



Faculty of Computer Science and Information Technology

**MEDGUARD: GAME-BASED LEARNING APPROACH
FOR QUALITY USE OF MEDICINE**

ANDERSON TANG KEE HIIT

Bachelor in Computer Science (Multimedia Computing) with Honour

2025

**MedGuard: Game-based Learning Approach for
Quality Use of Medicine**

ANDERSON TANG KEE HIIT

This project is submitted in partial fulfilment of the
requirements for the degree of Bachelor of Computer Science with Honors
(Multimedia Computing)

Faculty of Computer Science and Information Technology
UNIVERSITI MALAYSIA SARAWAK

2025

UNIVERSITI MALAYSIA SARAWAK

THESIS STATUS ENDORSEMENT FORM

TITLE MEDGUARD: GAME-BASED LEARNING APPROACH FOR
QUALITY USE OF MEDICINE

ACADEMIC SESSION: SEM 2 2024/2025

ANDERSON TANG KEE HIIT

(CAPITAL LETTERS)

hereby agree that this Thesis* shall be kept at the Centre for Academic Information Services, Universiti Malaysia Sarawak, subject to the following terms and conditions:

1. The Thesis is solely owned by Universiti Malaysia Sarawak
2. The Centre for Academic Information Services is given full rights to produce copies for educational purposes only
3. The Centre for Academic Information Services is given full rights to do digitization in order to develop local content database
4. The Centre for Academic Information Services is given full rights to produce copies of this Thesis as part of its exchange item program between Higher Learning Institutions [or for the purpose of interlibrary loan between HLI]
5. ** Please tick (✓)

☐

CONFIDENTIAL

(Contains classified information bounded by the OFFICIAL SECRETS ACT 1972)

☐

RESTRICTED

(Contains restricted information as dictated by the body or organization where the research was conducted)

☒

UNRESTRICTED



(AUTHOR'S SIGNATURE)

Validated by



(SUPERVISOR'S SIGNATURE)

Permanent Address

850G Taman Bintulu, Jalan Tanjung
Batu, 97000 Bintulu, Sarawak

Dr Amelia Jati Anak Robert Jupit
Programme Coordinator (Multimedia Computing Programme)
Faculty of Computer Science and Information
Technology
Universiti Malaysia Sarawak

Date: 23 June 2025

Date: 23 June 2025

Note * Thesis refers to PhD, Master, and Bachelor Degree

** For Confidential or Restricted materials, please attach relevant documents from relevant organizations / authorities

DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.



Signature

Name : Anderson Tang Kee Hiit

Matric No.: 78801

Faculty of Computer Science and Information Technology

Universiti Malaysia Sarawak

Date: 7th January 2025

ACKNOWLEDGEMENT

With great appreciation, I would like to thank everyone who made it possible for me to finish this final year project.

First and foremost, I would like to express my heartfelt gratitude to my supervisor, Dr Amelia Jati Anak Robert Jupit, for her invaluable guidance, patience, and support throughout this project. Her insightful feedback and encouragement have been instrumental in shaping this work into its final form.

I would also like to extend my sincere appreciation to my family and friends for their unwavering support and encouragement. Their belief in me has been a constant source of motivation during the challenging times of this journey.

Additionally, I would like to convey my deepest thanks to all the lecturers who have guided me throughout my academic journey. Their dedication and passion for teaching have greatly enriched my knowledge and skills, laying a strong foundation for this project and my future works. Your mentorship and inspiration have been invaluable in shaping my academic and personal growth.

Lastly, I would like to thank everyone who has directly or indirectly supported me during this attempt. Your contributions, no matter how small, have played a significant role in making this project a reality. Thank you all.

ABSTRACT

In recent years, self-medication has become increasingly common. This raises concerns about medication safety, especially for children that do not have enough medication knowledge. To address this, it is essential to enhance awareness and practices surrounding medication safety to protect children from potential harm. This project aims address this issue by developing a game that educates children about the safe and appropriate use of medications, focusing on the "5R" principles: right patient, right medicine, right dose, right route of administration, and right time of administration. The methodology used in this project is Agile methodology, which is a flexible and iterative approach that foster continuous improvement through regular feedback and adaptation. An interview session with a pharmacist from Klinik Kesihatan Petra Jaya (KKPJ) to gather opinions and preferences regarding the content and design of the game. Next, a flowchart and storyboard has been created to serve as blueprints of the game's structure for the development process. Third, the game is developed using Unity, a platform that is good at creating immersive 2D experiences. To evaluate functionality and user experience, the game is put through a playtesting. Fifth, the game is ready for release on the selected platforms, making sure that the intended audience can access it. Sixth, more playtesting of the game with the intended audience is conducted. The pre and post-test results are noted and assessed to determine whether MedGuard is a useful tool for teaching medication safety.

Keywords: Medication safety, game development, children, education

ABSTRAK

Dalam beberapa tahun kebelakangan ini, pengambilan ubat sendiri semakin lazim. Hal ini menimbulkan kebimbangan tentang keselamatan penggunaan ubat, terutamanya bagi kanak-kanak yang tidak mempunyai pengetahuan mencukupi tentang ubat-ubatan. Untuk menangani isu ini, adalah penting untuk meningkatkan kesedaran dan amalan keselamatan penggunaan ubat bagi melindungi kanak-kanak daripada bahaya yang berpotensi. Projek ini bertujuan untuk menangani isu tersebut dengan membangunkan sebuah permainan yang mendidik kanak-kanak tentang penggunaan ubat-ubatan secara selamat dan betul, dengan menekankan prinsip "5R": pesakit yang betul, ubat yang betul, dos yang betul, kaedah pentadbiran yang betul, dan masa pentadbiran yang betul. Metodologi yang digunakan dalam projek ini ialah metodologi Agile, iaitu pendekatan yang fleksibel dan beriterasi yang mendorong penambahbaikan berterusan melalui maklum balas dan adaptasi secara berkala. Sesi temu bual telah dijalankan dengan seorang ahli farmasi dari Klinik Kesihatan Petra Jaya (KKPJ) untuk mengumpulkan pandangan dan keutamaan mengenai kandungan dan reka bentuk permainan ini. Seterusnya, carta alir dan papan cerita telah direka sebagai pelan asas struktur permainan bagi proses pembangunan. Ketiga, permainan ini dibangunkan menggunakan Unity, sebuah platform yang sesuai untuk mencipta pengalaman 2D yang menarik. Untuk menilai fungsi dan pengalaman pengguna, permainan ini menjalani ujian main. Kelima, permainan ini disiapkan untuk dilancarkan di platform yang terpilih bagi memastikan ia boleh diakses oleh audiens sasaran. Keenam, lebih banyak ujian main dijalankan dengan audiens sasaran. Hasil ujian pra dan pasca dinilai untuk menentukan sama ada MedGuard merupakan alat yang berkesan dalam mendidik keselamatan penggunaan ubat-ubatan.

Kata kunci: Keselamatan ubat, pembangunan permainan, kanak-kanak, pendidikan

TABLE OF CONTENTS

	Page
DECLARATION	i
ACKNOWLEDGEMENT	ii
ABSTRACT	iii
ABSTRAK	iv
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF ABBREVIATIONS	xii
1.1 Background	1
1.2 Problem Statement	3
1.3 Aim and Objectives	3
1.4 Scope	4
1.5 Brief Methodology	4
1.6 Significance of Project	6
1.7 Project Schedule	6
1.8 Expected Outcome	7
1.9 Summary	7
2.1 Introduction	8
2.2 Reviews of Related Works	10
2.2.1 Designing a Mobile Serious Game for Raising Awareness of Diabetic Children	10
2.2.2 AntibioGame®: A serious game for teaching medical students about antibiotic use	12
2.2.3 Investigating the Use of a Serious Game to Improve Opioid Safety Awareness Among Adolescents: Quantitative Study	16
2.3 Reviews of Existing Games	19
2.3.1 Drug Round	19
2.3.2 Anato Trivia – Quiz Anatomy	25
2.3.3 Anatomy Game	33
2.4 Comparison between Related Works and Existing Games with the Proposed Game	39
2.5 Brief Overview of Proposed Game	44

2.6	Summary	44
3.1	Introduction	45
3.2	Agile Methodology	45
3.2.1	Planning	46
3.2.2	Interview	47
3.2.3	Features of the Proposed Game	48
3.3	Software and Hardware Requirement Specification	49
3.3.1	Software Requirement	49
3.3.2	Hardware Requirement	50
3.4	Designed Proposed Game	51
3.4.1	Flowchart	51
3.4.2	Storyboard	52
3.4.3	Development Phase	57
3.4.4	Testing Phase	58
3.4.5	Deployment Phase	58
3.4.6	Review Phase	58
3.5	Summary	58
4.1	Introduction	60
4.2	Design Related Elements	60
4.3	Implementation of the system	61
4.3.1	Loading Scene	61
4.3.3	Credits	62
4.3.4	Stage Select Scene	64
4.3.5	Stage 1	66
4.3.6	Stage 2	73
4.4	Summary	76
5.1	Introduction	77
5.2	Functionality Testing	77
5.3	Evaluation Testing	80
5.3.1	Control Group Demographic Information	80
5.3.2	Experimental Group Demographic Information	82
5.3.3	Testing Methodology	83
5.4	Summary	87
6.1	Introduction	88

6.2	Achievement of Project Objectives	88
6.3	Constraints and Limitations	89
6.4	Future Works and Recommendations	90
6.5	Summary	91
	Appendix A	94
	Appendix B	96
	Appendix C	96
	Appendix D	100
	Appendix E	102

LIST OF TABLES

		Page
Table 2.1	Comparison between related works and the proposed game	39
Table 2.2	Comparison between existing games and the proposed game	42
Table 3.1	Laptop specification	50
Table 5.1	Result of functionality testing	78
Table 5.2	Control group pre- and post-test marks	83
Table 5.3	Experiment group pre- and post-test marks	83
Table 5.4	Group analysis for control group and experiment group	84
Table 5.5	Dependent samples t-test for control and experimental group	86
Table 6.1	Project objectives and their respective achievements	88
Table A.1	Gantt chart of FYP 1 schedule	94
Table A.2	Gantt chart of FYP 2 schedule	94

LIST OF FIGURES

	Page
Figure 1.1	Agile Development Methodology 4
Figure 2.1	Database from 2000 to 2019 (Schöbel, Saqr, & Janson, 2021) 8
Figure 2.2	Gameplay Interface of QDG (Moosa, et al., 2020) 10
Figure 2.3	DEX: A virtual pet-based diabetic mobile game (Moosa, et al., 2020) 12
Figure 2.4	AntibioGame® interface (Tsopra, et al., 2020) 13
Figure 2.5	Gameplay Interface. Select responses for patient's question (Tsopra, et al., 2020) 13
Figure 2.6	AntibioGame® Gameplay Interface. Patient comment for incorrect answer (Tsopra, et al., 2020) 14
Figure 2.7	AntibioGame® Gameplay Interface. End of main clinical case (Tsopra, et al., 2020) 15
Figure 2.8	Screenshot from Level 1, A Quiet Sunday Afternoon (Abraham, et al., 2021) 17
Figure 2.9	Screenshot from Level 5, Last Minute Chore (Abraham, et al., 2021) 17
Figure 2.10	Title scene of Drug Round 19
Figure 2.11	How to Play Scene 20
Figure 2.12	Gameplay scene of Drug Round 21
Figure 2.13	Scene when dice button clicked 21
Figure 2.14	Single-choice question displayed after player moved 22
Figure 2.15	Result when wrong answer selected 23
Figure 2.16	Result when correct answer selected 23
Figure 2.17	Player reaches the finish point 24
Figure 2.18	Player score points for the game 24
Figure 2.19	Title scene of Anato Trivia 26
Figure 2.20	Infinite mode of Anato Trivia 26
Figure 2.21	Grades of Anato Trivia 27
Figure 2.22	Level selection scene of osteo-muscular 28
Figure 2.23	Level selection scene of topographic anatomy 28
Figure 2.24	Gameplay scene of Anato Trivia 29
Figure 2.25	Scene if correct answer selected 30
Figure 2.26	Scene if wrong answer selected 30

Figure 2.27	Anatomy unlocked once stage passed	31
Figure 2.28	Anatomy unlocked once topic passed	32
Figure 2.29	Anatomy unlocked once topic passed	32
Figure 2.30	Anatomy unlocked once topic passed	33
Figure 2.31	Title scene of Anatomy Game	34
Figure 2.32	Mode selection scene of Anatomy Game	35
Figure 2.33	Diagram gameplay scene	35
Figure 2.34	General knowledge gameplay scene	36
Figure 2.35	Diseases gameplay scene	36
Figure 2.36	Symptoms gameplay scene	37
Figure 2.37	Illustrations and pictures gameplay scene	37
Figure 3.1	Agile Development Methodology	46
Figure 3.2	Flowchart of the game	52
Figure 3.3	Title screen of the game	52
Figure 3.4	Stage selection screen	53
Figure 3.5	Example game scene — select correct medicine from cabinet	53
Figure 3.6	Example game scene — fill in medication label	54
Figure 3.7	Example game scene — double check the information	54
Figure 3.8	Example game scene — distribute medicine to patient	55
Figure 3.9	Player achieve 5R principle	55
Figure 3.10	Summary of the key point	56
Figure 3.11	Example game scene — checking kitchen	56
Figure 3.12	Example game scene — prepare medicine	57
Figure 3.13	Example game scene — make decision	57
Figure 4.1	Loading Scene of MedGuard	61
Figure 4.2	Main menu of MedGuard	62
Figure 4.3	Main menu in Bahasa Melayu	62
Figure 4.4	Credits first page	63
Figure 4.5	Credits second page	63
Figure 4.6	Credits first page in BM	63
Figure 4.7	Credits second page in BM	64
Figure 4.8	Tutorial panel	64

Figure 4.9	Stage selection	65
Figure 4.10	Tutorial panel in BM	65
Figure 4.11	Stage selection in BM	66
Figure 4.12	Background setting of Stage 1	66
Figure 4.13	Background setting in BM	67
Figure 4.14	Stage 1 starts with welcome and greet from senior	67
Figure 4.15	Welcome and greet in BM	67
Figure 4.16	Explanation panel that displays all 5R concepts	68
Figure 4.17	Last page of explanation panel	68
Figure 4.18	Minigame - select right medicine	69
Figure 4.19	Wrong medicine selected	69
Figure 4.20	Right medicine selected	69
Figure 4.21	Minigame – drag and drop information	70
Figure 4.22	Uncompleted information filled	70
Figure 4.23	Wrong information filled	71
Figure 4.24	Right information filled	71
Figure 4.25	Decision making scenario	72
Figure 4.26	Right decision made	72
Figure 4.27	Wrong decision made	72
Figure 4.28	Ending of Stage 1	73
Figure 4.29	Background setting of Stage 2	73
Figure 4.30	Amoxicillin	74
Figure 4.31	Explanation of Amoxicillin	74
Figure 4.32	Minigame – prepare medicine	75
Figure 4.33	Decision making to select number of medicines	75
Figure 4.34	End step of prepare medicine	75
Figure 4.35	Ending of Stage 2	76
Figure 5.1	Age distribution of control group	81
Figure 5.2	Gender distribution of control group	81
Figure 5.3	Age distribution of experiment group	82
Figure 5.4	Gender distribution of experiment group	82

LIST OF ABBREVIATIONS

5R	five rights
DGBL	digital game-based learning
MEEGA+	Model for the Evaluation of Educational Games
OTC	over-the-counter
QDG	Qatar Diabetes Game
SGs	Serious Games
VGs	video games

CHAPTER 1: INTRODUCTION

1.1 Background

Self-medication has become increasingly common in recent years. According to Aslam et al. (2021), 15.1% of 480 participants reported self-medicating with antibiotics. Antibiotics are a type of prescription medicine, which requires authorization from a licensed medical professional and is tailored to individual needs, necessitating close monitoring to ensure safety and effectiveness. Another category of medicines is over-the-counter (OTC) medicines, which can be purchased without a doctor's prescription. OTC medicines are typically used for treating minor health issues and promoting self-care, reducing the need for medical visits for non-severe conditions. Aslam et al. (2021) also revealed that more than half of the participants (51.5%) lacked proper knowledge about antibiotics, underscoring a significant gap in medication safety awareness.

In recent years, promoting medication safety has become a public health priority. The World Health Organization (WHO) has identified "Medication Safety" as the theme for Global Patient Safety Day 2022, aiming to increase global awareness of the significant impact of medication-related harm resulting from medication errors and unsafe practices, while calling for immediate action to enhance medication safety. The Ministry of Health Malaysia also introduced The Know Your Medicines Programmes in 2013, emphasizing the "five rights" (5R) concept of medication administration. This program aims to ensure patients take their medications rationally. The 5R principles include the *right patient*, *right medicine*, *right dose*, *right route of administration*, and *right time of administration*.

Hanson and Haddad (2023) further elaborate on the 5R principles in their article. The *right patient* ensures that the individual receiving the medication is the intended recipient, preventing errors due to misidentification. The right drug (*right medicine*) confirms that the medication matches the prescribed drug, critical because similarly named medications can have vastly different effects. The *right dose* guarantees the correct medication strength is

administered, avoiding errors related to incorrect dosage, unit conversion, or substance concentration. The *right route* involves the method of administration, common routes include oral, intramuscular, intravenous, topical, or subcutaneous. Finally, the *right time* ensures medication is given as prescribed, with timing deviations no greater than 30 minutes to maintain efficacy and avoid altering bioavailability or other mechanisms. Hanson and Haddad (2023) cited a study by Slight et al. (2018) that revealed adverse drug events (ADEs) result in more than 770,000 injuries or deaths in U.S. hospitals each year. These events are responsible for an estimated hospital expense of \$1.56 to \$5.6 billion annually.

Medical errors are an unfortunate reality that can occur despite best efforts. In this context, education on safe medication practices is essential to improve medication safety knowledge and reduce medical errors. While children are often considered too young to take responsibility for their own medications, early exposure to medication education can significantly influence their behaviour and attitudes toward medication use as they mature (Hampson et al., 2015). By equipping children with the knowledge and skills to understand safe medication practices, we can empower them to make informed and responsible decisions regarding medication-related issues.

Aguilera and de Roock (2022) highlighted that Seymour Papert was one of the first to recognize the potential of computer games for deep and complex learning, distinguishing serious games from conventional "edutainment" by emphasizing their role in fostering intrinsic learning rather than just serving predefined educational goals. This approach of learning via computer-based games is referred to as digital game-based learning (DGBL). Unlike passive forms of instruction, such as lectures or readings, games require players to be active and participatory in their learning process. Autonomy provides positive impact to one's learning experience (Ang, Afzal, & Crawford, 2021). By integrating DGBL into health education, children are given the opportunity to exercise autonomy in their learning process. This hands-

on approach allows them to experiment with scenarios related to medication safety at their own pace, reinforcing their understanding and retention through play.

1.2 Problem Statement

Aslam et al. (2021) found that the overall prevalence of self-medication with antibiotics was 15.1% among the 480 participants. The majority of participants reported self-medicating due to a lack of time for checkups (23.1%), while the second highest reason was to high cost (19.2%). However, only 51% sought advice from a doctor, pharmacist, or nurse before taking antibiotics, and 40.4% did not seek any advice prior to use. The study also revealed that more than half of the participants lacked correct knowledge about antibiotics, with 51.5% believing that antibiotics can be used to treat the common cold or flu.

The results from Aslam et al. (2021) stated that, despite self-medication becoming common in Malaysia, most people do not have sufficient knowledge about it. While knowledge about medication is strongly linked to health literacy and lower rates of nonadherence, it also influences health-related quality of life (HRQoL) (Zipprich et al., 2022). Meanwhile, children also having easier access to medicine in their daily lives, increasing the potential risk of accidental misuse or improper self-medication. These underscores the need for early education on medication safety to equip children with the knowledge and skills necessary to handle medicines responsibly and safely.

1.3 Aim and Objectives

The aim of this project is to develop a game that educate children about quality use of medicine.

Objectives of this project are shown as below:

- i. To design a game that teaches children the fundamentals of quality use of medicine.
- ii. To develop an interactive educational game focus on teaching issue related to health and medicine.

- iii. To evaluate the effectiveness of the game in increasing children's knowledge on quality use of medicine.

1.4 Scope

This project will cover the design and implementation of a game on a web-based platform. The target users are Malaysian children under 12 years old. The data analysed will include the players' knowledge about quality use of medicine before and after playing the game.

1.5 Brief Methodology

The project will apply agile methodology to achieve the objectives. Agile is a software engineering framework that begins with a planning phase and progresses toward deployment, using iterative and incremental interactions throughout the project lifecycle (Al-Saqqah, Sawalha, & Abdelnabi, 2020).

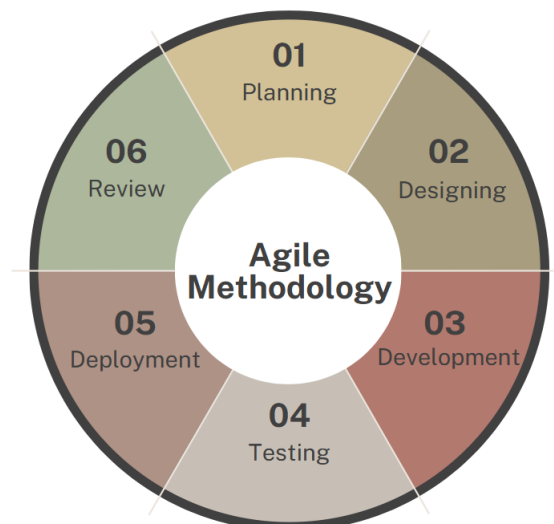


Figure 1.1 Agile Development Methodology

Based on Figure 1.1, the agile development methodology consists of six stages: planning, designing, developing, testing, deployment, and review.

The first stage, “planning”, identifies the requirements and features for the game. An interview session will be conducted with pharmacists from Klinik Kesihatan Petra Jaya, Kuching, during this phase to gather opinions and preferences regarding the content and design

of the game. The feedback gathered will be used to ensure that the game effectively addresses the educational needs of children. A project plan schedule will also be established to outline the timeline for each phase of development. This schedule will help keep the project on track, ensuring timely completion and allowing for adjustments based on ongoing feedback throughout the development process.

The second stage, “designing”, will focus on creating the overall architecture of the game, including defining the game mechanics to engage children effectively. A wireframe will be created to visualize the game's layout, illustrating menus, navigation pathways, and interactive components. User experience (UX) principles will guide design choices to ensure the game is visually appealing and easy to navigate for children. This stage is critical as it lays the groundwork for how players will interact with the game and how the game can promote medication safety.

The third stage, "developing", will involve the actual creation of the game based on the designs established in the previous phase. This stage will involve coding the game mechanics, integrating visuals and audio, and ensuring all functionalities align with the specified requirements. Interactive elements will be included to allow children to engage actively with the content and enjoy the process of learning about medication safety.

The fourth stage, "testing", will focus on evaluating the game to ensure it functions as intended and provides an effective learning experience. This phase will involve both functionality testing, and user experience testing. Functional testing will identify and fix any bugs, glitches, or performance issues within the game mechanics, visuals, and audio elements. Users experience testing, on the other hand, will involve gathering feedback from a small group of target users to assess how well the game engages its audience and delivers the intended medication safety lessons. Based on this feedback, necessary adjustments will be made to improve the game's usability, educational value, and overall appeal. Pre-game test and post-

game test about medication safety knowledge will also be examined to ensure that the game meets its educational objectives.

The fifth stage, "deployment", will focus on making the game available to the public. During this phase, the game will be launched on selected platforms, ensuring easy access for players. This stage will also involve initial monitoring to ensure smooth operation and to gather user feedback for any necessary quick fixes or adjustments. After the deployment, the game will move into the review stage to further evaluate its effectiveness and make long-term improvements.

Finally, the last stage "review" stage will focus on evaluating the overall success of the game post-deployment. Insights gained from review will be used to refine the game further, address any shortcomings, and explore potential expansions or updates. This stage ensures that the project meets its educational goals and continues to provide value over time.

1.6 Significance of Project

The significance of this project lies in its potential to foster long-term habits related to quality use of medicine in children. Although medicines are common in children's daily lives, many children are not adequately informed about the dangers of taking medications without adult supervision or about confusing medications with everyday items. This lack of awareness highlights the urgent need for effective educational interventions. This project equips children with knowledge about quality use of medicine through digital game-based learning, effectively educating them and raising their awareness of this crucial topic. The project aims to design an educational game that teaches children the fundamentals of quality use of medicine and evaluates its effectiveness in enhancing their knowledge on health and medicine-related issues.

1.7 Project Schedule

The project is planned to be completed within a year and is divided into two stages:

FYP 1 and FYP 2. Each stage spans one semester, lasting approximately 14 weeks. FYP 1 is scheduled for the first semester, running from October 7, 2024, to January 19, 2025. Following this, FYP 2 will take place in the second semester, from March 17, 2025, to June 29, 2025. Appendix A contains the Gantt charts displaying the tasks and timelines for both FYP 1 and FYP 2.

1.8 Expected Outcome

The expected outcome of this project is to produce a web-based game that teach fundamental of quality use of medicine to players. Furthermore, the project aims to determine how effectively the game works as a teaching tool for quality use of medicine.

1.9 Summary

In summary, this chapter provided an overview of background, problem statements, aim and objectives, scope, methodology, project schedule, significance and expected outcome. The consequences of misusing medicine could be dangerous and even fatal. That is why medication safety is crucial to be understood and practiced, especially for vulnerable groups like children. Therefore, this project aims to develop a web-based educational game that teaches children the fundamentals of the quality use of medicine. Methodology chosen for this project is the agile methodology due to its flexibility and rapid iteration. Additionally, this approach ensures that the game evolves in alignment with user needs and project goals. The significance of this project lies in its potential to educate children about the safe and proper use of medicine, addressing the lack of awareness about medication dangers and fostering long-term healthy habits through digital game-based learning. Outcome of this project is to develop and deploy an educational game that educate the essential principles of medication safety and the proper use of medicine to children.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

According to Asadzadeh et al. (2024), video games (VGs) can be categorized into eight main genres: action, adventure, fighting, puzzle, role-playing, simulation, sports, and strategy, which often overlap. Among these forms of VGs, Serious Games (SGs) is another form that designed for serious purposes rather than pure entertainment. It can be used for education and training in diverse fields such as military, business, art, sports, government, healthcare, and education. The authors also stated the growing popularity of SGs in education and training can be attributed to three key factors: the need for a new learning paradigm, the availability of innovative interactive technologies that engage learners in problem-solving, and the ability to involve students in curricular content in a more immersive and engaging way.

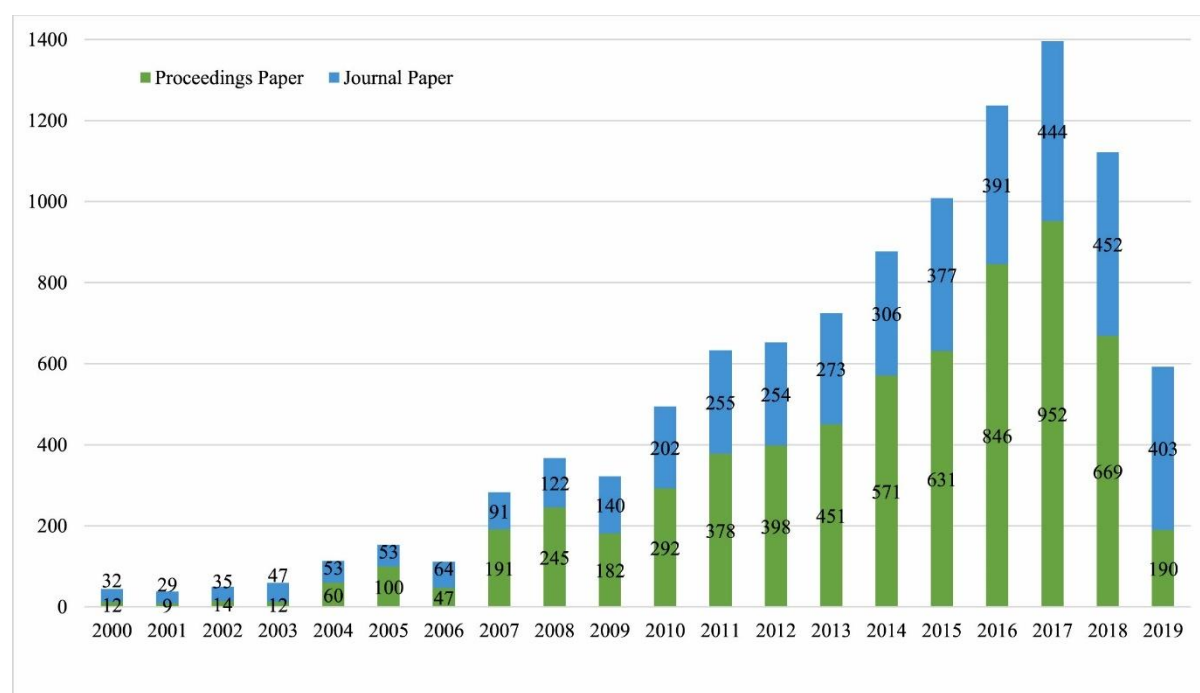


Figure 2.1 Database from 2000 to 2019 (Schöbel, Saqr, & Janson, 2021)

Figure 2.1 displays a histogram based on data from articles published on the ISI Web of Science (WoS) database between 2000 and 2019. The search terms "game", "games", "gaming", and "gamification" were used to gather articles on the topic. According to Schöbel, Saqr, and Janson (2021), the data shows that the use of game concepts in digital learning began to gain traction early in the 2000s, with 44 articles published that year. The number of

publications steadily increased year by year, reaching a peak in 2017 with 1,396 articles. However, following 2017, the number of published papers began to decline, which is attributed to the slower indexing of conference proceedings, rather than a decrease in the number of articles being published. This suggests that while there may be a delay in processing conference materials, the overall trend still points to an increasing interest in gamification and gaming as educational tools.

