Empowering Students in Network Security: A Web-Based Learning Strategy with the ARCS Model

BY

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ABSTRACT

According to nowadays, technology has become more advanced in the world. In Malaysia it also becomes the hot topic between the society. With the advancement of technology, people find out that technology is a double-edged sword to our society. Especially for students, they need to know how to protect themselves in network. It brings out that network security is a critical skill for students nowadays. However, the traditional methods of teaching network security lack engaging content and are expensive. This project proposes a website which uses the ARCS model that can teach students network security concept in a more efficient and affordable way. The website will include PowerPoint slides, quizzes, video about hands-on labs and tutorials that will help students learn the essential skills they need to protect themselves online and gain new knowledge. Not only that, but the website will also have some mini games which will further enhance engagement and reinforce key concepts for students when they are playing it. The website also can help the students to reduce learning time. In summary, this project is to enhance the student to be aware of the problem about network security. Students also can learn how to protect their personal privacy when using the network and let the student know how they can solve it if they face the network security problem.

Area of Study: Web-Based Learning

Keywords: Student engagement, Gamification in education, User-friendly Web-Based Learning, Interactive Learning, E-learning

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LIST OF ABBREVIATIONS

ARCS   Attention, Relevance, Confidence, and Satisfaction

HTML   Hypertext Markup Language

CSS   Cascading Style Sheets

Npm   Node Package Manager

CLI   Command Line Interface

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Chapter 1
INTRODUCTION

1.1 Introduction

Nowadays, the technology in our world has undergone an important change due to the fast progress of technology, the need for cybersecurity awareness has become paramount. Network security also becomes a hot topic in the world. What is network security, network security involves all step to protect the computer network and the data within it. Network security has become an important role in protecting the personal data from online threats and ensures the network's reliability and usage [1]. In Malaysia, this growing concern is reflected in ongoing discussions about online safety and the importance of protecting personal privacy information. For students, they need to have a solid understanding of network security concepts on order to navigate the digital environment. But in the traditional methods of teaching network security, such as classroom lectures and textbooks, can be limited their effectiveness. This is because those method often lack flexibility to cater to individual learning style, rely heavily on rote memorization, and it can cost more time and expensive to deliver. UTAR has a website which is call "WBLE". WBLE is the Online Learning Environment that let the students to access the latest course materials [2]. before the class. But in WBLE, it has lacked some efficient such as the student need to download the material, or the website will auto jump to other webpage before they read such as the Adobe Acrobat Reader. The purpose of the project is to design to address the limitations of WBLE and provide students with a more efficient, affordable, and engaging way to learn network security concepts which will use the ARCS Model in this Web-Based Learning. Also, use the gamification way such as quiz or mini game to let the student gain the knowledge.

1.2   Problem Statement

There is some limitation for getting the knowledge of network security nowadays, such as classroom lectures and textbooks, often come with limitations that limit the students' understanding and engagement. Below is the limitation that we are facing nowadays:

Firstly, the problem statement is **Inflexibility and Lack of Engagement**. Traditional methods may be inflexible and unadaptable to different learners' needs and levels of learning. Students might find it difficult to stay up with the class's rapid pace or may not have the chance to learn

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at their own pace. Also, that, Lectures and textbooks can be passive learning environments that cause the student no interest and make it harder to remember the material in the lecture or textbooks. The content may seem boring and uninspired to students, or they may find it difficult to relate to it. It also will cost that the student no attendance to the class.

Secondly, the problem statement is **Cost and Time Constraints**. The traditional method can be time-consuming and costly for both lecturer and students. This is because the classroom sessions may not offer enough time for in-depth exploration of concepts to students. Also, that the students may have limited opportunities to practice their skills. It will bring out that the student needs to take their extra time to learn the knowledge themselves using the extracurricular book. Next, effective network security education may be challenged by the expense of classroom space, curriculum materials, the tools for the students use when practical class and instructor training.

