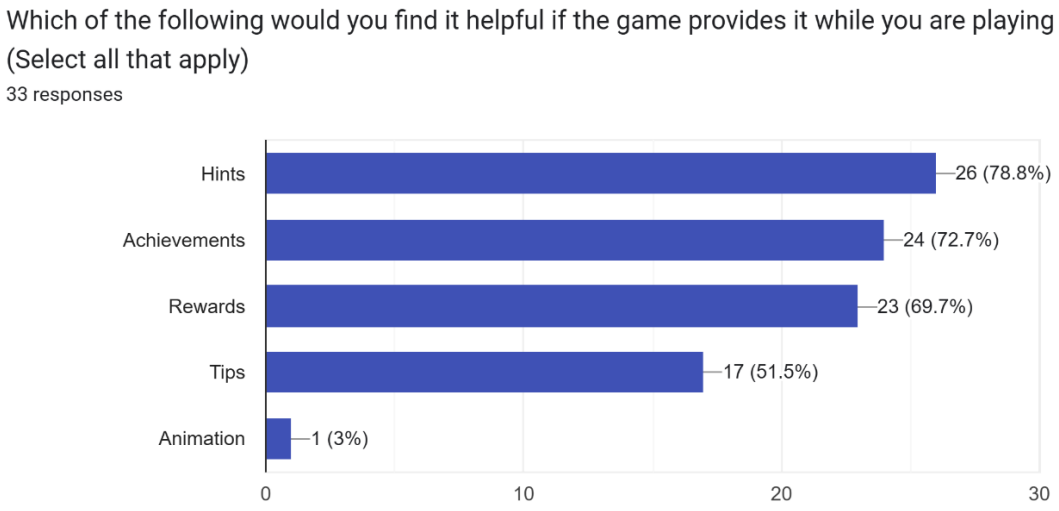

Figure 3.2. 17: Respondents' opinion on helpful game features

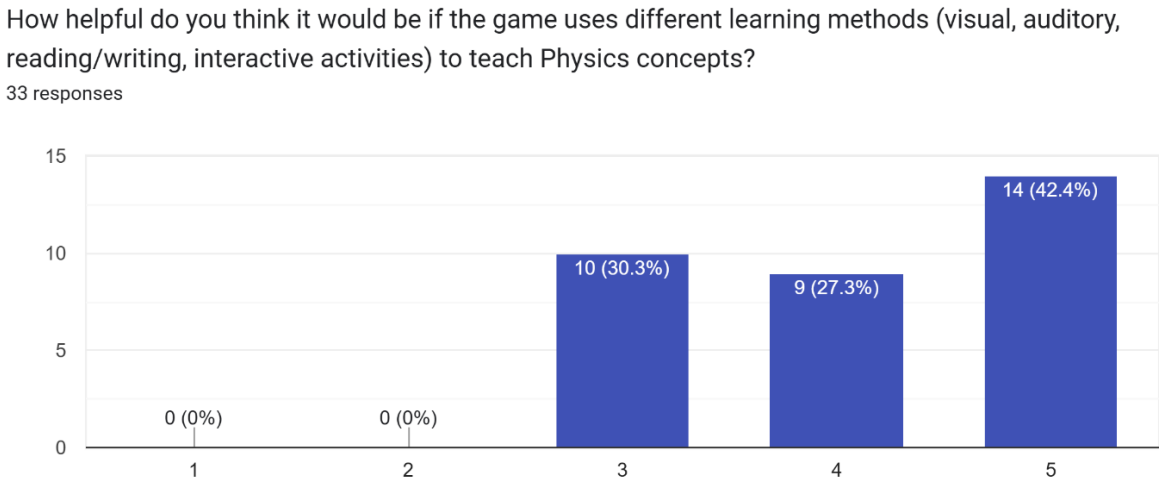

Figure 3.2. 18: Respondents' views on different learning methods usefulness in Physics game

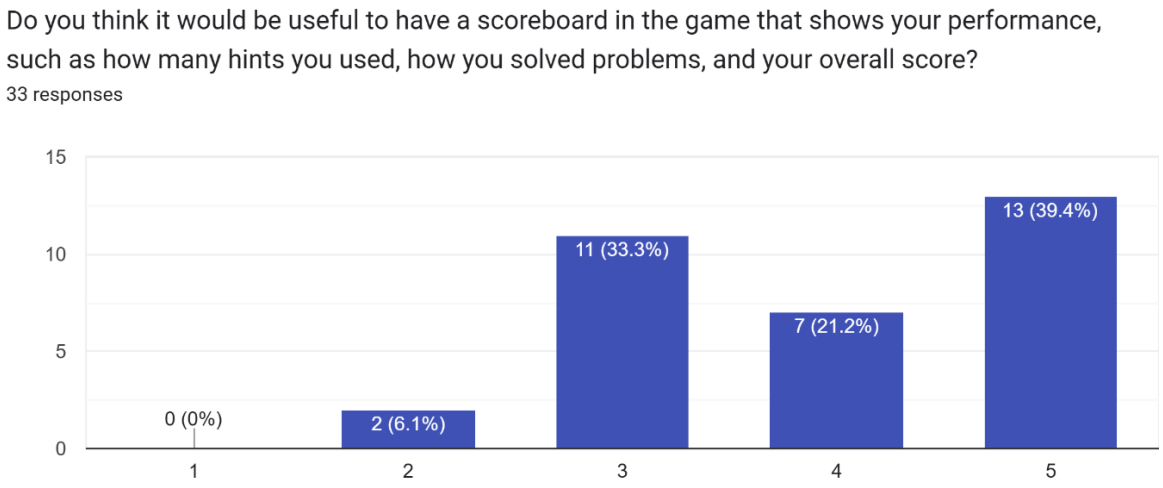

Figure 3.2. 19: Respondents' views on performance scoreboard usefulness in Physics game

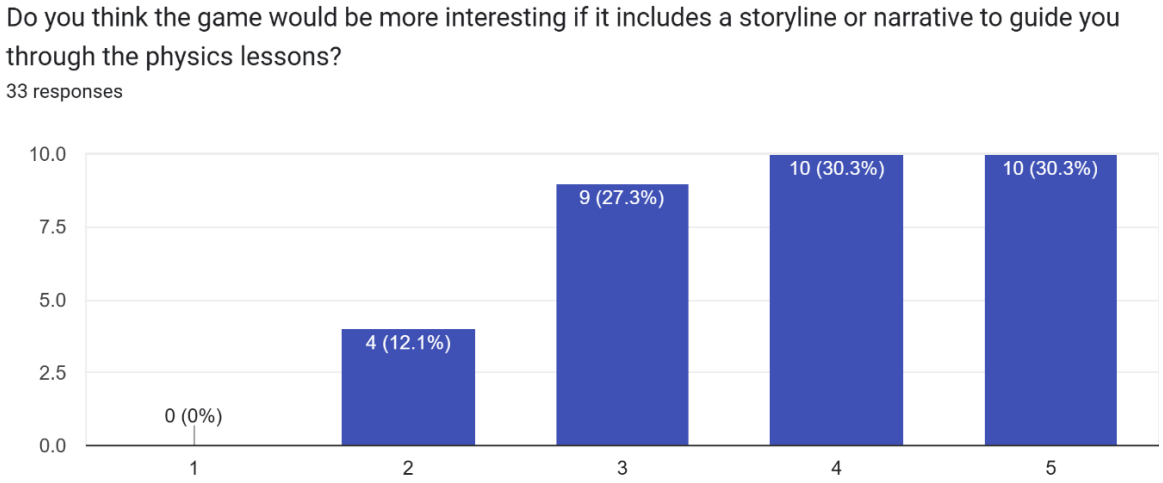

Figure 3.2. 20: Respondents' views on storyline in Physics game

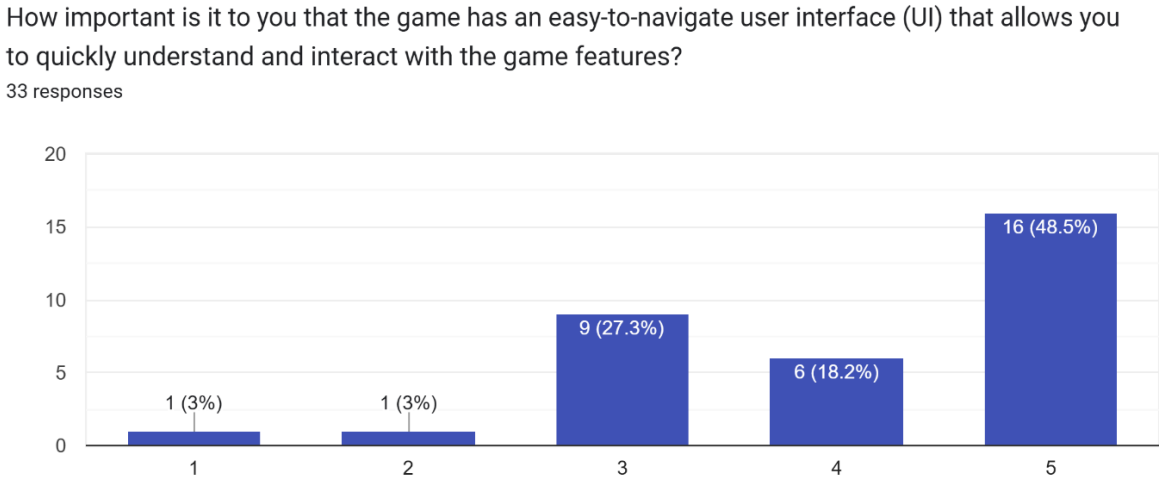

Figure 3.2. 21: Respondents' views on importance of easy-to-navigate user interface in Physics game

Figure 3.2.17 illustrates respondents' opinion on helpful features. A majority (78.8%) indicate that hints would be beneficial, followed by achievements (72.7%), and rewards (69.7%), as well as tips (51.5%), suggesting that respondents value feedback and reinforcement during gameplay. In terms of learning methods, visual, auditory, reading/writing, and interactive activities are considered crucial for teaching Physics concept (Figure 3.2.18), with 42.4% of respondents rating it as strongly agree and 27.3% as agree, highlighting a strong preference for multi-modal learning approaches. Figure 3.2.19 reveals respondents' view on performance scoreboard, with a majority of 39.4% agreeing that showing their performance, such as how many hints they used and how they solve problems would be useful. Storylines also receive significant support (60.6% combined agree and strongly agree) as shown in Figure 3.2.20, indicating respondents value context and guidance throughout the learning process. Alongside this, respondents also place high importance on easy-to-navigate user interface (Figure 3.2.21) with 48.5% rating it as highly important, suggesting usability as key factor in maintaining engagement and ensuring effectiveness of the game.

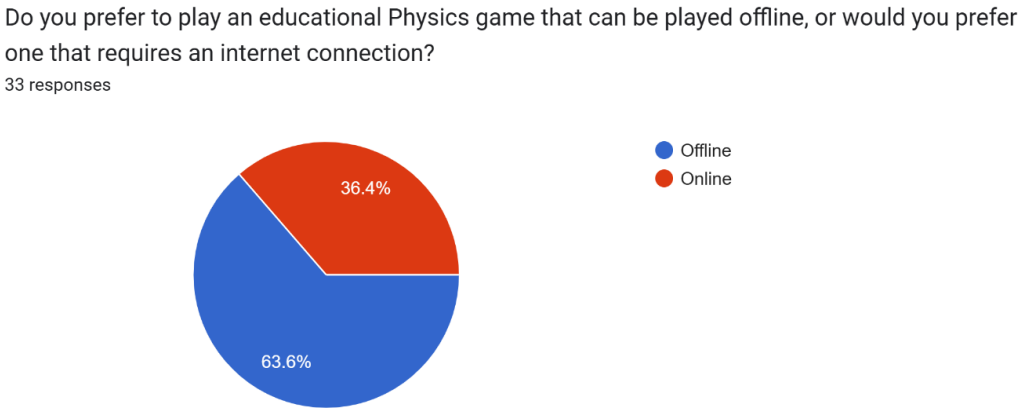

Figure 3.2. 22: Respondents' preference for Internet availability in Physics game

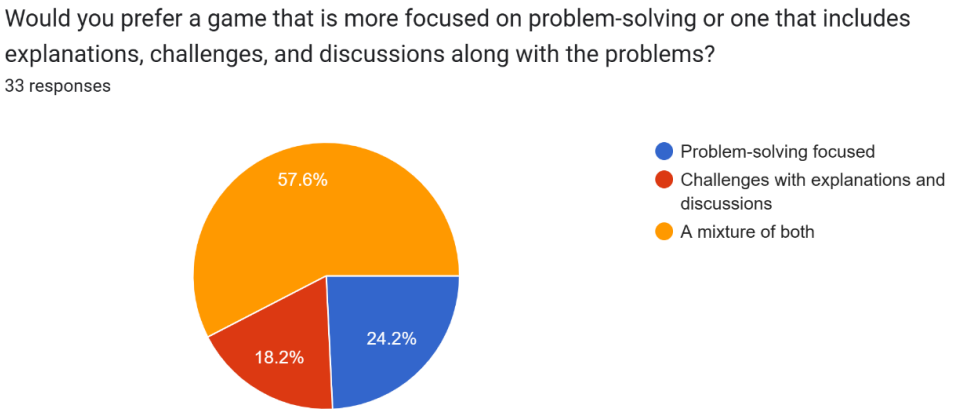

Figure 3.2.23: Respondents' preference on Physics game focus

Figure 3.2.22 shows that 63.6% prefer to have the game to be played offline, indicating favours in flexibility and accessibility. This feedback highlights that the proposed game should be offline, eliminating concerns about Internet connectivity. Regarding game content, 57.6% respondents prefer a mix of problem-solving, explanation, challenges and discussions (see Figure 3.2.23). This offer insights to balance the proposed game between interactive problem-solving tasks and supportive explanations, helping players to better understand Physics concept while still being challenged.

3.2.2 System Analysis

This section showcases the hardware and software requirements needed to develop the proposed “Physics Corner” game.

3.2.2.1 Hardware Requirements

The hardware requirements are as listed in Table 2.1.

Table 2. 1: Hardware requirements

Hardware	**Requirements**
Processor / CPU	Intel Core i5 or higher
RAM (Random Access Memory)	At least 8 GB or higher
Storage	10 GB or higher
Screen Resolution	Full HD (1920 x 1080) resolution or higher
Peripheral Devices	Laptops, mouse, keyboard

3.2.2.2 Software Requirements

The software requirements are as listed in Table 2.2.

Table 2. 2: Software requirements

Software	**Requirements**
OS (Operating System)	Windows 10 or higher
Game Development Engine	Unity
Programming Language	C#
Asset Design Software	Adobe Illustrator
Documentation	Microsoft Word

3.3 Design Phase

The System Design Phase involves creating logical and physical designs of "Physics Corner" such as system architecture diagram, workflow, context diagram, data flow diagram level 0, data flow diagram level 1, data flow diagram level 2, entity relationship diagram, data dictionary, and wireframe using the insights gathered from the previous phase.

3.3.1 System Architecture Design

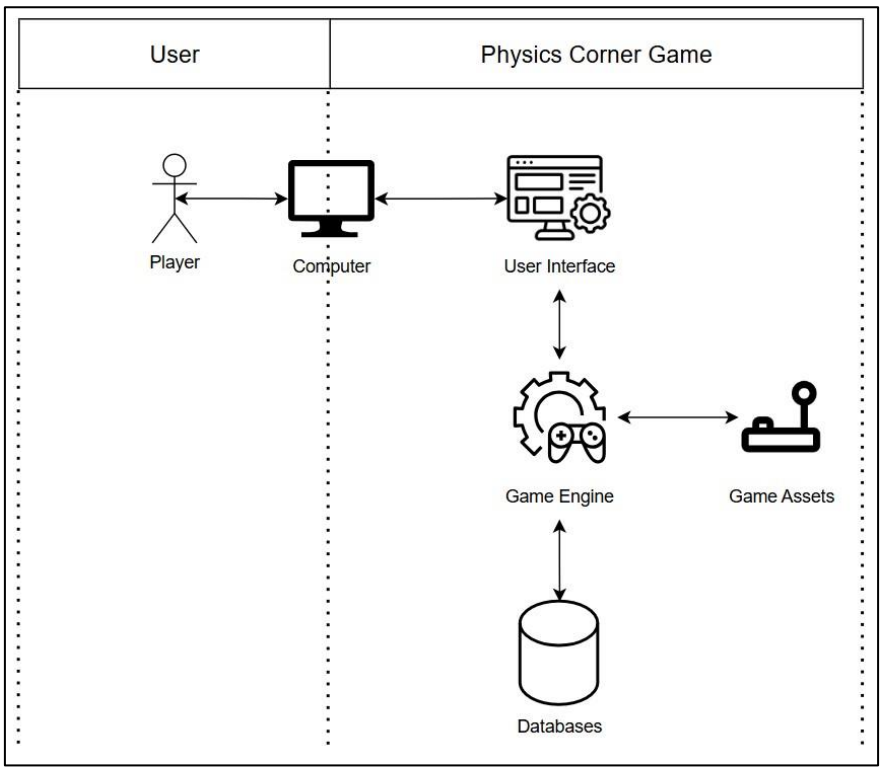

Figure 3.3. 1: System Architecture Diagram

Figure 3.3.1 shows the system architecture diagram of Physics Corner game, consisting of the User and the Physics Corner Game. The User section contains Player, who interacts with the Physics Corner Game through the Computer. As the player progresses through physics puzzles, they use various actions like point-click and drag-and-drop to manipulate game elements and solve challenges.