In the realm of medication, serious game offers a valuable platform to educate users about safe medication practices and management on specific disease states such as HIV and diabetes. For instance, Qatar Diabetes Game (QDG), a game designed to educate users about diabetes management can teach players about insulin administration, the significance of regular glucose monitoring, and how lifestyle choices such as diet and exercise impact blood sugar levels. By gamifying these concepts, stigma and misinformation can be reduced while promoting a better understanding of the disease among the general population.

To achieve a significant educational impact when teaching the quality use of medicines through game-based learning, this chapter reviews current existing works and games that implemented game-based learning approaches to deliver medication education knowledges. Academic search engine such as Google Scholar is used to identify relevant literatures published between 2020 to 2025, with keywords of “serious game”, “education”, “game-based learning” or “medication”. By selecting the most appropriate concepts, this review aims to highlight critical aspects of medication safety, such as proper administration, adherence to prescribed dosages, and understanding potential side effects, while also promoting broader health literacy. By examining existing literature and reviewing applications of serious games, this chapter providing a clear direction for the proposed game. It ensures that the developed game aligns with its objectives and effectively addresses the needs of its target audience.

2.2 Reviews of Related Works

This section reviews three existing works that implement game-based learning approach to deliver different topics. They will be mainly examined based on their purpose, methodology, improvement, and target users. The research to be reviewed are Designing a Mobile Serious Game for Raising Awareness of Diabetic Children (Moosa, et al., 2020), AntibioGame®: A serious game for teaching medical students about antibiotic use (Tsopra, et al. 2020), and Investigating the Use of a Serious Game to Improve Opioid Safety Awareness Among Adolescents: Quantitative Study (Abraham, et al., 2021).

2.2.1 Designing a Mobile Serious Game for Raising Awareness of Diabetic Children

The research paper was written by Moosa et al. in 2020, presents the development of a serious mobile game called the Qatar Diabetes Game (QDG). This game was designed to educate children with diabetes about their condition and encourage them to adopt a healthier lifestyle.

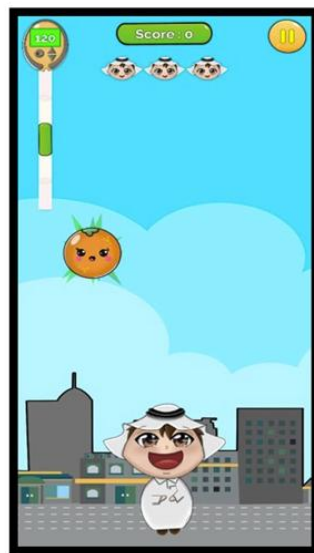


Figure 2.2 Gameplay Interface of QDG (Moosa, et al., 2020)

Figure 2.2 illustrates the gameplay interface of QDG. In the game, various types of food and insulin injections fall from above, and players must move the main character, Abood, left or right to collect suitable items. Each food type directly impacts Abood's visible blood sugar

level: for example, healthy food items improve Abood's health, while junk food increases blood sugar, alters Abood's body shape, leads to obesity, and may even cause the character to lose a life. The game adopts an arcade-style approach with a "best score" system rather than a winning condition, allowing players multiple lives to learn and improve through gameplay. Players can earn extra lives by consistently choosing healthy foods, reinforcing the lesson that simple dietary choices can help restore and maintain a healthy life. However, the game should incorporate a timer in the gameplay interface that display the total playtime for each round and allowing players to track their duration of play. The researchers also mentioned a limitation regarding the lack of diverse scenarios, which could lead to a boring experience for players. Furthermore, they highly recommended incorporating exercise instructions for diabetic children to enhance the game's educational value.

User-centered design (UCD) methodology was used during the game development phase. This approach emphasizes the importance of involving users throughout the game design process to ensure the final product meets their needs. Techniques such as playtesting, usability assessments, and user surveys were utilized to gather continuous feedback. The research involved 20 children aged 8 to 11, including both diabetic and non-diabetic participants, and was conducted at a diabetes winter camp in Doha, Qatar, with the necessary parental consent. Collaboration was made with specialists from the Qatar Diabetes Association to enhance user engagement with the developers.



Figure 2.3 DEX: A virtual pet-based diabetic mobile game (Moosa, et al., 2020)

The research divided the children into two groups to compare the impact of an arcade game approach with that of a non-arCADE diabetes mobile game. In the first part of the experiment, Group A played the Qatar Diabetes Game (QDG), while Group B played the DEX game: a virtual pet diabetic mobile game as shown in Figure 2.3. The groups then switched games for the second part of the experiment. The researchers refined MEEGA+ (Model for the Evaluation of Educational Games) model by reducing Likert scale and item description so children and adolescents can have easier understanding. Mean scores were compared to determine if there were significant differences between the games. Results showed that QDG achieved higher mean scores in perceived learning and user experience compared to DEX, while both games scored similarly in usability. This positive feedback emphasizes the success of arcade approach in designing attractive educational games.

2.2.2 AntibioGame®: A serious game for teaching medical students about antibiotic use



Figure 2.4 AntibioGame® interface (Tsopra, et al., 2020)

The paper was authored by Tsopra et al. in 2020. The research designed a web-based, case-driven game aimed at teaching medical students about the use of antibiotics in primary care. In the game, players are required to manage patients with various infectious diseases and assist other healthcare professionals facing challenges with their own patients. The scenarios are designed to be realistic and reflect learning goals established by a medical team, following an analysis of clinical practice guidelines. Figure 2.4 displays all interactive items available during the gameplay section. However, some icons do not clearly represent their intended meanings, which increases the difficulty for players at the start of the game.

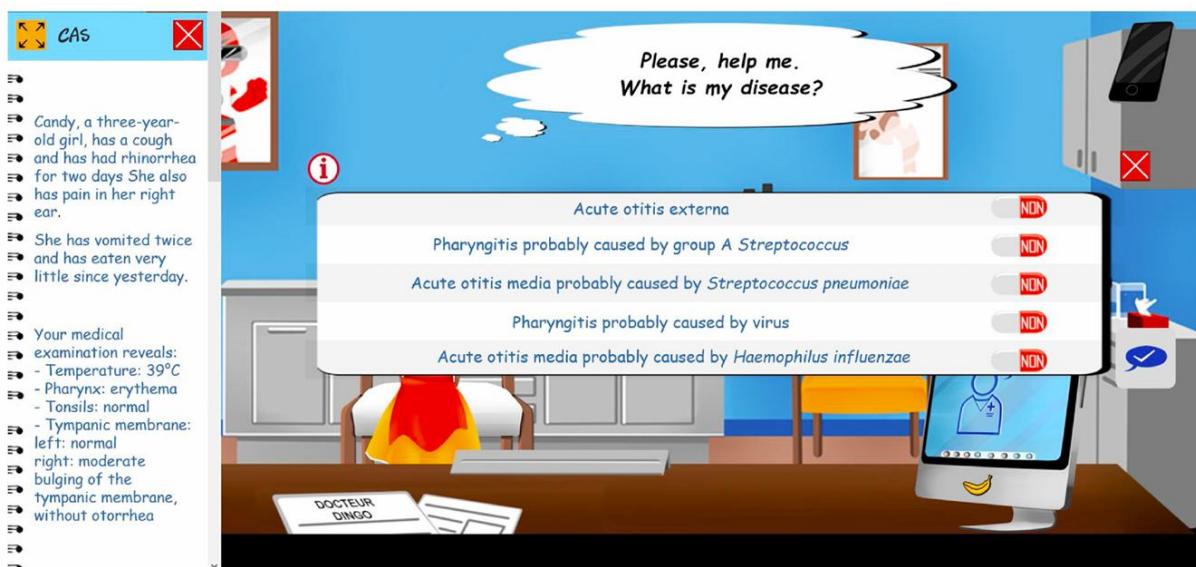


Figure 2.5 Gameplay Interface. Select responses for patient's question (Tsopra, et al., 2020)

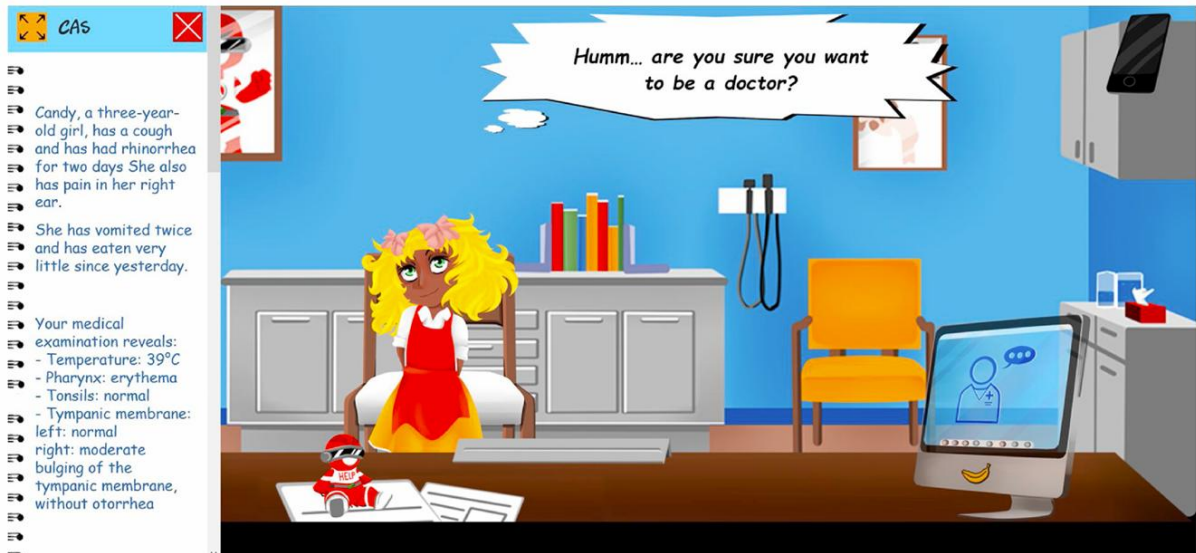


Figure 2.6 AntibioGame® Gameplay Interface. Patient comment for incorrect answer (Tsopra, et al., 2020)

The diagrams above illustrate the gameplay interface for AntibioGame®. At the start, players need to read the patient's record appears on the left side of the screen. The patient then asks a question, to which the players respond by selecting one or more of the displayed options (Figure 2.5). After players submit their responses, feedback will be received from the patient, whose comments vary from pleasant to sarcastic based on the accuracy of the answer. For example, in Figure 2.6, the patient gives a sarcastic remark in response to an incorrect answer. In this case, players can request hints and try again by clicking the AntibioMan mascot with “help” icon, located on the left side of the desk. After completing the question, the student can choose to review a summary of the medical knowledge related to it, which includes links to online resources.

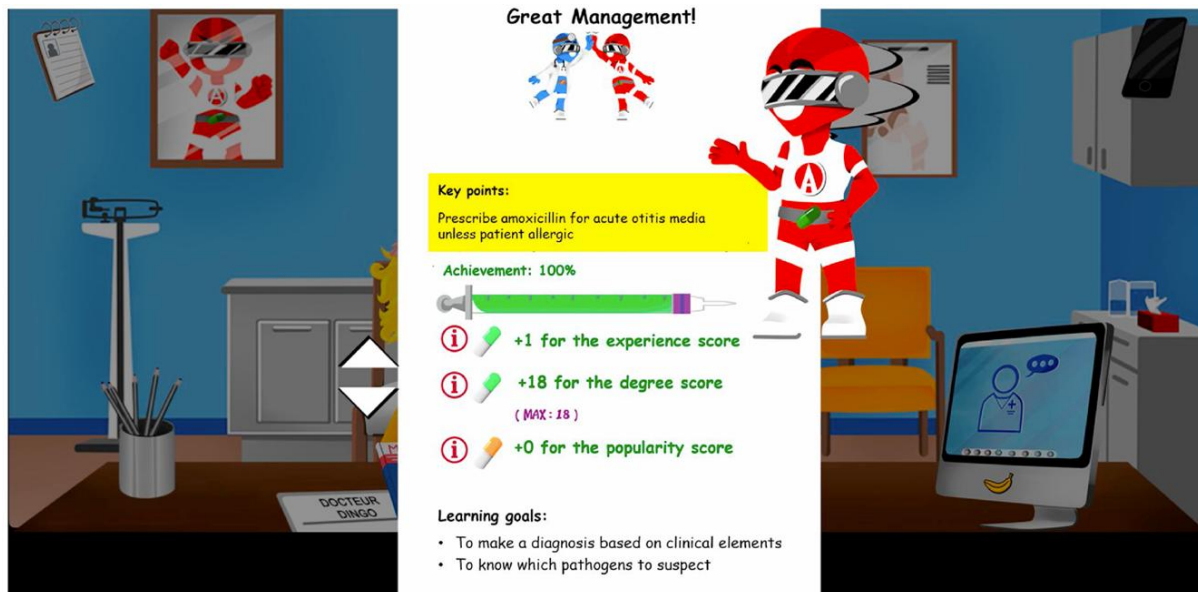


Figure 2.7 AntibioGame® Gameplay Interface. End of main clinical case (Tsopra, et al., 2020)

Figure 2.7 display the gameplay interface at the end of the main clinical case. Players can view a score window that includes the AntibioMan mascot, an amusing picture based on their achievements, key points highlighted in yellow, a syringe that fills up progressively with increased achievements, the number of points acquired across three scores, and the learning goals. The "experience score" increases with the number of clinical case games played and determines the avatar's "school year" badge. The "degree score" is calculated based on the number of correct answers provided for main scenarios and determines the avatar's "degree" badge, while the "popularity score" is derived from the number of correct answers given during phone calls and determines the avatar's "popularity with health professionals" badge. Each of these scores may vary as the game progresses. Upon completing all the clinical cases for a given topic, students can compare their scores on the leaderboard, which ranks them according to their degree score.

The researchers did not specify methodology used in the game development, which may hinder other researchers from replicating the work or applying the findings to other areas. For evaluation, a total of 57 students, with a mean age of 23, assessed AntibioGame®. Most of them were not frequent gamers and two were Erasmus students. According to the MEEGA++

scale, AntibioGame® received a quality score of 60, with 91% of students finding the design attractive, describing it as original and engaging. Most (89%) found it easy to play, and 98% understood the rules. Students highlighted the game's relevance in antibiotic education, with 93% and 98% affirming that it provided helpful content and facilitated learning, respectively. Many found the game instructive and professionalizing, with realistic clinical cases and challenges that promoted competition and cooperation.

Despite positive feedback, some areas for improvement suggested by the students, including enhancing icon interactions, readability, and engagement. Only 56% reported losing track of time, suggesting that the game did not fully capture students' attention. Recommendations included more questions, adaptive difficulty, a more detailed scoring system, and new functions such as a multiplayer mode, daily rewards, and tutorials. All students said they would recommend the game to their colleagues, with 96% enjoying it, 81% seeing it as a useful revision tool, and all students expressed interest in training sessions using the game. The feedback emphasized success of using serious game in promoting students' knowledge.

2.2.3 Investigating the Use of a Serious Game to Improve Opioid Safety Awareness Among Adolescents: Quantitative Study

Abraham et al. developed a serious game called MedSMART: Adventures in PharmaCity in 2021. MedSMART is a task-driven game, accessible on computers or tablets with keyboard controls, and developed using the Unity engine. The game contains five levels, where players take on the role of “Shan,” an anthropomorphic sheep prescribed opioids following an arm injury. The goal of the game is to help Shan make safe choices around opioid use and care. Aim of the game is to enhance adolescents' knowledge, awareness, behavioural intent, and self-efficacy related to opioid safety. Each level presents a distinct topic on opioid safety, guiding players through key decisions to reinforce safe practices.

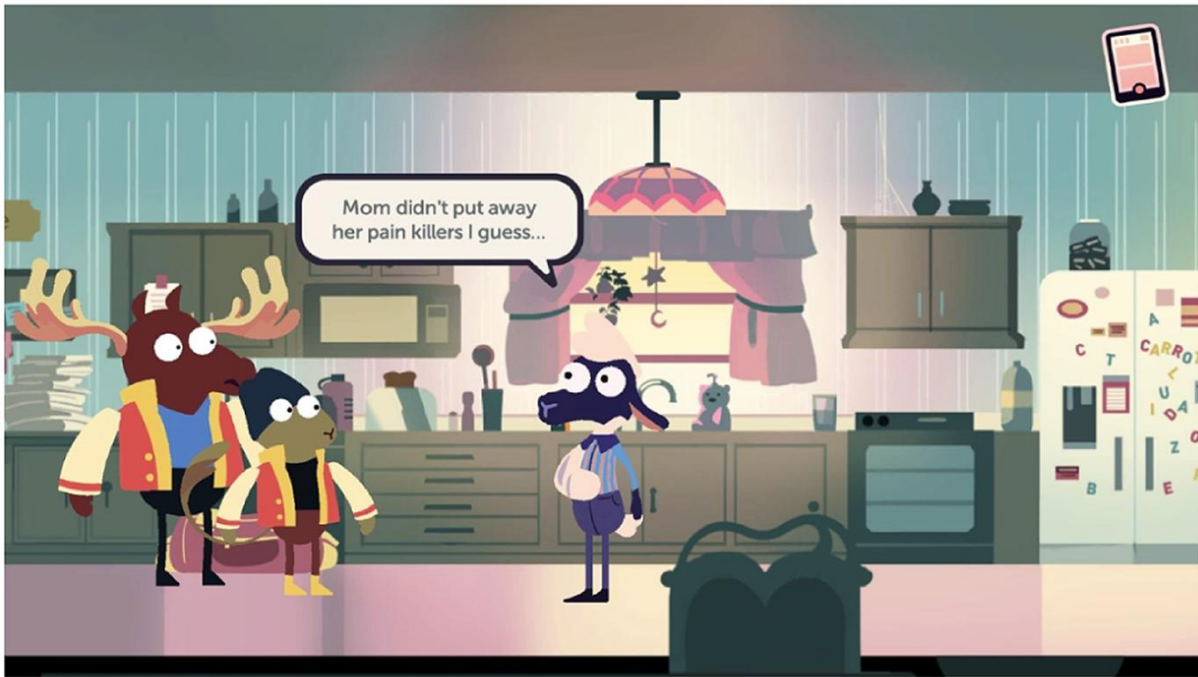


Figure 2.8 Screenshot from Level 1, A Quiet Sunday Afternoon (Abraham, et al., 2021)

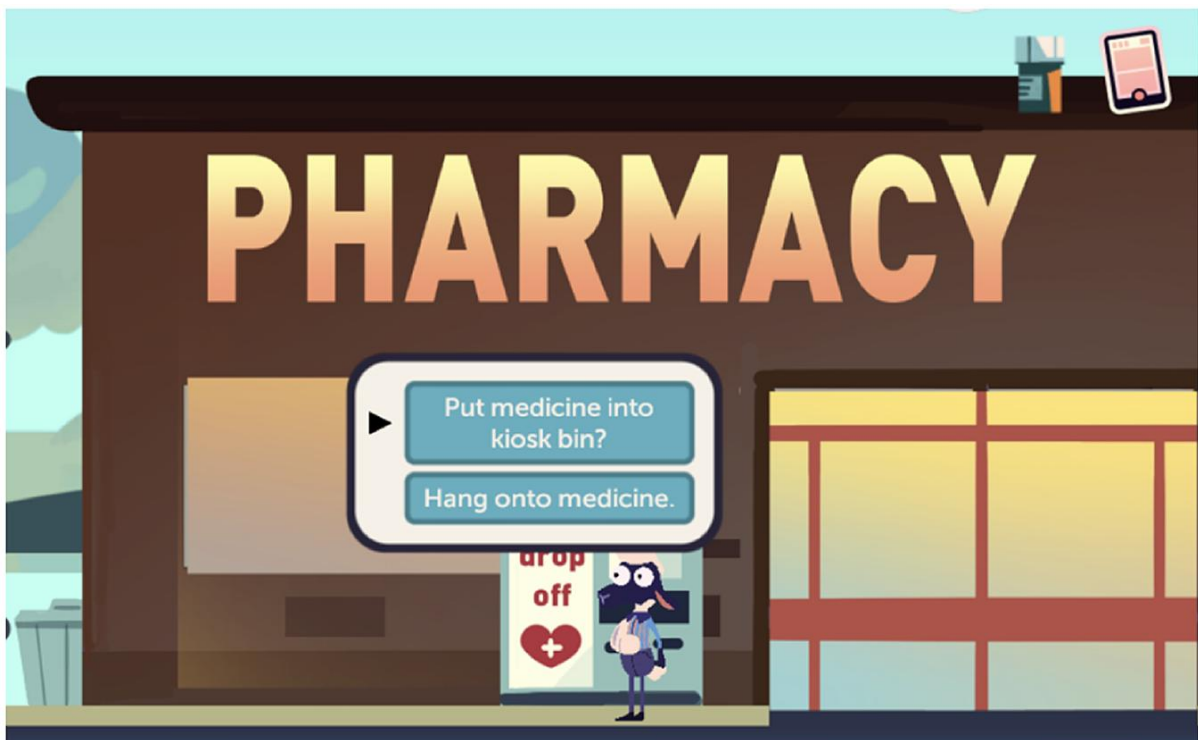


Figure 2.9 Screenshot from Level 5, Last Minute Chore (Abraham, et al., 2021)

Figure 2.8 shows screenshot from Level 1, A Quiet Sunday Afternoon. This level focused on teaching the player about the safe storage of opioids. Player is taught to lock up medication in a cabinet, so their friends do not have access to them. Meanwhile, Figure 2.9 shows screenshot from Level 5, Last Minute Chore. This level taught player the correct way to

dispose of an opioid medication and reason why medications should not be thrown or flush down through the toilet. Each level's scenarios are designed to be realistic and relatable to the daily lives of adolescents.

The methodology used for game development in this study was unspecified. The researchers evaluated the game using a pregame survey, 30 minutes of gameplay, and a postgame survey. The pregame survey included 66 items: 59 assessed participants' baseline knowledge of opioids, safety awareness, disposal practices, and understanding of misuse, as well as their perceptions of the impact of serious games on opioid safety awareness. Additionally, 2 items were used as attention check questions, and 5 demographic questions gathered participant characteristics. The postgame survey repeated the same 59 opioid-related questions and 2 attention checks while adding 25 questions about participants' views on *MedSMART*. Both surveys were conducted online via Qualtrics.

A total of 117 adolescents living in United States, all of whom could speak and understand English, took part in the survey with their parents' permission. Among the participants, 59 identified as male, 57 as female, and 1 as nonbinary, with the majority being Caucasian (48.72%). The game was evaluated based on its impact on participants' pregame and post-survey results across various categories: self-efficacy, perceived knowledge, harm and misuse behaviour, behavioural intent, safe storage and disposal, opioid knowledge, and Narcan knowledge. Result showed significant improvement on all concept scores in postgame survey except for Narcan (naloxone) knowledge (mean change -0.04, SD 0.29; $p=.60$) and safe storage of opioids (mean change 0.03, SD 0.20; $p=.09$). Participants who did not access the game or reported playing the wrong game in the postgame survey showed worse changes in perceived knowledge ($p=.05$), self-efficacy: opioid safety ($p=.05$), and self-efficacy: MUSE (Medication Understanding and Use Self-Efficacy) ($p=.01$) compared to those who played all five levels.

The study shows potential effectiveness of serious game in increasing adolescents'

knowledge and preventing opioid misuse. However, the researchers noted that participants who did not play the game or who reported playing the wrong game were treated as a self-selecting control group rather than being randomized. Additionally, the efficacy outcomes were based on self-completion questionnaires, which may have been influenced by participant dishonesty and reporting bias.

2.3 Reviews of Existing Games

This section reviews three existing games that utilize the GBL approach to teach medication knowledge. The games will be examined based on their UI design and supported platforms. The games under review are Drug Round, Anato Trivia – Quiz Anatomy, and Anatomy Game.

2.3.1 Drug Round



Figure 2.10 Title scene of Drug Round

Drug Round, launched by Focus Games Ltd in 2019, is an educational game available on Google Play Store and App Store. The game is designed to build and test players' knowledge of medication safety, particularly focusing on common medication errors and drug calculations. It targets healthcare staff involved in dispensing and administering drugs, including nurses,

student nurses, junior doctors, medical students, and pharmacy staff. The game's title screen, as illustrated in Figure 2.10, features the title, a play button to begin the game, and a help button for additional guidance. In the top left corner, the publisher's name is featured, while the top right corner highlights the corporate co-developer.

The game's UI layout leaves a significant amount of unused space, particularly at the top and bottom of the screen, which appears as a distracting pink background. This design choice not only reduces the visual appeal of the game but also affects user focus, making it harder for players to concentrate on the actual game content. Filling the entire screen with game elements or a more neutral background could enhance immersion and make the interface more visually cohesive, allowing players to engage more fully with the educational material.

From an auditory perspective, the game includes various sound effects, such as clicking sounds, dice-rolling sounds, and the sound of the chess piece moving. However, it lacks a continuous background soundtrack, which leaves the game feeling somewhat quieter and less immersive. The absence of background music might make the game feel somewhat sparse or disconnected, potentially detracting from the overall experience, especially in longer sessions.

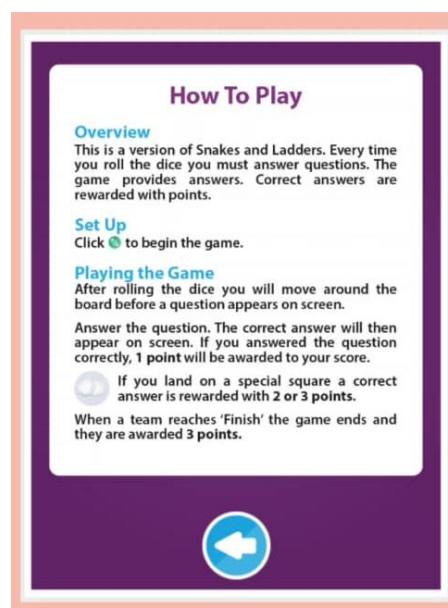


Figure 2.11 How to Play Scene

Figure 2.11 appears when the user selects the help button, presenting an overview and

rules of the game. The game operates as a Snakes and Ladders-style format, where each move involves a question. Correctly answering a question awards the player one point, while correct answers on special squares grant additional score points—either one or two extras. The game concludes when the player either reaches the finish line or the countdown timer runs out. Players can click a back button on this screen to return to the title page.



Figure 2.12 Gameplay scene of Drug Round

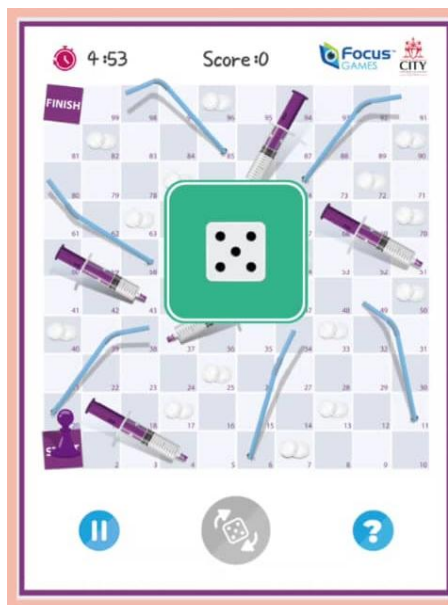


Figure 2.13 Scene when dice button clicked

Figure 2.12 displays the gameplay scene of the game, with key elements organized across the interface. At the top, a countdown timer, total score, and developer's icon are shown.

The bottom section includes essential controls such as a pause button, a dice button for rolling, and a help button showing rule as Figure 2.11. The main area in the middle showcases the board content: a purple chess piece representing the player, a start point, a finish point, and marked squares in alternating shades of grey for better visibility. Additionally, there are special squares that provide extra score points, ladders depicted by straws, and a syringe symbol representing a slide, similar to the snake in a traditional Snakes and Ladders game. In Figure 2.13, the scene shows the dice after the player clicks the dice button, displaying a randomly rolled number. The player's piece moves forward based on the number of steps rolled, adding a level of chance to the gameplay as they progress toward the finish line.