In today's digital world, network security has become increasingly important to all the people. Thirdly, the problem statement is **Network Security Awareness**. It is crucial that students are well-information about the principles of network security. This includes not just comprehensive how to keep personal information safe but also making sure that organizations data is protected from potential cyber threats when students are in internship or working. Promoting an understanding of network security awareness among students will make them be more equipped to handle the challenges of the digital world, both in their personal lives and when they are conducting an internship or start working in the company. By being this proactive approach not only improve individuals' ability to defence cyberattack but also help to improve cybersecurity in different areas of society.

Next based on the article [10], Web-Based Learning will also lead to some problem such as **student will feeling of isolation** because they are studying the knowledge with the computer not with their teacher or lecturer. Especially when they face the problem like how to solve technical problems or how to navigate the systems. Next, the **student's attitude** when using the Web-Based Learning also an importance element that will affect the learning result. So, it also brings out the problem to the Web-Based Learning need to use the ARCS such as Attention, Relevance, Confidence, and Satisfaction to make the student have the good engagement in using the Web-Based Learning. Next, the problem is **the website have the**

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relevance to the students. The relevance is how the students look at the instructional, did it match with their goals, compatibility with their learning styles. After that, the mini game on the website **should not allow students to become addicted** to them and lose sight of the purpose of learning using the gamification.

1.3 Motivation

The aim of the project is to let students know more educated population regarding online safety. Students must have a strong understanding of network security fundamentals since cyber threats are always evolving. To address **limitations of traditional methods** for teaching network security, A web-based learning can overcome these limitations by offering flexibility, interactive content, and more cost-effective approach. Besides that, a web-based platform has improved accessibility and inclusivity which it provides 24/7 access to learning materials, making it ideal for students with their busy schedules or those who like to learn with their own pace. Additionally, it can also be used to suit different learning styles through interactive elements and multimedia content. Not only that, but it will also have the webpage that let student to put their question that they can't solve it. So, other students that know how solve the question can just answer it in using the comment function. It will bring out that the students can exchange their knowledge by the discussion page. Also, the website will be design at focus on grab and maintain the student's attention. Stimulating student curiosity, interest and content search and other related topics attention are important to the website. After that, the website will make the students have more confident by the materials of the website. When the student found out that their ability to succeed is based on their efforts, and their success is affected by their own rather than the external factors. It will lead that the student have the motivation to learn by using the website. Finally, this website also will let students to direct read the lecture slide at the website without using the third party to read or focus the student to download it.

1.4 Project Objectives

This project was aimed to address the learning issues faced by student which to help students to effective learning via used Web-Based Learning using ARCS model:

I)   Enhancing learning experiences

    a. Create a user-friendly Web-Based Learning platform for students to easy access the learning materials.

II)   Increasing engagement by using interactive elements

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a. In the Web-based Learning, it has included the quizzes and mini game to let the students have engagement.

III) Facilitating knowledge sharing among students and improve students' understanding of network security.

a. Students can post the question to the Web-Based Learning to ask other students to answer which it brings out that the students can exchange their idea and learn with each other.

Ultimately, these efforts will not only benefit the students but also aid in constructing a society that is more knowledgeable about and could respond to cyberthreats. So, when the students have graduate, they will possess the skills needed to protect their own information as well as that of organizations from variable cyber threats.

1.5   Project Scope and Direction

The scope of the project is to develop a user-friendly web-based learning environment that is specific for students from UTAR to gain knowledge of network security education needs. This website will aim to provide students with engaging content that includes interactive elements and multimedia features. The content is specifically designed to accommodate different learning styles. Additionally, it will include functionality such as discussion forums, question submission portals or global chat box to facilitate collaboration and knowledge exchange among students. The primary of the website is accessibility and inclusivity the website will offering 24/7 access to learning materials, so that students with different schedules and preferences can easily take or use the learning materials. Moreover, the website will act as a central point for increasing knowledge about network security principles among UTAR's students, giving them the ability to protect their personal data and organizational data with confidence. Furthermore, the website will not need the students to download the learning materials slide, it will also be eliminating the need for third-party software when they wanted to study it. The website will provide a seamless learning experience to students. The direction for this project is finding the existing research paper about Web-based learning using ARCS model. To find out more the result, limitation and improvement for Web-based learning. After the research, designed and developed the web-based learning using ARCS. After developing, announce to students to have a test use the web-based learning to gain the feedback to improve the web-based learning become more consistent. After improving it, keep announce to

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students to gain more feedback about the website. Lastly, summarize all information and the report will be done in documentation.