The User Interface is a component of Game Engine that allows the player to interact with the game. It displays vital information such as puzzle progress, time, and trial counts, as well as visual feedback like achievements, scoreboards and dialogues. If the player successfully solves a puzzle, an achievement is unlocked and displayed a pop-up on the screen. Additionally, each solved puzzle adds an entry to the Journal, which add key lessons from the challenges.

The Game Engine handles the logic behind the puzzles, tracks the player's progress, and manages the game's core functionality. It interacts with Game Assets, which include visual elements like sprite, animations, and physics models used throughout the game. The engine uses these assets to create the game world and ensure smooth interactions, such as puzzle animations and feedback when actions are performed.

The Database stores player progress data, including hint usage, time records, and trial counts. It also stores the player's achievement and journal entries. The Game Engine retrieves this information to update the User Interface, allowing the player to see their progress, achievement, and new journal entries. This data is also saved for later sessions, ensuring continuity in the player's experience.

3.3.2 Workflow

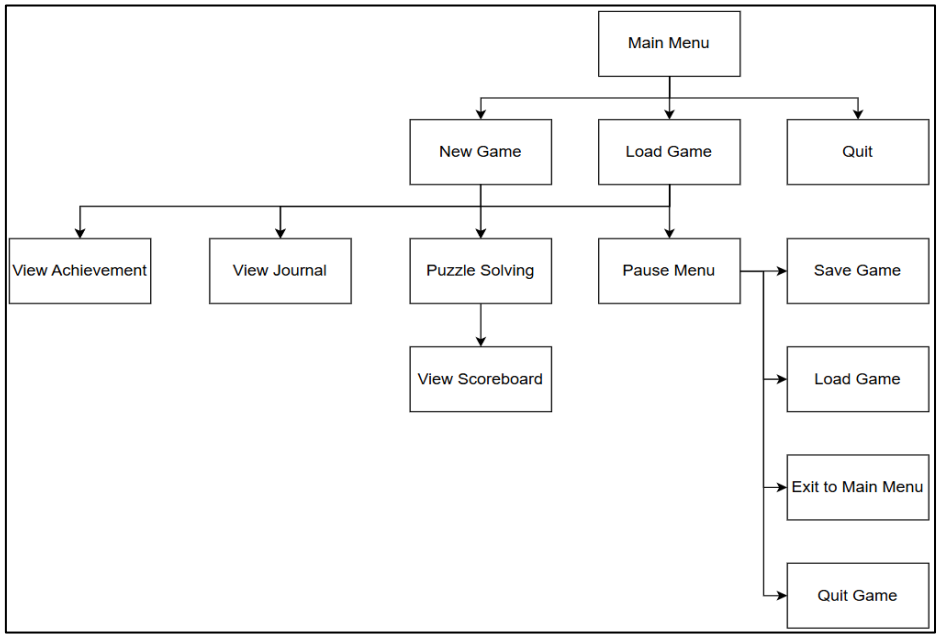

Figure 3.3. 2: Workflow of Physics Corner

Figure 3.3.2 depicts the workflow of 'Physics Corner'. After launching the game, players will be presented with a main menu, consisting of 3 selections (New Game, Load Game, and Quit), with only the 'New Game' and 'Quit' options active for new players, while the 'Load Game' selection is disabled. If players start a 'New Game', they will be greeted with storyline before proceeding to solving puzzles, while those who choose to 'Load Game' may continue from where they left off. Once a section of puzzle is completed, they can view the scoreboard containing number of hints used, time taken to complete the puzzle, trial and error on the attempt, along with supplement message based on performance and short message regarding journal entry on corresponding topics. The game will autosave after completing each puzzle. Players can 'View Journal' for journal entries after each puzzle completions to learn more about the respective topics, or 'View Achievement' to check progress. Players can also pause the game during gameplay, where they can choose to save their game, load previous saved file, exit to main menu, or quit the game.

3.3.3 Context Diagram

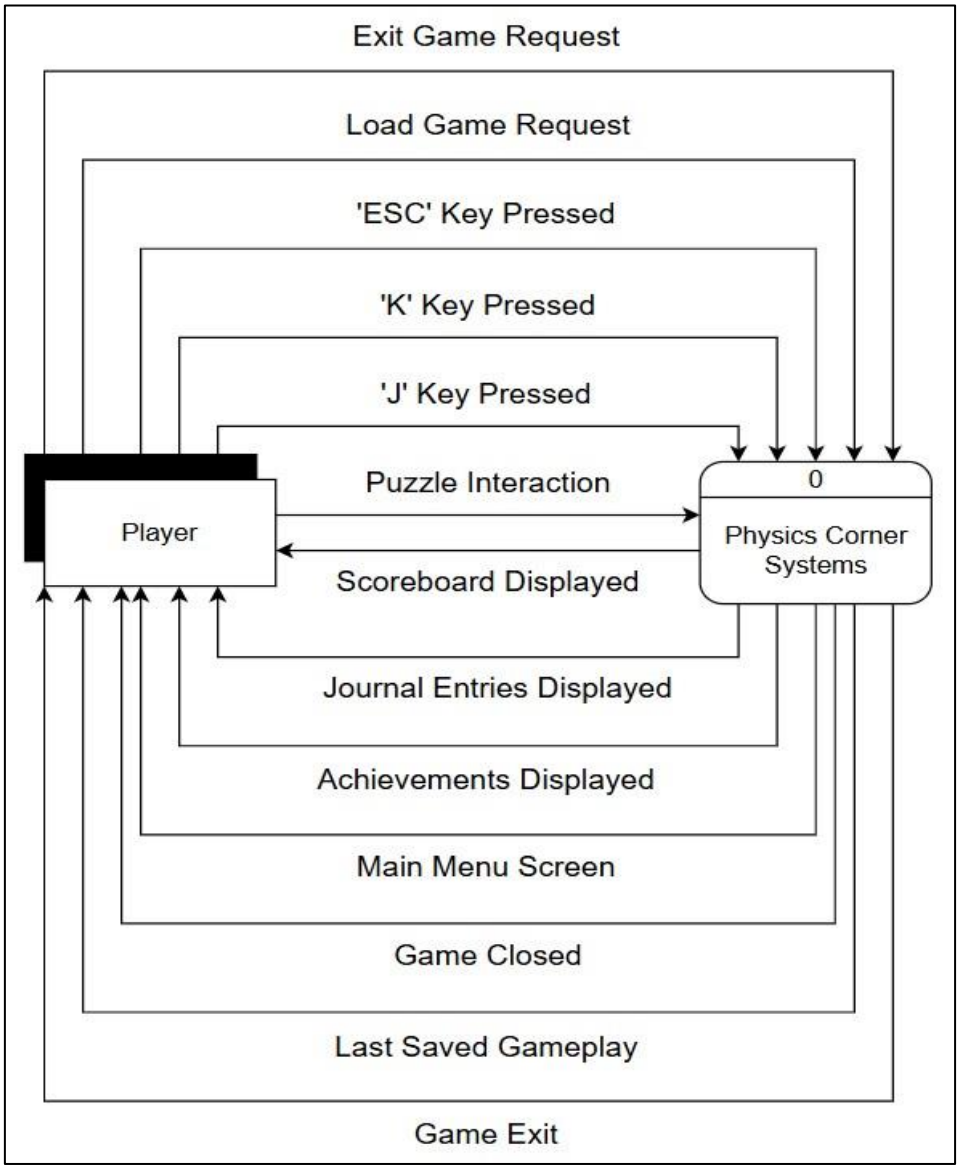

Figure 3.3. 3: Context Diagram

Figure 3.3.3 illustrates the context diagram of "Physics Corner" consisting of two main entities, Player and Physics Corner System. The Player will need to input their requests, such as pressing keys on keyboard or selecting game menus. In turn, Physics Corner System will process these requests and provide appropriate actions in response, such as display the journal entries or load latest saved game.

3.3.4 Data Flow Diagram Level 0

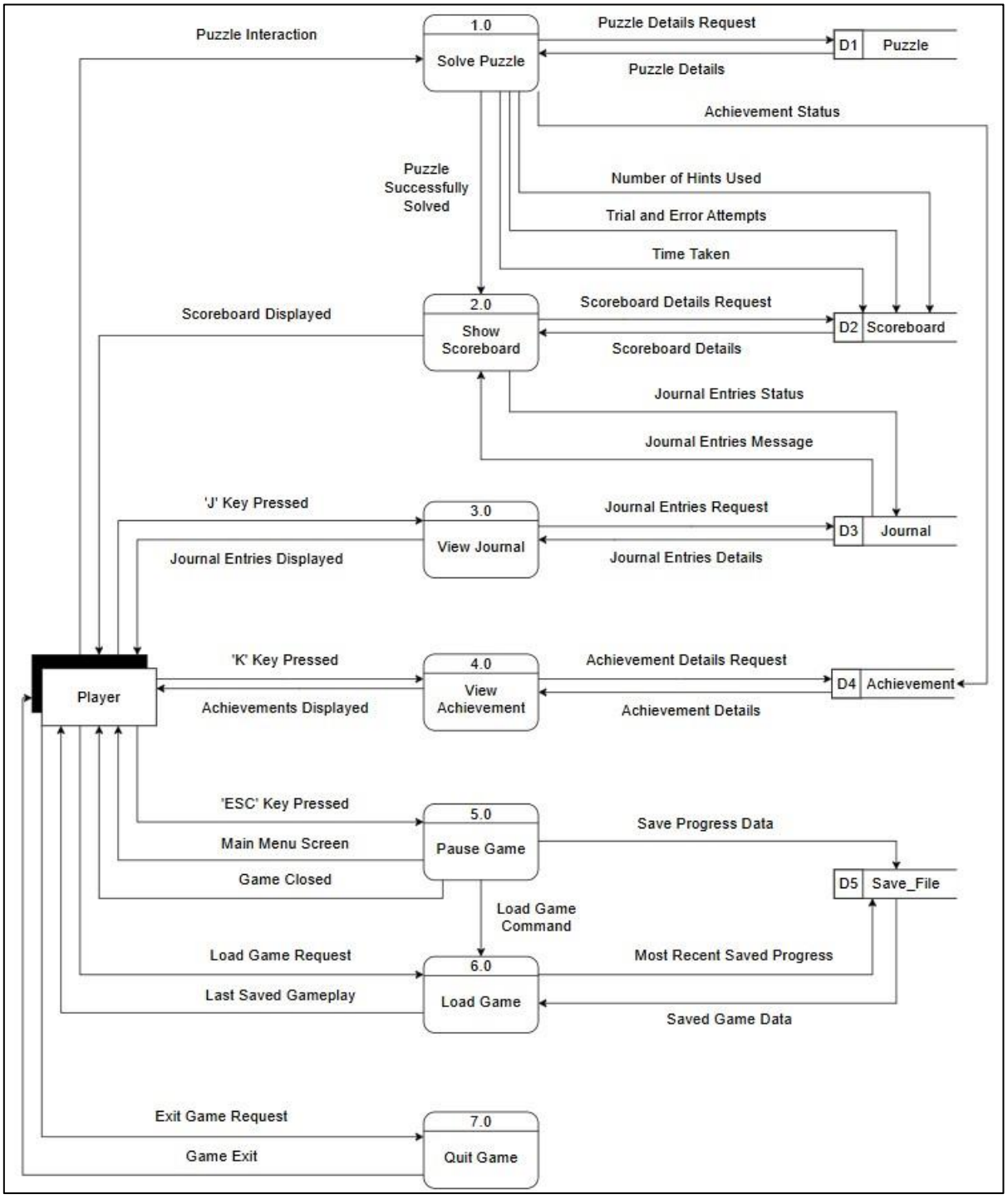

Figure 3.3. 4: Data Flow Diagram Level 0

Figure 3.3.4 shows the Data Flow Diagram Level 0, a detailed overview of context diagram, with 7 processes and 5 data stores. The first process is 1.0 Solve Puzzle, where the Player would need to do puzzle interaction by engaging with the puzzles. Then, 1.0 Solve Puzzle Process will send a request for puzzled details to the first data store, D1 Puzzle. It will then provide the requested puzzle details back to 1.0 Solve Puzzle Process, enabling the Player to continue to solve the puzzle. In the meantime, it will also send data of number of hints player used, trial and error attempts while interacting with the puzzle, and time taken to finish the puzzle to the second data store, D2 Scoreboard which will be used later.

Once the puzzle is successfully solved, it will trigger the second process, 2.0 Show Scoreboard. This process will request scoreboard details from D2 Scoreboard and get essential information like hints used, trial and error attempts, and time taken to be shown on the scoreboard. It will also check for journal entries status from the third data store, D3 Journal to display journal entries message if the puzzle is a first-time completion. An insightful scoreboard will be displayed for the Player to view.

Next, the Player can press the ‘J’ key on the keyboard to trigger the third process, 3.0 View Journal. This process will request journal entries from D3 Journal and get needed information to be displayed on the screen. Additionally, the Player can also press the ‘K’ key on the keyboard to trigger the fourth process, 4.0 View Achievement. This process will request achievement details from the fourth data store, D4 Achievement, which will check whether the achievement is granted based on action done while in 1.0 Solve Puzzle. The achievements gained by the Player will be displayed on the screen for review, as well as ways on how to achieve it.

To trigger to fifth process, 5.0 Pause Game, the Player needs to press the ‘ESC’ key on the keyboard. This will go through the sub-processes as detailed in Figure 3.3.5 and choose to either save the game, where it will send the progress data to the fifth data store, D5 Save_File, exit to main menu, close the game, or load the game which will trigger the sixth process, 6.0 Load Game. The player could also trigger 6.0 Load Game at the main menu, given that the Player had saved progress before, which will be checked and retrieved from D5 Save_File. If the status is true, it will send the saved game data to load the game, and the Player will be able to continue from last saved playthrough.

Finally, the last process, 7.0 Quit Game will be triggered if the Player request to exit the game. The process will handle the request and close the game by terminating the game.

3.3.5 Data Flow Diagram Level 1 of 1.0 Solve Puzzle

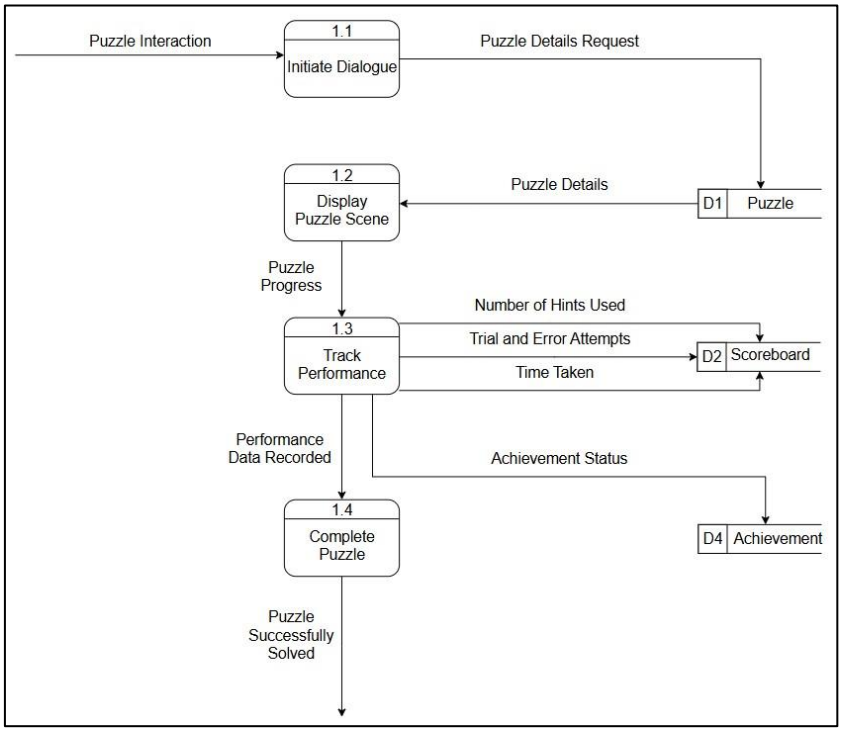

Figure 3.3. 5: Data Flow Diagram Level 1 of 1.0 Solve Puzzle

Figure 3.3.5 shows the breakdown of the first process 1.0 Solve Puzzle into its sub-processes. The first sub-process, 1.1 Initiate Dialogue begins when Player chooses to interact with the puzzle, starting a dialogue session with the in-game character who needs assistance. Upon acceptance, the system will send the puzzle details request to D1 Puzzle, which will trigger sub-process 1.2 Display Puzzle Scene to start the puzzle. Throughout the puzzle progression, the third sub-process 1.3 Track Performance monitors Player's actions, recording hints, errors, and time, while storing them in D2 Scoreboard. It will also check the achievement by sending it to D4 Achievement. After the performance data is recorded and the Player complete the puzzle by triggering the fourth sub-process 1.4 Complete Puzzle, it will then proceed to the process 2.0 Show Scoreboard to display the performance feedback.