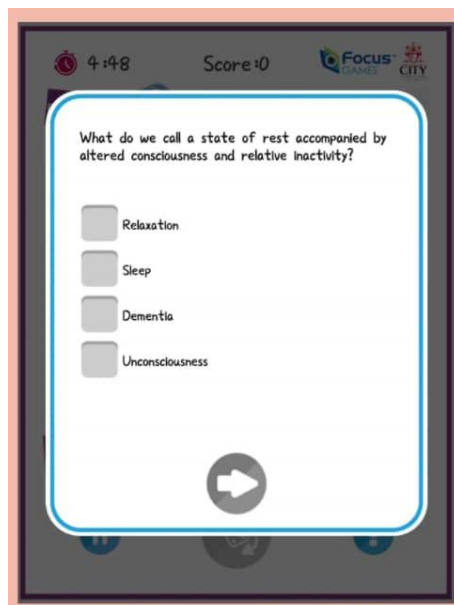


Figure 2.14 Single-choice question displayed after player moved



Figure 2.15 Result when wrong answer selected

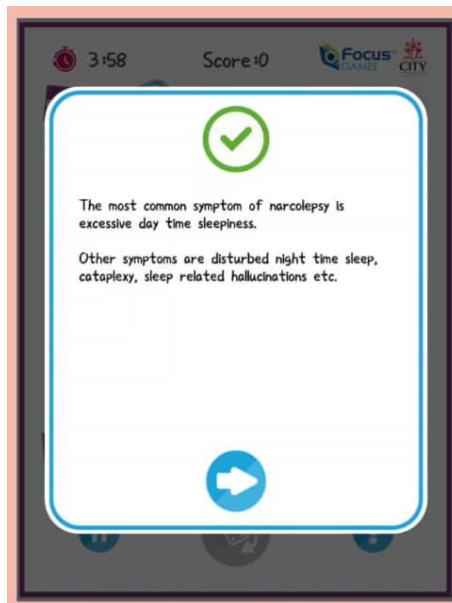


Figure 2.16 Result when correct answer selected

After the player's piece moves, a single-choice question related to medication and drug knowledge appears on the screen, as shown in Figure 2.14. The player must select the correct answer and then click the "Next" button. Since the countdown timer continues during the question phase, players must answer quickly to maximize their chances of finishing the game before time runs out. This setup challenges the player's knowledge, leaving no room for overthinking. Depending on the answer, different outcomes occur: if the player selects the wrong answer, player's score point remain the same, a red cross icon and an explanation appear,

as shown in Figure 2.15. If the answer is correct, Figure 2.16 shows a confirmation message and explanation, and the player earns score points. The player can then click the "Next" button to continue the gameplay.

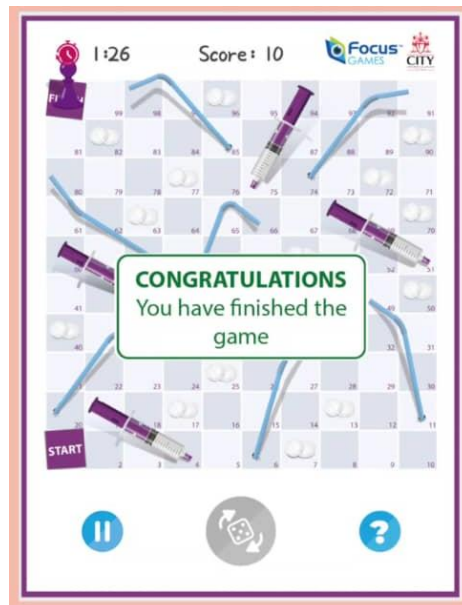


Figure 2.17 Player reaches the finish point

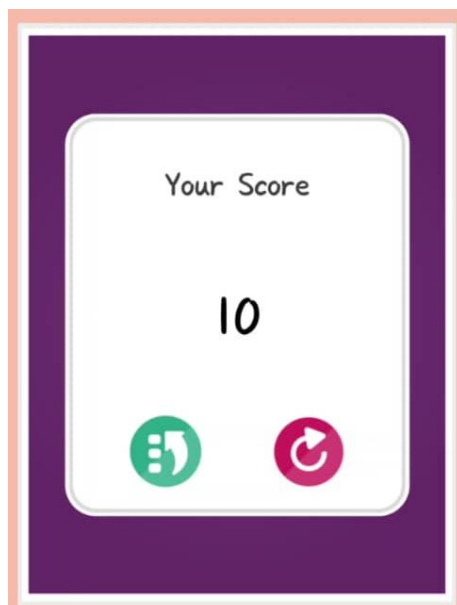


Figure 2.18 Player score points for the game

After the player reaches the finish point, a firework effect is triggered, following by a celebratory notification, as shown in Figure 2.17. Players can click anywhere on the screen to proceed. However, if the player does not reach the finish point within the time limit, they are directed to Figure 2.18, which displays their total score. From here, players can either return to

the title page (Figure 2.10) by clicking the left button or replay the game using the button on the right.

2.3.2 Anato Trivia – Quiz Anatomy

Anato Trivia – Quiz Anatomy is a game launched by Tarter Studio in 2020 and built using the Unity Engine. The quiz game focused on human anatomy, available on both the Google Play Store and the App Store. It allows players to expand their knowledge about various aspects of human anatomy through interactive questions, making it a valuable educational tool. Although the game does not specify a particular target demographic, it is rated as suitable for all age groups on the Google Play Store, suggesting its accessibility for a broad audience interested in learning about the human body.

The game does not include background music but has a variety of sound effects, such as for the countdown, clicking, and when players answer correctly or incorrectly. These sound effects give immediate feedback, creating a dynamic and interactive gaming experience for players. The use of distinct audio cues adds to the intensity and enjoyment of the gameplay, ensuring players remain attentive and motivated.



Figure 2.19 Title scene of Anato Trivia

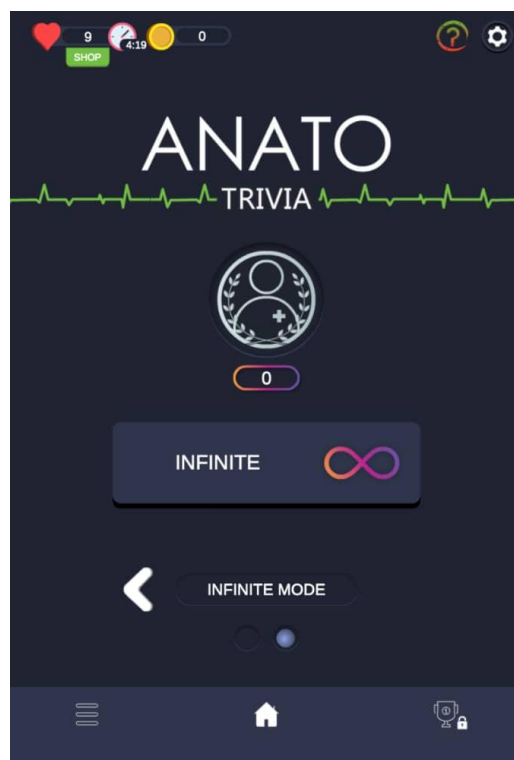
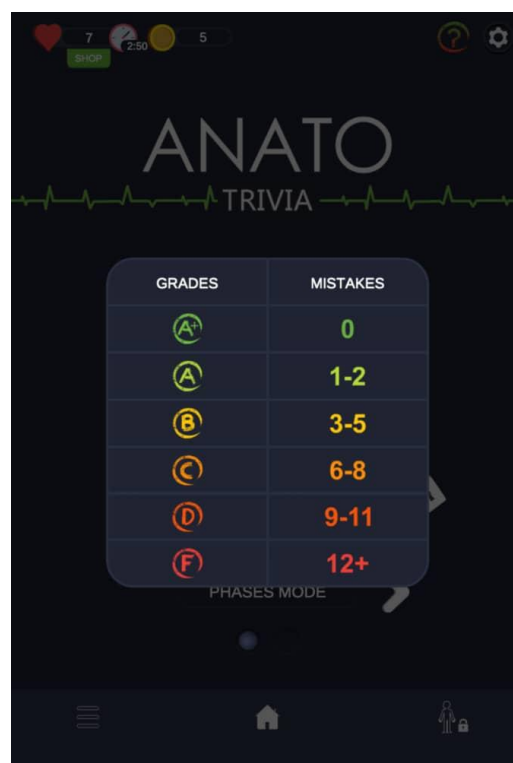


Figure 2.20 Infinite mode of Anato Trivia

Figure 2.19 displays the title screen of Anato Trivia. At the top, players can view their health, accumulated coins, a question button that opens the game's grading standards (Figure 2.21), and a settings button. Below, the game title is plainly displayed. Players have two

primary options: they can choose to answer questions from the osteo-muscular category (such as skull, sacrum, lumbar vertebrae) or topographic anatomy (such as heart, spleen, trachea). A button on the right provides access to infinite mode (Figure 2.20), where players can tackle questions created by other users. Each attempt in infinite mode costs one health point, challenging players to achieve a high score.

In the bottom section, both phases mode (Figure 2.19) and infinite mode (Figure 2.20) have a hamburger menu button and a home button for easy navigation. In phases mode, the right side displays the anatomy sections unlocked as players progress (Figure 2.27). In contrast, in infinite mode, the right side features a button for checking player rankings (Figure 2.30). This title scene design effectively maximizes screen space on user devices, creating a comfortable and engaging gameplay experience.



GRADES	MISTAKES
A ⁺	0
A	1-2
B	3-5
C	6-8
D	9-11
F	12+

PHASES MODE

Figure 2.21 Grades of Anato Trivia

Figure 2.21 shows the grading standards for phases mode in Anato Trivia. Players are encouraged to minimize errors throughout gameplay, as fewer mistakes lead to higher grades. This grading system encourage accuracy, pushing players to improve their knowledge retention

and precision when answering questions on human anatomy.

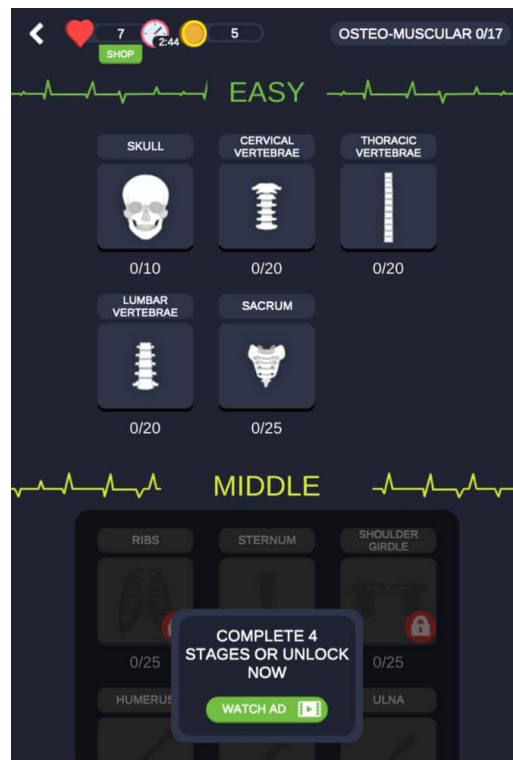


Figure 2.22 Level selection scene of osteo-muscular

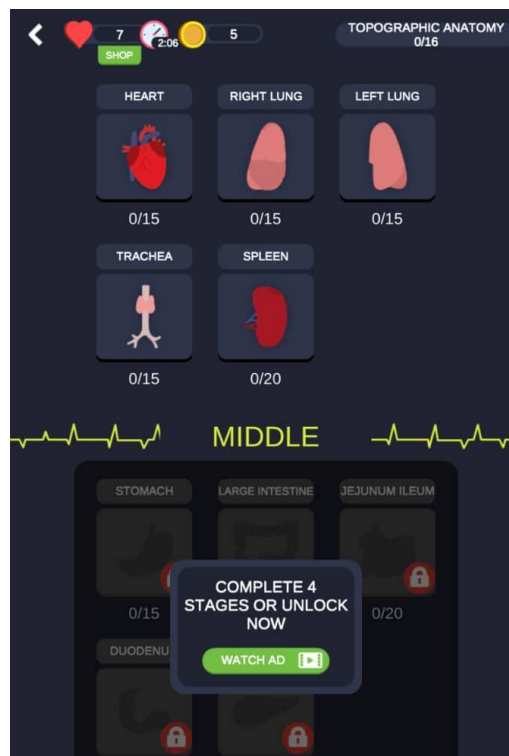


Figure 2.23 Level selection scene of topographic anatomy

Figures 2.22 and 2.23 describe the level selection screens for the Anato Trivia game's osteo-muscular and topographic anatomy categories. Each stage within these categories

features questions specific to anatomical regions or parts, helping players reinforce their knowledge systematically. To unlock topographic anatomy stages, players have the option to either watch ads or complete 10 osteo-muscular stages. Each level selection scene offers three difficulty tiers: easy, middle, and expert. Access to the next level of difficulty requires either ad viewing or completing a certain number of stages in the prior level. The stages completed are marked with grades based on the player's total mistakes, encouraging players to replay levels and improve their scores. However, the frequent interruptions from ads may negatively impact player engagement and reduce their motivation to continue playing the game.

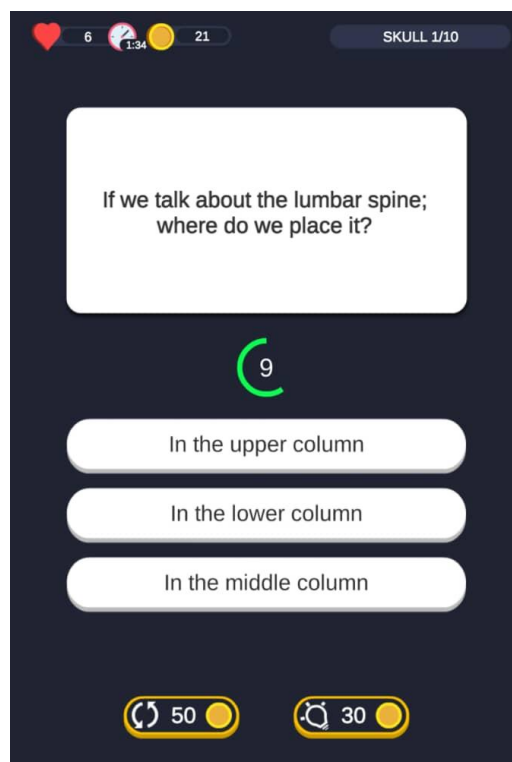


Figure 2.24 Gameplay scene of Anato Trivia

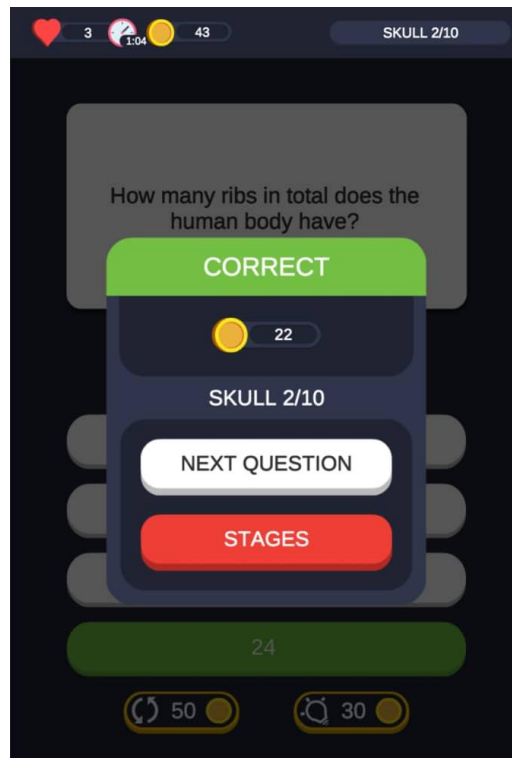


Figure 2.25 Scene if correct answer selected

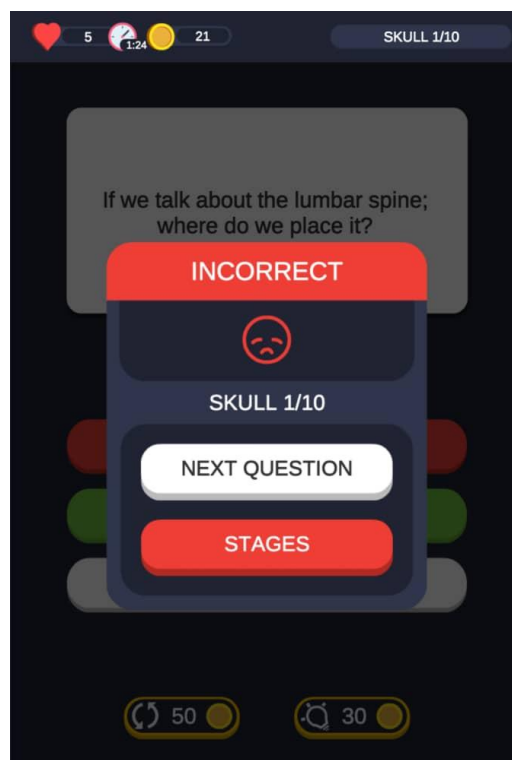


Figure 2.26 Scene if wrong answer selected

Figure 2.24 shows the gameplay section for Anato Trivia. The question is displayed prominently in the centre of the screen, allowing players to see it immediately and focus on answering without distractions. Below the question is a countdown timer, requiring players to

choose one of the four answer options within the time limit; otherwise, they fail to answer. If a player selects an incorrect answer, a notification appears (Figure 2.26), and one health point is deducted as a penalty before proceeding to the next stage. Correct answers reward players with coins (Figure 2.25), which can be used during gameplay to generate new questions or obtain hints.



Figure 2.27 Anatomy unlocked once stage passed

Once a player completes a stage, a new body part within the anatomy section is unlocked. For instance, as shown in Figure 2.27, passing the skull stage unlocks the skull in the anatomical view. A fraction on the left displays the number of unlocked parts relative to the total available. The right-side features three buttons that allow the player to filter the view by bones, organs, or both. This section serves as an achievement tracker, enabling players to visualize their progress while simultaneously offering an interactive way to learn human anatomy through images.

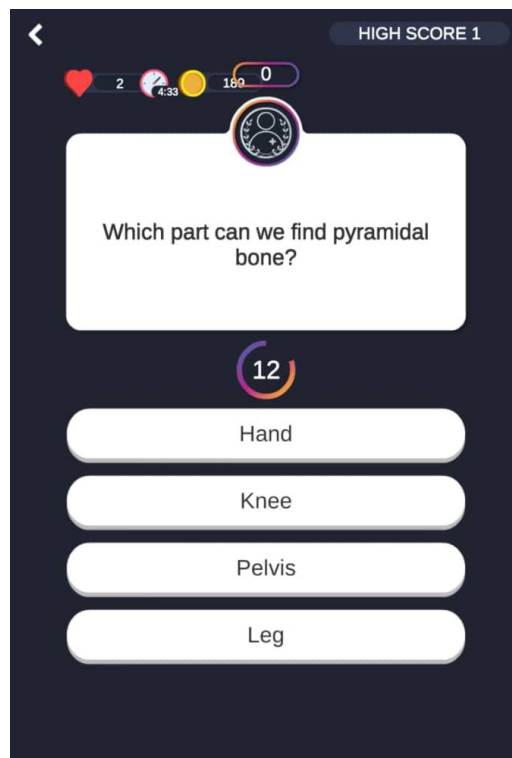


Figure 2.28 Anatomy unlocked once topic passed

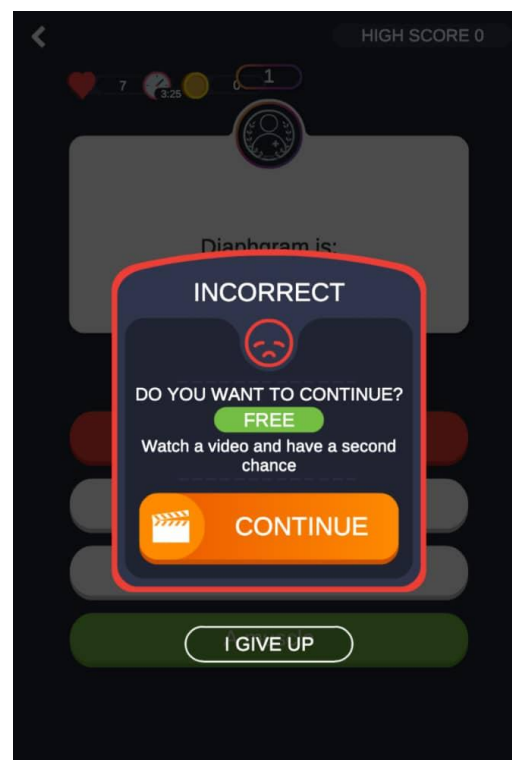


Figure 2.29 Anatomy unlocked once topic passed

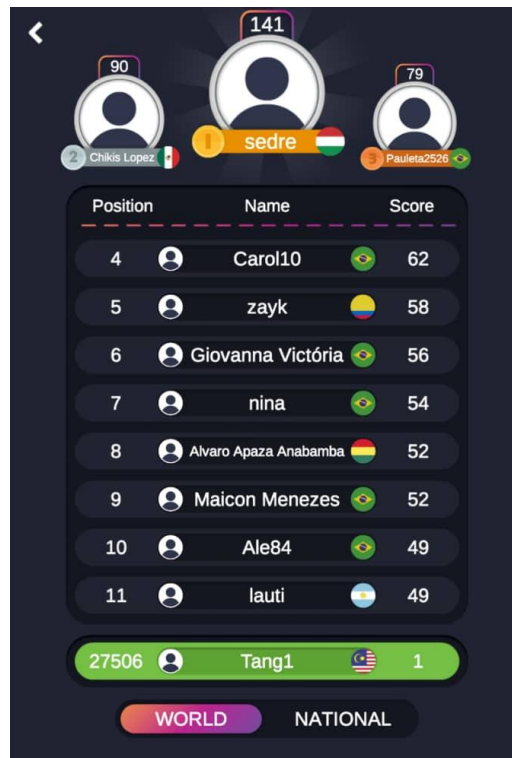


Figure 2.30 Anatomy unlocked once topic passed

Figure 2.28 shows the gameplay scene of infinite mode. In this mode, players answer questions created by other users with only a single health point, challenging their knowledge of anatomy. This mode raises the level of challenge by allowing no room for mistakes. To maintain the quality and relevance of the questions, the game also provides a review system where players can evaluate and ensure that submitted questions are appropriate and topic related.

Figure 2.29 displays the scene where players fail to answer a question correctly. They are offered a second chance if they watch an advertisement; otherwise, they must exit the stage. Once players complete the mode, they can view their rankings, either globally or nationally, as shown in Figure 2.30. This feature adds a competitive element, motivating players to improve their scores and compare their performance with others.

2.3.3 Anatomy Game

Anatomy Game is a mobile game developed by Habapps (2019), available on both Google Play Store and App Store. It allows players to improve their general anatomy

knowledge through a question-and-answer format, supported by images. Although the game does not specify its target audience, it is rated as suitable for all age groups on Google Play Store.



Figure 2.31 Title scene of *Anatomy Game*

Figure 2.31 shows the title scene of *Anatomy Game*, where the interface reveals a design flaw: the screen is not fully utilized, leaving empty spaces at the top and bottom. This issue suggests a lack of optimization for different device sizes.

At the top of the screen, there is a setting button allowing players to toggle sound effects on or off, and an option to delete game progress and restart. However, despite providing an option for sound control, the game only features minimal sound effects, with the sole sound occurring when players answer questions correctly. This limited use of sound might affect the overall user experience, as audio feedback is often key to keeping players engaged.

Beside the settings button in *Anatomy Game* is the game title and a purchase button, which allows players to unlock additional features, such as the option to translate the game into Latin. Below the title, the total score of the player is displayed. The game is organized into various categories, including organs, bones, muscles, and the circulatory system. Each category includes a fraction score that represents the player's progress, helping to track improvement as

they move through the content.

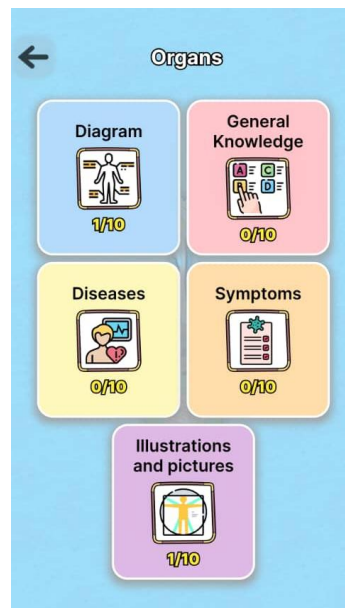


Figure 2.32 Mode selection scene of Anatomy Game

Once the player selects a category in the title scene, they are taken to the mode selection screen (Figure 2.32). The game offers five different play modes: diagram, general knowledge, diseases, symptoms, and illustrations and pictures. Each mode has a varying number of questions depending on the category selected, providing players with a diverse range of ways to test and expand their anatomical knowledge.

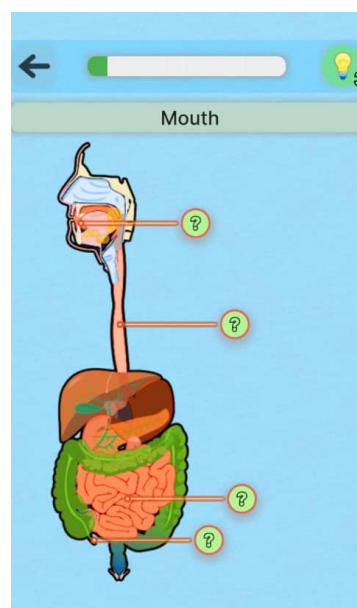


Figure 2.33 Diagram gameplay scene

Figure 2.33 displays the diagram gameplay scene. In this mode, the player is tasked

with selecting the correct body part from the given options based on its name. If the player answers incorrectly, the question is reshuffled with other unanswered questions. This visualization helps players recognize body parts through images, reinforcing anatomical knowledge and aiding in visual learning.

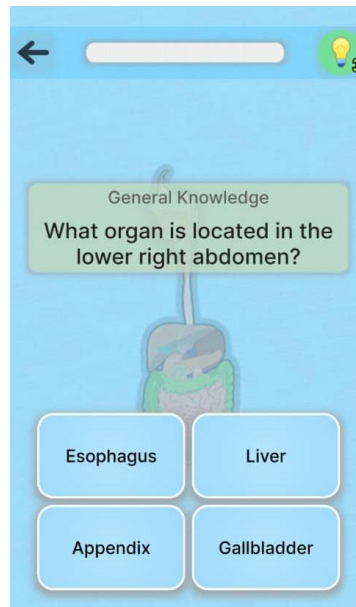


Figure 2.34 General knowledge gameplay scene

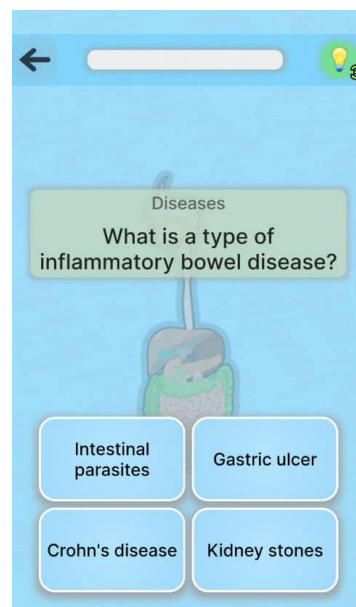


Figure 2.35 Diseases gameplay scene

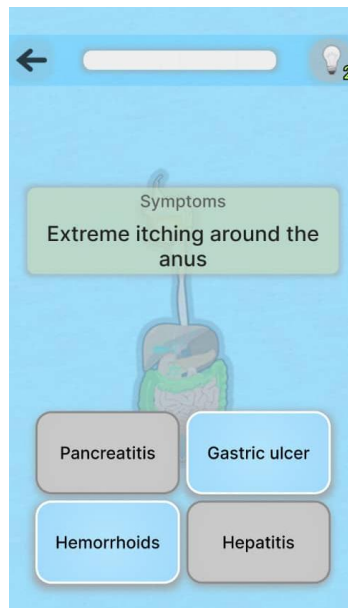


Figure 2.36 Symptoms gameplay scene

Figures 2.34, 2.35, and 2.36 represent gameplay scenes for the general knowledge, diseases, and symptoms categories, respectively. In all three modes, the gameplay mechanics are similar: the player must choose the correct answer from four options. Additionally, players can click on the bulb button to request a hint. When they do, the game removes two incorrect answers from the choices, making it easier for players to answer correctly. These mechanics are designed to help players learn by reinforcing their knowledge and providing a way to get guidance when they are uncertain.

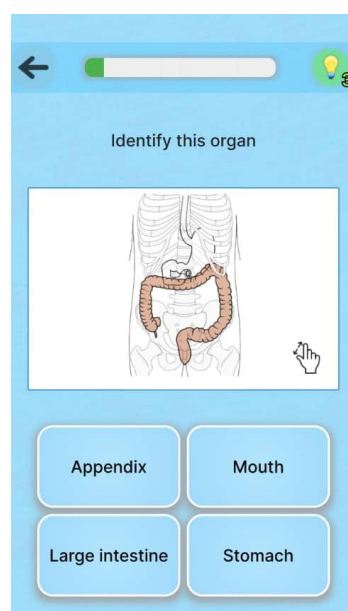


Figure 2.37 Illustrations and pictures gameplay scene

The illustrations and pictures gameplay mode, as shown in Figure 2.37, follows a similar structure to the general knowledge, diseases, and symptoms modes. However, this mode includes an additional visual element: an image related to the question. This visual aid to boost the learning experience of player through a more tangible, visual connection.