1.6   Contributions

This project at the end will contribute to UTAR students on rising awareness and provide the information about network security. Not the student from any faculty can use the website to gain the extra knowledge. The knowledge can help the students to make prevention earlier to avoid their personal information getting hack. After that, the students will also have the ways to cope with the situation to prevent a worse outcome.

1.7   Report Organization

This report has cover total seven chapters. In the first chapter, the report begins with an introduction of this report then an overview of problem statements which are inflexibility and lack of engagement, cost and time constraints and Network security awareness. Next, the chapter also includes motivation, project objective, project scope and direction, contributions and report organization were listed to let the readers have more understanding about the project.

Chapter two presents the review of literature, focusing on e-learning theory, review the ARCS model, web-based learning using ARCS model and previous work. In the e-learning theory, review the ARCS model and web-based learning using ARCS model have provides an overview of theory, ARCS model and how it affects the web-based learning. For the previous works, this section provides an overview of existing web-based learning system with some limitations and proposed solutions presented. It also has provided the table by comparison of previous work result.

Chapter three summarizes the methodology, approach use, and system model used in development of Web-Based Learning system. This chapter is divided into several sections such methodology that used to develop the system, system and functional requirements, project timeline with milestone, estimate cost and a concluding remark. Chapter four focuses on system design of the Web-Based Learning which includes system block diagram, system components specifications, system architecture diagram of system, use case diagram and flowchart for each activity of Web-Based Learning.

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Chapter five is about the implementation of Web-Based Learning system such as hardware and software setup, configuration of the project for deployment and testing purpose. System operations for Web-Based Learning, implementation issues and challenges during the deployment and testing phase.

Chapter six are about providing evaluation of Web-Based Learning system and discussion of the system outcome and performance. This chapter includes the questionnaire result that the user answer for the Web-Based Learning system, test case for Web-Based Learning, project challenge, objective evaluation and a concluding remark. Chapter seven provides a conclusion and recommendations of report which focus on summarize the result of project and provide suggestions for future development.

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Chapter 2
Literature Reviews

In this section will focus on doing the research for the previous work

2.1   The E-learning Theory and Web-based Learning

Online education has become more efficient to students to learn knowledge compared to the traditional classroom education [13]. Online education also calls as "E-learning" which is using a digital tool. By this education method it has create a higher impact on education practices by connecting students to each other. This is because E-learning has provided some advantages such as easy accessibility to information, ease of content updating and standardization of content, among others [14]. In E-learning, students can have more flexibility to plan their own time and follow their own pace to learning which will lead them to achieve the personal learning objective. One of the most useful tools for E-learning is Web-based Learning. Web-based Learning is using the Information and Communication Technology (ICT) to share information for educational with instructors and learners when the distance is far between both by using real-time conferencing, collaboration and communication which only needs a good internet speed and advanced computers, the online education and research will become easier compared to the past. Based on the research paper [11], it has used the create a course which is information security to students use the Teaching principles and ARCS model strategies shown Figure 2.1.2. After done the research, the outcome of the research paper has shown that ARCS model is a good tool use to improve student's learning outcomes. Using the information of research paper [11] as foundation, it has been shown that having a Web-Based Learning using ARCS model can lead to more effective student learning.

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Categories	Principles	Teaching strategies
Attention	1. Perceptual arousal 2. Inquiry arousal 3. Variability	1. Use news of InfoSec incidents to cause protection motivation. 2. Use daily InfoSec issues to maintain students' curiosity. 3. Use weekly changes in teaching methods and content.
Relevance	1. Goal orientation 2. Motive matching 3. Familiarity	1. Combine the students' daily mobile phone operation experience. 2. Set teaching goals to make students aware of daily InfoSec risks. 3. Combine current news to set up learning.
Confidence	1. Learning requirements 2. Success opportunities 3. Personal control	1. Use Interactive Response System activities to provide a successful learning experience 2. Assign a final report that matches the students' abilities. 3. Provide online teaching materials for self-directed learning.
Satisfaction	1. Natural consequences 2. Positive consequences 3. Equity	1. Ask students to design the team games tournament for team reports. 2. Provide verbal praise and rewards. 3. Maintain consistent assessment standards in the semester grades.