3.3.6 Data Flow Diagram Level 2 of 1.3 Track Performance

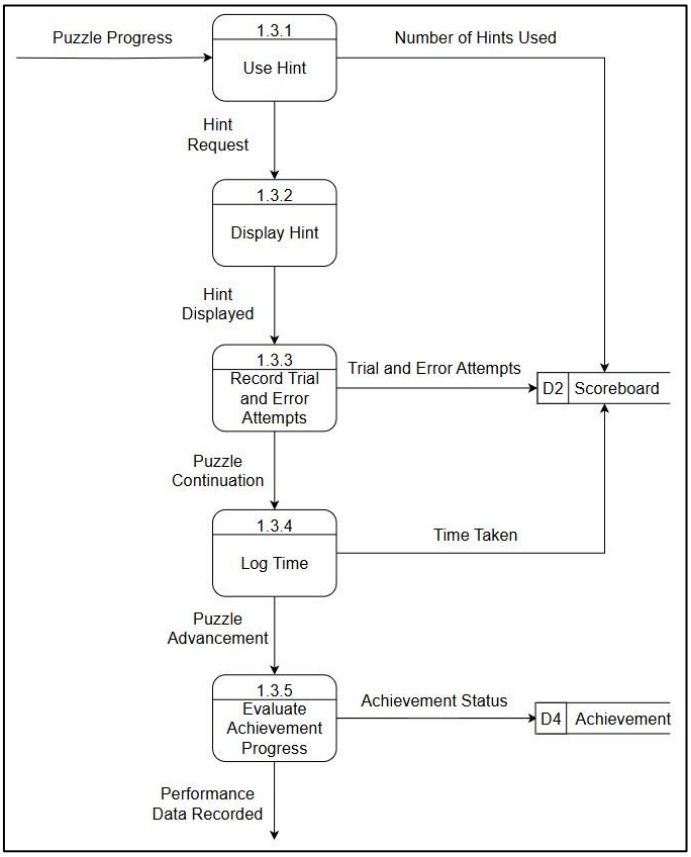

Figure 3.3. 6: Data Flow Diagram Level 2 of 1.3 Track Performance

Figure 3.3.6 shows the detailed view of the process 1.3 Track Performance, further decomposing it down to 5 sub-processes. After the puzzle scene is displayed from 1.2 Display Puzzle Scene, Player will progress the game with the ability to utilize hints – 1.3.1 Use Hint, where triggered, will send the number of hints used to D2 Scoreboard to be tracked, as well as sending the request to sub-process 1.3.2 Display Hint to show the hint to the Player. Furthermore, sub-process 1.3.3 Record Trial and Error Attempts will be triggered and send the records to D2 Scoreboard when the Player randomly guess and click on the screen, triggering a false sequence. Upon continuing the puzzle, the system will trigger the fourth sub-process 1.3.4 Log Time, to record the time taken Player used to complete the puzzle, storing it in D2 Scoreboard. If the Player are to trigger certain action or sequence while solving the puzzle, or

successfully completing one, it will trigger sub-process 1.3.5 Evaluate Achievement Process to check the achievement progression, by sending the achievement status to D4 Achievement. Lastly, the performance data will be recorded and proceed to process 1.4 Complete Puzzle.

3.3.7 Data Flow Diagram Level 1 of 5.0 Pause Game

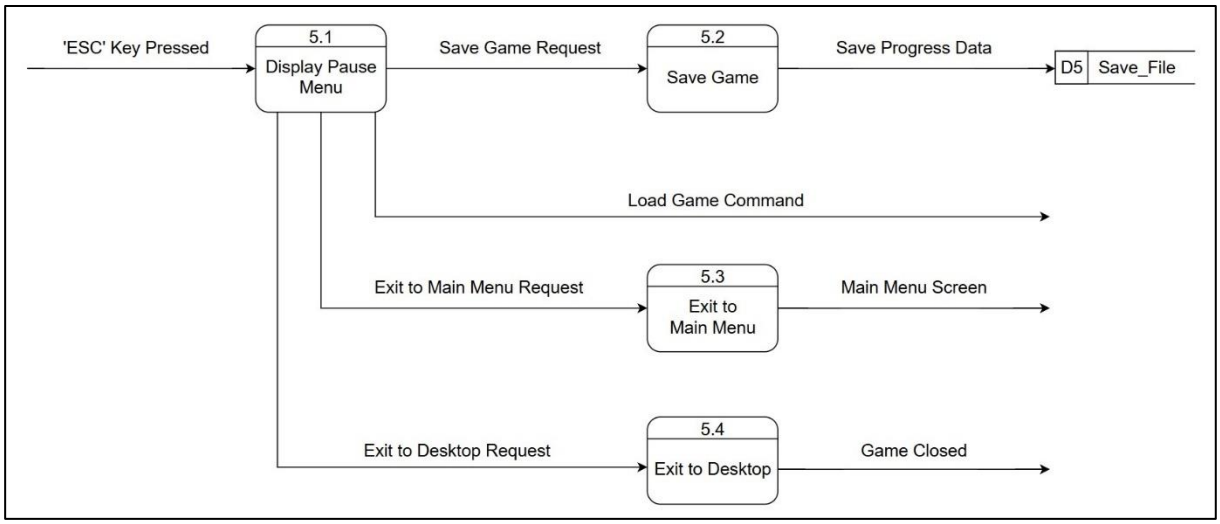

Figure 3.3. 7: Data Flow Diagram Level 1 of 5.0 Pause Game

In Figure 3.3.7, an exploded view of the fifth process 5.0 Pause Game is presented, breaking it down into its sub-processes. The action from Player by pressing the 'ESC' key will trigger the first sub-process 5.1 Display Pause Menu. In the pause menu, the Player can choose to save the game progress, which is the second sub-process 5.2 Save Game, and it will send the progress data to D5 Save_File. The Player can also choose to load the game by sending the command to 6.0 Load Game (as seen in Figure 3.3.4), which will load the last saved playthrough. Moreover, the Player can choose to either exit to main menu by triggering the third sub-process 5.3 Exit to Main Menu, which will lead the Player to the Main Menu screen or exit the game by triggering the fourth sub-process 5.4 Exit to Desktop, which will close the game.

3.3.8 Entity Relationship Diagram

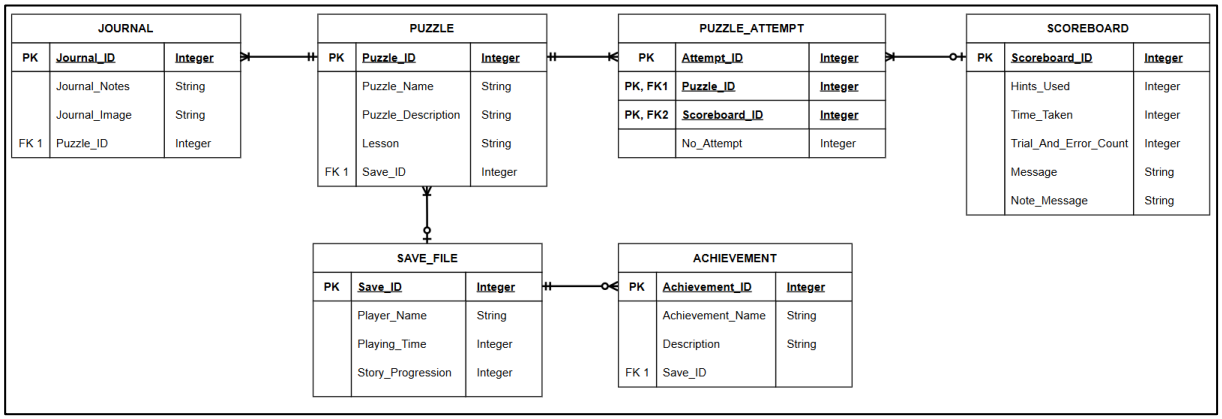

Figure 3.3. 8: Entity Relationship Diagram

Figure 3.3.8 illustrates the Entity Relationship Diagram (ERD) of 'Physics Corner', with 5 main entities, Save_File, Achievement, Puzzle, Journal, and Scoreboard, along with 1 composite entity, Puzzle_Attempt.

The Save_File entity keep records of player's progress and game state, with Save_ID as primary key to distinctly identify each save file. It contains Player_Name to differentiate players across various save files, Playing_Time to monitor total playtime in seconds, and Story_Progression to log player's current advancement in the game. Together, these attributes ensure each player's data is accurately tracked and stored for future sessions, allowing for personalized gameplay experiences.

The Achievement entity keep records of in-game achievements unlocked by the players, with Achievement_ID as primary key to uniquely keep track of each achievement. It includes Achievement_Name, which specifies the name of the achievement, Description, which provides a brief explanation on how to unlock it, and Save_ID as foreign key to link the achievement to specific player's save file. These attributes ensure that each achievement is properly identified, described, and associated with correct player's progress.

The Puzzle entity keep records of in-game puzzle details, with primary key of Puzzle_ID to uniquely identify each puzzle throughout the game. It has attributes like Puzzle_Name to specify the name of the puzzle like “Boil an egg”, Puzzle_Description providing an overview of the puzzle’s objective such as “Make a hard boil egg as breakfast for Grandpa.”, Lesson indicating the topic or concept the puzzle is meant to teach like “Thermal Equilibrium”, and foreign key of Save_ID to link the puzzle to a specific player’s save file. These attributes collectively assure that each puzzle is clearly described and appropriately associated with player’s learning path.

The Journal entity keep records of journal entries collected after solving each Puzzles, with Journal_ID as primary key to distinguish each entry. It includes Journal_Notes to provide extra information about the topic of the puzzle solved, which is achieved by linking to the Puzzle entity through Puzzle_ID as foreign key. This relationship ensures that each journal is tied to a specific puzzle and offers relevant context according to the puzzle’s topic. It also has Journal_Image to provide a snippet of real-world application related to the topic.

The Scoreboard entity keep records of information needed to display on scoreboards, with primary key of Scoreboard_ID to maintain a record of each scoreboard details. It contains Hints_Used, which tracks the number of hints utilized, Time_Taken, which records total time spent on the puzzle, Trial_and_Error_Count, calculating error in attempting the puzzle, Message, which displays a supplementary message based on the player’s performance, such as “You did great!” and Note_Message notifying about new journal entries. These attributes ensure the player’s performance is fully captured and displayed along with any relevant feedback.

The Puzzle_Attempt is a composite entity from Puzzle entity and Scoreboard entity, storing unique attempt made on each puzzle and update number of attempts on the scoreboard,

with Attempt_ID as the primary key. It includes Puzzle_ID, a composite foreign key linking to puzzle attempted, as well as Scoreboard_ID, another composite foreign key connecting to the relevant scoreboard, and No_Attempt to track and update the number of attempts on the scoreboard. This association provides an overview of player's attempt made on each puzzle.

3.3.9 Data Dictionary

Table 3.1 until Table 3.6 tabulate the data dictionary for Save_File, Achievement, Journal, Puzzle, Scoreboard, and Puzzle Attempt respectively.

Table 3. 1: Save_File Data Dictionary

Field Name	**Description**	**Data Type**	**Data Format**	**Field Size**	**Example**
Save_ID	Unique ID for save file	Integer	NNN	3	001
Player_Name	Player game name	String		20	Lewis
Playing_Time	Player play time in seconds	Integer	NNNNNN	6	000300
Story_Progression	Player progress per sections	Integer	NN	2	10

Table 3. 2: Achievement Data Dictionary

Field Name	**Description**	**Data Type**	**Data Format**	**Field Size**	**Example**
Achievement_ID	Unique ID for achievement	Integer	NNN	3	001
Achievement_Name	Name of achievement	String		55	Eggcellent!
Description	Description of achievement	String		255	Bring the eggs to thermal equilibrium,
Save_ID	Unique ID for save file	Integer	NNN	3	001

Table 3. 3: Journal Data Dictionary

Field Name	Description	Data Type	Data Format	Field Size	Example
Journal_ID	Unique ID for journal	Integer	NNN	3	001
Journal_Notes	Notes for journal entries	String		255	During the day, the land heats up faster than the sea, creating an area of lower pressure over the land, which draws cooler air from the sea, forming a sea breeze. At night, the land cools quicker than the sea, causing a reversal: the warmer air over the sea rises, and cooler air from the land moves in, creating a land breeze.
Journal_Image	Image for journal entries	String		255	/asset/land_sea_breeze.png
Puzzle_ID	Unique ID for puzzle	Integer	NNN	3	001

Table 3. 4: Puzzle Data Dictionary

Field Name	Description	Data Type	Data Format	Field Size	Example
Puzzle_ID	Unique ID for puzzle	Integer	NNN	3	001
Puzzle_Name	Name of puzzle	String		55	Boil an egg.
Puzzle_Description	Description of puzzle	String		255	Make a hard boil egg as breakfast for Grandpa.
Lesson	Puzzle topic	String		55	Thermal Equilibrium
Save_ID	Unique ID for save file	Integer	NNN	3	001

Table 3. 5: Scoreboard Data Dictionary

Field Name	Description	Data Type	Data Format	Field Size	Example
Scoreboard_ID	Unique ID for scoreboard	Integer	NNN	3	001
Hints_Used	Number of hints used	Integer		3	003
Time_Taken	Time taken to solve the puzzle	Integer	NNNNNN	6	000300
Trial_And_Error_Count	Player's error in attempting the puzzle	Integer	NN	2	10
Message	Supplement message based on performance	String		255	You did great! You have learned about thermal equilibrium.
Note_Message	Message about new journal entries	String		255	Notes about thermal equilibrium has been added to Journal.

Table 3. 6: Puzzle_Attempt Data Dictionary

Field Name	Description	Data Type	Data Format	Field Size	Example
Attempt_ID	Unique ID for puzzle attempt	Integer	NNN	3	001
Puzzle_ID	Unique ID for puzzle	Integer	NNN	3	001
Scoreboard_ID	Unique ID for scoreboard	Integer	NNN	3	001
No_Attempt	Number of attempts of the puzzle	Integer	NNN	3	001

3.3.10 Wireframe

Figure 3.3. 9: Main menu of the game

Figure 3.3.9 shows the game's main menu, greeting the player with the title of the game 'Physics Corner', alongside with illustration background, and buttons such as 'New Game' to start a new game, 'Load Game' to load a saved game, and 'Quit' to exit the game.

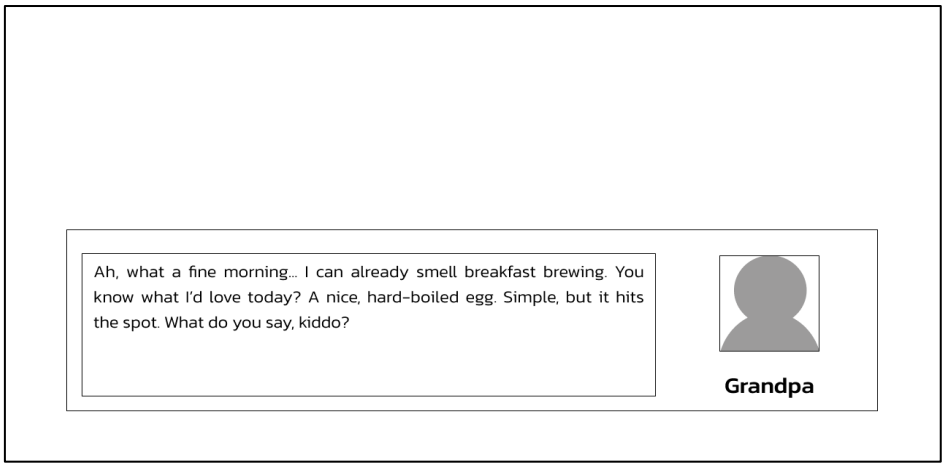

Figure 3.3. 10: Dialogue of in-game characters

Figure 3.3.10 depicts a dialogue scene featuring an in-game character who provides both narrative context and instructions for the upcoming puzzle in the next scene.