Once the player completes a game section, they are redirected to the mode selection scene. However, the game does not provide any form of celebration or reward to acknowledge the player's achievement for finishing the section. This could be a missed opportunity for engagement, as celebratory elements, such as animations or positive feedback, are commonly used in games to motivate players and enhance their sense of accomplishment.

2.4 Comparison between Related Works and Existing Games with the Proposed Game

This section provides a comparison between the proposed game and three related works, as well as three existing games. Table 2.1 compares the three related works with the proposed game across several aspects: related topics, target users, methodology and sample size. Meanwhile, Table 2.2 compares the three existing games with the proposed game based on related topics, game types, languages, and platforms.

Paper Title	Game	Author	Year	Topic(s)	Target users	Methodology	Sample size
Designing a mobile serious game for raising awareness of diabetic children	Qatar Diabetes Game	Moosa, Al-Maadeed, Saleh, Al-Maadeed & Aljaam	2020	Diabetes, Serious games	Children	User-centered design	20
AntibioGame®: A serious game for teaching medical students about antibiotic use	AntibioGame®	Tsopra, Courtine, Sedki, Eap, Cabal, Cohen, Bouchaud, Mechaï & Lamy	2020	Antibiotic use, Serious games	Medical students	Unspecified	57
Investigating the Use of a Serious Game to Improve Opioid Safety Awareness Among Adolescents: Quantitative Study	MedSMART: Adventures in PharmaCity	Abraham, Rosenberger, Tierney & Birstler	2021	Opioid knowledge, Serious games	Adolescents	Unspecified	117
MedGuard: Game-based Learning Approach for Quality Use of Medicine	MedGuard	Anderson Tang Kee Hiit	2024	Quality use of medicine, Serious games	Children	Agile	30

Table 2.1 Comparison between related works and the proposed game

Qatar Diabetes Game, AntibioGame, MedSMART: Adventures in PharmaCity, and MedGuard all share the common goal of educating users about medication-related knowledge, but each game focuses on different topics and target audiences. The Qatar Diabetes Game is designed to educate children about diabetes, helping them understand the condition and encouraging healthier lifestyle choices. AntibioGame is aimed at teaching medical students the appropriate use of antibiotics in primary care, using realistic examples provided by medical experts. MedSMART: Adventures in PharmaCity focuses on educating adolescents about opioid safety, teaching them how to handle opioid medications responsibly. MedGuard, the proposed game, will focus on the quality use of medicine, aiming to educate children on safely managing medications and improving overall medication safety.

Qatar Diabetes Game uses a user-centered design (UCD) methodology, which ensures that users' needs and preferences are prioritized throughout the design process. This approach helps create a more intuitive and engaging game, improving its educational effectiveness. By involving users from the very beginning, the game is tailored to the target audience, ensuring it aligns with their needs. In contrast, AntibioGame and MedSMART: Adventures in PharmaCity do not explicitly specify the methodologies used in their development, making them harder to be replicated. For MedGuard, the game will utilize an Agile methodology. Agile is a flexible, iterative development process that encourages constant feedback and continuous improvement. The flexibility of Agile allows the developer to adapt the game based on player feedback, testing results, and evolving educational objectives. As highlighted by Al-Saqqa, Sawalha, and Abdelnabi (2020), Agile's focus on rapid iterations and responsiveness to change makes it especially beneficial for educational games like MedGuard. It ensures that the game can be refined and updated regularly, based on real-time user interactions and feedback, improving its effectiveness in teaching the intended concepts of quality use of medicine.

In the studies referenced, the sample sizes for different games vary: Qatar Diabetes

Game used a sample size of 20, AntibioGame had 57, and MedSMART: Adventures in PharmaCity utilized 117 participants. For the proposed MedGuard game, a sample size of 30 participants is planned, with 15 participants in the experimental group (who will play the game) and 15 in the control group (who will not play the game). This sample size is chosen to ensure that the results are statistically significant, offering enough data to analyse the effectiveness of the game in improving the knowledge of the participants about the quality use of medicine.

Game Title	Developer	Topic(s)	Type(s)	Language(s)	Platform(s)
Drug Round	Focus Games Ltd	Medication errors, drug calculations	Board, Quiz, Educational	English	iOS, Android
Anatomy Trivia – Quiz Anatomy	Tarter Studio	Human anatomy	Quiz, Educational	English, Portuguese and Spanish	iOS, Android
Anatomy Game	Habapps	Human anatomy	Quiz, Educational	English and Latin	iOS, Android
MedGuard	Anderson Tang Kee Hiit	Quality use of medicine, Serious games	Educational	English and Bahasa Melayu	HTML5

Table 2.2 Comparison between existing games and the proposed game

Drug Round, Anato Trivia – Quiz Anatomy, and Anatomy Game are existing games utilizing game-based learning approach to teach medication knowledge to players. Drug Round is designed to raise awareness about medication errors and drug calculations, with the primary goal of helping players learn how to avoid mistakes in medication administration. Anato Trivia – Quiz Anatomy focuses on improving knowledge of human anatomy through quiz-based interactions, helping players learn about various body parts and their functions. Anatomy Game also use similar quiz-based mechanics to teaches human anatomy. The proposed game, MedGuard, like the other games, it will take the form of a educational game, with the goal of improving players' understanding of quality use of medicine.

All three games, Drug Round, Anato Trivia – Quiz Anatomy, and Anatomy Game, are available in English. Additionally, Anato Trivia offers extra language support in Portuguese and Spanish, while Anatomy Game allows players to unlock a Latin version through in-app purchases. The choice of English as the primary language aligns with its role as a global lingua franca, enabling developers to reach the widest possible audience without the need for multiple language versions at launch. The proposed game, *MedGuard*, will use English as the primary language and Bahasa Melayu as the secondary language. This decision aims to maximize the potential player base in Malaysia while also ensuring that children can easily understand the content in their native language.

The games are available on both iOS and Android platforms, which are widely used across the globe. This provides flexibility and allows the games to reach a large audience. However, the proposed game, MedGuard, will be developed using HTML5. The primary reasons for this choice are its platform independence and low performance requirements. HTML5 games do not rely on specific hardware or operating systems, enabling users to access the game even on low-end devices. Additionally, HTML5 games are easily shareable via a URL, which simplifies access and broadens the potential audience. This removes the need for

installation, lowering the entry barrier for players and enhancing accessibility.

2.5 Brief Overview of Proposed Game

The proposed game, MedGuard, will be a 2D educational game specifically designed for children. The game will be developed using Unity and will be published on itch.io. The game will select English and Bahasa Melayu to ensure accessibility to the majority of children in Malaysia. The focus of the game will be on teaching the "five rights" (5R) of medication administration—right patient, right medicine, right dose, right route, and right time. These critical concepts will be presented in an interactive and visually appealing format to help children understand the importance of safe medication practices. By combining engaging visuals with an educational approach, the game can make the learning process enjoyable for children while fostering a foundational understanding of the quality use of medicines.

2.6 Summary

In summary, this chapter examines various research studies and games that employed game-based learning approach. Comparison tables of the studies and games have been created to assess their strengths and limitations. The proposed game will incorporate key features from the existing games to improve its design and enhance its educational impact.

CHAPTER 3: METHODOLOGY

3.1 Introduction

The methodology applied in this project is the Agile methodology. Agile methodology is defined by core principles like iterative development, ongoing feedback, and flexible planning (Ibeh, et. al., 2024). These principles make agile highly suited for projects where requirements and objectives may evolve over time. One of agile methodology's key characteristics is the ability to adapt to changes effectively, even in later stages of development (Al-Saqqa, Sawalha, & Abdelnabi, 2020). Through iterative development, agile facilitates continuous improvement by breaking the project into manageable phases, allowing for adjustments at every stage. Agile's adaptability can minimize the impact of unforeseen changes on timeline, making it particularly suitable for projects that require continuous refinement based on feedback.

Overall, agile methodology provides a structured yet flexible framework for development. Its flexibility makes it particularly suitable for the dynamic and innovative demands of game development, where refinement and responsiveness to feedback are crucial for success.

3.2 Agile Methodology

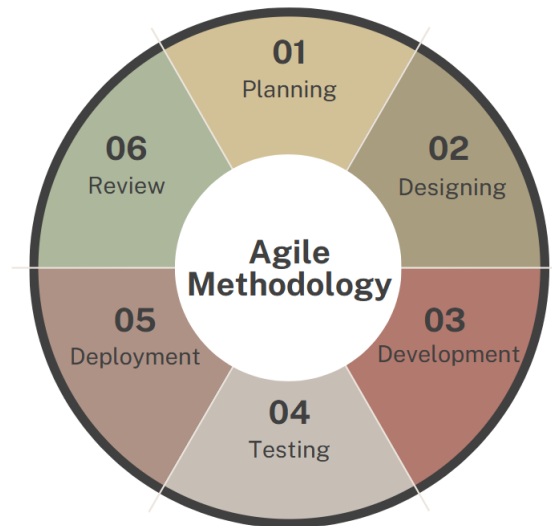


Figure 3.1 Agile Development Methodology

Based on Figure 3.1, the agile development methodology consists of six phases: planning, designing, development, testing, deployment, and review. In the "planning" phase, requirements will be gathered through interview session with pharmacist from Klinik Kesihatan Petra Jaya. The "designing" phase will focus on building the game's overall structure, including creating a wireframe to show how the game will look and work. The "developing" phase will involve coding the game mechanics, adding visuals and audio, and ensuring all functionalities align with the specified requirements. In the "testing" phase, the game's functionality will be tested to ensure it runs smoothly and user experience testing will be conducted to get feedback from target users. The "deployment" phase will ensure the game is accessible to users. Finally, in the "review" phase, the game's overall success will be evaluated and look at how well it met its goals.

3.2.1 Planning

The planning phase focuses on setting a clear direction while identifying specific requirements and features for the project. An interview session was conducted with a pharmacist from Klinik Kesihatan Petra Jaya. The interview was carried out via email in a question-and-answer format. Through this process, the pharmacist shared her experiences and insight regarding children's medication use. The session aimed to identify common and

recurring issues in real case scenarios, and ensure the game's design aligns with practical, real-world needs. This approach establishes a shared understanding of the project's vision, fostering the development of a more successful and engaging gaming experience.

3.2.2 Interview

An interview session was conducted with a pharmacist from Klinik Kesihatan Petra Jaya, Kuching. This session provided an opportunity to uncover real-life experiences and gain valuable insights into medication practices. Beyond data collection, the interview allowed for a deeper exploration of practical challenges and best practices related to children's medication safety. It highlighted that medication use is not merely a clinical task but a crucial aspect of promoting health and well-being. The consent form is included in Appendix B, while the questions and transcripts from the interview can be found in Appendix C for reference.

The interview session started with a discussion about the most common scenarios in which children are prescribed medications. The interviewee highlighted acute illnesses like the common cold, eczema, asthma, and diarrhoea/vomiting as the primary conditions. The interview shifted to discussing key challenges in children's medication-taking habits. The interviewee mentioned that the key issue with children's medication-taking habits revolves around adherence to the prescribed regimen. It is crucial for children not to self-medicate or take medications without parental supervision. She further emphasized the importance of encouraging a better understanding in children about the benefits of taking their prescribed medications to improve adherence and ensure proper medication use over time. Even though some medicines may be bitter or unpalatable, prescribed medications are given for a reason, and it is crucial for children to take them for their health benefits and swift recovery.

The interview moved on to discussing common misunderstandings about medication use and cultural factors influencing medication safety. The interviewee highlighted common misunderstandings, such as parents' concerns about side effects, antibiotic resistance, and the

belief that healthy lifestyles or herbal remedies can replace medication. Some parents also self-discontinue treatment when they don't see immediate benefits. However, these actions may cause more harm than benefit to their children. The interview also delved into cultural or regional factors that might influence how children or their parents approach medication safety. One concern raised was the source of ingredients used in medications, particularly whether they are derived from bovine or porcine sources. This is a significant issue for some families due to cultural or religious beliefs.

For the final question of the interview session, the interviewee shared her insights on medication knowledge that should be prioritized. This includes the 5R principles, correct medication storage, education of medication generic names and the importance of avoiding self-purchase of medications from unreliable sources. She particularly emphasized the risks of purchasing medications from unreliable resources, as this could cause potential harm to patients.

Overall, this interview provided a rich understanding of children's medication safety within interviewee's experience. The insights gained will be instrumental in shaping the educational content of the game, allowing the game to be more relevant and sensitive to diverse audiences.

3.2.3 Features of the Proposed Game

The proposed game integrates several essential elements, aim at improving player engagement when playing the game. The following features will be included during the gameplay to create an entertaining and educational gaming environment:

- i. Level progression

The game features multiple levels, each presenting a unique story and set of challenges.

This can provide players engaging experience as they progress through the game.

- ii. Quest and task system

Players will be guided by a task system throughout the gameplay. This can ensure that they have a clear understanding of the next steps to take.

iii. Instant feedback

Instant feedback will be provided once player make the right choice according to “5R” principle. This can help to reinforce the principles, ensuring that players retain the information effectively.

iv. “5R” concept of medication administration

Educational content of “5R” principles will be added into the gameplay, allowing players to learn and apply these principles through interactive tasks and decisions.

3.3 Software and Hardware Requirement Specification

Developing the proposed medication education game requires both software and hardware resources. This section details the essential software tools and hardware specifications needed for the game's creation.

3.3.1 Software Requirement

Software requirements are crucial for developing the proposed game. Below is an outline of the software used throughout the development process:

i. Figma (Figma Inc., n.d.)

Figma is a collaborative interface design tool used to create wireframes and mockups. It is employed in this project to develop the game’s wireframe, providing a clear visual representation of the user interface and layout before implementation.

ii. Lucidchart (Lucid Software, n.d.)

Lucidchart is a web-based diagramming tool used for creating detailed flowcharts. It is used to design and visualize the game’s logic during the development process.

iii. Krita (KDE, 2025)

Krita is a powerful tool for digital drawing. It is used in this project to create or edit game art.

iv. Unity (Unity Software Inc., 2025)

Unity is a powerful game engine for developing 2D and 3D games. It is the core platform used to build the medication education game, including designing interactive gameplay, implementing game mechanics, and integrating visuals and animations.

v. Visual Studio Code (Microsoft, 2025)

Visual Studio Code is a lightweight code editor used for scripting and debugging in the game development process. It supports Unity's C# programming, making it essential for writing scripts to manage game logic, interactivity, and player progression.

3.3.2 Hardware Requirement

Hardware plays a crucial role in developing the proposed game. The hardware required for creating the medication education game is detailed as follows:

1. Laptop

A laptop capable of handling game development, coding tasks, and graphic design is necessary for this project. Unity, Visual Studio Code, and Krita are the primary tools used, and the laptop's specifications are outlined in Table 3.1.

Brand	Lenovo
Model	Legion 5 15IMH05H
CPU/Processor	Intel(R) Core(TM) i7-10750H CPU @ 2.60GHz 2.59 GHz
Memory	16.0 GB
Storage	1TB PCIe NVMe SSD
Display screen	15.6-inch, Lenovo Display 1920x1080

Graphic card	NVIDIA GeForce GTX 1660 Ti
Operation system	Windows 11 Home Single Language

Table 3.1 Laptop specification

3.4 Designed Proposed Game

In designing the proposed game, two key components have been taken into account: the flowchart and the storyboard. Both the components provide solid foundation for the game's structure and development.

3.4.1 Flowchart

A flowchart is a visual representation of a process or workflow, using symbols and arrows to illustrate steps and decision points. It helps in planning and organizing the sequence of actions within a system. Figure 3.2 displays the flowchart for the game, outlining its structure and logic during progression of the game.

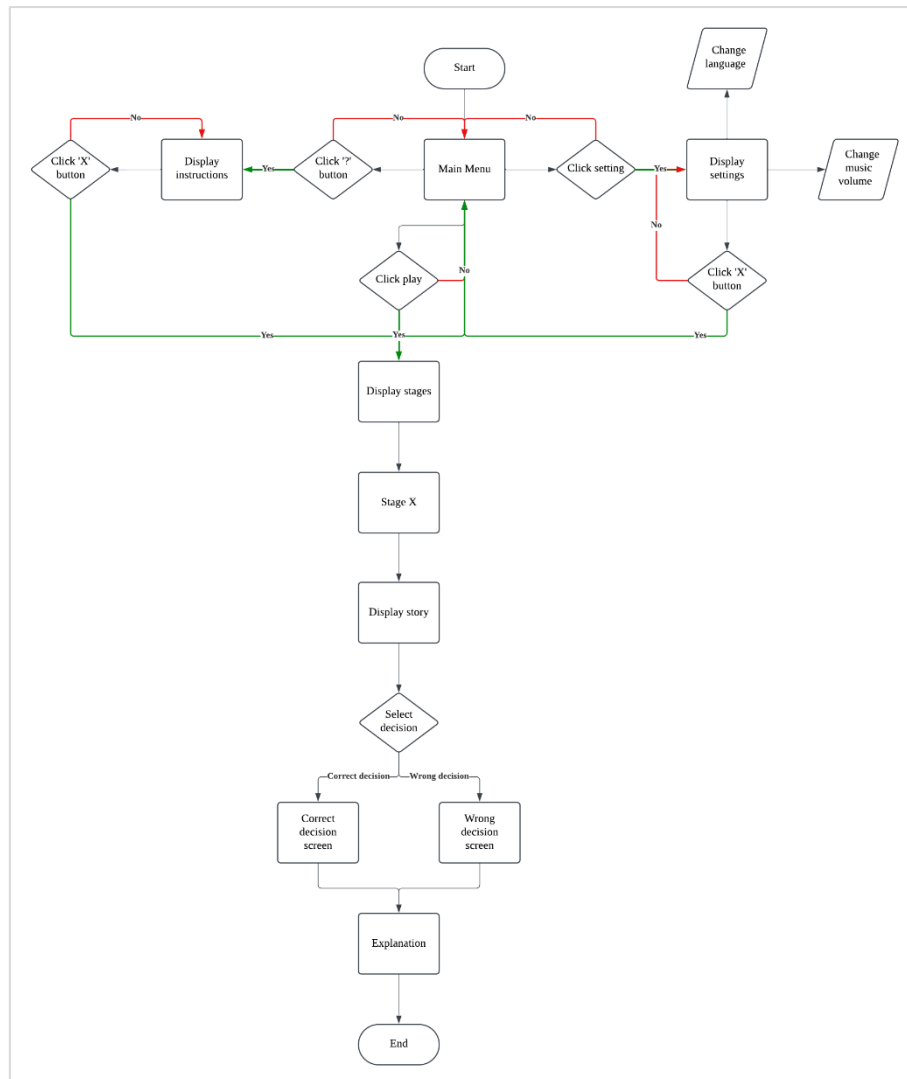


Figure 3.2 Flowchart of the game

3.4.2 Storyboard

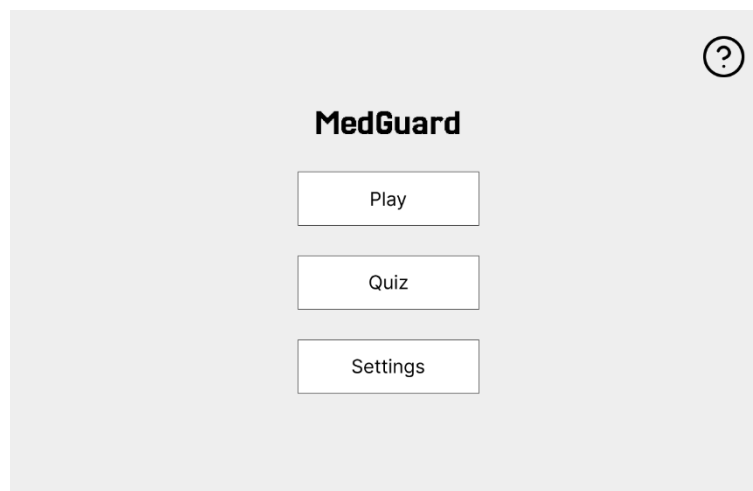


Figure 3.3 Title screen of the game

Figure 3.3 display the title screen of the game, with instruction button at top right corner,

game title at the top middle of the screen, followed by three district buttons: "Play", "Quiz", and "Settings".

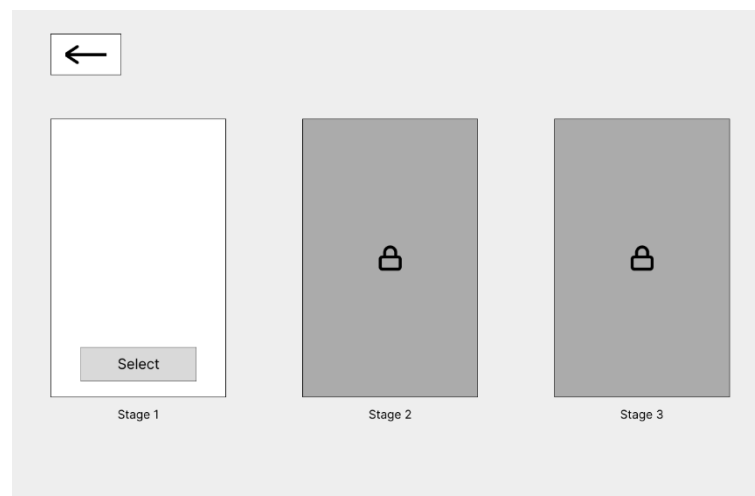


Figure 3.4 Stage selection screen

Figure 3.4 displays the stage selection screen of the game. After clicking the “Play” button on the title page, players are directed to this screen where they can choose from different stages. Each stage features an independent story that incorporates the quality use of medicine. Player can click on the stage card or the “Select” button to enter the stage. During the game, players need to make correct decisions while navigate through various scenario. Through the game, players can reinforce the importance of the *right patient*, *right medicine*, *right dose*, *right route*, and *right time* from 5R principles of medication safety in a fun and memorable way.

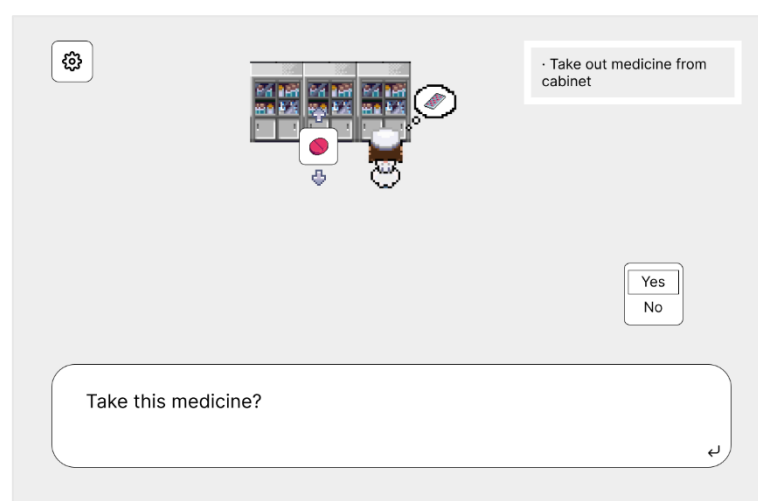


Figure 3.5 Example game scene — select correct medicine from cabinet

In Stage 1, players take on the role of an intern pharmacist tasked with distributing

medication to patients. Players will receive a prescription record and proceed to prepare the medication for the patient. To complete the task, they must select the correct medicine from the cabinet (Figure 3.5), reinforcing their understanding of accurate medicine identification and dispensing practices.

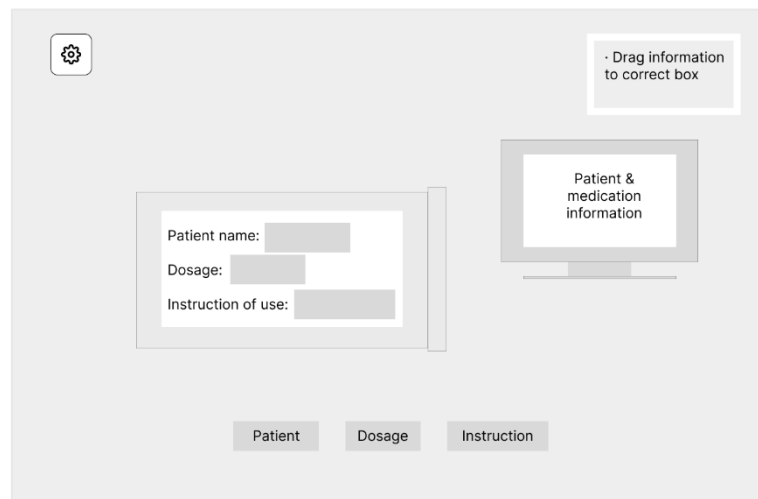


Figure 3.6 Example game scene — fill in medication label

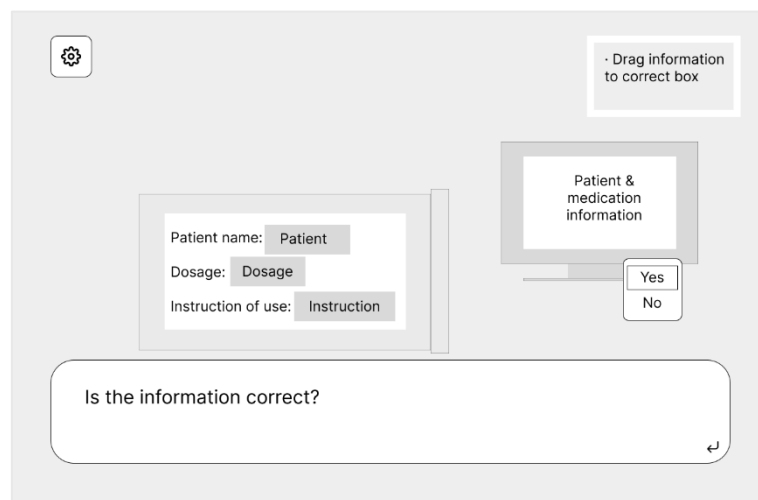


Figure 3.7 Example game scene — double check the information

After selecting the correct medicine, the player must fill in the medication label by dragging the appropriate pieces of information from the patient's record into the correct boxes (Figure 3.6). Once the puzzle is completed, a confirmation box will appear to verify the accuracy of the task (Figure 3.7). This step emphasizes the importance of precision and attention to detail in medication preparation when working as a pharmacist.

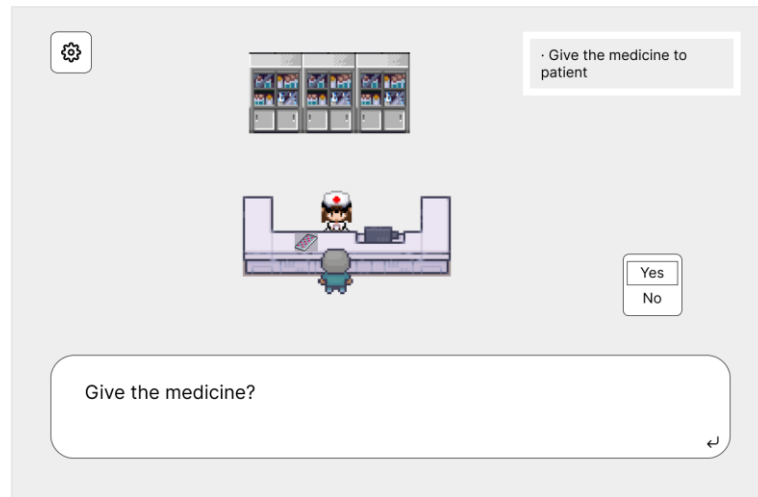


Figure 3.8 Example game scene — distribute medicine to patient

Once the prescribed medication is prepared, the player will move the character to the counter of the medicine dispensing station and call for the patient. At this step, the player must confirm that the patient is the correct one before distributing the medication. This is a crucial step to ensure the right patient receives the correct medication. Figure 3.8 shows an example of distributing medication to a patient.

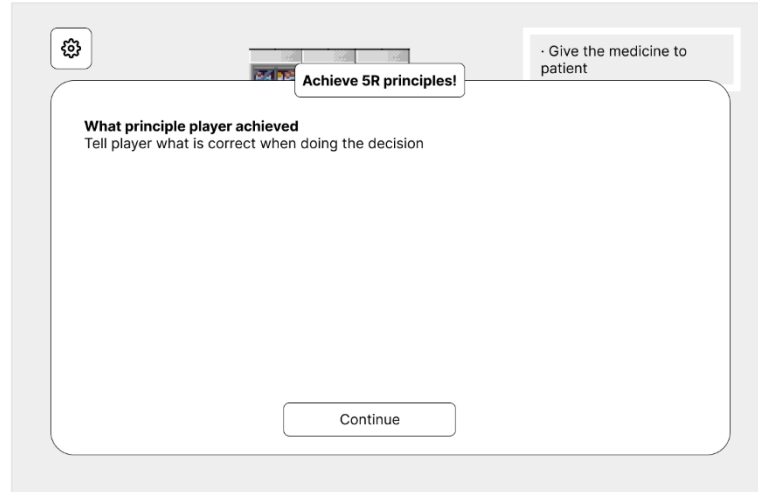


Figure 3.9 Player achieve 5R principle

If the player successfully adheres to the 5R principles during the game, a pop-up window will summarize the principle. The summary includes the selected principle, the player's correct or incorrect decisions, and explanations for why the actions were appropriate or not. For example, when the player distributes the medication to the correct patient, the pop-up will display the *right patient* principle and explain the correct action and its significance.