Figure 2.1.2 Teaching principles and ARCS model strategies in this research

2.2 Review ARCS model

What is ARCS model? ARCS model is a model that focusing on Attention, Relevance, Confidence, and Satisfaction which developed by John M. Keller in the late 1970s and introduced in 1983, is a framework for enhancing learner motivation in education setting. After that, the ARCS model has become widely adopted in various educational context such as K-12 education, higher education, corporate training, and online learning. It also a foundation tool in instructional design, helping educators and trainers create more engaging and effective learning experiences.

2.3 Web-Based Learning using ARCS Model

Web-Based Learning enhanced by the ARCS model the four component such as Attention, Relevance, Confidence and satisfaction which can significantly increase student engagement and learning outcomes. As the Figure 2.3.1 show the framework for the component of ARCS model that will affect the effective of online learning which is from the [15] research paper, The first component is Attention, second is relevance, follow by confidence. Next, the satisfaction and lastly the effectiveness of online learning tools. The Web-Based Learning using ARCS model can focus on capturing attention through interactive elements such quiz and hangman, ensuring content relevance, building confidence when learning using web-based learning, and providing satisfaction via feedback and rewards. By applying this model, educators can create personalized and motivating online learning experiences that keep students focused and improve their overall learning effectiveness.
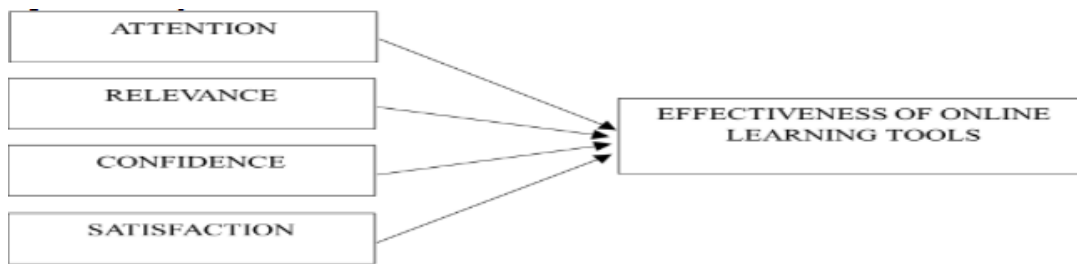
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Figure 2.3.1 ARCS model Framework

2.4 Previous works on Web-Based Learning using ARCS

2.4.1 ARCS model use in Web-Based Learning education

Based on [12] research paper, the author has applied the ARCS model to real education settings, including computer-based learning approaches. In the research paper, author use content analysis for this review because the most articles did not report enough statistical result for meta-analysis. The author has discussed how researchers used the ARCS model to three perspectives which are the components of the ARCS model, the context in which study was undertaken, and which part of the course are embedded in the ARCS strategy.

I) The component ARCS model

The most literature review are used for this research paper have all four component of the ARCS which have Attention which to engage students' interest in the learning material, Relevance such as connect the material to students' personal goals and needs, Confidence like help students believe they can succeed through effort and Satisfaction which ensure students feel rewarded and proud of their achievement.

II) The Study Context

To know the specific educational environment needed, the author has summarised a few countries, participants, course delivery methods, and fields. The countries of studies have shown as the Table 2.4.1.1. The wide range of participants including K-12 students and teachers, higher education students, vocational students, and employed adults which shown as the Table 2.4.1.2. As shown in Table 2.4.1.3, there has most vocational areas are represented in the table. The authors only have used the multiple subject areas to recruited participants who were educators teaching various subjects. Type of courses to which the ARCS model needed also different based on the technology of the learning environment which shown as Table 2.4.1.4.