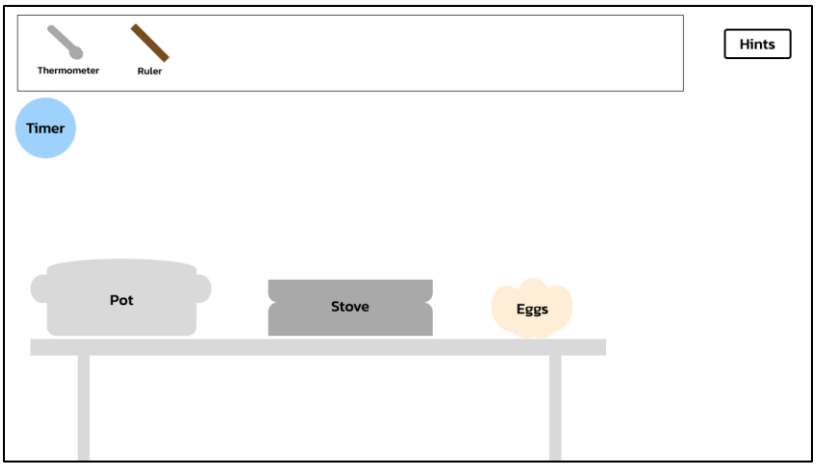

Figure 3.3. 11: Puzzle scene

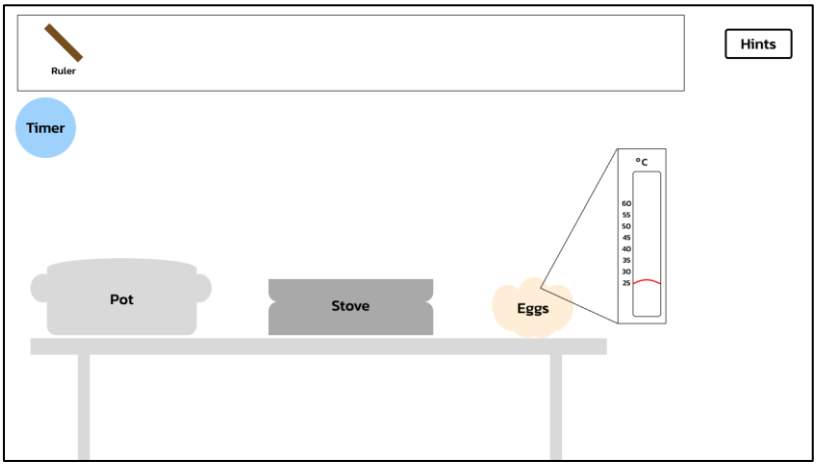

Figure 3.3. 12: Using tools to interact with object

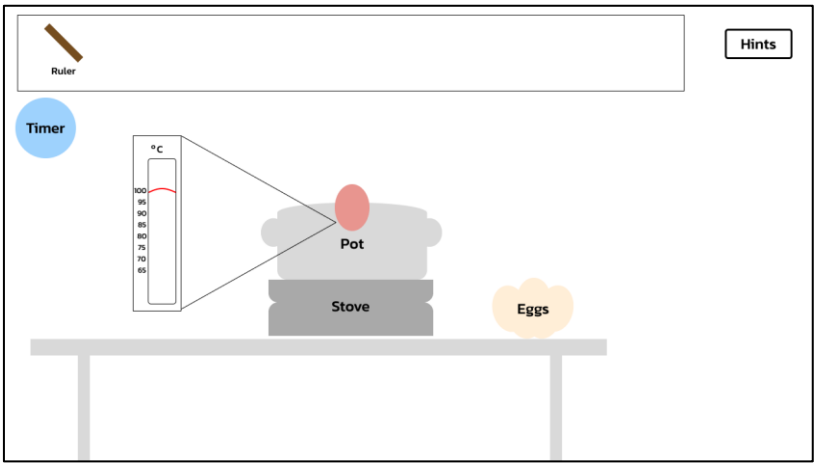

Figure 3.3. 13: Visual indicator of object changing colour

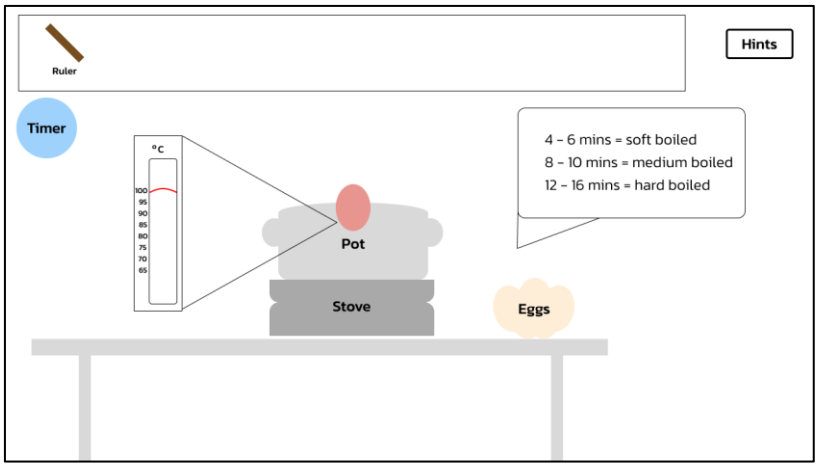

Figure 3.3. 14: When ‘hint’ button is clicked

Figure 3.3.11 and Figure 3.3.12 display one of the puzzle scenes of the game, where tools are provided above the player to interact with the puzzle. When using the thermometer on the egg, a visual thermometer reading is shown. Furthermore, when the player tries to boil the egg using the pot and stove, the egg will gradually turn red (see Figure 3.3.13), indicating the temperature is rising. These visual indicators can help guide player in solving the puzzles by providing clear feedback on their actions. If the player struggles to boil the egg at the correct temperature, after several attempts, the game will give hints explaining how the time taken to boil the egg will affect its temperature and lead to different outcomes. Alternatively, In Figure 3.3.14, when the ‘Hint’ button is clicked, a pop-up message appears, providing clue on how long the egg should be boiled, helping the player to set the timer correctly. This hint is designed to assist players who may stuck or fail in trial and error, preventing frustration and helping them move forward in the scene.

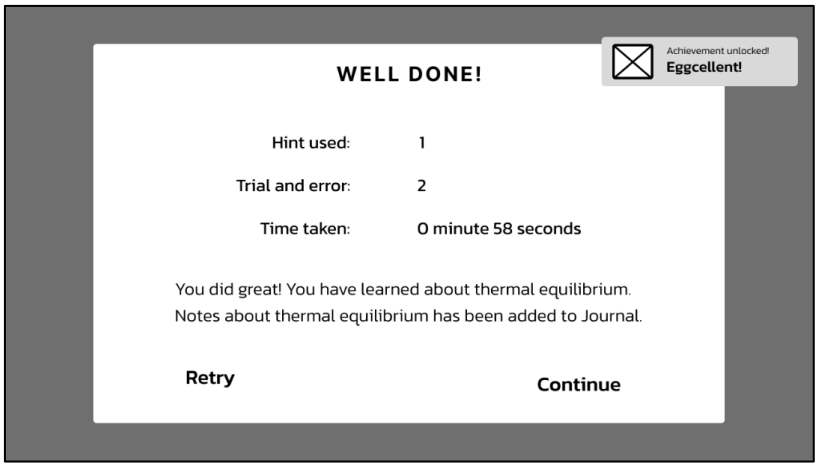

Figure 3.3. 15: Scoreboard page

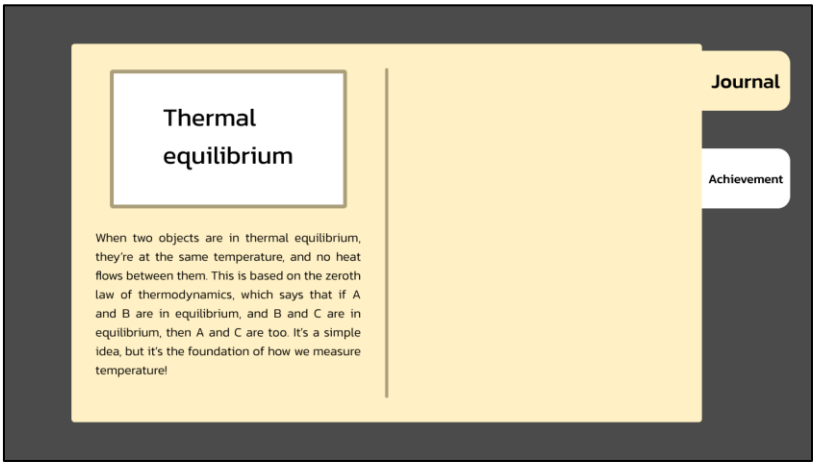

Figure 3.3. 16: Journal page

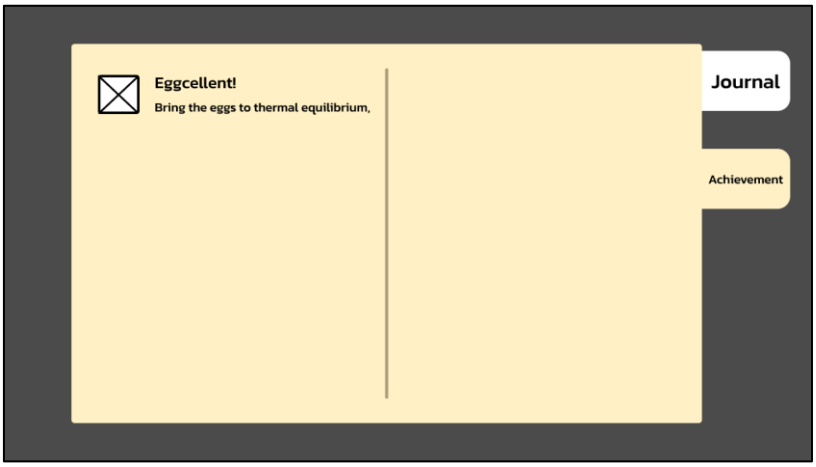

Figure 3.3. 17: Achievement page

After successfully solve the puzzle, a scoreboard will greet the player, displaying the number of hints used, trial and error, and the time taken to complete the puzzle, as shown in Figure 3.3.15. This information provides insight into the player's performance and encourages them to either retry for a better score or proceed to the next scene. The timer is shown not to create time pressure but to track the player's progress. Additionally, an encouraging message will appear, along with a note indicating that more information about puzzle's lesson will be added to Journal page. In Figure 3.3.16, player can press 'J' key to open the Journal page where it showcases all the unlocked Physics notes, with sliding page feature allowing players to navigate through them. These journal entries will be unlocked depends on player's performance, and it contains images and description to further explain Physics concepts. If an achievement is unlocked, a pop-up message will be displayed on the top right (see Figure 3.3.15) and saved in the Achievement page (see Figure 3.3.17), which can be accessed by pressing 'K' key.

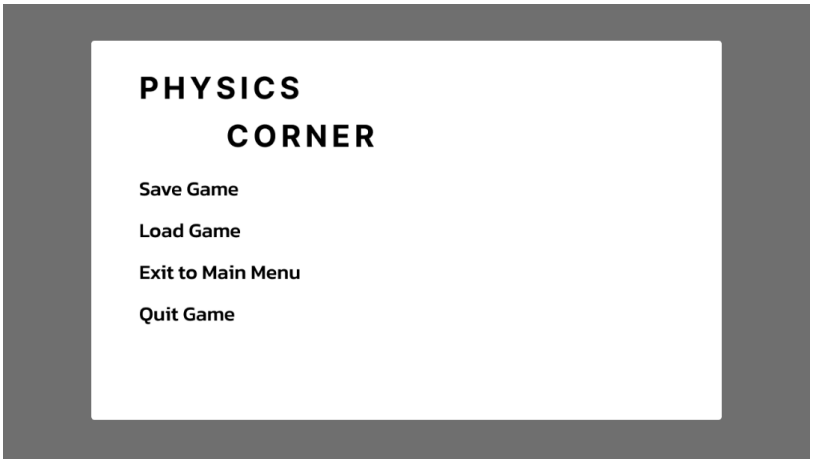

Figure 3.3. 18: Pause menu

Lastly, Figure 3.3.18 shows the Pause menu of the game, by pressing 'ESC' key. The player can choose to save the game, load previous saved game, exit to main menu, or quit the game.

3.4 Implementation Phase

During the implementation phase, the designs and specifications from the previous phase are translated into working software. Game mechanics, controls, and interactions are coded using Unity game engine and C# programming language. Additionally, game assets such as sprites, animations, visual elements, and UI components like buttons are created and integrated. The outcome of this phase will be a playable version of the game, which will then undergo testing in the next phase.

3.5 Testing Phase

The testing phase involves identifying and fixing bugs within the game. Functional testing will be performed to ensure all the game features work as intended, while usability testing will assess the user experience to confirm the game meets the specific requirements and provide an enjoyable experience for players.

3.6 Deployment Phase

After comprehensive testing, the game will be prepared for deployment, making it available to the public for offline download.

3.7 Maintenance Phase

The maintenance phase involves ongoing support and updates after the game's release. This includes fixing post-launch bugs, releasing patches, and updating the game to enhance features. Furthermore, player feedback is continually reviewed to make necessary improvements, as well as regular monitoring on game's performance, ensuring the game remains relevant and enjoyable after its initial release.

3.8 Summary

This chapter focused on the requirement analysis and design phase of the waterfall model, with a brief overview of the other phases. The analysis was based on a structured questionnaire and provided valuable insights into the user demographics, which include current and former higher secondary school students. The findings revealed that while most students find Physics difficult yet interesting, they preferred interactive and visual learning methods over traditional classroom approaches. There was also a strong inclination towards using educational games as motivational tools for learning Physics. Moreover, students expressed a desire for multi-modal learning approaches (combination of visual and interactive extensively) and various helpful tools to aid comprehension. Additionally, the design phase is thoroughly examined, covering both logical design – such as system architecture diagram, workflow, context diagram, data flow diagrams, entity relationship diagram and data dictionary, as well as physical design, which is the wireframe of the proposed 'Physics Corner' game. These designs will serve as a blueprint for implementation phase in the next chapter.

CHAPTER 4: IMPLEMENTATION

4.1 Introduction

This chapter discusses the thorough process of Implementation Phase for 'Physics Corner', including implementation tools used to develop the system, and how it was made, based on the data requirement gathered from previous chapter.

4.2 Implementation Tools

Physics Corner is developed primarily using the Unity Game Engine, which provides the core framework for building and managing the game environment with Microsoft Visual Studio for writing and debugging C# scripts. Game assets, including vector graphics, are designed in Adobe Illustrator and then imported into Unity to be integrated into the game.

4.2.1 Unity

Unity Game Engine is the primary development environment used to build 'Physics Corner'. It handles scene creation, game object management, and asset integrations. The engine's flexibility and extensive feature set allow for smooth handling of game mechanics and user interaction. C# programming is used to implement game logic, functions, and interactions between user interfaces. Figure 4.1.1 shows the homepage of Unity Hub, providing a clean, centralized interface to view, open and create new projects. This is useful when several projects are on the go or shifts between different stages of game development is needed. The intuitive visual interface like Hierarchy to set up the components, Inspectors to easily attach functions and centralized project window facilitate level design, object placement and property manipulation.

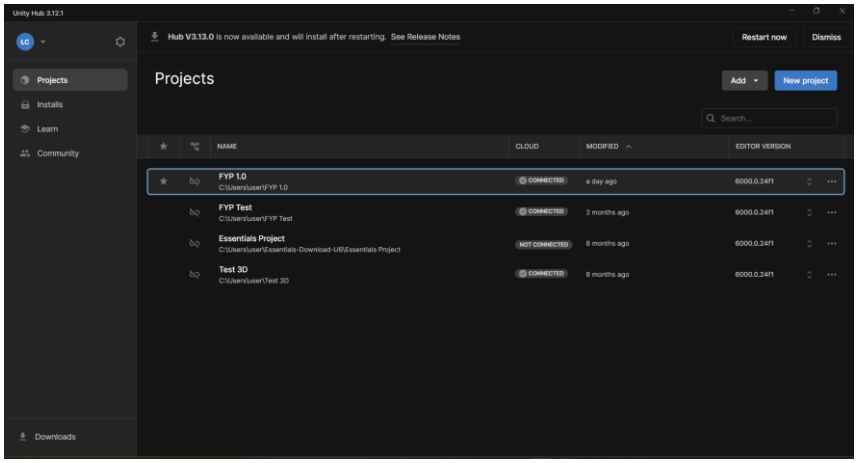

Figure 4.1. 1: Unity Hub Homepage

4.2.2 Microsoft Visual Studio

Microsoft Visual Studio (see Figure 4.1.2) is employed as the Integrated Development Environment (IDE) for writing, debugging, and managing the C# scripts used in Unity. Its advanced code editing like IntelliSense, is a huge help in coding as it reduces typos while making it easier to learn. Debugging tools, and project management capabilities streamline the programming workflow, allowing for efficient development and troubleshooting of game features.