This feature helps players understand the correct approach to handling medication-related issues. Players can click the “Continue” button to continue the game. Figure 3.9 illustrates an example of a pop-up when a player applies one of the 5R principles in their decision-making.

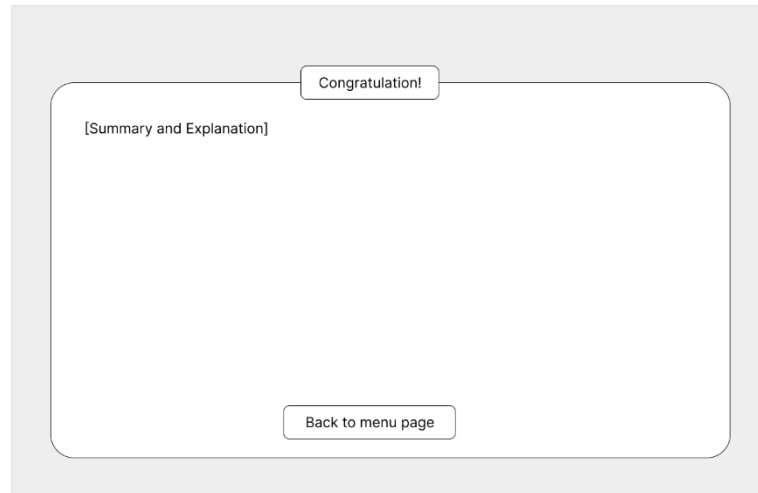


Figure 3.10 Summary of the key point

Figure 3.10 displays a summary window highlighting the key points of the stage. After completing the stage, a summary window will pop up, showing what the player learned in the game. Other than the 5R principles, the summary will include other key takeaways, such as the importance of discarding expired medications. This summary helps players remember the key lessons from the stage, ensuring players retain essential knowledge about safe medication practices. Players can click the “Back to Menu” button to return to the stage selection screen.

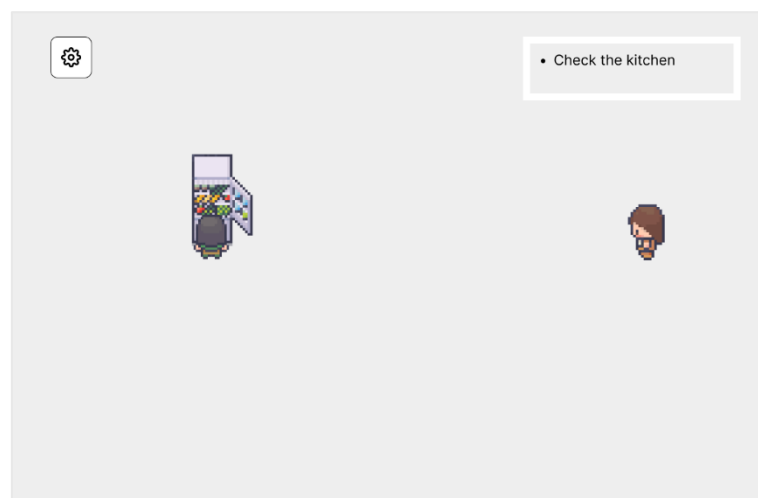


Figure 3.11 Example game scene — checking kitchen

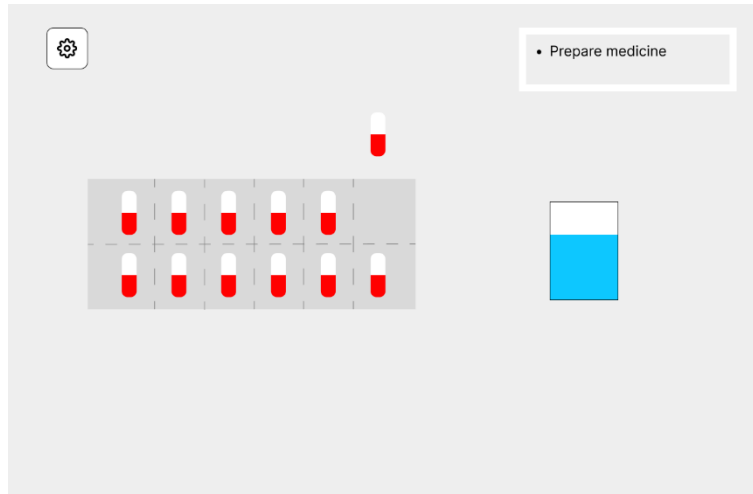


Figure 3.12 Example game scene —prepare medicine

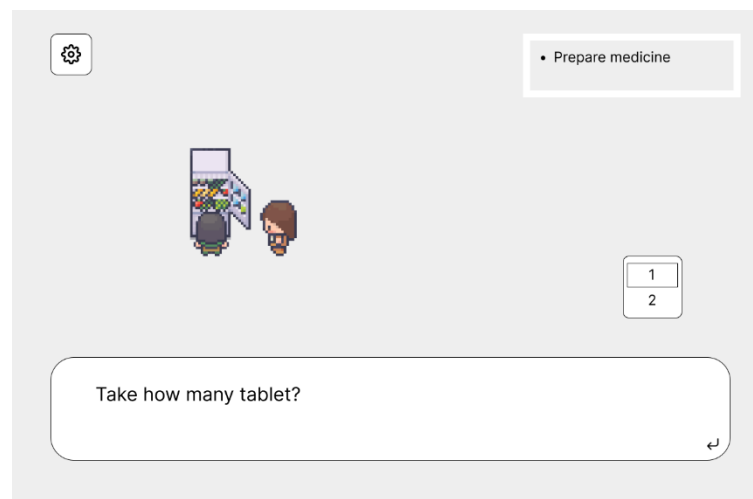


Figure 3.13 Example game scene —make decision

Figure 3.11, Figure 3.12 and Figure 3.13 represent the story of stage 2. In this stage, the player act as a mother, make decisions regarding medication safety. The game begins with the mother found out her sick daughter trying to take medicine on her own. The player must intervene to stop the child from self-medicating and then proceed to prepare the appropriate medicine for her. his scenario is designed to educate players on the importance of adult supervision when children are taking medication. A pop-up window will appear, as shown in Figure 3.9, after the player makes a decision, summarizing the values and lessons learned from the scene.

3.4.3 Development Phase

In the *Development* phase, the game is developed based on the design and requirements.

This involves coding the game mechanics, integrating visual and audio assets, and building features like interactivity and navigation. The focus of this phase is on translating ideas into a working prototype. This phase will be further explained in Chapter 4: Implementation.

3.4.4 Testing Phase

The phase following the development of the game is the *Testing* phase. This phase is crucial for ensuring that the game functions correctly and delivers a good user experience. It involves debugging, identifying and resolving performance issues, and conducting user testing to gather feedback on gameplay and educational effectiveness. Further details about this phase will be provided in Chapter 5: Testing.

3.4.5 Deployment Phase

The *Deployment* phase involves releasing the game to its intended platform, ensuring it is accessible to a broad audience. This process includes making necessary adjustments, optimizing the game for different devices or platforms, and verifying that it performs reliably across various environments.

3.4.6 Review Phase

The final phase, the *Review* phase, evaluates the success of the game after deployment. Feedback from users is collected to assess gameplay, educational value, and overall experience. This feedback serves as a guide for potential updates or improvements. Regular reviews and updates ensure the game remains engaging, effective, and aligned with users' needs, contributing to its long-term success.

3.5 Summary

In summary, Chapter 3 explores the specific design and planning elements of the proposed game, MedGuard. This chapter starts with briefing on the Agile methodology,

providing an overview of its application in the project. It also includes insights gathered through an interview session, which helped shape the game's development. The chapter then discusses the features, software, and hardware needed for the proposed game. Additionally, this chapter outlines the proposed game's features and details the design phase, including the flowchart and storyboard. These serve as the foundation for the game's structure and functionality, also providing a visual representation of the game's story and logic. Overall, this chapter provides a thorough examination into the game planning and design process, emphasizing how interactive elements and instructional content should be carefully integrated to provide a meaningful and interesting user experience.

CHAPTER 4: IMPLEMENTATION

4.1 Introduction

This chapter describes how the suggested medication education game "MedGuard" was put into practice, with an emphasis on both system implementation and design-related components. With a focus on the technical and artistic elements required to make the game come to life, the chapter details the creation of the main menu, level selection screens, and individual story levels. The visual elements utilized in the game were either made with Krita or obtained from internet sources. The game features two story-driven stages, each centered around the theme of quality use of medicine. Using Unity and Visual Studio Code, the design ideas were turned into a fully functional game during the implementation phase.

4.2 Design Related Elements

- i. Educational Content: Both stages convey educational knowledge about quality use of medicine. Each stage includes mini games designed to enhance the overall gameplay experience.
- ii. Visual Assets: Some visual elements, including game backgrounds, characters, and items, were purchased from itch.io. Certain elements were modified using Krita. Some user interface (UI) components such as homepage icon and setting icon were obtained from Flaticon and created by Freepik. Additional elements were created using ChatGPT.
- iii. Audio Assets: The game contains two background music tracks, both sourced from Pixabay. The music used for the main menu and selection scene is "Just Relax" by music_for_video. The other track, used during the game stages, is "Piano Background Music Soft" by Viacheslav Starostin.

4.3 Implementation of the system

This phase involved transforming the design elements into a functional game using Unity and Visual Studio Code. This section provides an overview of the development process for each major component of the game.

4.3.1 Loading Scene



Figure 4.1 Loading Scene of MedGuard

The loading scene features the game title, MedGuard, along with a subtitle that introduces the educational topic — the 5R concept of medication dispensing. Below the title is a loading bar, and once the animation completes, the player proceeds into the game. The bottom-left corner displays the game's release year and the author's name.

4.3.2 Main Menu



Figure 4.2 Main menu of MedGuard



Figure 4.3 Main menu in Bahasa Melayu

Figure 4.2 shows the main menu of the game. The title and subtitle are positioned on the left side of the scene. In the top-right corner, there are two buttons: one allows the player to change the game language, and the other toggles the background music on or off. Below these are three main buttons: Game, Quiz, and Credits. Figure 4.3 displays the main menu after the language has been changed to Bahasa Melayu (BM).

4.3.3 Credits

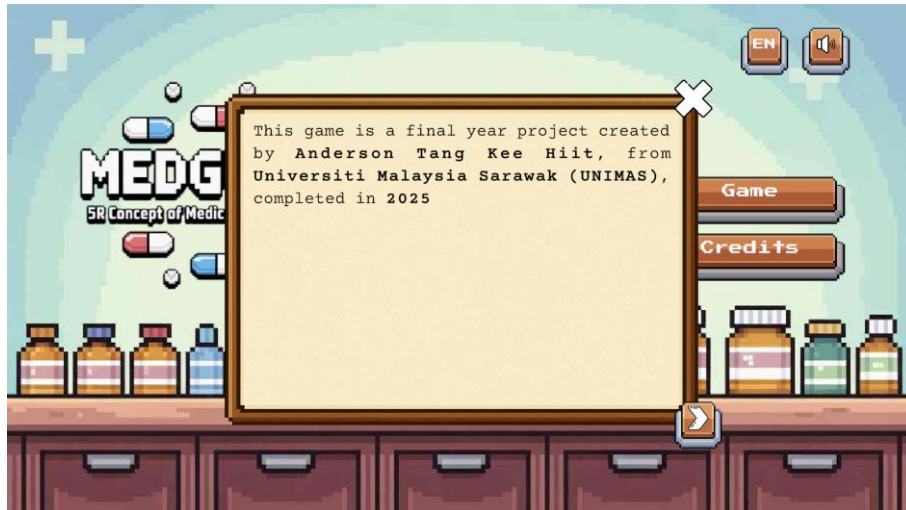


Figure 4.4 Credits first page

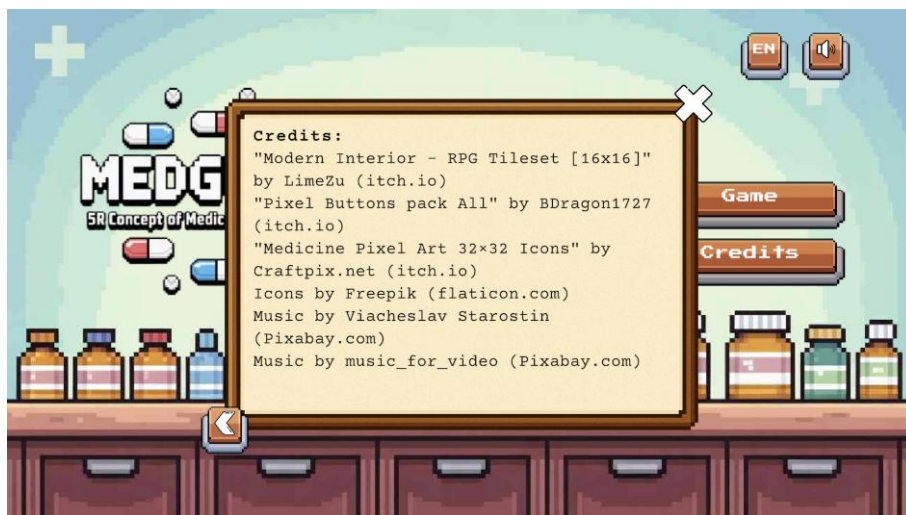


Figure 4.5 Credits second page

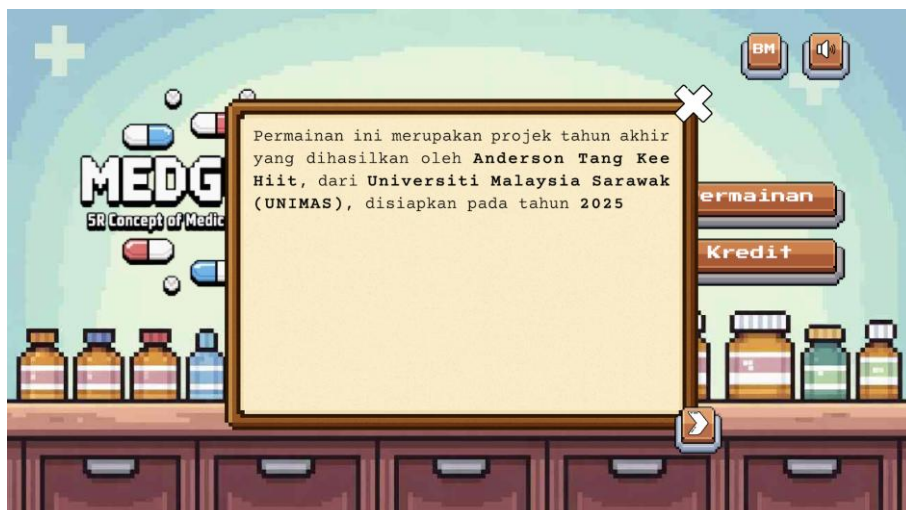


Figure 4.6 Credits first page in BM

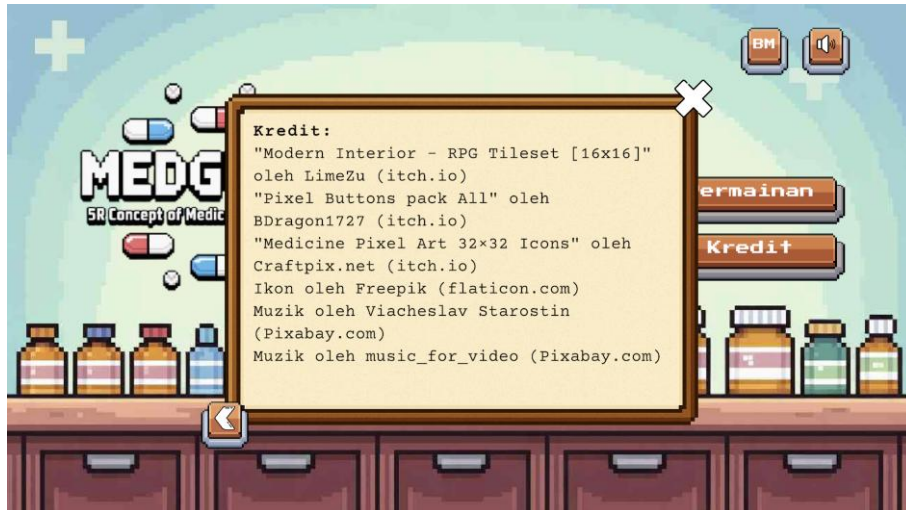


Figure 4.7 Credits second page in BM

Figure 4.4 and Figure 4.5 show the Credits panel of the game. Players can access this panel by clicking the "Credits" button on the main menu. The window initially displays the content shown in Figure 4.4. Players can switch between Figure 4.4 and Figure 4.5 using a button located in the bottom panel. The panel can be closed by clicking the "X" button in the top-right corner. Figure 4.6 and Figure 4.7 displays Credits panel in BM.

4.3.4 Stage Select Scene



Figure 4.8 Tutorial panel

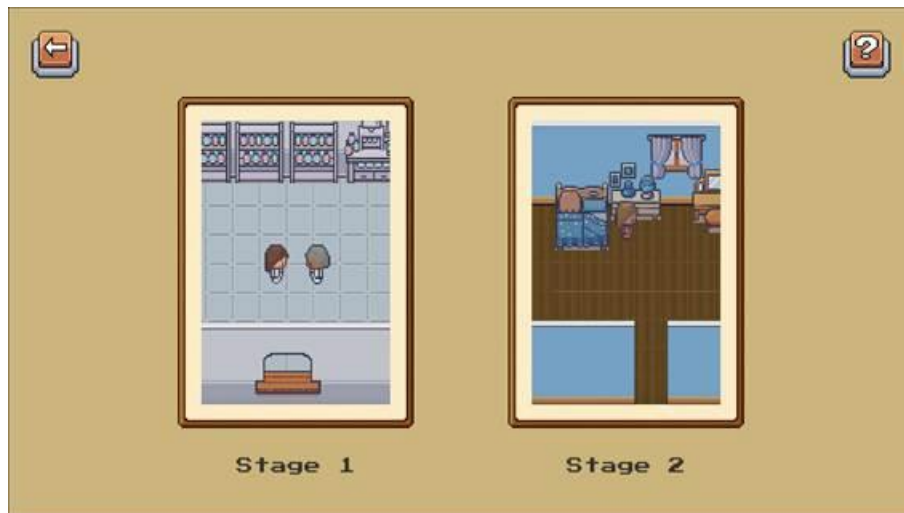


Figure 4.9 Stage selection

Players can enter the Stage Select scene by clicking the “Game” button in Figure 4.2. Upon entering this scene from the main menu, a tutorial panel will appear to guide players on how to control the game. In the game, players can use the WASD keys on the keyboard to move the character. Pressing Space continues the dialogue, while Enter is used to interact with items or NPCs. Items or NPCs that can be interacted with are marked by a question mark or exclamation mark icon. The top-right corner of the screen displays the current tasks that players need to complete.



Figure 4.10 Tutorial panel in BM



Figure 4.11 Stage selection in BM

After closing the tutorial using the “X” button, players can choose to start the story for Stage 1 or Stage 2. Players can return to the main menu by clicking the back button in the top-left corner or reopen the tutorial panel at any time by clicking the question mark icon in the top-right corner. Figure 4.10 displays the tutorial panel in BM, while Figure 4.11 shows the Stage Selection screen in BM.

4.3.5 Stage 1

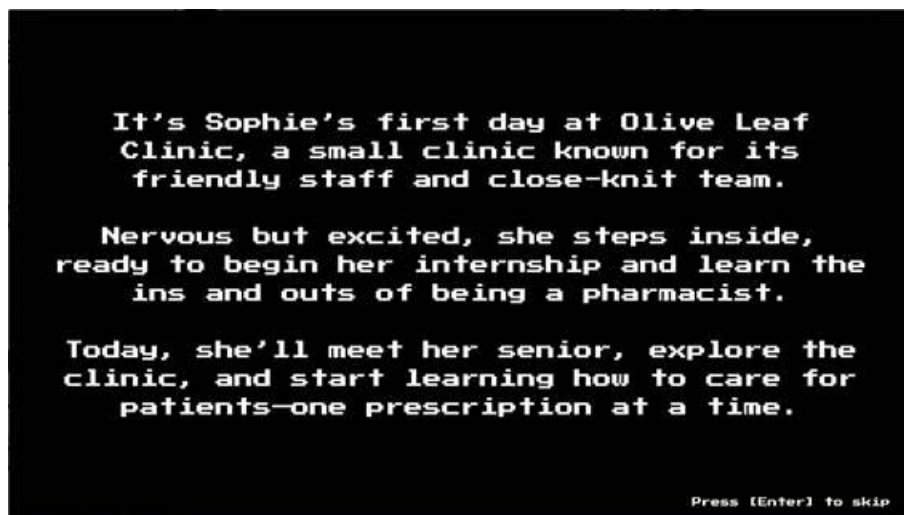


Figure 4.12 Background setting of Stage 1

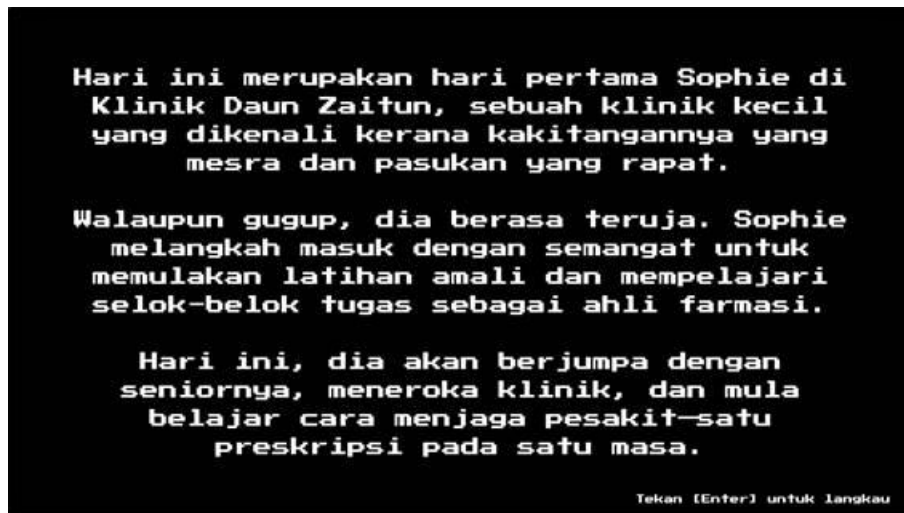


Figure 4.13 Background setting in BM

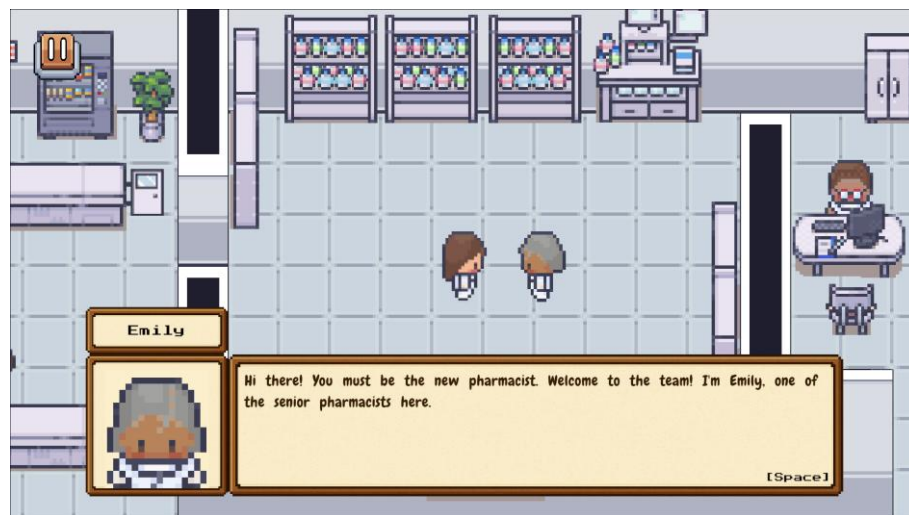


Figure 4.14 Stage 1 starts with welcome and greet from senior

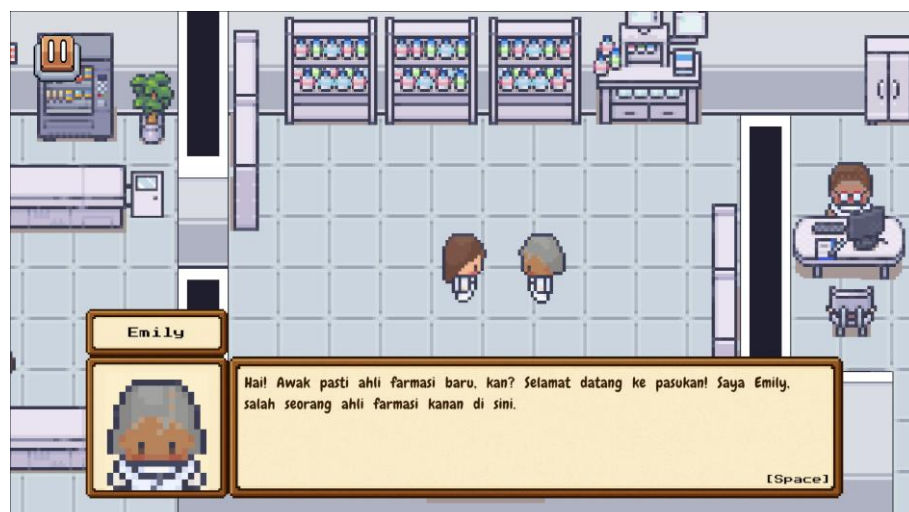


Figure 4.15 Welcome and greet in BM

Figure 4.12 displays background setting of Stage 1. In Stage 1, the main character, Sophie, is an intern pharmacist on her first day at Olive Leaf Clinic. In the story, she learns

from her senior, Emily, about the steps involved in dispensing medication to patients and putting the 5Rs of medication dispensing into practice. Figure 4.14 shows the beginning of the story, where the senior welcomes and greets the player. The dialogue box includes the name and avatar of each character, allowing players to easily identify who is speaking. Figure 4.13 and Figure 4.15 show both scene in BM.

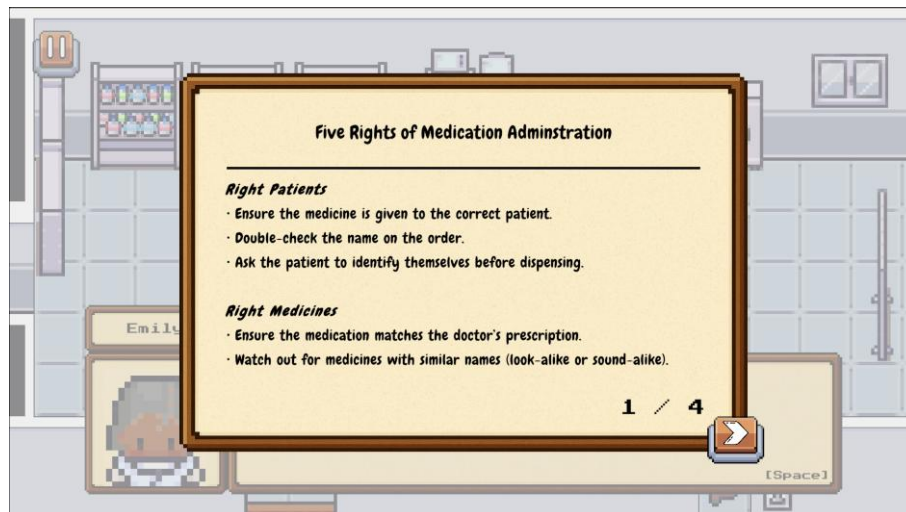


Figure 4.16 Explanation panel that displays all 5R concepts

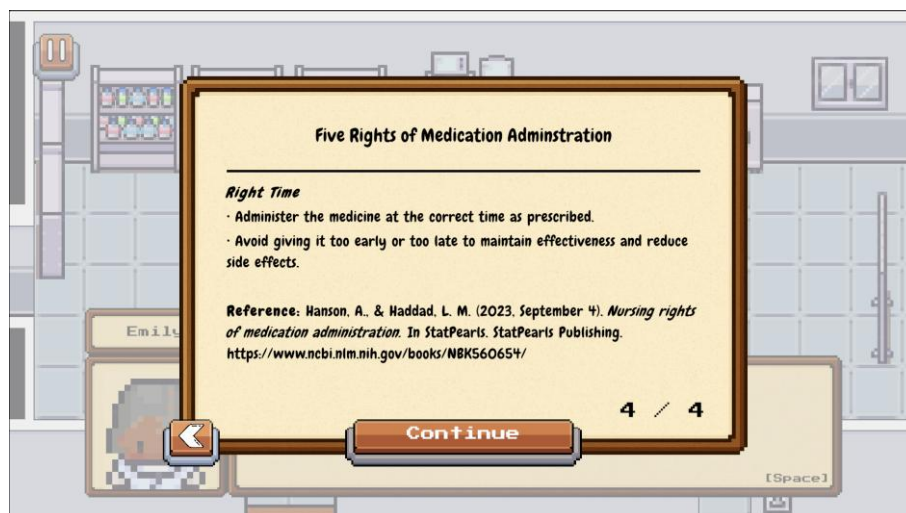


Figure 4.17 Last page of explanation panel

Figure 4.16 and Figure 4.17 show the explanation panel used to educate players during the game. The panel includes a title, content area, and page numbers. Players can navigate through the pages using the Next and Back buttons. When the player reaches the final page, a "Continue" button appears, allowing them to close the panel and proceed with the story.