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Countries	Studies
Austria	Astleitner and Hufnagl (2003), Astleitner and Lintner (2004)
China	Zhang (2017)
Malaysia	Annamalai (2016), Wah (2015)
Mozambique	J. Visser and Keller (1990)
Taiwan	C. Chang, Chang, and Shih (2016), M.-M. Chang and Lehman (2002), ChanLin (2009), Chen (2014), Feng and Tuan (2005), Hung, Chao, Lee, and Chen (2013), Liao and Wang (2008), Wu, Tsai, Yang, Huang, and Lin (2012)
Turkey	Aşıksoy and Özdamlı (2016), Karakis, Karamete, and Okçu (2016), Kurt and Keçik (2017), Ocak and Akçayır (2013)
U.K.	L. Visser, Plomp, Amirault, and Kuiper (2002)
U.S.A.	Doering, Scharber, Riedel, and Miller (2010), Hodges and Kim (2013), Huett, Kalinowski, Moller, and Huett (2008a), Huett, Kalinowski, et al. (2008a) and Huett, Moller, et al. (2008), Kim and Keller (2008), Means et al. (1997), Moller and Russell (1994), Song and Keller (2001)

Table 2.4.1.1 Countries of studies

Participants	Studies
K-12 students	Feng and Tuan (2005), Karakis et al. (2016), Ocak and Akçayır (2013), Song and Keller (2001), Wah (2015)
K-12 teachers	Doering et al. (2010)
Technological and vocational students	Annamalai (2016), Liao and Wang (2008), Wu et al. (2012)
College students	Aşıksoy and Özdamlı (2016), Astleitner and Lintner (2004), Astleitner and Hufnagl (2003), C. Chang et al. (2016), M.-M. Chang and Lehman (2002), ChanLin (2009), Chen (2014), Hodges and Kim (2013), Huett, Kalinowski, et al. (2008a) and Huett, Moller, et al. (2008b), Huett, Kalinowski, et al. (2008a) and Huett, Moller, et al. (2008b), Kim and Keller (2008), Kurt and Keçik (2017), Means et al. (1997), Zhang (2017)
Graduate students	L. Visser et al. (2002)
Both college and graduate students	Hung et al. (2013), Moller and Russell (1994)
In service learners	J. Visser and Keller (1990)

	second language	Chang and Lehman (2002), Hung et al. (2013), Kurt and Keçik (2017),
	Social science	Astleitner and Lintner (2004), L. Visser et al. (2002)
	STEM	Aşıksoy and Özdamlı (2016),ChanLin (2009), Feng and Tuan (2005), Hodges and Kim (2013), Karakis et al. (2016), Kim and Keller (2008), Song and Keller (2001), Means et al. (1997), Wah (2015), Zhang (2017)
	Technical, professional and vocational	Astleitner and Hufnagl (2003), Chen (2014), Huett, Kalinowski, et al. (2008a) and Huett, Moller, et al. (2008b), Huett, Kalinowski, et al. (2008a) and Huett, Moller, et al. (2008a), Liao and Wang (2008), Ocak and Akçayır (2013), J. Visser and Keller (1990), Wu et al. (2012)
	Multiple	Doering et al. (2010)

Table 2.4.1.3 Subject areas of studies

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Delivery method	Studies
No computer or Internet supported instruction	Astleitner and Lintner (2004), Kim and Keller (2008), Liao and Wang (2008), Means et al. (1997), Moller and Russell (1994), Kurt and Keçik (2017), J. Visser and Keller (1990), L. Visser et al. (2002)
Blended instruction	Aşıksoy and Özdamlı (2016), Hodges and Kim (2013), Ocak and Akçayır (2013)
Web-based instruction	Astleitner and Hufnagl (2003), M.-M. Chang and Lehman (2002), ChanLin (2009), Chen (2014), Doering et al. (2010), Feng and Tuan (2005), Huett, Kalinowski, et al. (2008a) and Huett, Moller, et al. (2008b), Huett, Kalinowski, et al. (2008a) and Huett, Moller, et al. (2008)
Computer assisted instruction	Annamalai (2016), Hung et al. (2013), Karakis et al. (2016), Song and Keller (2001), Wah (2015), Wu et al. (2012)
Mobile learning	C. Chang et al. (2016), Zhang (2017)

Table 2.4.1.4 Course delivery methods

III) Course component

The author divided course components into which the ARCS strategies into six categories which has shown as Table 2.4.1.5. As the Table 2.4.1.5 shown the Email/message, instructional text and video are chosen the most frequently to apply the ACRS strategies as a single course.