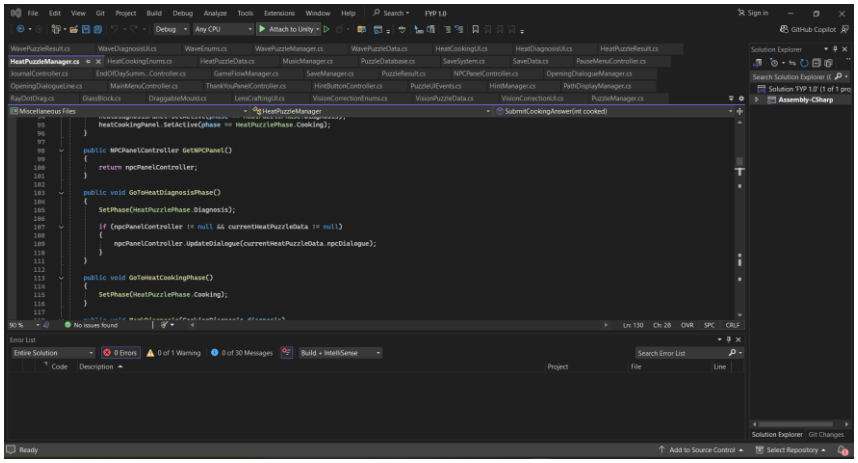

Figure 4.1. 2: Interface of Microsoft Visual Studio

4.2.3 Adobe Illustrator

Figure 4.1.3 illsutrates the workspace of Adobe Illustrator which is used to create high-quality vector-based graphics and assets for ‘Physics Corner’. Its precision and versatility allow the design of scalable, clean visuals that can be easily imported into Unity, ensuring that the game’s art style remains consistent and visually appealing across different screen sizes and resolutions.

Figure 4.1. 3: The workspace of Adobe Illustrator

4.2.4 Unity Asset Store and BandLab

To efficiently manage the project’s development timeline and resources, the Unity Asset Store proved to be an invaluable resource for acquiring high-quality audio assets. ‘The Season Cycle: Casual Gaming Music Pack’ by Steve Base Music, as shown in Figure 4.1.4, is specifically utilized for the main menu background, offering a welcoming composed soundtrack that immediately warms the game’s atmospheric quality.

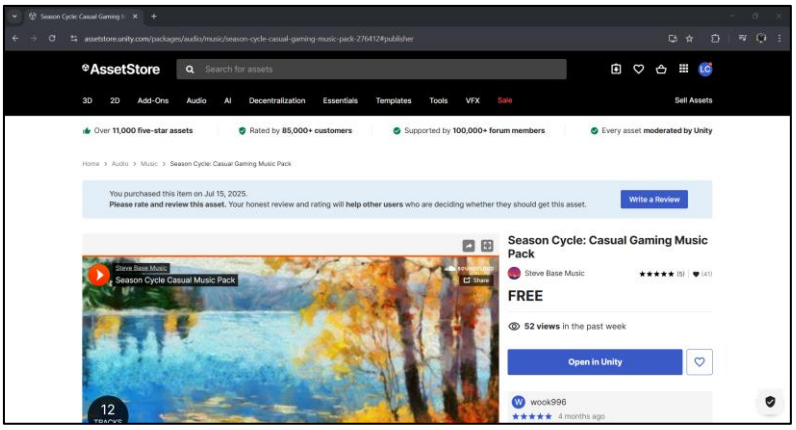

Figure 4.1. 4: Steve Base Music's free to download music pack in Unity Asset Store

While the Asset Store provides read-made tracks, AI generation like BandLab allows for more tailored and unique compositions that might better fit specific scene requirements or moods. For the 'puzzle scene', a track generated via BandLab's AI capabilities (as shown in Figure 4.1.5) is chosen to create a calming yet engaging auditory backdrop that complements the intellectual challenge without being distracting. Similarly, the 'end-of-day summary scene' uses another AI-generated track to evoke a sense of completion, providing a fitting auditory closure to the player's session.

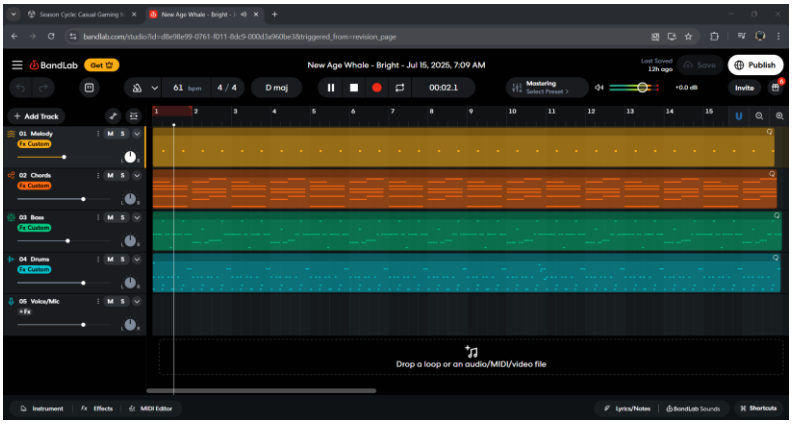

Figure 4.1. 5: BandLab's studio

4.3 Application Implementation

'Physics Corner' is a linear game style where player needs to help NPCs (Non-Playable Character) solve their problems based on day-to-day basis. The following subsections detail the game features implemented in Physics Corner.

4.3.1 Main Menu

Physics Corner greets the player with a main menu (as shown in Figure 4.2.1), with the options to start a new game or quit the game. The option to load game is not interactable as there is no save file detected, else it will be as depicted in Figure 4.2.2. Starting a new game with an existing file will trigger a pop-up alert (see Figure 4.2.3), warning the player that doing so will overwrite the existing data. Two buttons were available to cancel the process or continue with the overwrite.

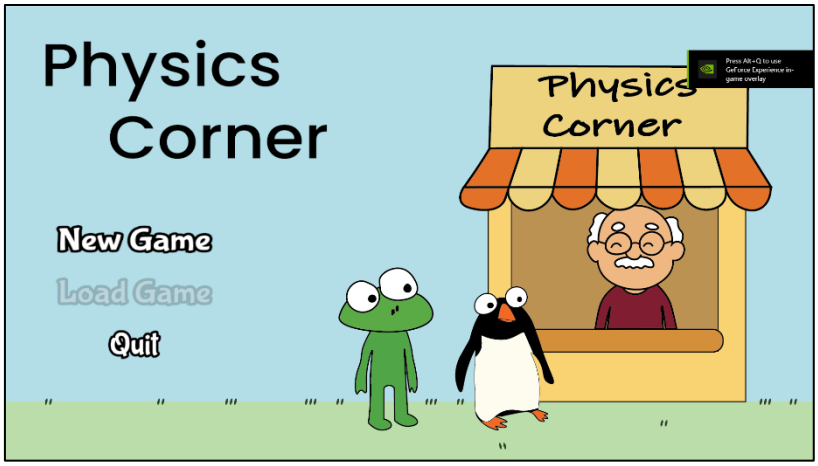

Figure 4.2. 1: Main Menu without save file

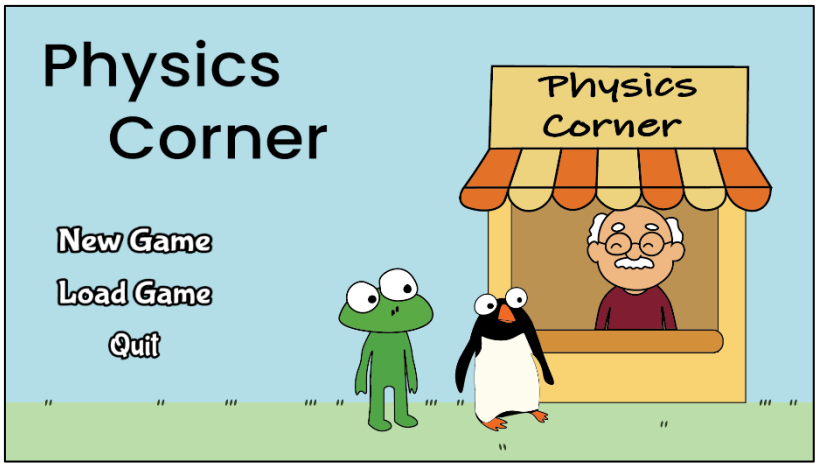

Figure 4.2. 2: Main Menu with save file

Figure 4.2. 3: Starting a new game with an existing save file

4.3.2 Opening Scene

Starting a new game without any saved files will trigger an opening scene, as shown in Figure 4.2.4, where Grandpa appears to be welcoming the player for the visitation. This provides narrative context to the gameplay, thereby enhancing player engagement.

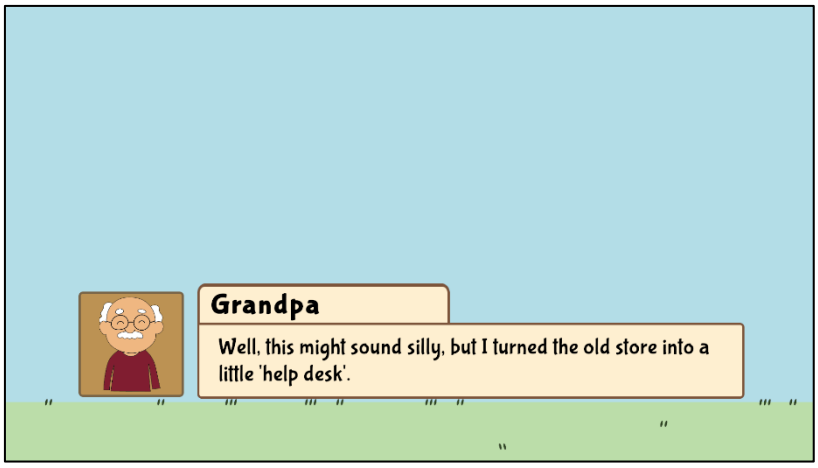

Figure 4.2. 4: Opening scene with Grandpa

4.3.3 Puzzle Scene

For the Puzzle Scene, the player starts at Day 1 and progresses the game by helping each NPC with their problem. Figure 4.2.5 showcases Froggy's trouble in seeing the road sign. The player can diagnose the problem by inferring directly through Froggy's dialogue or choose to start an eye test (see Figure 4.2.6), further visualizes the diagnosis with Froggy's real-time feedback based on the road sign's clarity to guide the player.

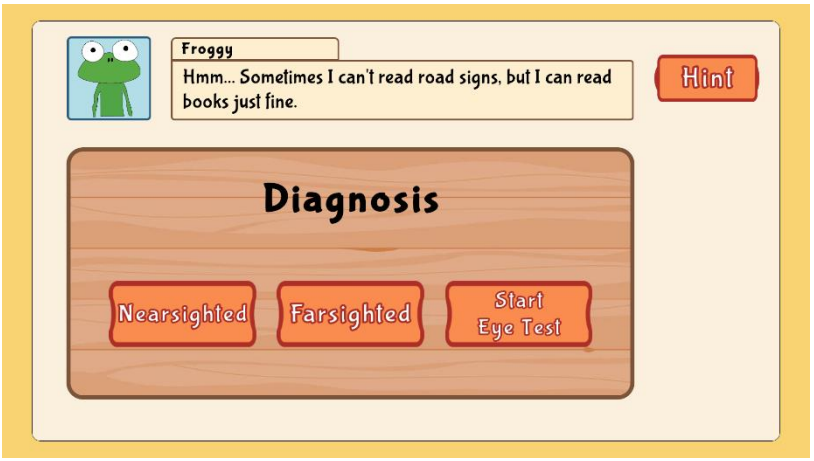

Figure 4.2. 5: Diagnosis stage of Vision Correction Puzzle

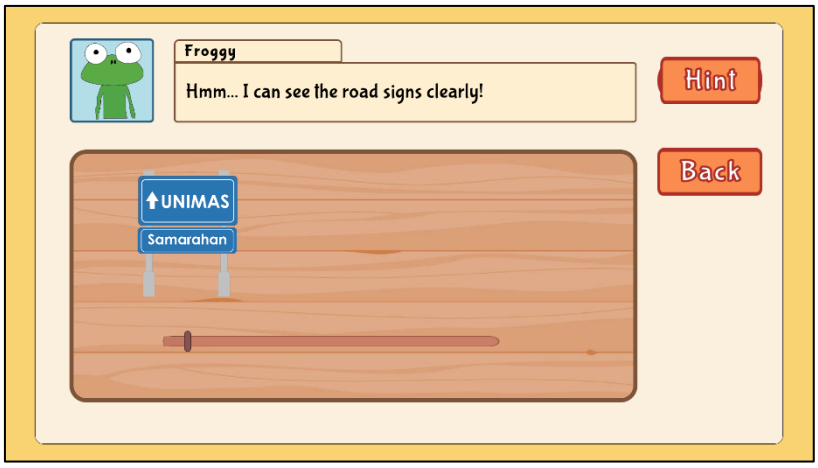

Figure 4.2. 6: Eye Test stage of Vision Correction Puzzle

Each stage of the puzzle includes a Hint button that provides a clue specific to the current mini game. The Hint button is there to aid the player and is optional to use. Once clicked, a pop-up hint message will appear on the screen, as shown in Figure 4.2.7. Pressing the 'OK' button will close the hint message and count as one hint usage.

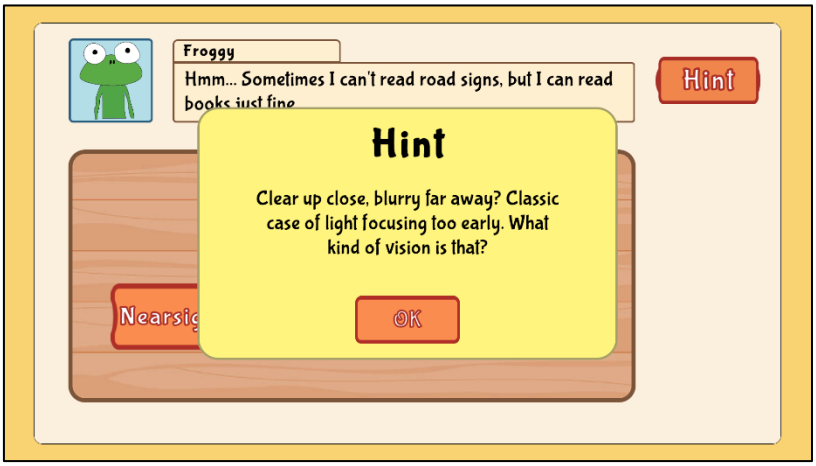

Figure 4.2. 7: Hint display

Figure 4.2.8 and Figure 4.2.9 showcase the puzzle level of Heats and Waves respectively. The game levels are designed in such a way that each day are tailored to each chapter, allowing players easily tackle their knowledge within each domain before proceeding to another.

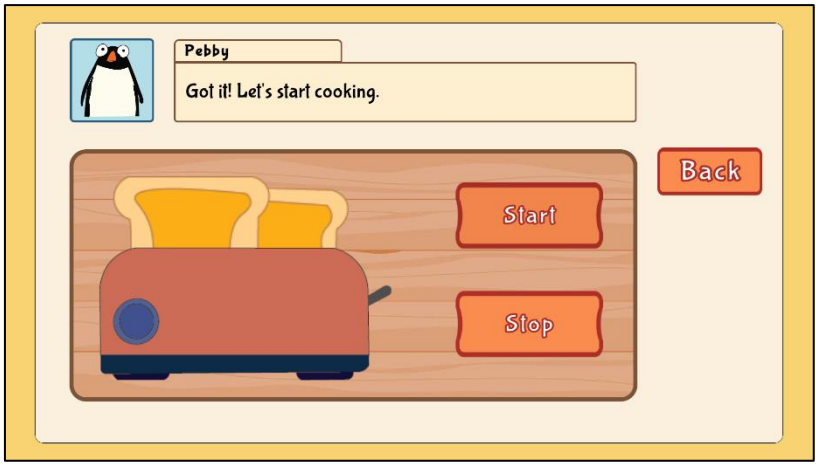

Figure 4.2. 8: Heat transfer puzzle in Day 2

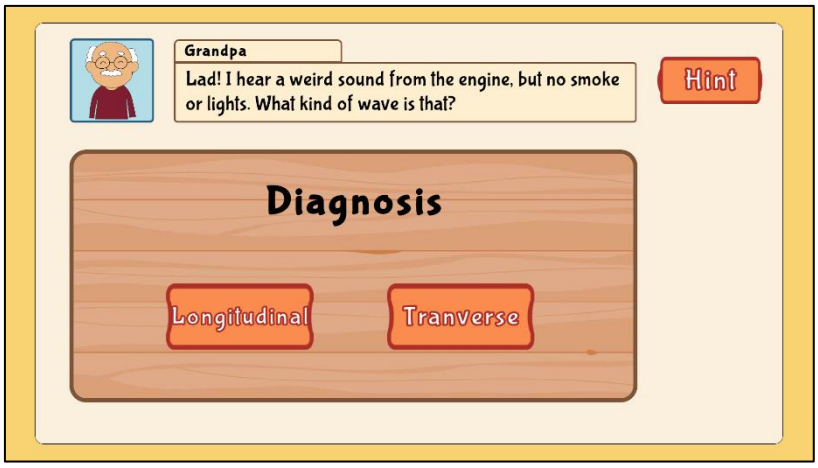

Figure 4.2. 9: Wave propagation in Day 3

After progressing through daily requests, an evaluation session will be displayed at the end of the day (see Figure 4.2.10). A scoreboard is displayed on the left side of the of the panel, containing number of correct requests solved, total time taken, and total hints used. If a journal entry is added, a text will be displayed below the scoreboard. Requests solved throughout the day will be listed at the right side of the panel, with Retry Button available for those who are

solved wrongly. Clicking the Retry Button will replay the puzzle, allowing player to revisit the puzzle without pressure.