Figure 4.18 Minigame - select right medicine



Figure 4.19 Wrong medicine selected

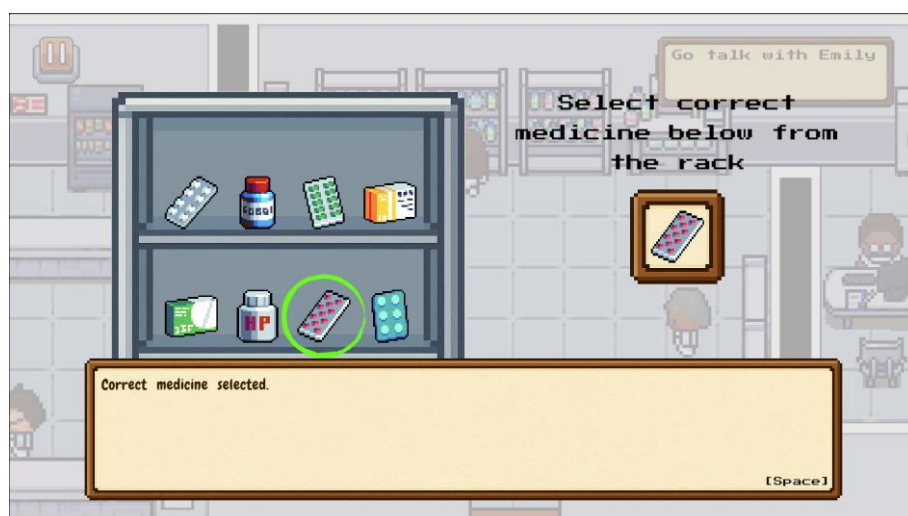


Figure 4.20 Right medicine selected

The game includes several minigames to enrich the player's experience. Figure 4.18

shows a minigame in which the player must select the correct medicine from a rack. If the player selects the wrong medicine, a dialog box will appear providing feedback, and the player will need to try again by selecting the correct medicine (Figure 4.19). Figure 4.20 shows the dialog feedback that appears when the player selects the correct medicine.

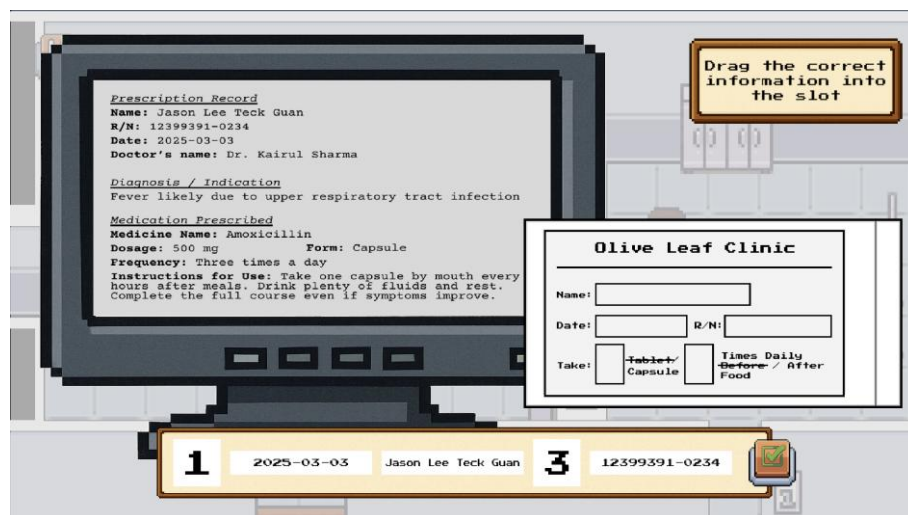


Figure 4.21 Minigame – drag and drop information

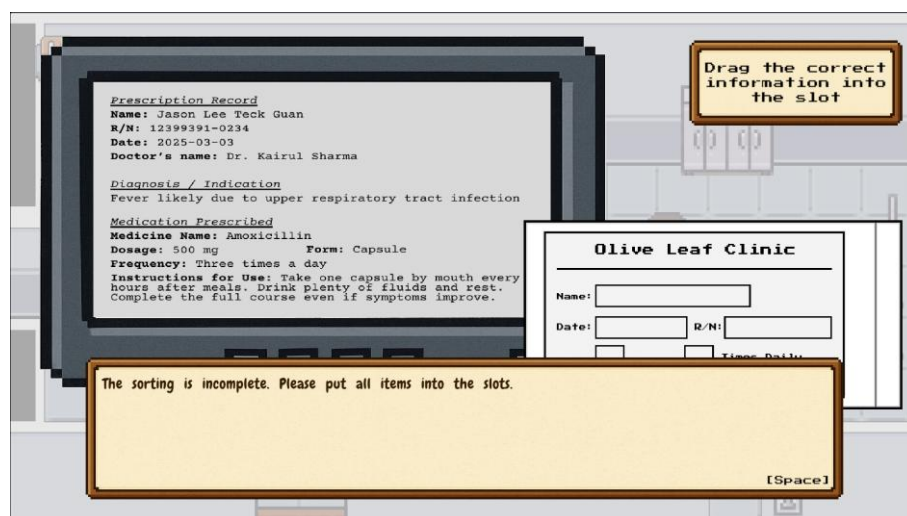


Figure 4.22 Uncompleted information filled

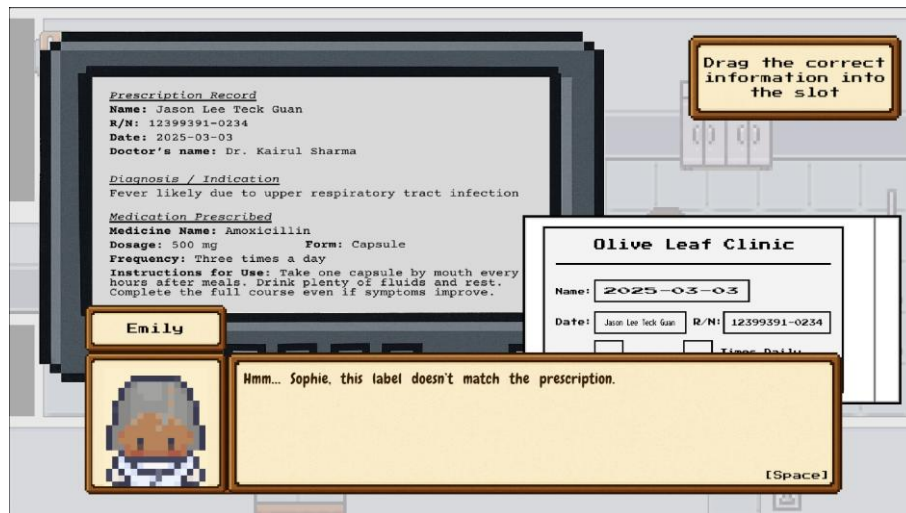


Figure 4.23 Wrong information filled



Figure 4.24 Right information filled

Figure 4.21 displays the second minigame in this stage. The player must drag and drop the correct information into the appropriate slots on the medication information label. Three types of dialog feedback will appear based on the player's actions: if some slots are left incomplete (Figure 4.22), if incorrect information is placed (Figure 4.23) — in which case the information will reset to its original position — and if all information is correctly filled in (Figure 4.24).



Figure 4.25 Decision making scenario

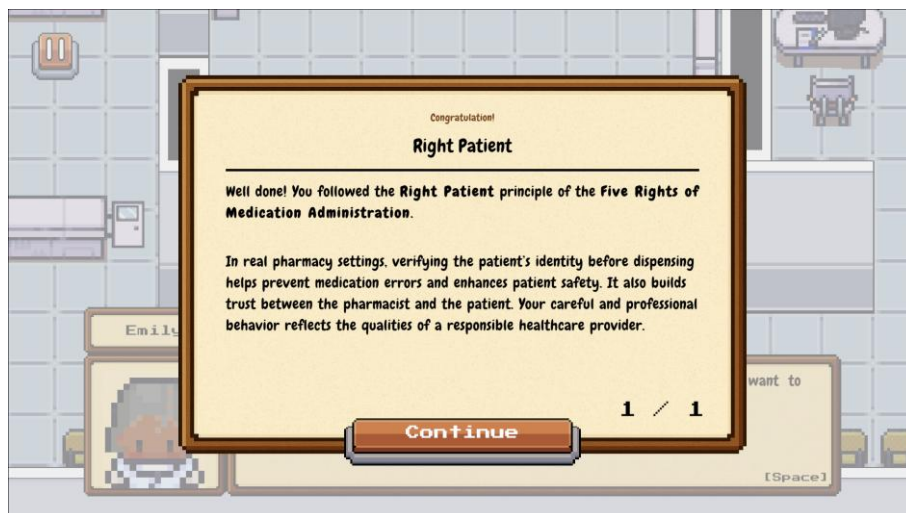


Figure 4.26 Right decision made

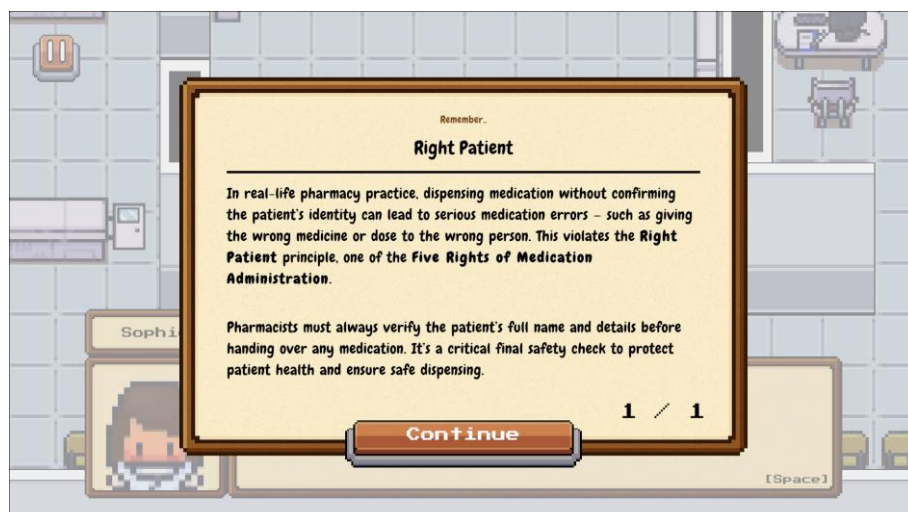


Figure 4.27 Wrong decision made

In Stage 1, the player will also encounter decision-making scenarios that influence the progression of the story (Figure 4.25). An explanation panel will display different content

depending on the player's choices (Figures 4.26 and 4.27).

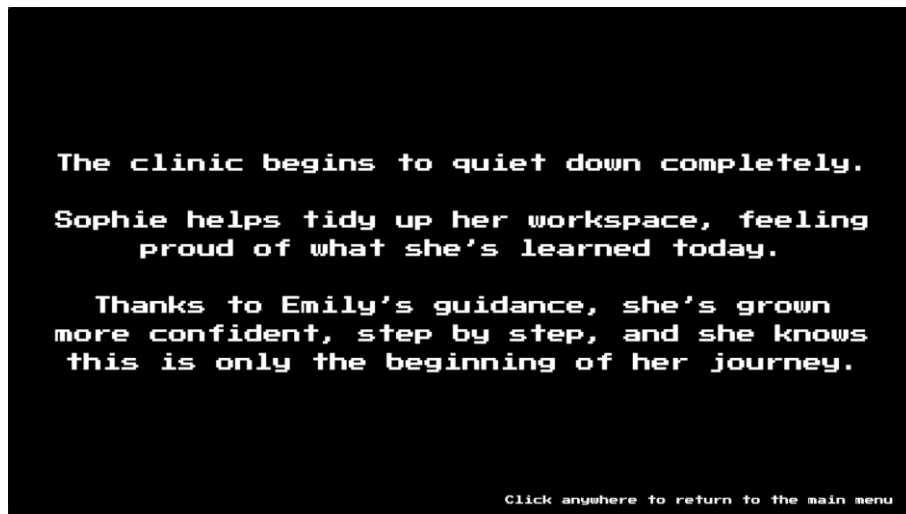


Figure 4.28 Ending of Stage 1

At the end of the game, a fade-in animation accompanied by an ending of the story will be shown (Figure 4.28). The player can click anywhere on the screen to return to the stage selection scene (Figure 4.9).

4.3.6 Stage 2

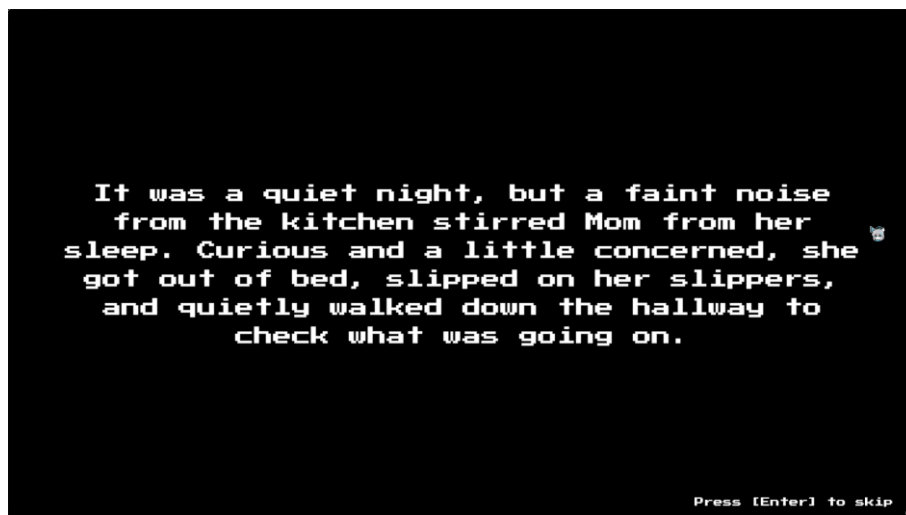


Figure 4.29 Background setting of Stage 2

The second stage also begins with an introduction to the story's background setting (Figure 4.29). The player can press Enter to skip the animation or wait for it to finish after the fade-out.



Figure 4.30 Amoxicillin

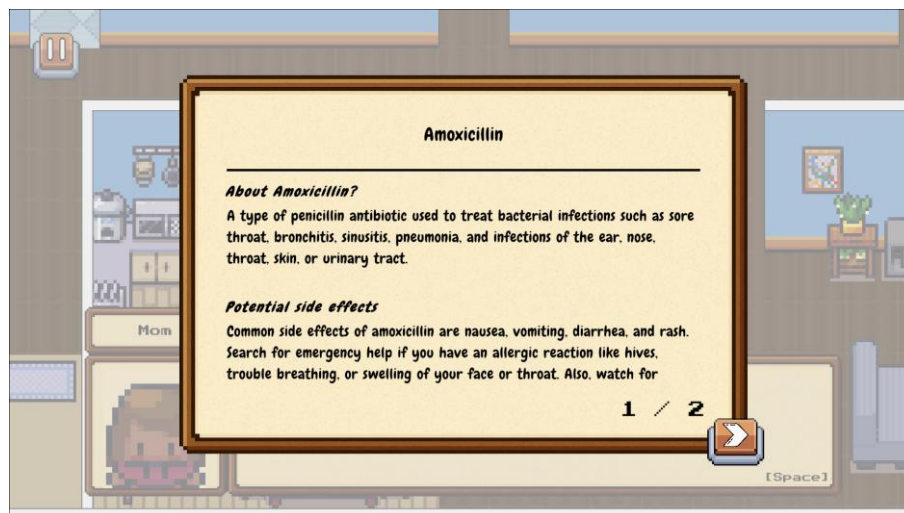


Figure 4.31 Explanation of Amoxicillin

In this stage, players can learn about common medicines used in real life, such as Amoxicillin (Figure 4.30). The game presents information about the medicine through an explanation panel (Figure 4.31).



Figure 4.32 Minigame – prepare medicine



Figure 4.33 Decision making to select number of medicines



Figure 4.34 End step of prepare medicine

The minigame in this stage involves preparing medicine for the daughter. Glowing animations and arrows are used to guide the player toward the next item to interact with (Figure

4.32). A decision-making phase is included in this stage, and different responses will be triggered based on the player's choices (Figure 4.33). Figure 4.34 shows the final step of the medicine preparation process.

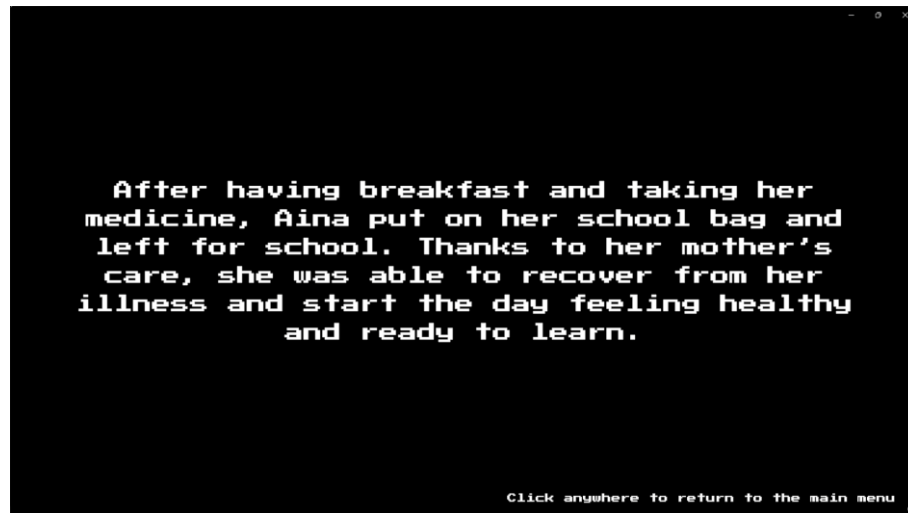


Figure 4.35 Ending of Stage 2

A fade-in animation accompanied by the ending of the story also show up in the stage at the end of the game (Figure 4.35). The player can click anywhere on the screen to return to the stage selection scene (Figure 4.9).

4.4 Summary

Chapter 4 provided an in-depth look at the implementation of the proposed educational simulation game, "MedGuard." Each element, from creating individual storylines and gameplay levels to designing the main menu and level selection screens, was thoughtfully designed to provide an entertaining and educational experience. The conceptual design was effectively turned into a playable game with valuable content that fosters awareness of the appropriate use of medicine with the use of Unity and Visual Studio Code.

CHAPTER 5: TESTING

5.1 Introduction

This chapter outlines the testing process conducted to ensure the quality and effectiveness of the proposed game. Two primary methodologies, functionality testing and evaluation testing were employed. Functionality testing focuses on verifying the technical aspects of the game. This includes ensuring that all interactive elements, such as buttons, menus, and navigation controls, operate smoothly without errors. It also involves checking whether the game responds correctly to player inputs and behaves as expected across different scenarios. On the other hand, evaluation testing is aimed at measuring the educational impact of the game. It assesses whether the game successfully improves children's understanding of the quality use of medicine. To achieve this, a pre-test and post-test approach was implemented. Participants were given a test before playing the game to assess their baseline knowledge. After completing the game, they were given a similar test to evaluate any changes in their understanding. By comparing the results of the pre- and post-tests, the effectiveness of the game in enhancing health literacy and safe medication practices among children could be analysed and validated.

5.2 Functionality Testing

Testing for functionality was essential to ensuring that every part of "MedGuard" worked as intended. This procedure included thorough testing to identify and fix any problems or glitches within the game. Table 5.1 displays the functionality testing results.

	Function	Expected Result	Check
Main menu	“Game” button	Navigate to Stage Select scene	✓
	“Language” button	Swap between English and Bahasa Melayu	✓
	“Sound” button	Mute or unmute background music	✓
	“Credits” button	Display credits panel	✓
	Credit panel	Display credits of the game	✓
Stage Select scene	“Stage 1” button	Navigate to Stage 1	✓
	“Stage 2” button	Navigate to Stage 2	✓
	“Back” button	Navigate to Main menu	✓
	“Question” button	Display tutorial panel	✓
	Tutorial panel	Display tutorial instruction of the game	✓
Story Stage 1	“Option” button	Display the option panel	✓
	“Resume” button	Allow player to continue the game	✓
	“Home” button	Navigate to Stage Select scene	✓
	“Sound” button	Mute or unmute background music	✓
	“Sound” slider	Control the volume of background music	✓
	“Language” button	Swap between English and Bahasa Melayu	✓
	Choice button	Allow player to make decision when available	✓
	Dialog panel	Display dialog of the story	✓
	Explain panel	Display medication educational content to player	✓

Story Stage 2	“Setting” button	Display the option panel	✓
	“Resume” button	Allow player to continue the game	✓
	“Home” button	Navigate to Stage Select scene	✓
	“Sound” button	Mute or unmute background music	✓
	“Sound” slider	Control the volume of background music	✓
	“Language” button	Swap between English and Bahasa Melayu	✓
	Choice button	Allow player to make decision when available	✓
	Dialog panel	Display dialog of the story	✓
	Explain panel	Display medication educational content to player	✓

Table 5.1 Result of functionality testing

5.3 Evaluation Testing

The purpose of evaluation testing was to assess the overall efficacy of MedGuard as an educational tool for teaching the quality use of medicine. The game was published on its h.io, a platform that supports HTML5 games. It was uploaded in a compressed .zip format to enable easy access for participants. Participants can play the game at <https://anderson99939.itch.io/medguard>.

During the evaluation phase, user testing was conducted with both a control group and an experimental group, with a focus on pre- and post-test evaluations to determine the impact of the game. Participants were divided into two groups: the control group, which received printed reading materials on safe medication use, and the experimental group, which played through both stages of the MedGuard game. To ensure ethical participation, a consent form was distributed to the parents of all child participants. A copy of the consent form is provided in Appendix D.

For the pre-test, both groups completed a set of questions on Kahoot related to the quality use of medicine. After the pre-test, the control group proceeded to read the provided educational materials, while the experimental group played MedGuard. Following the intervention, a post-test, which also conducted through Kahoot, was administered to evaluate each participant's understanding of the topic. The results from both the control and experimental groups were compared to assess the educational effectiveness of the game. The pre- and post-test questions used in this evaluation are included in Appendix E for reference.

5.3.1 Control Group Demographic Information

For the control group, there are total 10 children participating in the pre-test and post-test. The pre-test was administered before the students read the reading materials from the game. The post-test was given once the children completed the reading.

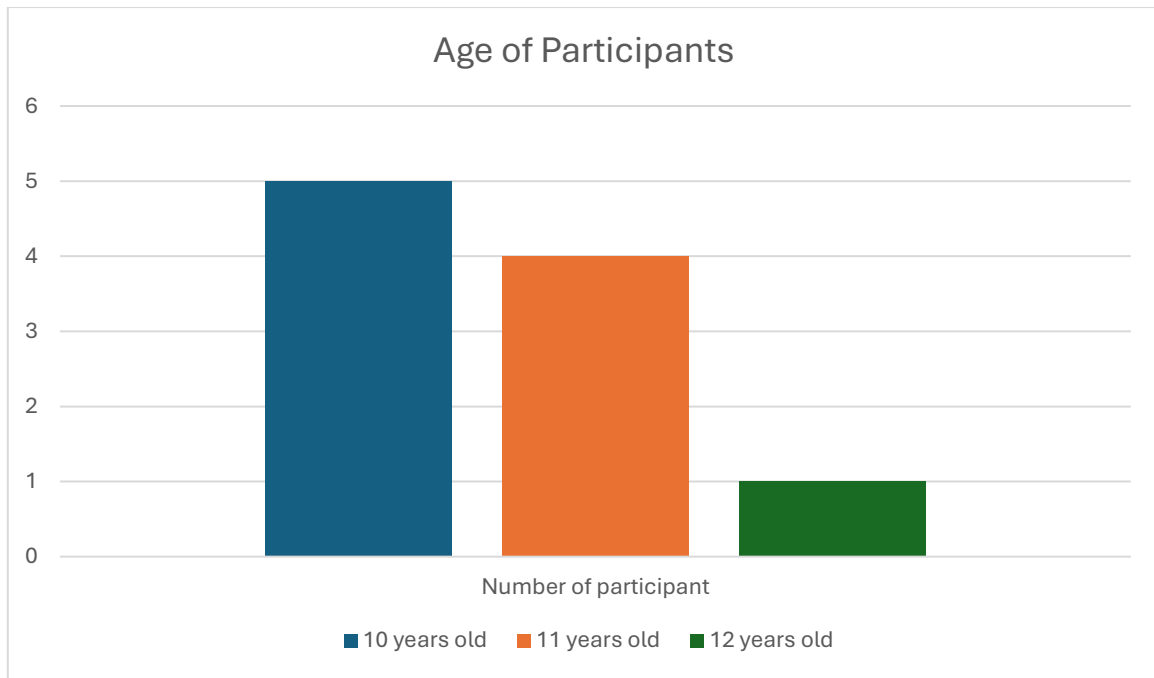


Figure 5.1 Age distribution of control group

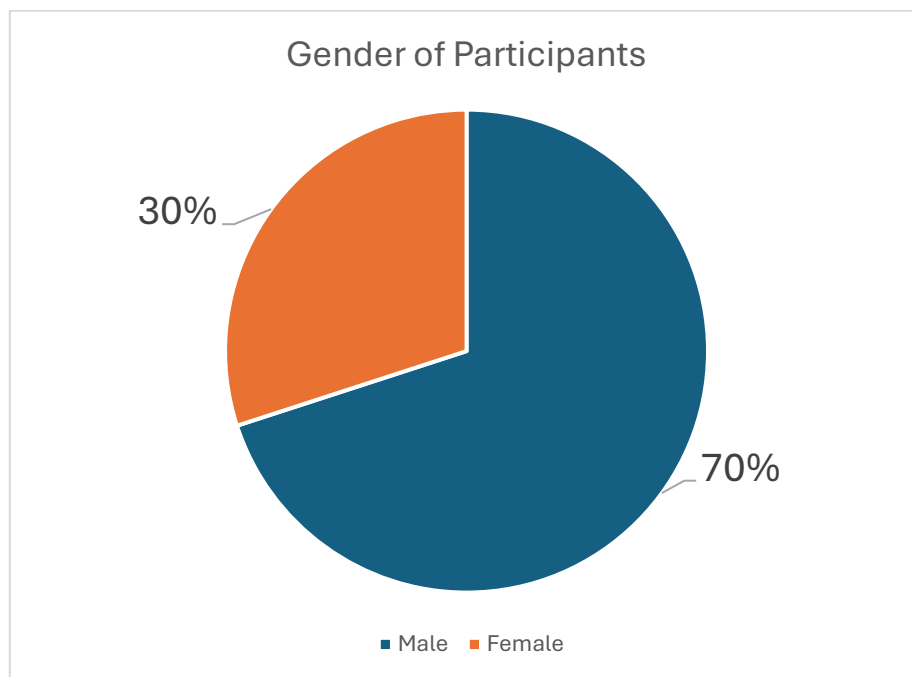


Figure 5.2 Gender distribution of control group

Figure 5.1 displays the age distribution of participants in the control group. According to the graph, the majority of participants are 10 years old, accounting for a total of 5 participants. This is followed by 4 participants aged 11, and 1 participant aged 12. While Figure 5.2 illustrates the gender distribution of participants in the control group. According to the pie chart, 7 out of the 10 participants are male, while the remaining 3 participants are female.

5.3.2 Experimental Group Demographic Information

A total 10 children participating in the pre-test and post-test for the experiment group. The pre-test was administered before the students play the game. The post-test was given once the children completed the game.