Course Components	Studies
Email/Message	Huett, Kalinowski, et al. (2008a) and Huett, Moller, et al. (2008b), Kim and Keller (2008), J. Visser and Keller (1990), L. Visser et al. (2002)
Face-to-face instruction	Kurt and Keçik (2017)
Instructional texts	Astleitner and Lintner (2004), Means et al. (1997), Moller and Russell (1994)
Video	Astleitner and Hufnagl (2003), Hodges and Kim (2013),
Different course components	Aşıksoy and Özdamlı (2016), M.-M. Chang and Lehman (2002), ChanLin (2009), Chen (2014), Feng and Tuan (2005), Liao and Wang (2008), Ocak and Akçayır (2013), Wu et al. (2012)
Other programs	Annamalai (2016), C. Chang et al. (2016), Doering et al. (2010), Huett, Kalinowski, et al. (2008a) and Huett, Moller, et al. (2008b), Hung et al. (2013), Karakis et al. (2016), Song and Keller (2001), Wah (2015), Zhang (2017)

Table 2.4.1.5 Course components with ARCS strategies

The one type of research design used for the author in research paper is factorial design, widely used is experimental design method and mixed method study. The factorial design is to find out the effect of each the factors and the interaction. The factors are including did the students have intrinsic or extrinsic relevance to a given topic, the learning materials that the students receive have relevance strategies or without it and the satisfaction of the students

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such as did the students satisfied with their previous scores, and motivational messages. According [12], there also have other design method which is widely used is experimental design method and mixed method study.

The research outcome for the research paper uses the ARCS model on students' motivation and achievement have been categorized into four different domain which are affective domain, cognitive domain, learner behaviours, and other psychological traits [12].

2.4.2 U-Net: Convolutional Networks for Biomedical Image Segmentation

Based on the [3] research paper that was about the e-learning service quality. This research paper aims to find out whether user satisfaction has an impact on the quality of e-learning website. There are 3 important things in this research paper which is E-learning Issues, E-learning Trends and E-learning Service Quality.

I) E-learning Issues

E-learning tools are being use as course materials due to its usability and accessibility. As compare with traditional method the environment of learning is different. As the traditional method is face-to-face [4] and the E-learning is less face-to-face. It might make students lack interaction. Therefore, it requires inspiration and impressive skills to motivate the users and make them focus on virtual learning.

II)E-learning Trends

Due to the technology nowadays become more advancement, the E-learning had become the trends in educational institutions. It also helps the institutions are lacking professional skills and learning equipment. For example, the country call Tanzania is exploring the E-learning development because of the country is suffering from lack of learning resources and less experience in development [5]. By using the E-learning Tanzania has proven that the students in their country are believed to E-learning is a useful tool that enable them to understand the learning content faster and efficiently [5].

III)   E-learning Service Quality

Service quality in e-learning are determined by comparing the user's expectations of the service via the way the service is perceived to be delivered through the features of services [6]. The goal of the service quality is to determine the quality of teaching and learning materials to the students. According to [7], the key to success of an online course can be influenced by the correct on use the media can facilitate the students between the teacher which can be measured in terms of the quality of the system, information, students' satisfaction, and the use of the system.

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The example system that takes in this research paper is call MEDIU E-learning system. MEDIU has provides learning by transferring the knowledge through their website. MEDIU has developed an Internal web portal where the learning and teaching process happen. The students also can take their learning materials from the portal. Furthermore, teaching and learning are also part of the system where the students can attend classes online. MEDIU was chosen as a case study in this research because the university provides online education to local and international students.

Category	Type	No. of Respondent
Gender	Male	36
	Female	26
Nationality	Local	34
	International	28
Level of education	Undergraduate	34
	Postgraduate	15
	Others	13
Study workload	Full Time	44
	Part Time	18

Table 2.4.2.1 Demographic Analysis

Factor	Mean	Interpretation
User Satisfaction	3.46	Satisfied
System Quality	3.40	Satisfied
Information Quality	3.82	Satisfied

Table 2.4.2.2 Influencing Factor Analysis

From the previous research [3], it also has made research which is show as the Table 2.4.2.1. it shows that the respondents are composed of international and local students. This research is focusing on how nationality influences the length of learning distance, whether it be short or long. Through the distance learning, this research able to compare the results of the surveys that include previously determined service quality variables to understand each remote learning group's point of view. Table 2.4.2.2 shows that the results of the 3 influence which is User satisfaction, System Quality, and Information Quality. As referring to the table it has shown that all respondents were satisfied with the MEDIU E-learning system.