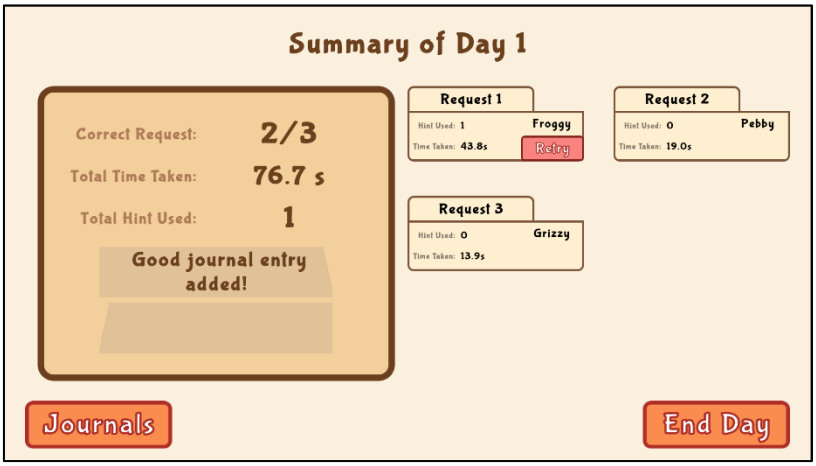

Figure 4.2. 10: Summary of Day 1

4.3.4 Journals

Figure 4.2.11 illustrates the Journals page, archiving journal entries earned by the player, which can be open by pressing 'J' key or at the end of the day. The journal entry is rewarded in two ways, if the player performs well and achieve a high overall score (Figure 4.2.10), a journal entry containing trivia or real-life applications of the topic will be unlocked, as shown in Figure 4.2.11). Conversely, if the player's performance is lower and does not meet the target score, a different journal offering deeper insight and explanation of the puzzle mechanics is awarded to support learning and improvement (Figure 4.2.12).

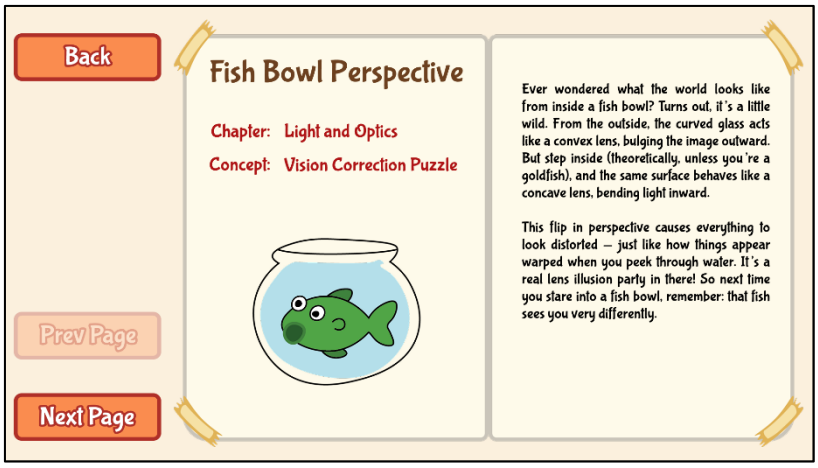

Figure 4.2. 11: Journal entry of Fishbowl Perspective

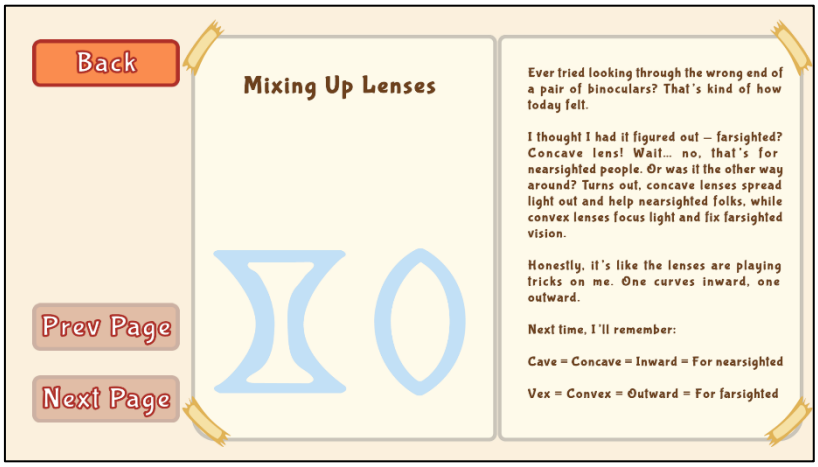

Figure 4.2. 12: Journal entry of Mixing Up Lenses

4.3.5 Achievements

Figure 4.2.13 illustrates the achievement list of Physics Corner. It can be viewed by pressing the 'K' key or at the end of the day. Achievements are awarded based on player's performance, like "No Clue, Just Genius" for not using any hints to complete a run, and progression, like "Eye Can Fix That" for unlocking the Vision Correction Puzzle.

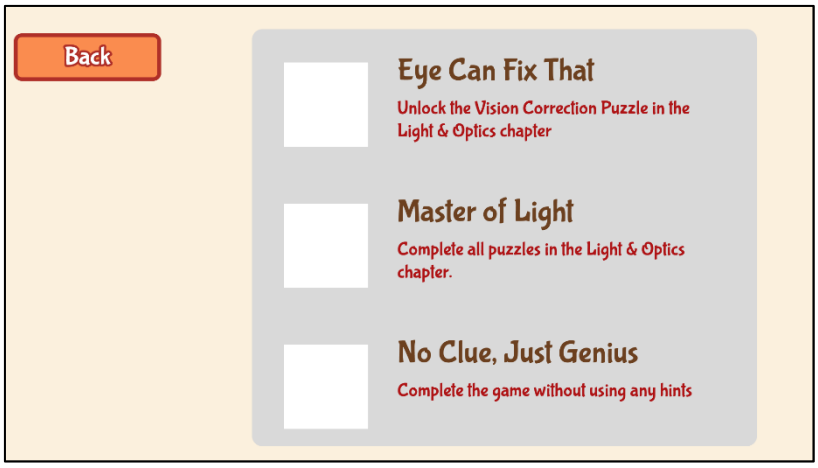

Figure 4.2. 13: Achievement list

4.3.6 Pause Menu

As the game style is linear, the saving system utilized a single save file as it is simple than dynamic save progression system. Furthermore, it also enhances retainment in the game as it requires the player to finish the day to have their progress saved. Alternatively, player can pause the game at any time by pressing the 'ESC' key (see Figure 4.2.14), then choose to either exit to Main Menu or quit the game. A confirmation will pop-up to verify player's decision (see Figure 4.2.15 and Figure 4.2.16) In both cases, the current progress will be saved. Loading back the game will restart the player at the respective level, instead of resetting the entire progress.

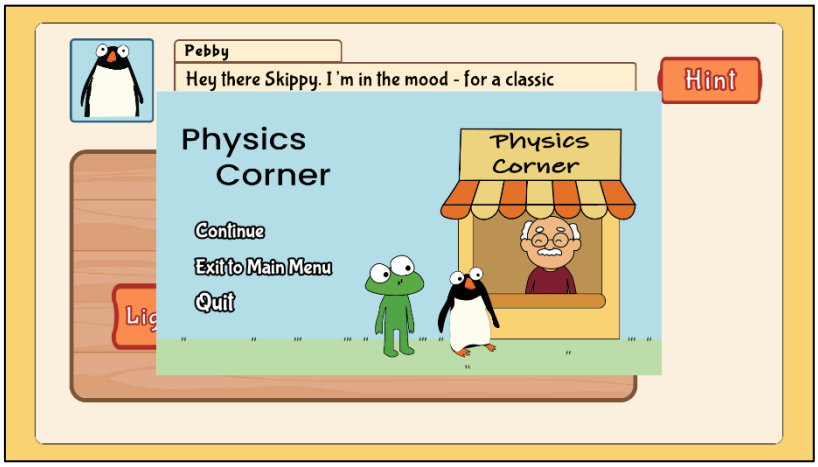

Figure 4.2. 14: Pause Menu

Figure 4.2. 15: Exit to Main Menu confirmation message

Figure 4.2. 16: Quit Game confirmation message

4.4 Summary

In this chapter, the implementation tools used to developed Physics Corner is Unity Game Engine, paired with Microsoft Visual Studio for writing and debugging C# scripts, while Adobe Illustrator for graphics design. Game features like Main Menu, Opening Scene, Puzzle Scene, Journals, Achievements, and Pause Menu are detailed subsequently to showcase the design interface and flow of Physics Corner. Testing on Physics Corner will be done in the upcoming chapter.

CHAPTER 5: TESTING

5.1 Introduction

This chapter discusses the Testing Phase for Physics Corner to ensure a smooth and engaging gameplay experience. The Testing Phase is segmented into two, functional testing to assess every feature of Physics Corner, and usability testing to gather feedback from students on the usability of the game. Insights gathered from the students will be used as future references to improve the game. The purpose of this phase is to improve stability, performance, overall quality and playability of the game.

5.2 Functional Testing

Functional testing in Physics Corner aim to ensure all core systems, game mechanics and features operate as intended. Each feature will be tested against its expected behaviour using predefined test cases, focusing on input accuracy, correct responses to in-game triggers, and error handling. This includes verifying whether the puzzle logic works correctly, user interactions are responsive, journal entries unlock under the correct conditions, and the saving system functions reliably. All test cases are tabulated below with the aim as references for future modifications.

Table 5. 1: Test Case for Main Menu and Game Start

Test Case ID	Test Scenario	Test Case	Pre-condition	Test Steps	Test Data	Expected Result	Post-condition	Actual Result	Status (Pass / Fail)
TC-MM-01	Launch Game	Start game and show Main Menu	Game is installed	Launch game		Main Menu appears with New Game, Load Game, Quit buttons	Game at Main Menu	Main Menu appears with New Game, Load Game, Quit buttons	Pass
TC-MM-02	Start New Game	Start a new game	On Main Menu	Click "New Game"		New game begins with dialogue scene	Player starts Day 1	New game begins with Grandpa's dialogue scene	Pass
TC-MM-03	Load Game Disabled	Load game button should be disabled when no save	No save file exists	Launch game ➔ View Load Game Button		Load Game button is disabled	Load Game not accessible	Load Game button not interactable	Pass
TC-MM-04	Quit Game	Exit from the game	On Main Menu	Click "Quit"		Game app exits	Game closed	Game app exits	Pass
TC-MM-05	Unlock New Game +	Finish full game once	Game completed , Day 5 reached	Return to main menu ➔ New Game + option appears	Save file with full completion	New Game+ option visible on main menu	Player can access NG+ mode	New Game+ option visible on main menu	Pass

Table 5. 2: Test Case for Vision Correction Puzzle

Test Case ID	Test Scenario	Test Case	Pre-condition	Test Steps	Test Data	Expected Result	Post-condition	Actual Result	Status (Pass / Fail)
TC-VC-01	Start Puzzle	Player starts the Vision Correction Puzzle	Puzzle data is loaded	Click "Start Puzzle"		Diagnosis panel opens; timer starts	Diagnosis panel active	Diagnosis panel opens; timer starts	Pass
TC-VC-02	Select Diagnosis	Player selects Nearsighted or Farsighted	Diagnosis panel is active	Click diagnosis button	Vision Diagnosis: Nearsighted	Selection is saved; debug log shows correct value	Selected diagnosis stored in PuzzleManager	Selection is saved; debug log shows correct value	Pass
TC-VC-03	Go to Eye Test	Transition from Diagnosis to Eye Test	Diagnosis Selected	Click "Next" or trigger transition		Eye Test panel opens; Diagnosis close	currentPhase = Eye Test	Eye Test panel opens; Diagnosis close	Pass
TC-VC-04	Eye Test Interaction	Perform slider-based eye test	Eye Test panel is open	Drag slider to test clarify	Clarity Score: 0.7	Slider updates visual feedback	Slide value logged and shown	Slider updates visual feedback	Pass
TC-VC-05	Go to Lens Crafting	Transition to Lens Crafting panel	Eye test complete	Click "Next"		Lens Crafting panel opens; Eye Test closes	currentPhase = LensCrafting	Lens Crafting panel opens; Eye Test closes	Pass
TC-VC-06	Select Lens	Player chooses concave or	Lens Crafting panel is active	Click on a lens button	Lens Type: Convex	Lens choice saved and debugged	selectedLens stored	Lens choice saved and debugged	Pass

		convex lens							
TC-VC-07	Go to Ray Alignment	Proceed to ray alignment minigame	Lens is crafted	Click “Next”		Ray Alignment panel opens	RayDotDrag initializes	Ray Alignment panel opens	Pass
TC-VC-08	Complete Ray Tracing	Align rays correctly	Ray panel is active	Drag dots to align rays	Depends on lens type	Ray path matches goal image	Validates correct alignment	Ray path matches goal image	Pass
TC-VC-09	Submit Puzzle	Finish the puzzle	All steps completed	Click “Submit”		Completion is validated, thank you panel opens	isPuzzleComplete = true; results recorded	Completion is validated, thank you panel opens	Pass
TC-VC-10	Hint Used	Use hint during puzzle	Puzzle in progress	Click “Hint”		HintsUsed increments; hint panel shows	hintsUsed ++	HintsUsed increments; hint panel shows	Pass

Table 5. 3: Test Case for Pause Menu and Confirmation

Test Case ID	Test Scenario	Test Case	Pre-condition	Test Steps	Test Data	Expected Result	Post-condition	Actual Result	Status (Pass / Fail)
TC-PM-01	Continue Game	Resume after pause	Game is paused	Click "Continue"		Pause Menu closes; game resumes	Time.time scale = 1	Pause Menu closes; game resumes	Pass
TC-PM-02	Exit to Main Menu with (save)	Exit while saving	Game is paused	Click "Exit to Main Menu" ➔ Click "Confirm"		Gane state saved; return to main menu	Save file updated, back at title screen	Gane state saved; return to main menu	Pass
TC-PM-03	Exit to Main Menu (cancel)	Cancel exit	Game is paused	Click "Exit to Main Menu" ➔ Click "Cancel"		Remains in Pause Menu	No changes	Remains in Pause Menu	Pass
TC-PM-04	Quit Game (with save)	Exit game with confirmation	Game is paused	Click "Quit Game" ➔ Click "Confirm"		Game state saved; application quits	Save file updated, game exits	Game state saved; application quits	Pass
TC-PM-05	Quit Game (cancel)	Cancel quitting game	Game is paused	Click "Quit Game" ➔ Click "Cancel"	Save file with full completion	Remains in Pause Menu	No changes	Remains in Pause Menu	Pass