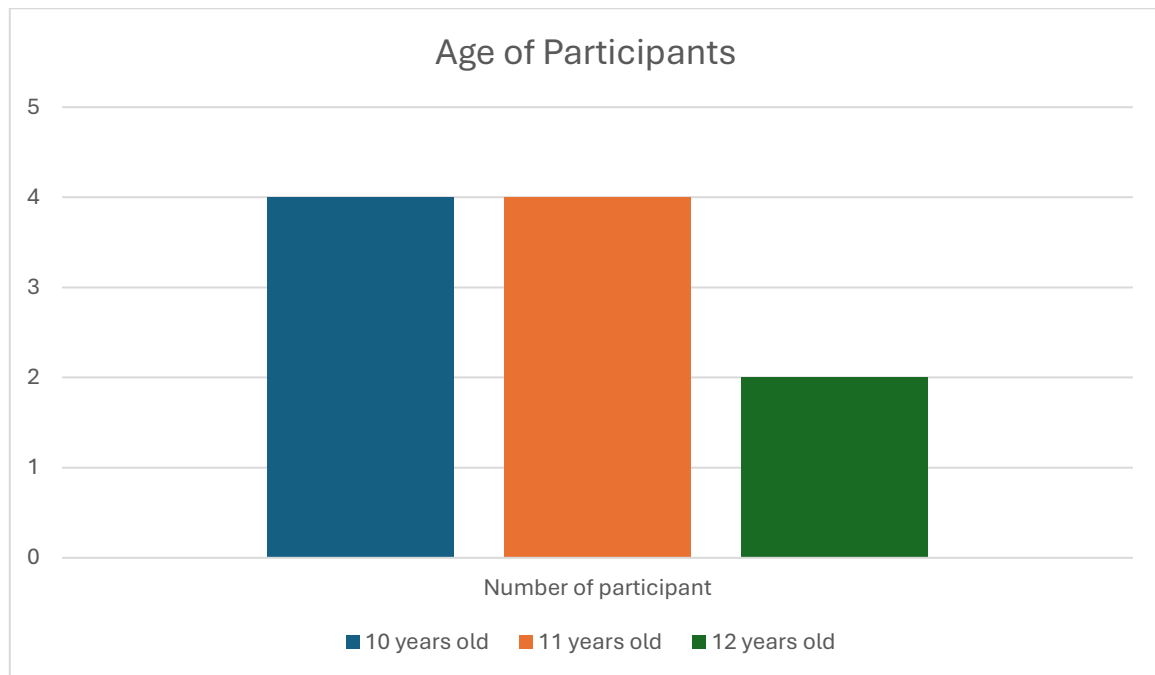


Figure 5.3 Age distribution of experiment group

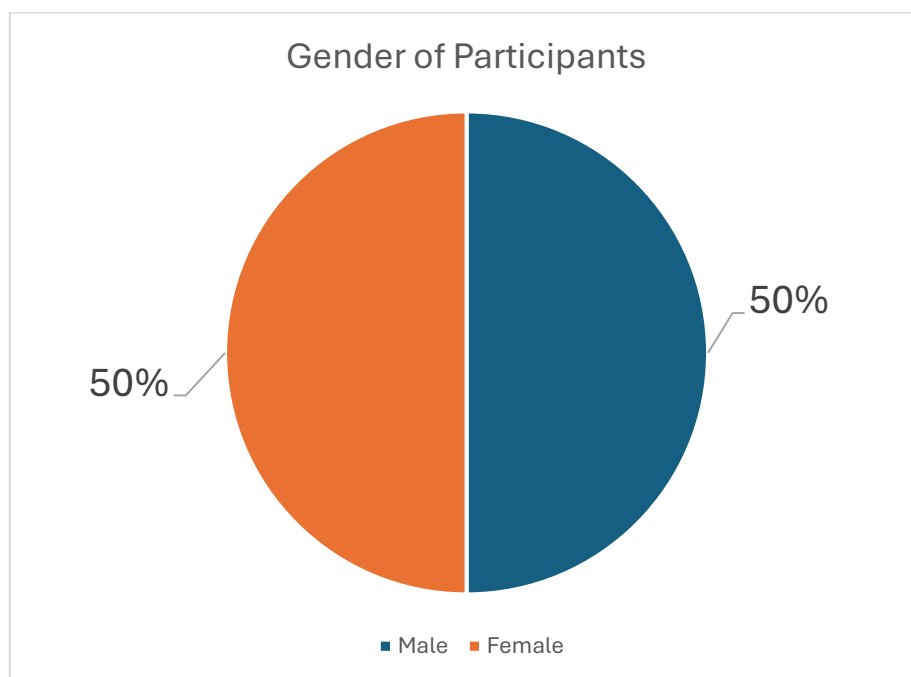


Figure 5.4 Gender distribution of experiment group

Figure 5.3 presents the age distribution of participants in the experimental group. Based on the graph, the participants are evenly spread across three age groups, with 4 participants aged 10, another 4 participants aged 11, and 2 participants aged 12. Figure 5.4 illustrates the gender distribution of the experimental group participants. According to the pie chart, the group is evenly divided, with 5 male and 5 female participants.

5.3.3 Testing Methodology

Participants	Pre-test Mark	Post-test Mark	Difference, x_d
1	3	4	1
2	6	7	1
3	5	8	3
4	2	3	1
5	3	5	2
6	3	5	2
7	5	6	1
8	6	9	3
9	6	8	2
10	4	5	1
Mean	4.3	6.0	1.7

Table 5.2 Control group pre- and post-test marks

Participants	Pre-test Mark	Post-test Mark	Difference, x_d
1	6	7	1
2	6	6	0
3	5	9	4
4	5	7	2
5	7	10	3
6	3	6	3
7	5	8	3
8	3	5	2
9	4	5	1

10	6	9	3
Mean	5.0	7.2	2.2

Table 5.3 Experiment group pre- and post-test marks

Table 5.2 and Table 5.3 display the mark of each participant in the pre- and post-test for control group and experiment group. The scores for the control and experimental groups were evaluated independently using a dependent samples t-test for hypothesis testing. To determine which group has a bigger impact, the dependent samples t-test compares the scores of two groups.

Control group

- Null Hypothesis, H_{0_C} : There is no significant change in the test scores of participants in the control group between the pre-test and post-test. ($H_{0_C} : \mu_{control} = 0$)
- Alternative Hypothesis, H_{a_C} : There is a significant change in the test scores of participants in the control group between the pre-test and post-test. ($H_{0_C} : \mu_{control} \neq 0$)

Experiment group

- Null Hypothesis, H_{0_e} : There is no significant change in the test scores of participants in the control group between the pre-test and post-test. ($H_{0_e} : \mu_{experiment} = 0$)
- Alternative Hypothesis, H_{a_e} : There is a significant change in the test scores of participants in the control group between the pre-test and post-test. ($H_{0_e} : \mu_{experiment} \neq 0$)

Group Statistics					
	Group	N	Mean	Std. Error Mean	Std. Deviation
Pre-test	Control	10	4.30	0.473	1.494
	Experiment	10	5.00	0.422	1.333

Group Statistics					
	Group	N	Mean	Std. Error Mean	Std. Deviation
Post-test	Control	10	6.00	0.615	1.944
	Experiment	10	7.20	0.554	1.751
Difference	Control	10	1.70	0.260	0.823
	Experiment	10	2.20	0.389	1.229

Table 5.4 Group analysis for control group and experiment group

To identify any possible differences, the mean scores of the experimental and control groups were analysed, as shown in Table 5.4. In the control group, the mean score increased from 4.3 in the pre-test to 6.0 in the post-test. Similarly, the experimental group showed an improvement, with the mean score rising from 5.0 in the pre-test to 7.2 in the post-test. These results suggest a positive trend in both groups, with a greater improvement observed in the experimental group.

Paired Samples T-Test								
	t	df	p	Mean	SE	SD	95% Confidence Interval	
							Lower	Upper
Post_Control - Pre_Control	6.53	9.00	<.001	1.70	0.260	0.823	1.11	2.29
Post_Experiment - Pre_Experiment	5.66	9.00	<.001	2.20	0.389	1.229	1.32	3.08
Note. $H_a: \mu_{\text{Measure 1} - \text{Measure 2}} \neq 0$								

Table 5.5 Dependent samples t-test for control and experimental group

Table 5.5, generated using Jamovi, presents the results of a paired samples t-test conducted with a 95% confidence interval (CI) and a significance level of $\alpha = 0.05$. For the control group, the results showed a t-value of 6.53 and a p-value of 0.001, meaning there was a clear and significant improvement in scores after reading the educational materials. The average score increased by 1.70, so the null hypothesis (which assumed no improvement) was rejected.

For the experimental group, the t-value was 5.66 and the p-value was less than 0.001, also showing a strong and significant improvement in scores after playing MedGuard. The average increase was 2.20, leading to the rejection of the null hypothesis for this group as well.

Even when using a stricter 99% confidence level, both the control and experimental groups still showed very strong improvements ($p < 0.001$), confirming that both methods were effective. However, since the experimental group had a larger improvement (2.20 vs. 1.70), this suggests that MedGuard may be more effective in helping children understand the safe and proper use of medicine.

5.4 Summary

Chapter 5 details the testing procedures used to assess MedGuard's effectiveness on educating knowledges about quality use of medicine. This chapter includes two key components: functionality testing and evaluation testing. Functionality testing focuses on verifying that all interactive elements within the game, such as buttons, dialogue sequences, and transitions between scenes, operate smoothly and as intended. This step ensures that players can experience the game without technical issues. On the other hand, evaluation testing aims to assess the educational value of the game by measuring its impact on players' understanding of the quality use of medicine. This involves comparing the knowledge gained by players who interacted with MedGuard to those in a control group who received the same information through educational materials. The results indicate that MedGuard is more effective in educating players compared to reading materials provided to the control group.

CHAPTER 6: CONCLUSION AND FUTURE WORK

6.1 Introduction

This chapter provides an in-depth overview of the MedGuard project, highlighting its key achievements, challenges, and constraints that were faced during the development phase. It also identifies possible areas for development and makes suggestions for upcoming game improvements. This chapter attempts to offer important insights into the project's overall impact, the lessons learned, and potential future development directions by documenting the journey from initial concept to final implementation.

6.2 Achievement of Project Objectives

Table 6.1 display the objectives and their corresponding achievements.

Objectives	Achievements
To design a game that teaches children the fundamentals of quality use of medicine.	The project successfully designed an educational game, MedGuard, incorporating core concepts such as the “Five Rights” of medication administration.
To develop an interactive educational game focus on teaching issue related to health and medicine.	An interactive 2D game was developed using Unity and HTML5, featuring decision-making scenarios, dialogue-based storytelling, and visual cues that simulate real-life situations involving medication use.
To evaluate the effectiveness of the game in increasing children’s knowledge on quality use of medicine.	A user study involving pre- and post-tests was conducted with both control and experimental groups. The results

	demonstrated that children who played MedGuard showed a greater improvement in their understanding of medicine safety compared to those who learned through reading materials, indicating the game's effectiveness as an educational tool.
--	--

Table 6.1 Project objectives and their respective achievements

6.3 Constraints and Limitations

The development of the MedGuard project faced several constraints that influenced its overall scope and implementation. One significant limitation was time constraint. As the game was developed within a limited academic timeline, trade-offs needed to be made between features and quality. This restricted the depth and variety of in-game content, and constrained the integration of advanced features such as voiceovers, animations, and interactive tutorials that could have further improved the learning experience.

Furthermore, platform compatibility posed a technical limitation. Despite the game was developed using HTML5 and hosted on the itch.io platform, the game does not fully support mobile play. Given that many children primarily use smartphones and tablets for digital entertainment and learning, this limitation significantly reduces the game's accessibility and reach. Without responsive mobile support or a dedicated app version, the game's potential impact is constrained, especially in households where desktop access is limited.

Lastly, small sample size used during the evaluation phase. The study involved a total of 20 participants, with 10 in the control group and 10 in the experimental group. The relatively small and localized sample may not adequately represent the broader population of children with different educational backgrounds. As a result, the findings should be interpreted with caution and seen as an initial step toward broader-scale evaluation.

6.4 Future Works and Recommendations

While MedGuard has shown promising results in educating children about the quality use of medicine through game-based learning, there are several areas where the project can be improved and expanded in the future.

1. Platform Diversification

Currently, despite MedGuard is published on itch.io and developed using HTML5, which allows access via web browsers, the game does not fully support mobile devices. This limits accessibility for children who are more likely to have smartphones or tablets than computer. Future development should focus on optimizing the game for mobile platforms to ensure a broader reach and greater convenience for younger players.

2. Clearer Game Instructions

Feedback from testing suggests that some players were confused about the game controls or objectives. Future versions should include more intuitive tutorials or on-screen prompts to guide players through each stage of the game, ensuring a smoother and more user-friendly experience.

3. Increased Game Content and Shorter Dialogues

To maintain player interest and encourage replay ability, future updates should expand the variety of scenarios and tasks available in the game. At the same time, the length of dialogues should be reduced, with a focus on concise and engaging storytelling. This approach can help sustain the attention of younger players, who typically have shorter attention spans, while ensuring that key educational messages are delivered effectively.

4. Enhanced Visuals and Voiceovers

Improving the game's visual quality, including character animations and interface design, can make the gameplay experience more engaging for children. Additionally, incorporating voiceovers for instructions and key dialogues would enhance accessibility for

younger players or those with reading difficulties, helping to reinforce learning through both visual and auditory channels.

6.5 Summary

Chapter 6 provided a comprehensive reflection on the outcomes of the *MedGuard* project, including the extent to which its objectives were achieved, the constraints and limitations encountered during development, and recommendations for future improvements. The game successfully met its core goal of educating children about the quality use of medicine through an engaging, game-based learning experience.

References

- Abraham, O., Rosenberger, C., Tierney, K., & Birstler, J. (2021). Investigating the Use of a Serious Game to Improve Opioid Safety Awareness Among Adolescents: Quantitative Study. *JMIR serious games*, 9(4), e33975. doi:10.2196/33975
- Aguilera, E., & de Roock, R. (20 June, 2022). Digital game-based learning: Foundations, applications, and critical issues. *Oxford Research Encyclopedia of Education*. Retrieved from <https://doi.org/10.1093/acrefore/9780190264093.013.1438>
- Al-Saqqa, S., Sawalha, S., & Abdelnabi, H. (2020). Agile Software Development: Methodologies and Trends. *International Journal of Interactive Mobile Technologies (iJIM)*, 14, 246-270. doi:10.3991/ijim.v14i11.13269
- Ang, K. C. S., Afzal, F., & Crawford, L. H. (2021). Transitioning from passive to active learning: Preparing future project leaders. *Project Leadership and Society*, 2, Article 100016. Retrieved from <https://doi.org/10.1016/j.plas.2021.100016>
- Asadzadeh, A., Shahrokhi, H., Shalchi, B., Khamnian, Z., & Rezaei-Hachesu, P. (2024). Serious educational games for children: A comprehensive framework. *Heliyon*, 10(1), e28108. doi:10.1016/j.heliyon.2024.e28108
- Aslam, A., Zin, C. S., Ab Rahman, N. S., Gajdács, M., Ahmed, S. I., & Jamshed, S. (2021). Self-Medication Practices with Antibiotics and Associated Factors among the Public of Malaysia: A Cross-Sectional Study. *Drug, healthcare and patient safety*, 13, 171–181. Retrieved from <https://doi.org/10.2147/DHPS.S331427>
- Figma Inc. (n.d.). *Figma*. Retrieved from <https://www.figma.com>
- Hampson, S. E., Edmonds, G. W., Goldberg, L. R., Dubanoski, J. P., & Hillier, T. A. (2015). A life-span behavioral mechanism relating childhood conscientiousness to adult clinical health. *Health Psychology*, 34(9), 887–895. Retrieved from <https://doi.org/10.1037/hea0000209>
- Hanson, A., & Haddad, L. M. (2023). Nursing rights of medication administration. In *StatPearls*. StatPearls Publishing. Retrieved from <https://www.ncbi.nlm.nih.gov/books/NBK560654/>
- Ibeh, C. V., Awonuga, K. F., Okoli, U. I., Ike, C. U., Ndubuisi, N. L., & Obaigbena, A. (2024). A review of agile methodologies in product lifecycle management: Bridging theory and practice for enhanced digital technology integration. *Emerging Science and Technology Journal*, 5(2), Article 805. Retrieved from <https://doi.org/10.51594/estj.v5i2.805>
- KDE. (2025). *Krita (version 5.29)*. Retrieved from <https://krita.org>

- Lucid Software. (2009). *Lucidchart*. Retrieved from <https://www.lucidchart.com>
- Microsoft. (2025). *Visual Studio Code (version 1.97)*. Retrieved from <https://code.visualstudio.com>
- Mirani Sergzi, N., Ordoni, M., Besharatnia, M. S., Dastamooz, M. R., & Heydari Abravan, M. J. (2020). Impact of educational computer games on academic motivation and stress reduction in students. *International Journal of Elementary Education*, 9(3), 71–76. Retrieved from <https://doi.org/10.11648/j.ijeedu.20200903.13>
- Moosa, A. M., Al-Maadeed, N., Saleh, M., Al-Maadeed, S. A., & Aljaam, J. M. (2020). Designing a mobile serious game for raising awareness of diabetic children. *IEEE Access*, 8, 222876–222889. Retrieved from <https://doi.org/10.1109/ACCESS.2020.3043840>
- Schöbel, S., Saqr, M., & Janson, A. (2021). Two decades of game concepts in digital learning environments – A bibliometric study and research agenda. *Computers & Education*, 173, 104296. Retrieved from <https://doi.org/10.1016/j.compedu.2021.104296>
- The Know Your Medicine Programmes*. (2013). Retrieved from Ministry of Health Malaysia: <https://pharmacy.moh.gov.my/en/content/know-your-medicine-programmes.html>
- Tsopra, R., Courtine, M., Sedki, K., Eap, D., Cabal, M., Cohen, S., Bouchaud, O., Mechaï, F., & Lamy, J.-B. (2020). AntibioGame®: A serious game for teaching medical students about antibiotic use. *International Journal of Medical Informatics*, 139, Article 104074. Retrieved from <https://doi.org/10.1016/j.ijmedinf.2020.104074>
- Unity Software Inc. (2025). *Unity (version 6000.0.40f1)*. Retrieved from <https://unity.com>
- World Patient Safety Day 2022*. (17 September, 2022). Retrieved from World Health Organization: <https://www.who.int/news-room/events/detail/2022/09/17/default-calendar/world-patient-safety-day-2022>
- Zipprich, H. M., Mendorf, S., Schönenberg, A., & Prell, T. (2022). The impact of poor medication knowledge on health-related quality of life in people with Parkinson's disease: a mediation analysis. *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation*, 31(5), 1473–1482. Retrieved from <https://doi.org/10.1007/s11136-021-03024-8>

Appendix A

Table A.1 Gantt chart of FYP 1 schedule

Task	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
Brief Proposal Submission and Approval														
Submission of Full Proposal														
Preparation of Chapter 1														
Preparation of Chapter 2														
Preparation of Chapter 3														
Submission of FYP 1 Final Report														

Table A.2 Gantt chart of FYP 2 schedule

Task	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
Designing and developing game														
Preparation of Chapter 4														
Testing game														

Preparation of Chapter 5														
Preparation of Chapter 6														
Deploying and reviewing game														
Submission of FYP 2 Final Report														

Appendix B

Sample Consent Form

INFORMED CONSENT FORM FOR FINAL PROJECT YEAR RESEARCH You are being asked to volunteer by participating in a research of task-driven medication game. Please read the following information carefully before deciding to participate, as it is important to fully understand the purpose of this research. Principal Researcher My name is Anderson Tang Kee Hui, and I am a final-year undergraduate student in the Multimedia Computing course at the Faculty of Computer Science and Information Technology (FCSIT) at the Universiti Malaysia Sarawak (UNIMAS). I am currently working on my Final Year Project, which involves developing a task-driven medication game focused on promoting the quality use of medicine. My project is supervised by Dr. Amelia Jati Anak Robert Jupit. Purpose of Research This research aims to gather insights into your preferences, experiences, and expectations regarding the quality use of medicine and gaming. Your honest feedback is crucial to the success of this project and will greatly contribute to its development. The information you provide will help shape the design of educational games that promote safe and effective medication use. Your participation will be highly valued and appreciated. Procedures By signing below, you acknowledge that you have read and understood the details of this consent form and agree to participate in the interview. Name : _____ Signature: _____ Date : _____

Appendix C

Original Interview Question

1. What are the most frequent scenarios where children are prescribed medications, and how

are these typically explained to parents?

2. What are the most frequent scenarios where children are prescribed medications, and how are these typically explained to parents?
3. Have you noticed any patterns or recurring issues in how children react to or manage their medications over time?
4. Are there any common misunderstandings or myths about medications that parents or children often believe?
5. Are there any cases related to children's medication safety that stand out to you or are particularly memorable?
6. What key concepts about medication safety do you think children struggle to understand?
7. Are there any cultural or regional factors that might influence how children or their parents approach medication safety?
8. Are there any specific medical topics or medications you believe should be prioritized in the game?

Transcript of Interview Questions

1. What are the most frequent scenarios where children are prescribed medications, and how are these typically explained to parents?

Mostly acute illness such as common cold, eczema, asthma, diarrhoea/vomiting. These prescribed medications will be routinely screened by pharmacists for their correct dosage, and dosage form as well as any other related aspects. We will explain how to administer (route of administration) the medications, to take as directed (total prescribed duration) to complete the antibiotic course or if the medication is meant for when necessary), teach the caregivers how to reconstitute certain powdered antibiotics, and appropriate medication storage.

Educate on the medication's shelf life after reconstitution/opening.

2. What common mistakes do you observe in children or their parents regarding medication use?

Certain medications meant to be given when necessary only (ie cough and cold), but caregivers tend to give until finished. Storage of medications especially certain syrups, parents tend to store in the fridge (this is only applicable for certain reconstituted powdered antibiotics). Some eyedrops/ cream once opened, can only be used within 4 weeks, but caregivers still administer past the shelf life.

Sharing of medications without doctor's consultation, unaware of the different brands/ strength/dose by body weight which leads to incorrect dose administration.

Parents do not directly observe their child taking (oral medications) or using the medication (device like inhalers/ nasal spray) – possibility of incorrect use/ missed doses/ did not swallow the dose.

3. Have you noticed any patterns or recurring issues in how children react to or manage their medications over time?

We aim for parents or caregivers to manage the children's medications, especially those 12 years and below. Children should only be taking medications under the parents supervision, not to self-medicate. The issue with children's medication taking habit would be more to whether patient can adhere to the regime prescribed (as syrups are not palatable to most kids, correct administration time based on prescribed frequency, fear of needles for injectables like insulin). So we need to encourage better insights for children to understand the benefits of taking the medications prescribed.

4. Are there any common misunderstandings or myths about medications that parents or

children often believe?

Parents would be concerned with the common side effects, long term side effects on major organs such as kidneys, antibiotic resistance (due to irrational use of antibiotics or non-compliance/non completion of course).

Parents may not understand that certain medical condition requires long term follow up to keep the condition under control or even life-long management, hence they self-discontinue treatment especially when they do not see the benefit/ recovery within a short period of time.

Some believe that healthy lifestyle can cure their medical condition, or prefer to try herbal remedies alone to alleviate their symptoms or cure their disease not knowing it may cause more harm than benefit.

5. Are there any cases related to children's medication safety that stand out to you or are particularly memorable?

Child self-administered an overdose of medication as it was within easy reach, as they do not know the potential harm it could cause.

Child self-administered medication belonging to a family member thinking that it was candies.

6. What key concepts about medication safety do you think children struggle to understand?

Vitamins are not candies. Prescribed medications are given for a reason, children need to understand that even though its bitter or unpalatable, its for their health benefit and swift recovery.

7. Are there any cultural or regional factors that might influence how children or their parents approach medication safety?

The source of the ingredients used, either as excipients or medication itself (bovine, porcine based) are a concern to some.

8. Are there any specific medical topics or medications you believe should be prioritized in the game?

Correct medication **storage** place according to type of medication.

Read medication **labelling** before use/administration.

Understand the **medication administration times** based on prescribed frequency.

Route of administration of the different types of medications.

Do not self purchase medications from unreliable resources.

If possible, its good to educate parents on medication generic names instead of brand names, in case they might over-dose the same medications just because they have different brand names.

Example: Paracetamol (generic name ie. Main ingredient)

Uphamol, Panadol, Paracil, Axcel (all brand names, manufactured by different manufacturers)

Appendix D

Consent Form for Control Group

Consent Form for Participation in Research Testing

Student Researcher: Anderson Tang Kee Hiit

University: Universiti Malaysia Sarawak (UNIMAS)

Faculty: Faculty of Computer Science and Information Technology

Dear Parent/Guardian,

Your child is invited to participate in a research project aimed at developing and evaluating an game focus on fundamentals of quality use of medicine. Before you decide whether to allow your child to participate, it is important for you to understand the purpose of this study, what your child's participation will involve, and your rights as a parent/guardian.

Purpose of the Study:

The purpose of this study is to design a game that teaches children the fundamentals of quality use of medicine, to develop an interactive educational game focused on health and medicine-related issues, and to evaluate the effectiveness of the game in increasing children's knowledge on the quality use of medicine.

Study Procedure:

If you consent for your child to participate in this study, your child will be asked to:

- Play the prototype of medication education game.
- Complete a pre-test and post-test questionnaire consisting of multiple-choice questions related to knowledge about quality use of medicine.

The study will be conducted in a safe and supervised environment. No sensitive or personal medical data will be collected.

Consent:

By signing below, you acknowledge that you have read and understood the information provided in this consent form. You voluntarily agree to allow your child to participate in the study under the terms described above.

Parent/Guardian's Signature: _____

Date: _____

Consent Form for Experiment Group

Consent Form for Participation in Research Testing

Student Researcher: Anderson Tang Kee Hiit

University: Universiti Malaysia Sarawak (UNIMAS)

Faculty: Faculty of Computer Science and Information Technology

Dear Parent/Guardian,

Your child is invited to participate in a research project aimed at developing and evaluating an game focus on fundamentals of quality use of medicine. Before you decide whether to allow your child to participate, it is important for you to understand the purpose of this study, what your child's participation will involve, and your rights as a parent/guardian.

Purpose of the Study:

The purpose of this study is to design a game that teaches children the fundamentals of quality use of medicine, to develop an interactive educational game focused on health and medicine-related issues, and to evaluate the effectiveness of the game in increasing children's knowledge on the quality use of medicine.

Study Procedure:

If you consent for your child to participate in this study, your child will be asked to:

- Read the paper material provided, which contained information about the quality use of medicine.
- Complete a pre-test and post-test questionnaire consisting of multiple-choice questions related to knowledge about quality use of medicine.

The study will be conducted in a safe and supervised environment. No sensitive or personal medical data will be collected.

Consent:

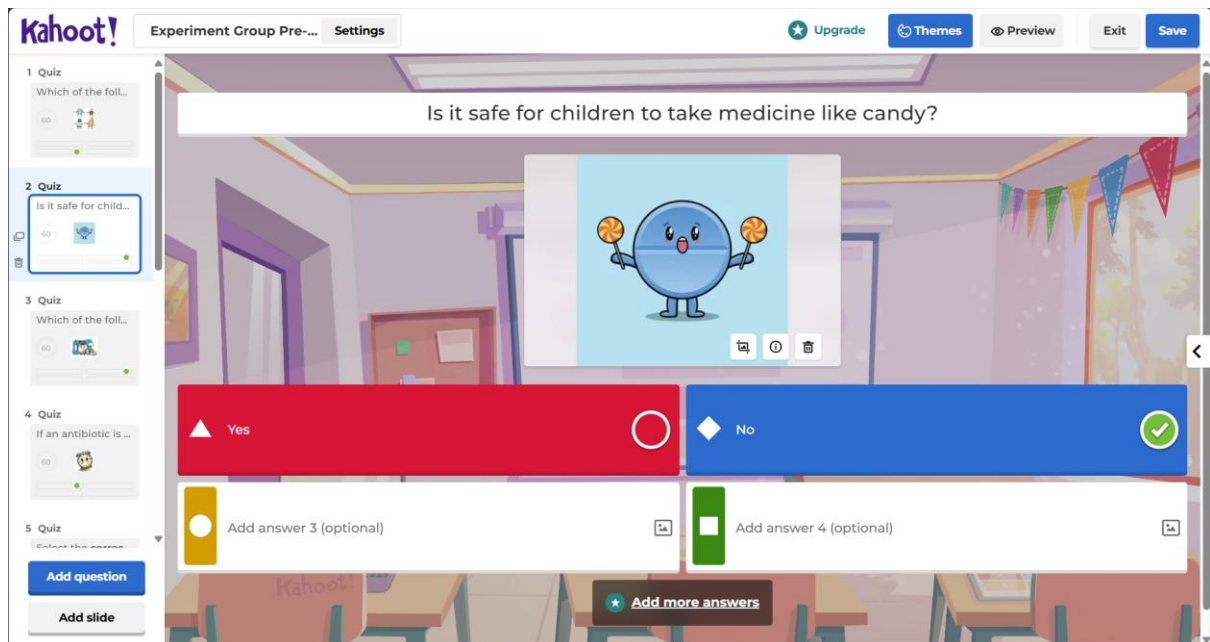
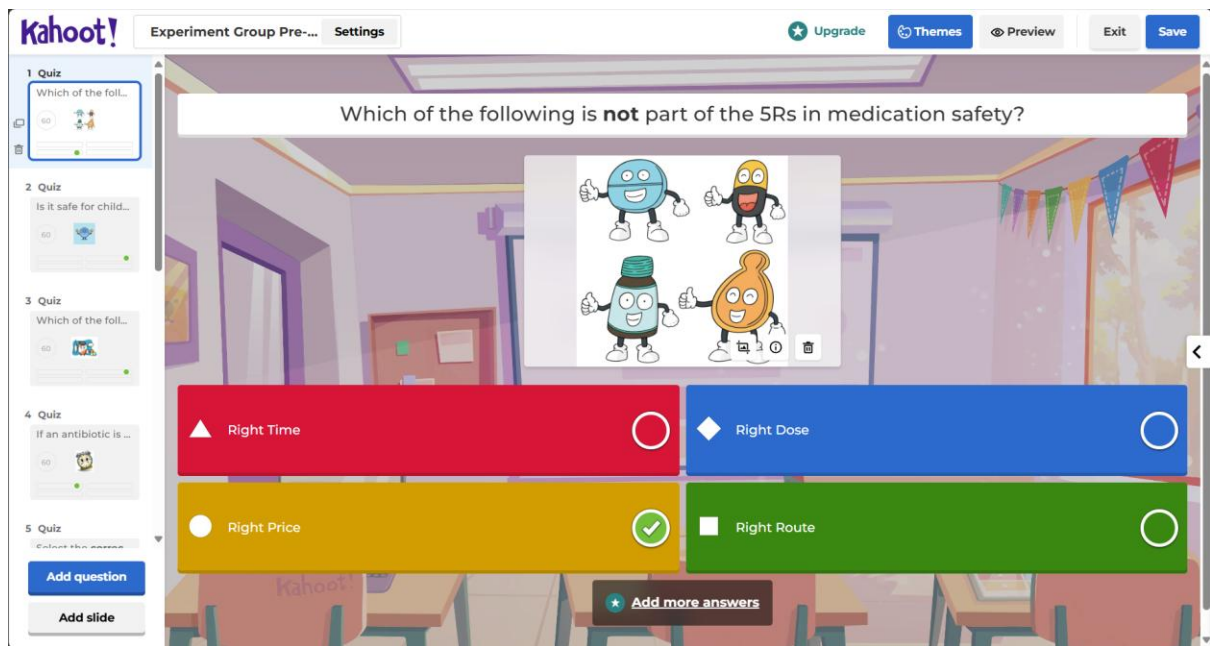
By signing below, you acknowledge that you have read and understood the information provided in this consent form. You voluntarily agree to allow your child to participate in the study under the terms described above.