Table 5. 4: Test Case for End-of-Day Progression, Journal and Achievement

Test Case ID	Test Scenario	Test Case	Pre-condition	Test Steps	Test Data	Expected Result	Post-condition	Actual Result	Status (Pass / Fail)
TC-ED-01	End Day after puzzle	Player completes puzzle and ends the day	Puzzle marked complete	Click "End Day" button	Completed puzzle	Player receives score screen, performance evaluation	Game data saved, next day triggered	Player receives score screen, performance evaluation	Pass
TC-ED-02	Save on End Day	Automatically save after ending the day	Puzzle completed and "End Day" clicked	Click "End Day"		Save file updated with latest progress (journal, achievements, puzzle state)	Save system reflects new day and puzzle unlocked	Save file updated with latest progress (journal, achievements, puzzle state)	Pass
TC-ED-03	Journal Entry (Good Score)	Add correct journal entry for good performance	Puzzle completed correctly	End Day ➔ Journal system triggered	Diagnosis = correct, lens = correct, hint = 0	Jounral entry (good) Added	Entry viewable in Journal	Jounral entry (good) Added	Pass
TC-ED-04	Journal Entry (Bad Score)	Add alternate journal entry for poor performance	Puzzle completed incorrectly or with hints	Click "Quit Game" ➔ Click "Confirm"	Diagnosis = wrong	Jounral entry (bad) Added	Entry viewable in Journal	Jounral entry (bad) Added	Pass
TC-ED-05	Retry specific	End Day men uhas	Click "Retry" on	Click "Quit Game" ➔		Vision Puzzle 1 restarts with new attempt	Reset puzzle progress	Vision Puzzle 1 restarts with new attempt	Pass

	puzzle request	retry option	Vision Puzzle 1	Click “Cancel”					
TC-ED-06	Unlock Achievement (No Hints)	Earn achievement for solving a puzzle with no hints used	Complete a puzzle	Use 0 hints during entire puzzle	Puzzle data: Hint = 0	Achievement “Clear without Help is unlocked”	Added to achievement panel	Achievement “Clear without Help is unlocked”	Pass
TC-ED-07	Unlock Achievement (Retry Success)	Earn achievement after retrying failed request and succeeding	Puzzle previously failed, mow retrying	Retry puzzle via End Day ➔ Retry button	Second attempt completed correctly	Achievement “Redemption” is unlocked	Added to achievement panel	Achievement “Redemption” is unlocked	Pass

Table 5. 5: Test Case for Keyboard Shortcuts

Test Case ID	Test Scenario	Test Case	Pre-condition	Test Steps	Test Data	Expected Result	Post-condition	Actual Result	Status (Pass / Fail)
TC-KS-01	Pause Game	Press ESC to pause the game	Game is active (any panel)	Press ESC		Pause Menu appears; game time pauses	Time.time scale = 0, Pause UI active	Pause Menu appears; game time pauses	Pass
TC-KS-02	Open Journal	Press J key to open Journal	Game is active (any panel)	Press J		Journal UI opens with entries	Journal system opens correctly	Journal UI opens with entries	Pass
TC-KS-03	Open Achievements	Press K key to open Achievements	Game is active (any panel)	Press K		Achievements UI open	Achievement system UI shows	Achievements UI open	Pass

5.3 Usability Testing

Usability testing was conducted to evaluate the player experience and ensure Physics Corner is intuitive, accessible and enjoyable for its target audience. This type of testing focuses on how players interact with the interface, navigate through puzzles, understand instructions, and respond to visual and audio feedback. Test sessions involved observing players as they played through specific sections of the game, noting confusion points, interface misinterpretations, or areas where players hesitated or relied on hints unexpectedly. Feedback was gathered through Google Form (see **Appendix C**) distributed to 20 secondary school students, to identify any usability issues in terms of knowledge acquisition, user interface feedback, and functionality of the game. The insights gained from usability testing directly informed UI improvements, hint adjustments, and clarity enhancements, ensuring that players can focus more on learning and solving rather than struggling with controls or layout.

5.3.1 Section A: Knowledge Acquisition from Gameplay

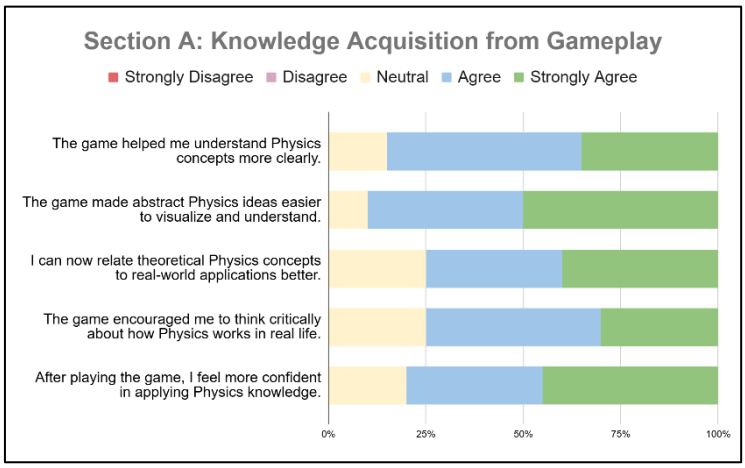

Figure 5.1. 1: Knowledge acquisition from gameplay

Figure 5.1.1 charts the knowledge acquisition from Physics Corner's gameplay. Respondents' feedback indicates Physics Corner poses as a great learning aid to understand Physics concept more clearly (85%), visualize abstract ideas (90%) and helping them to be more confident in applying Physics knowledge (80%). With an average score of 16.2 of positive responses, this suggests the educational objectives are being successfully met.

5.3.2 Section B: User Interface Feedback

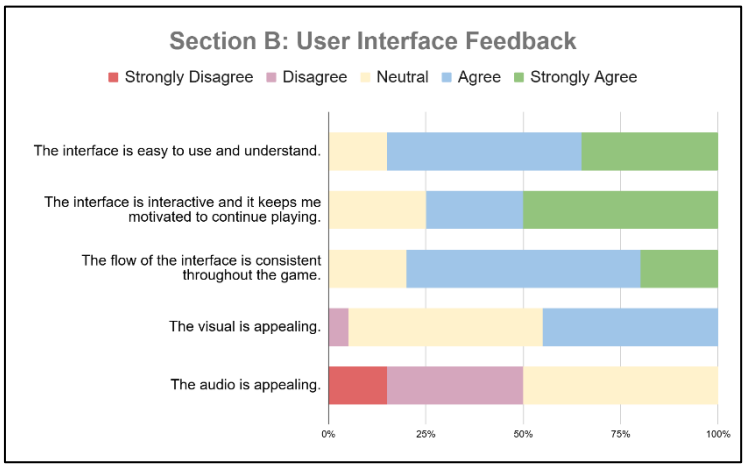

Figure 5.1. 2: User interface feedback

Figure 5,1,2 illustrating respondents on user interface feedback, with a unique skew compared to previous section. Feedback on the interface was mostly positive, with users finding it easy to use (85%), consistent (80%), and interactive (75%). However, while visuals received moderate approval (leaning toward neutral, 7 and 1 disagree), audio was the weakest area, with 10 neutrals and 10 total negative responses. This implies a need to either improve or rethink the sound design to better support immersion or feedback clarity.

5.3.3 Section C: Gameplay Functionality

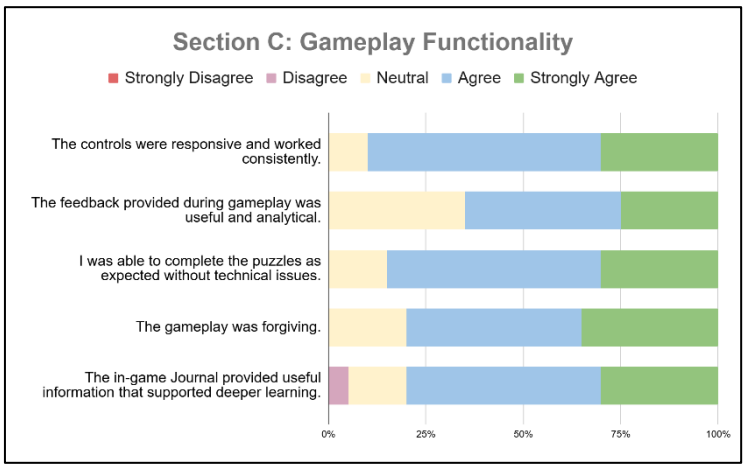

Figure 5.1. 3: Gameplay functionality

Figure 5.1.3 visualizes respondents experience on gameplay functionality. They found the controls responsive (90%) and the puzzles technically sound (85%). Most agreed the feedback provided was useful (though with more neutrals here, 7), and that gameplay was forgiving (80%). The in-game journal was seen as a helpful learning support tool. No major functional issues were reported, indicating the core gameplay is stable and effective.

5.4 Summary

This chapter goes through the testing phase of Physics Corner, with functional testing using test cases, and usability testing using Google Form. Functional testing has shown greenlight as all test cases are passed. Students' evaluations were insightful, illustrating the game's strength in relating Physics concept with real-life application through game. From the feedback, improvement is needed as audio is not as appealing as it seems. This will be seen as one of the limitations and will be addressed further in the next chapter.

CHAPTER 6: CONCLUSION AND FUTURE WORK

6.1 Introduction

This chapter marks the final phase of the development of Physics Corner. In this chapter, the initial objectives of proposing Physics Corner will be tallied with the achievements. Limitations and constraints faced during the development of the proposed system will also be addressed. Moreover, future works are outlined to pave the possibilities in improving and branching out the game.

6.2 Achievements

The primary objectives of the proposed system are evaluated against the project achievements, as tabulated in Table 6.1.

Table 6. 1: Comparison between objectives and achievements

Project Objectives	Project Achievements
To design and develop an interactive game, "Physics Corner" to enhance Physics learning for SPM students.	Achieved by successfully developed a 2D interactive puzzle game with performance insights like hints, scoreboards, and real-time feedback. Performance-based journal system providing 2 unique journal entries for every chapter broaden the exposure of real-life application and deepen the knowledge understanding.
To evaluate the usability of the game "Physics Corner"	Achieved by conducting a comprehensive user evaluation 20 secondary school students. Results gathered highlight that the game allowed students to visualize abstract idea easily, as well as better in relating theoretical Physics concepts with real-world applications.

6.3 Limitations and Constraints

There are several limitations and constraints faced during the development of Physics Corner, particularly in terms of design, content and technical aspect. Firstly, although the journal system implemented in Physics Corner dynamically responds to the player's overall performance by factoring in number of correct puzzles answered, hint usage and time taken, the game's linear design imposes certain limitations. Players will receive relative journal entries based on their performance, such as real-life applications for high scorers, or deeper conceptual explanation for lower scorer, however the gameplay itself does not adapt accordingly. That is, the puzzles for the following day are pre-defined and do not update based on player's strengths or weaknesses. As a result, the system is not fully dynamic, indicating that is not an optimal personalized learning environment, but more to an exposure to Physics concept. Additionally, the game uses a single save-file system, inhibiting players to freely experiment or replay specific sections without overwriting their progress.

Secondly, due to limited development time and scope, several planned features could not be fully implemented. The scope of the game covers only 3 Physics chapters, which are Heat, Waves, and Light and Optic out of the full Form 4 and Form 5 syllabus. This results in limited puzzle variation, although significant effort was placed on ensuring each puzzle was unique and conceptually meaningful. Furthermore, time constraints affected other aspects of Physics Corner development, particularly in audio design. As reflected in the usability testing, most players found the audio to be unengaging or unappealing. This is because of the insufficient time and expertise in music composition and sound effect design. While features like animations were deprioritized, as they were considered less critical compared to hints or achievements, their absence may have reduced the overall quality.

Lastly, as addressed in Chapter 1, Physics Corner is currently limited to Windows platform and has only been tested on laptops. Mobile and other platform compatibility are not supported, due to knowledge and resource limitations, like the lack of optimization for touch-based interaction, different screen resolution, and even the knowledge on porting it to another operating system. This constraint heavily limits the accessibility of the game, especially for those who prefer mobile gaming.

6.4 Future Works

As Physics Corner is crawling its way into educational game, future iterations may include a more adaptive learning system to further expand the educational value and depth of the game. A future upgrade could allow the game to dynamically tailor upcoming puzzles based on a player's weakness, offering reinforcement in topics where they struggled. This would help shift the experience from general exposure to Physics concepts and relating with real-life applications, toward a more personalized and responsive learning journey. Other than that, a flexible save system like multiple save slots, or checkpoints on chapters, could provide the player more freedom in exploring alternative outcomes, dwell more into that topic, providing them a branched learning environment.

Secondly, to boom immersion, future development should also address audio and visual design improvements. Sound design, identified in user testing as a weaker point, could be improved with more context-aware background music and clearer feedback cues. Likewise, adding some animations or transition effects would elevate the visual storytelling and give a more polished, game-like feel. Expanding the game's scope is also a key direction. Future

updates could introduce additional chapters from the Form 4 and Form 5 syllabus, offering new puzzles and mechanics, further supporting syllabus-aligned learning goals.

From a narrative standpoint, adding NPC lore and interconnected character arcs would help strengthen player engagement and narrative cohesion. Giving each NPC a unique personality, motivation, or experience related to the Physics topic they introduce could make the gameplay more memorable and meaningful. For instance, linking two NPCs through shared experiences or cross-puzzle dialogue could build a stronger narrative thread throughout the game. Finally, expanding Physics Corner to support cross-platform play, including mobile devices, would be a worthwhile step to reach more learners.

6.5 Conclusion

In conclusion, Physics Corner marks a milestone in developing a functional and engaging Physics learning game that bridges real-life applications and theoretical concepts, as well as visualizing them. Routine modifications and improvements will be made in the future to further enhance and expand the possibilities of Physics Corner, making it a more comprehensive and well-rounded experience for students, and for anyone with a spark of curiosity of how the world works.

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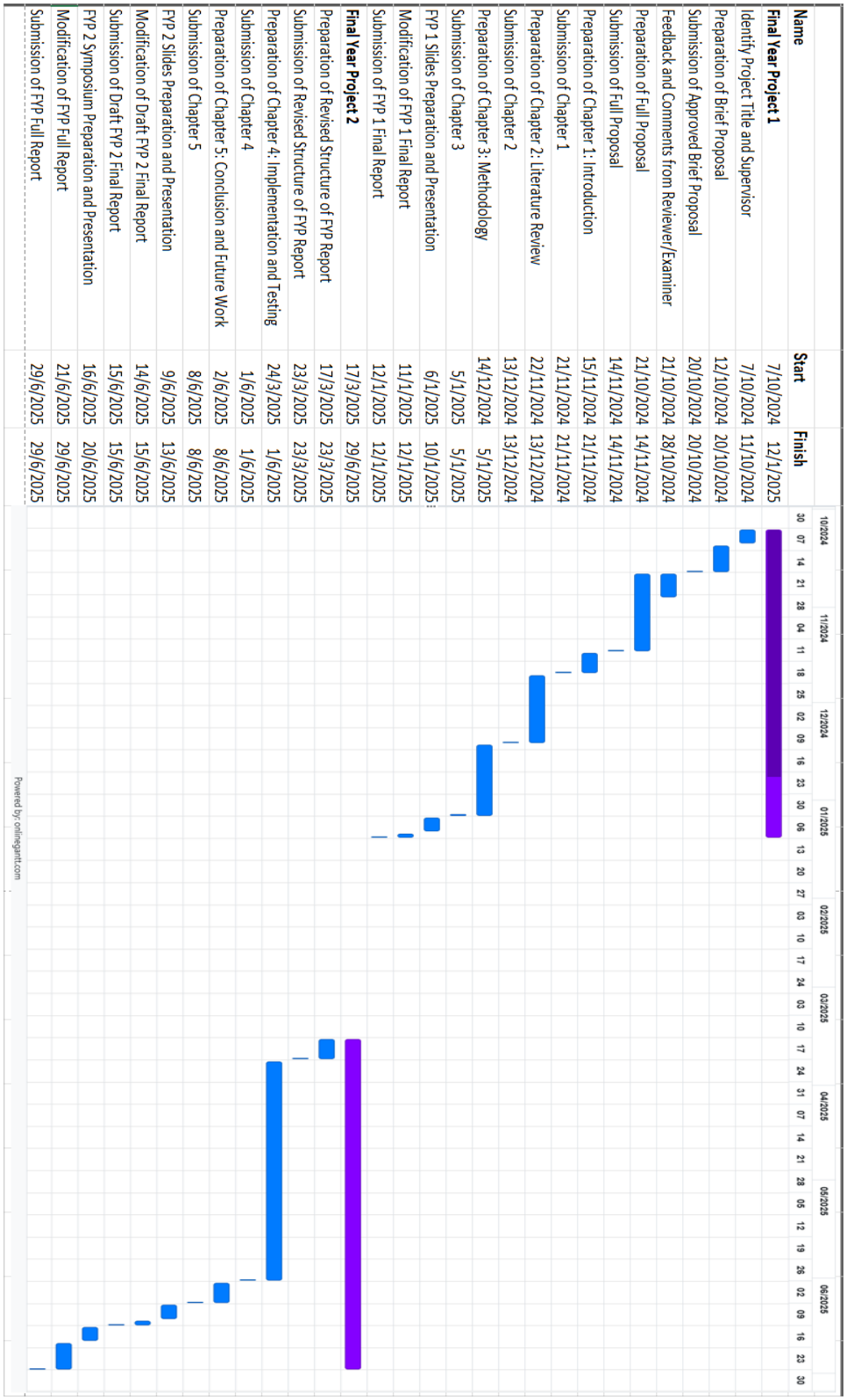
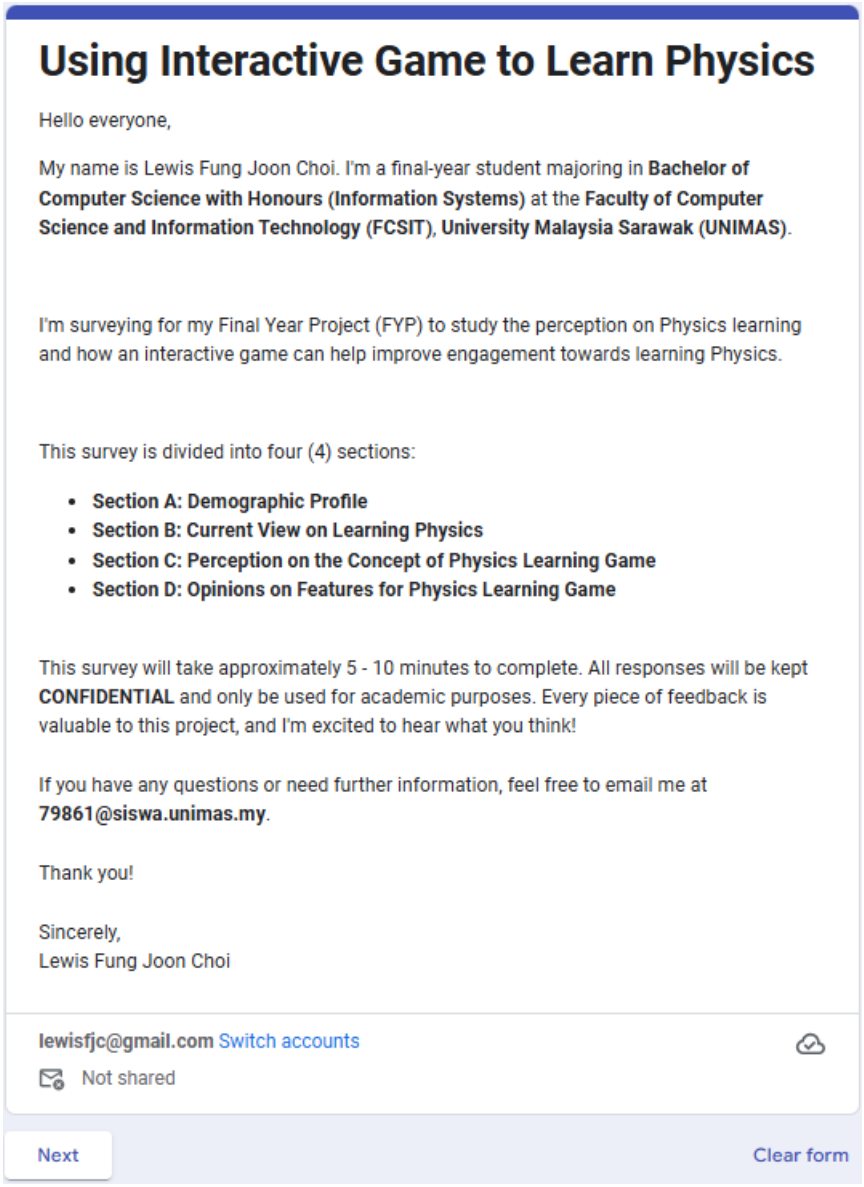
APPENDIX A: GANTT CHART