Parent/Guardian's Signature: _____

Date: _____

Appendix E

Pre-test Questions (EN)



Kahoot! Experiment Group Pre-... Settings Upgrade Themes Preview Exit Save

1 Quiz Which of the foll...

2 Quiz Is it safe for child...

3 Quiz Which of the foll...

4 Quiz If an antibiotic is ...

5 Quiz Select the answer

Add question Add slide

Which of the following helps ensure the "Right Medicine"?



☐ Giving medication based on packaging color
 ☒ Double-checking the medicine name and form before dispensing
 ☐ Relying on patient memory
 ☐ Using handwritten prescriptions without verification

Add more answers

Kahoot! Experiment Group Pre-... Settings Upgrade Themes Preview Exit Save

1 Quiz Which of the foll...

2 Quiz Is it safe for child...

3 Quiz Which of the foll...

4 Quiz If an antibiotic is ...

5 Quiz Select the answer

Add question Add slide

If an antibiotic is prescribed as one tablet twice daily, what are the times you can take it?



☒ 8am and 8pm
 ☐ 6am and 11pm
 ☐ 9am and 6pm
 ☐ 2pm and 7pm

Add more answers

Kahoot! Experiment Group Pre-... Settings Upgrade Themes Preview Exit Save

If an antibiotic is ...

5 Quiz Select the correc...

6 Quiz Today is March 17...

7 Quiz Checking the pat...

8 Quiz Which medicine ...

Add question Add slide

Select the **correct** storage location for medicine.



▲ Car ☐ ◆ Medicine cupboard ☒

● Beside the bed ☐ ■ Table drawer ☐

Add more answers

Kahoot! Experiment Group Pre-... Settings Upgrade Themes Preview Exit Save

Today is March 17, 2025. This medicine expired two months ago, on January 17. Should you still take it?



▲ Yes ☐ ◆ No ☒

● Add answer 3 (optional) ■ Add answer 4 (optional)

Add question Add slide

Add more answers

Kahoot! Experiment Group Pre-... Settings Upgrade Themes Preview Exit Save

6 Quiz Today is March 17...

7 Quiz Checking the pat...

8 Quiz Why is it importa...

9 Quiz My mom takes t...

Add question Add slide

Checking the patient's identity before giving medicine ensures which "Right"?



▲ Right Time Right Medicine

● Right Patient Right Dose

Add more answers

Kahoot! Experiment Group Pre-... Settings Upgrade Themes Preview Exit Save

7 Quiz Checking the pat...

8 Quiz Which medicine ...

9 Quiz My mom takes t...

10 Quiz What is the main...

Add question Add slide

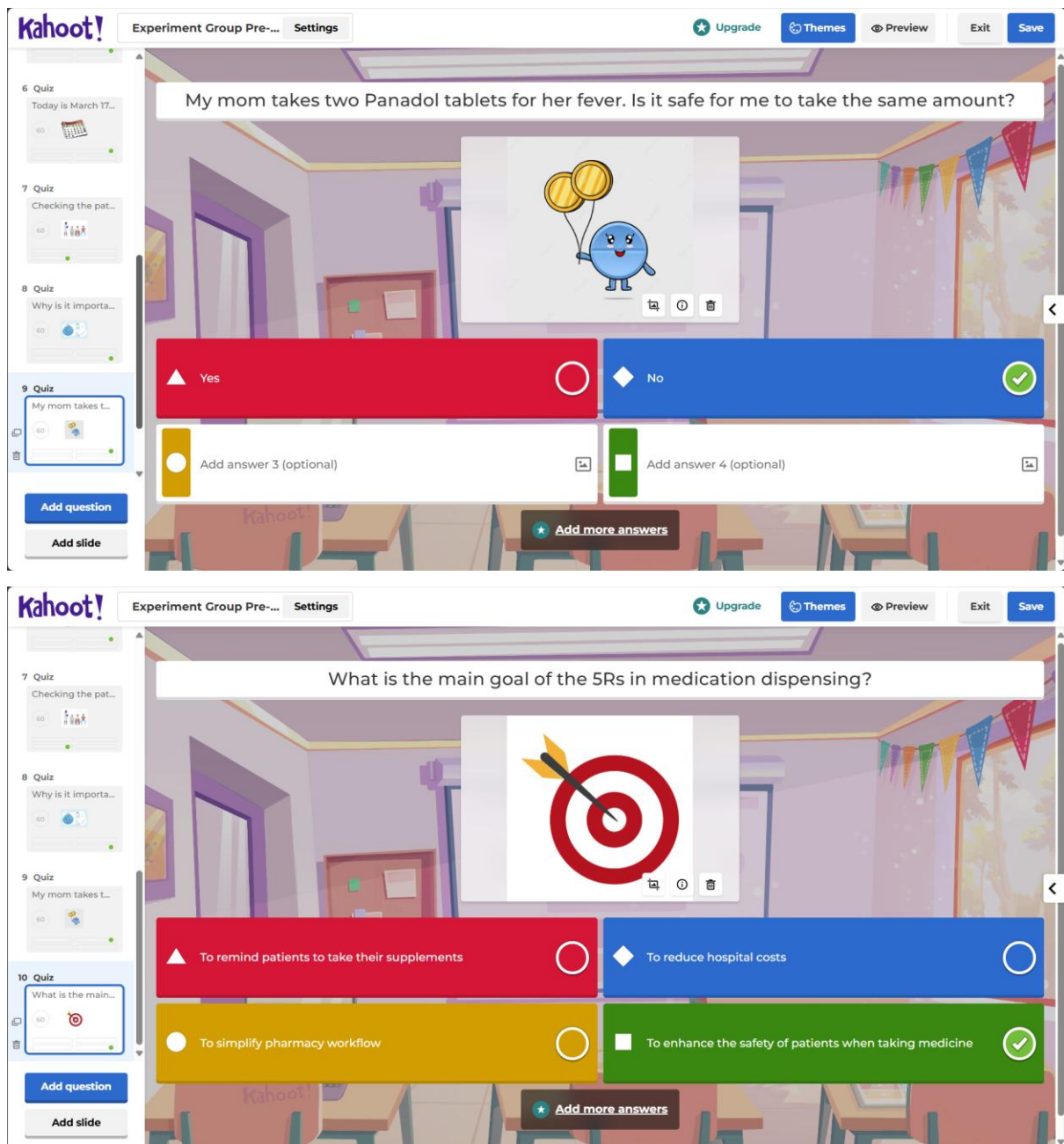
Which medicine **should not** be swallowed?



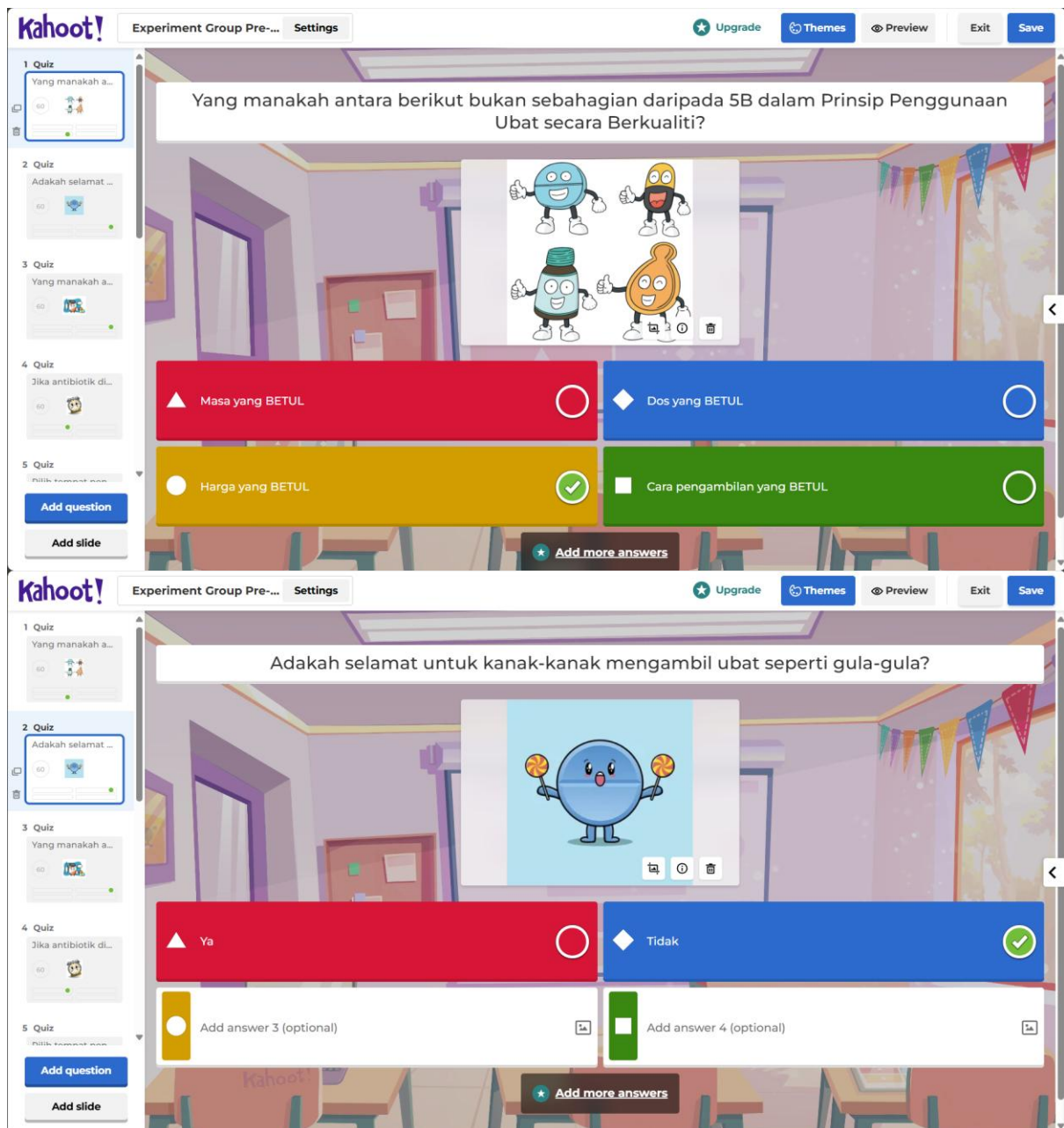
▲ Tablet Capsule

● Skin cream Cough syrup

Add more answers



Pre-test Questions (BM)



Kahoot! Experiment Group Pre-... Settings Upgrade Themes Preview Exit Save

1 Quiz Yang manakah a... 60

2 Quiz Adakah selamat ... 60

3 Quiz Yang manakah a... 60

4 Quiz Jika antibiotik di... 60

5 Quiz Pilih format ...

Add question Add slide

Yang manakah antara berikut membantu memastikan "Ubat yang Betul"?

▲ Memberi ubat berdasarkan warna bungkus ☐

◆ Menyemak semula nama dan bentuk ubat sebelum memberikannya ☒

● Bergantung pada ingatan pesakit ☐

■ Menggunakan preskripsi tulisan tangan tanpa pengesahan ☐

Add more answers

Kahoot! Experiment Group Pre-... Settings Upgrade Themes Preview Exit Save

1 Quiz Yang manakah a... 60

2 Quiz Adakah selamat ... 60

3 Quiz Yang manakah a... 60

4 Quiz Jika antibiotik di... 60

5 Quiz Pilih format ...

Add question Add slide

Jika antibiotik dipreskripsikan sebagai satu tablet dua kali sehari, pada waktu bilakah anda boleh mengambilnya?

▲ 8 pagi dan 8 malam ☒

◆ 6 pagi dan 11 malam ☐

● 9 pagi dan 2 petang ☐

■ 2 petang dan 7 malam ☐

Add more answers

Kahoot!

Experiment Group Pre-...

Settings

Upgrade

Themes

Preview

Exit

Save

Jika antibiotik di...

60

5 Quiz

Pilih tempat pen...

60

6 Quiz

Hari ini 17 Mac 20...

60

7 Quiz

Menyemak identi...

60

8 Quiz

Ubat manakah y...

60

Add question

Add slide

Pilih tempat penyimpanan ubat yang betul.



▲ Kereta

◆ Almaru ubat

✓

● Di sebelah katil

■ Laci meja

Add more answers

Kahoot!

Experiment Group Pre-...

Settings

Upgrade

Themes

Preview

Exit

Save

Jika antibiotik di...

60

4 Quiz

Jika antibiotik di...

60

5 Quiz

Pilih tempat pen...

60

6 Quiz

Hari ini 17 Mac 20...

60

7 Quiz

Menyemak identi...

60

Add question

Add slide

Hari ini 17 Mac 2025. Ubat ini telah tamat tempoh dua bulan lepas, pada 17 Januari. Patutkah anda masih mengambilnya?



▲ Ya

◆ Tidak

✓

● Add answer 3 (optional)

■ Add answer 4 (optional)

Add more answers

Kahoot! Experiment Group Pre-... Settings Upgrade Themes Preview Exit Save

Menyemak identiti pesakit sebelum memberi ubat memastikan "Prinsip" yang mana satu?



▲ Masa yang BETUL ☐ ◆ Ubat yang BETUL ☐

● Pengguna ubat yang BETUL ☒ ■ Dos yang BETUL ☐

Add question Add slide Add more answers

Kahoot! Experiment Group Pre-... Settings Upgrade Themes Preview Exit Save

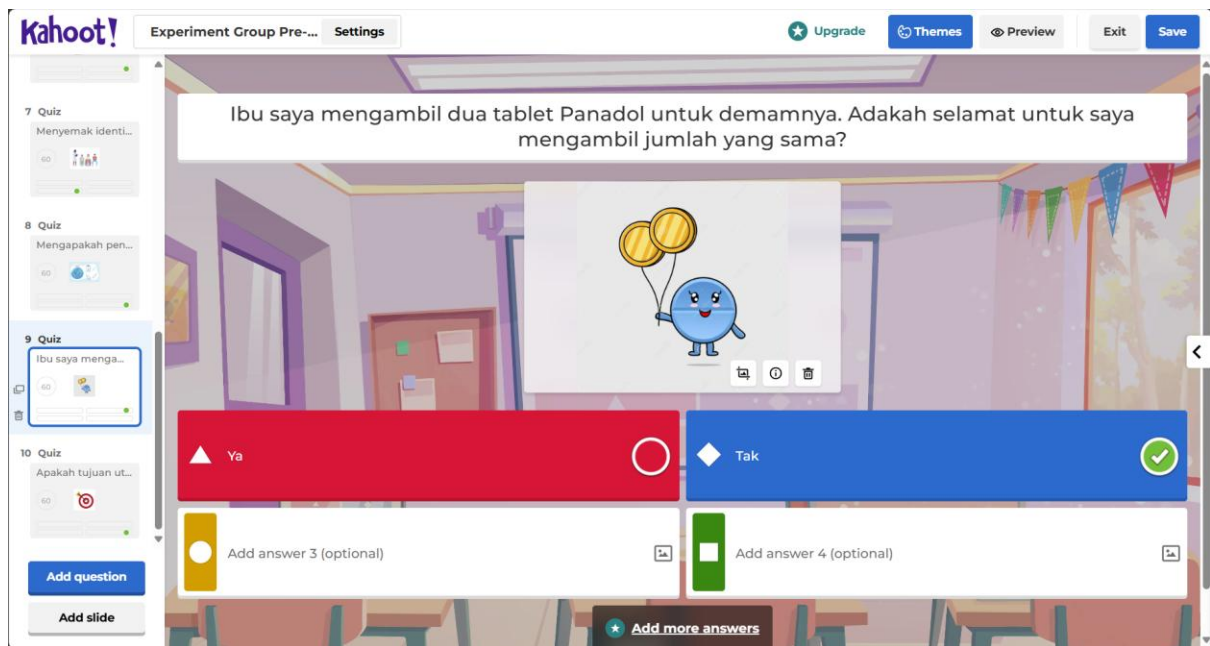
Ubat manakah yang **tidak** patut ditelan?



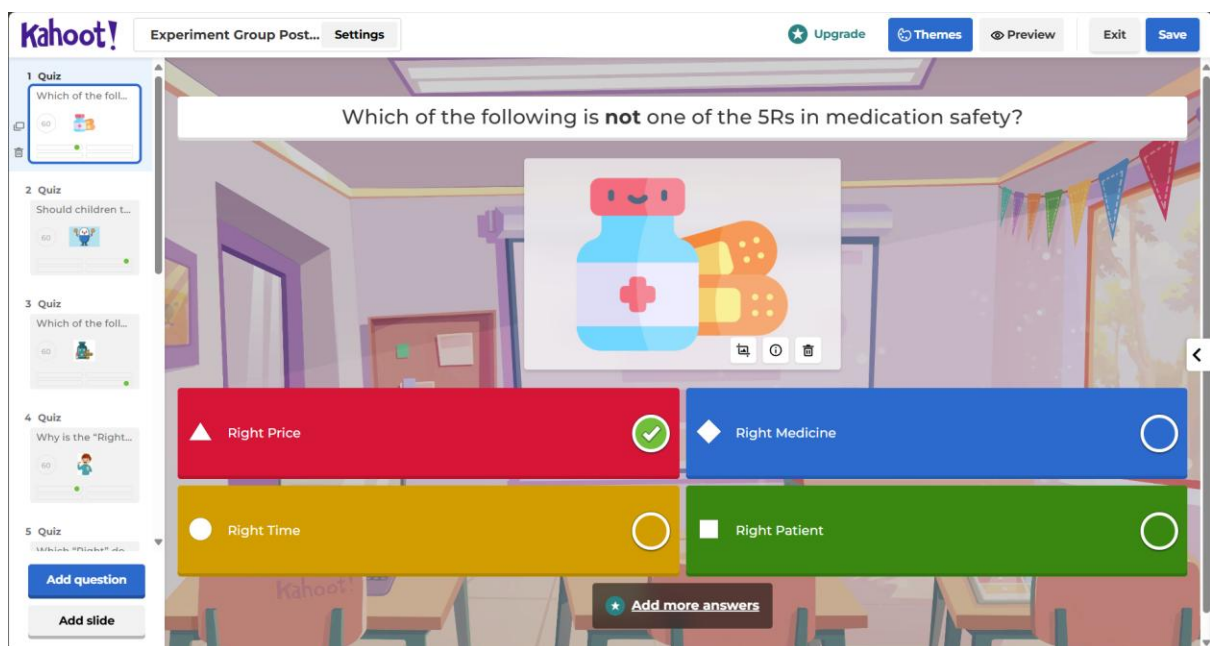
▲ Tablet ☐ ◆ Kapsul ☐

● Krim kulit ☒ ■ Sirap batuk ☐

Add question Add slide Add more answers



Post-test Questions (EN)



Kahoot! Experiment Group Post... Settings Upgrade Themes Preview Exit Save

1 Quiz Which of the foll... 60

2 Quiz Should children t... 60

3 Quiz Which of the foll... 60

4 Quiz Why is the "Right... 60

5 Quiz Which of the foll... 60

Add question Add slide

Should children treat medicine the same way they treat candy?

Yes No

Add answer 3 (optional) Add answer 4 (optional)

Add more answers

Kahoot! Experiment Group Post... Settings Upgrade Themes Preview Exit Save

1 Quiz Which of the foll... 60

2 Quiz Should children t... 60

3 Quiz Which of the foll... 60

4 Quiz Why is the "Right... 60

5 Quiz Which of the foll... 60

Add question Add slide

Which of the following helps ensure the "Right Medicine"?

Choosing medicine based on the label design Accepting unclear prescriptions without checking

Trusting what the patient remembers they took Verifying the medicine's name and dosage form before giving it

Add more answers

Kahoot! Experiment Group Post... Settings Upgrade Themes Preview Exit Save

2 Quiz Should children t... 60

3 Quiz Which of the foil... 60

4 Quiz Which medicine ... 60

5 Quiz Which "Right" do... 60

6 Quiz 60

Add question Add slide

Which medicine **should not** be swallowed?

▲ Skin cream ✓

◆ Tablet ○

● Cough syrup ○

■ Capsule ○

Add more answers

Kahoot! Experiment Group Post... Settings Upgrade Themes Preview Exit Save

4 Quiz Why is the "Right... 60

5 Quiz Which "Right" do... 60

6 Quiz If the label on th... 60

7 Quiz If mom takes 2 ta... 60

Add question Add slide

Which "Right" does verifying a patient's identity before administering medication help ensure?

▲ Right Medicine ○

◆ Right Patient ✓

● Right Dose ○

■ Right Time ○

Add more answers

Kahoot!

Experiment Group Post... Settings

Upgrade Themes Preview Exit Save

60

4 Quiz

Why is the "Right...

60

5 Quiz

Which "Right" do...

60

6 Quiz

If the label on th...

60

7 Quiz

If mom takes 2 ta...

60

Add question

Add slide

If the label on the antibiotic says to take 1 tablet, 2 times a day, what are the times you can take it?

8am and 6pm

7am and 12pm

7am and 7pm

✓

2pm and 10pm

Add more answers

Kahoot!

Experiment Group Post... Settings

Upgrade Themes Preview Exit Save

60

4 Quiz

Why is the "Right...

60

5 Quiz

Which "Right" do...

60

6 Quiz

If the label on th...

60

7 Quiz

If mom takes 2 ta...

60

Add question

Add slide

If mom takes 2 tablets of panadol for her fever, Can I take 2 tablets as well?

Yes

No

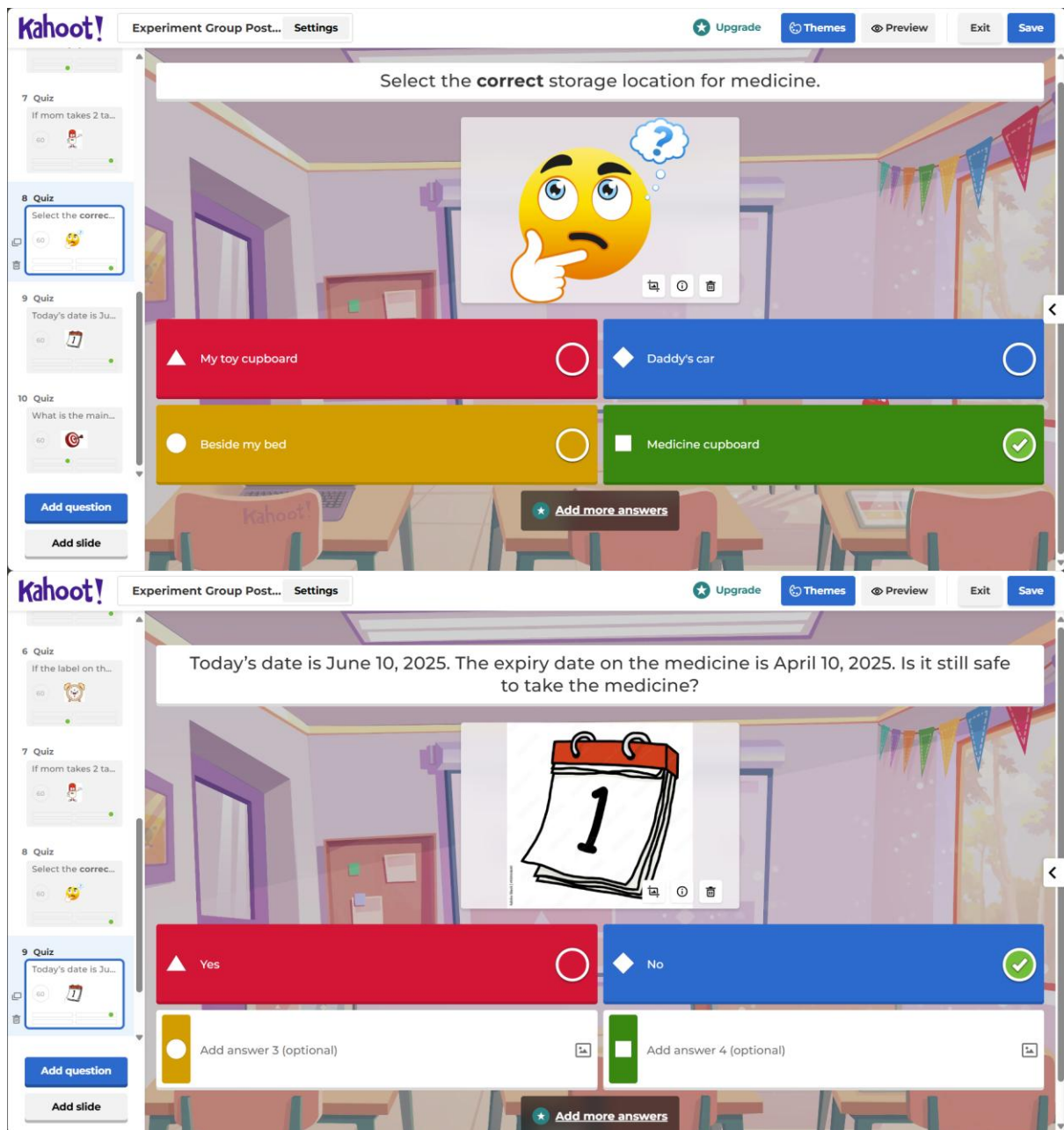
✓

Add answer 3 (optional)

Add answer 4 (optional)

Add more answers

115



Post-test Questions (BM)

Kahoot! Experiment Group Post... Settings Upgrade Themes Preview Exit Save

1 Quiz Yang manakah a... 60

2 Quiz Bolehkah kanak-... 60

3 Quiz Yang manakah a... 60

4 Quiz Mengapakah "Ca... 60

5 Quiz Pilihan jawapan... 60

Add question Add slide

Yang manakah antara berikut **bukan** salah satu daripada 5B dalam Prinsip Penggunaan Ubat Secara Berkualiti?

Harga yang BETUL ☒ Pengguna ubat yang BETUL ☐

Masa yang BETUL ☐ Dos yang BETUL ☐

Add more answers

Kahoot! Experiment Group Post... Settings Upgrade Themes Preview Exit Save

1 Quiz Yang manakah a... 60

2 Quiz Bolehkah kanak-... 60

3 Quiz Yang manakah a... 60

4 Quiz Mengapakah "Ca... 60

5 Quiz Pilihan jawapan... 60

Add question Add slide

Bolehkah kanak-kanak melayan ubat seperti mereka melayan gula-gula?

Boleh ☐ Tidak boleh ☒

Add answer 3 (optional) Add answer 4 (optional)

Add more answers

Kahoot! Experiment Group Post... Settings Upgrade Themes Preview Exit Save

1 Quiz Yang manakah a... 60

2 Quiz Bolehkah kanak... 60

3 Quiz Yang manakah a... 60

4 Quiz Mengapakah "Ca... 60

5 Quiz 60

Add question Add slide

Yang manakah antara berikut membantu memastikan "Ubat yang BETUL"?

Memilih ubat berdasarkan reka bentuk label

Menerima preskripsi yang tidak jelas tanpa membuat semakan

Mempercayai apa yang pesakit ingat mereka telah ambil

Mengesahkan nama dan bentuk dos ubat sebelum memberikannya

Add more answers

Kahoot! Experiment Group Post... Settings Upgrade Themes Preview Exit Save

2 Quiz Bolehkah kanak... 60

3 Quiz Yang manakah a... 60

4 Quiz Ubat manakah y... 60

5 Quiz Prinsip yang man... 60

6 Quiz 60

Add question Add slide

Ubat manakah yang **tidak** patut ditelan?

Krim kulit

Tablet

Sirap batuk

Kapsul

Add more answers

Kahoot! Experiment Group Post... Settings Upgrade Themes Preview Exit Save

Prinsip yang mana satu dipastikan dengan mengesahkan identiti pesakit sebelum memberikan ubat?



Ubat yang BETUL ☐ Pengguna ubat yang BETUL ☒

Dos yang BETUL ☐ Masa yang BETUL ☐

Add more answers

Kahoot! Experiment Group Post... Settings Upgrade Themes Preview Exit Save

Jika label pada antibiotik menyatakan untuk mengambil 1 tablet, 2 kali sehari, waktu bilakah anda boleh mengambilnya?



8 pagi dan 3 petang ☐ 7 pagi dan 12 tengah hari ☐

7 pagi dan 7 malam ☒ 2 petang dan 10 malam ☐

Add more answers