APPENDIX B: QUESTIONNAIRE



Using Interactive Game to Learn Physics

Hello everyone,

My name is Lewis Fung Joon Choi. I'm a final-year student majoring in **Bachelor of Computer Science with Honours (Information Systems)** at the **Faculty of Computer Science and Information Technology (FCSIT)**, **University Malaysia Sarawak (UNIMAS)**.

I'm surveying for my Final Year Project (FYP) to study the perception on Physics learning and how an interactive game can help improve engagement towards learning Physics.

This survey is divided into four (4) sections:

- **Section A: Demographic Profile**
- **Section B: Current View on Learning Physics**
- **Section C: Perception on the Concept of Physics Learning Game**
- **Section D: Opinions on Features for Physics Learning Game**

This survey will take approximately 5 - 10 minutes to complete. All responses will be kept **CONFIDENTIAL** and only be used for academic purposes. Every piece of feedback is valuable to this project, and I'm excited to hear what you think!

If you have any questions or need further information, feel free to email me at **79861@siswa.unimas.my**.

Thank you!

Sincerely,
Lewis Fung Joon Choi

lewisfjc@gmail.com Switch accounts

Not shared

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Section A: Demographic Profile

Gender *

- ◯ Male
- ◯ Female

Race *

- ◯ Malay
- ◯ Chinese
- ◯ Indian
- ◯ Bumiputera Sarawak
- ◯ Bumiputera Sabah
- ◯ Other: _____

What is your role? *

- ◯ Student
- ◯ Teacher

What is your highest educational level **completed**? *

- ◯ Form 3
- ◯ Form 4
- ◯ Form 5
- ◯ Pre-University (Diploma / Foundation / Matriculation / STPM / A-Level / STAM / UEC)
- ◯ Bachelor's Degree
- ◯ Other: _____

Have you taken Physics subject in the Malaysian Certificate of Education (SPM)? *

- ◯ Yes (I've completed it)
- ◯ No (I didn't take it)
- ◯ I'm currently preparing for it

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Section B: Current View on Learning Physics

Physics is the study of matter, energy, and their interactions, explaining how the world works, from movement of objects to the forces that shape everything around us.

How do you usually learn Physics? *(Select all that apply)* *

- [ ] Traditional classroom method (e.g., lectures, textbooks)
- [ ] Watching educational videos (YouTube channel like Veritasium, physicsfun)
- [ ] Playing video games that involve Physics elements
- [ ] Hands-on experiments or activities
- [ ] Reading books or articles related to Physics
- [ ] Listening to Physics-related podcast (e.g., StarTalk)
- [ ] Other: _____

What learning style do you think helps you the most when studying Physics? *

- ◯ Visual (e.g., watching videos, diagrams, animations)
- ◯ Auditory (e.g., listening to lectures, podcasts, discussions)
- ◯ Reading (e.g., textbooks, notes, articles)
- ◯ Kinaesthetic/Interactive (e.g., experiments, games, hands-on activities)

What is your first impression when someone mentions Physics? (*Select all that apply*) *

- [ ] Boring
- [ ] Difficult
- [ ] Interesting
- [ ] Exciting
- [ ] Confusing
- [ ] Fun
- [ ] Frustrating
- [ ] Overwhelming
- [ ] Other: _____

Do you think Physics is hard to learn? *

- ( ) Yes, it's challenging
- ( ) No, it's not difficult
- ( ) Sometimes, depending on the topic
- ( ) I'm not sure

Why do you think people (or you, if you chose 'yes') find Physics difficult to learn? *
(Select all that apply)

- [ ] The traditional classroom method feels boring or unengaging
- [ ] It's hard to relate theoretical concepts to real-world situations or visualize them
- [ ] Lack of interactive and engaging learning aid
- [ ] Struggling with the math or formulas involved
- [ ] Not enough support or help from teachers
- [ ] Fear of asking teachers for help or not wanting to bother them
- [ ] Difficulty in understanding the abstract nature of Physics concepts
- [ ] Other: _____

For each of the following statements, please select the option that best reflects your thoughts or experiences. The scale goes from: *

1 – Strongly Disagree
2 – Disagree
3 – Neutral
4 – Agree
5 – Strongly Agree

	1	2	3	4	5
I am interested in learning Physics.	○	○	○	○	○
I find Physics relevant to my everyday life.	○	○	○	○	○
I feel engaged and motivated during my Physics lesson.	○	○	○	○	○

I often wonder how things work around me.	◯	◯	◯	◯	◯
I find Physics concepts challenging, but I enjoy the process of solving problems.	◯	◯	◯	◯	◯
I think learning Physics will be useful for my future studies/career.	◯	◯	◯	◯	◯
I prefer to learn Physics through interacting with it rather than just reading from materials.	◯	◯	◯	◯	◯
I find Physics more interesting when I can relate it to real-world situations.	◯	◯	◯	◯	◯

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Section C: Perception on the Concept of Physics Learning Game

Have you ever played a game that involves Physics concepts, but you didn't realize it at the time? *

- ◯ Yes
- ◯ No

If yes, can you name one of the games you played?

Your answer

Have you ever intentionally played a game to learn about Physics or because you knew the game involved Physics concepts? *

- ◯ Yes
- ◯ No

If yes, can you name one of the games you played?

Your answer

For each of the following statements, please select the option that best reflects your thoughts or experiences. The scale goes from: *

1 – Strongly Disagree
2 – Disagree
3 – Neutral
4 – Agree
5 – Strongly Agree

	1	2	3	4	5
I think that technology plays an important role in my Physics learning journey.	◯	◯	◯	◯	◯
I believe that educational games could make the process of learning Physics more enjoyable.	◯	◯	◯	◯	◯
I believe that games can help me better visualize difficult Physics concepts.	◯	◯	◯	◯	◯
I think games can help me understand Physics concept better by relating them to real-world applications.	◯	◯	◯	◯	◯

I believe that learning through games would allow me to explore, learn and experiment at my own pace.	○	○	○	○	○
I would be more motivated to learn Physics if I can play games that expose me to the subject.	○	○	○	○	○
I believe that playing Physics-related games can help me retain Physics concepts more effectively than traditional learning methods.	○	○	○	○	○
I would be interested in using an educational game to learn more about Physics.	○	○	○	○	○

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Section D: Opinions on Features for Physics Learning Game

Which of the following would you find it helpful if the game provides it while you are playing it? *(Select all that apply)* *

- [ ] Hints
- [ ] Achievements
- [ ] Rewards
- [ ] Tips
- [ ] Other: _____

How helpful do you think it would be if the game uses different learning methods (visual, auditory, reading/writing, interactive activities) to teach Physics concepts? *

	1	2	3	4	5	
Not Helpful	○	○	○	○	○	Extremely Helpful

Do you think it would be useful to have a scoreboard in the game that shows your performance, such as how many hints you used, how you solved problems, and your overall score? *

	1	2	3	4	5	
Not Useful	○	○	○	○	○	Extremely Useful

Do you think the game would be more interesting if it includes a storyline or narrative to guide you through the physics lessons? *

	1	2	3	4	5	
Not Interested	○	○	○	○	○	Extremely Interested

How important is it to you that the game has an easy-to-navigate user interface (UI) that allows you to quickly understand and interact with the game features?

	1	2	3	4	5	
Not Important	◯	◯	◯	◯	◯	Extremely Important

Do you prefer to play an educational Physics game that can be played offline, or would you prefer one that requires an internet connection? *

- ◯ Offline
- ◯ Online

Would you prefer a game that is more focused on problem-solving or one that includes explanations, challenges, and discussions along with the problems? *

- ◯ Problem-solving focused
- ◯ Challenges with explanations and discussions
- ◯ A mixture of both

Back Submit Clear form

APPENDIX C: EVALUATION FORM

Evaluation Form: Physics Corner - An Interactive Game to Learn Physics

Hello everyone,

My name is Lewis Fung Joon Choi. I'm a final-year student majoring in **Bachelor of Computer Science with Honours (Information Systems)** at the **Faculty of Computer Science and Information Technology (FCSIT)**, **University Malaysia Sarawak (UNIMAS)**.

Thank you for participating in the **user testing of Physics Corner**, a 2D Physics Learning Game designed to enhance engagement and understanding towards Physics Learning.

Link to download Physics Corner:

https://drive.google.com/drive/folders/1Mpi-s515QuwJ-YCymTxe1AhMzQGkbRiM?usp=drive_link

This survey is divided into three (3) sections:

- **Section A: Knowledge Acquisition from Gameplay**
- **Section B: User Interface Feedback**
- **Section C: Gameplay Functionality**

This survey will take **approximately 5 - 20 minutes to complete**. All responses will be kept **CONFIDENTIAL** and only be used for improving Physics Corner.

If you would like to contact me for further information, please use this email: **79861@siswa.unimas.my**.

Thank you!

Sincerely,
Lewis Fung Joon Choi

lewisfjc@gmail.com Switch accounts

Not shared

Next

Clear form

Evaluation Form: Physics Corner - An Interactive Game to Learn Physics

lewisfjc@gmail.com Switch accounts

Not shared

* Indicates required question

Section A: Knowledge Acquisition from Gameplay

This section evaluates how well Physics Corner helped you understand and apply Physics concepts.

It focuses on learning outcomes, your ability to relate theory to real-world situation, and how effectively the game enhanced your understanding.

Please select the option that most accurately reflects your experience for each of the following statements.
1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

The game helped me understand Physics concepts more clearly. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

The game made abstract Physics ideas easier to visualize and understand. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

I can now relate theoretical Physics concepts to real-world applications better. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

The game encouraged me to think critically about how Physics works in real life. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

After playing the game, I feel more confident in applying Physics knowledge. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

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Not shared

* Indicates required question

Section B: User Interface Feedback

This section evaluates the design, usability, and clarity of the game's user interface (UI).

It focuses on how easily you could navigate, interact with, and understand the game visually and functionally.

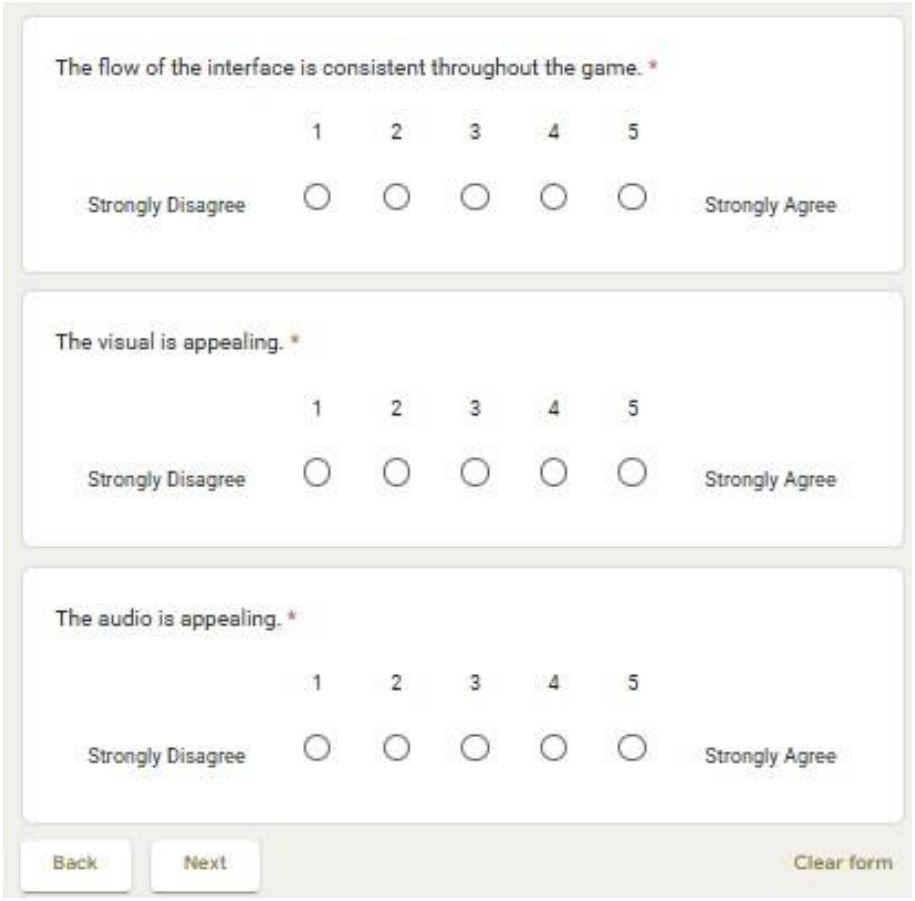
Please select the option that most accurately reflects your experience for each of the following statements.
1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

The interface is easy to use and understand. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

The interface is interactive and it keeps me motivated to continue playing. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree


The flow of the interface is consistent throughout the game. *
1 2 3 4 5
Strongly Disagree
Strongly Agree
The visual is appealing. *
1 2 3 4 5
Strongly Disagree
Strongly Agree
The audio is appealing. *
1 2 3 4 5
Strongly Disagree
Strongly Agree
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Section C: Gameplay Functionality

This section evaluates how well the game's features, mechanics, and functions worked.

It focuses on the stability, responsiveness, and effectiveness of the gameplay experience.

Please select the option that most accurately reflects your experience for each of the following statements.
1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

The controls were responsive and worked consistently. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

The feedback provided during gameplay was useful and analytical. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

I was able to complete the puzzles as expected without technical issues. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

The gameplay was forgiving. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

The in-game Journal provided useful information that supported deeper learning. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

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