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Next, referring to the research [8], web-based teaching and learning self-directed platform also need to carry out the three aspects such as strategy analysis, infrastructure framework, and design method and visualization technology. This research promotes the use of more diverse learning methods in higher education. By combining the traditional education and web-based teaching and learning methods. Even though, the students can gain the base knowledge at the lecture class. But it still has a lot of students will use their free time in network to explore the extracurricular knowledge. It might cost the interest of the students for their main course will decrease because of the specialty preference. The purpose of web-based learning function is to enhance students 'capacity of cultural understanding [9], self-directed learning, and effective self-evaluation. The element that needs in the design strategy of web-based teaching and learning self-directed platform is shown as Fig.2.4.2.3
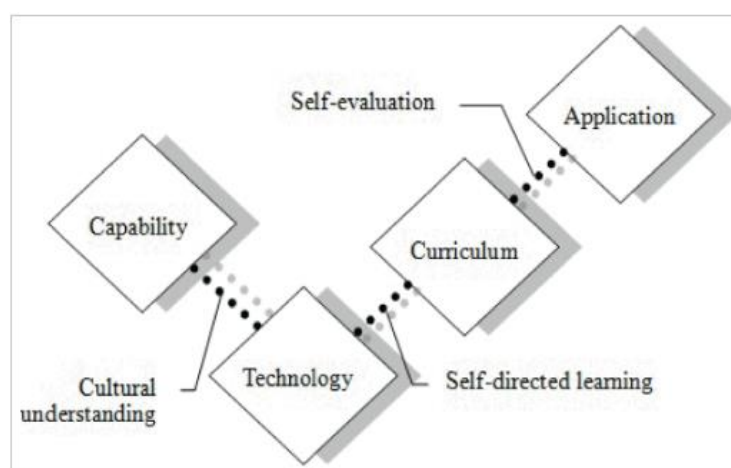

Figure 2.4.2.3 Strategy relationship of platform

2.4.3 Gamification Teaching Based on ARCS model to improve students' perceived information

The concept of using games or gamification in online learning is become the hot topic for social nowadays. The gamification in online learning aims to make the learning process become fun and simplify by using technology. Based on research paper [16], the authors have reminded that a lot of tool and technology has been created to improve the education system. The tool authors focus on the research paper are Game. This because the aims of the authors are to enhance the job opportunities for graduated students using serious game. The methodology of [16] have use three process which are Preparation, Analysis and Writing which have shown as the Figure 2.4.4. The authors have collected 224 research paper which is related to the gamification online learning to do the data analysis method research which shown as Figure 2.4.5. After the research, authors have gained the outcome which authors believe that apply gamification in e-learning have a potential to improve the engagement, performance and motivation for students, graduated students or other users. With this paper we can say that gamification is also a factor in improve the success of web-based learning. Not only that, it also sustainable for the ARCS models such as make student attention and having the network security game to let students learn via playing.

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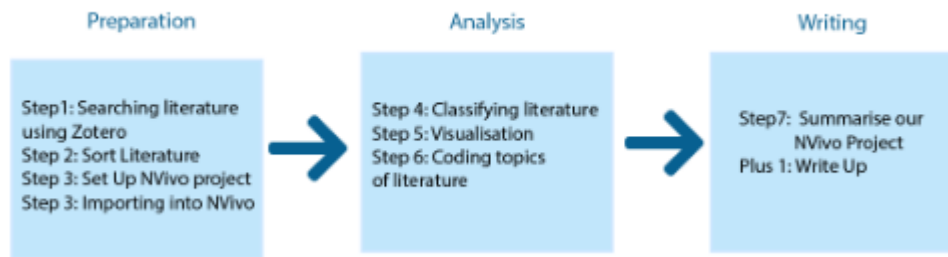
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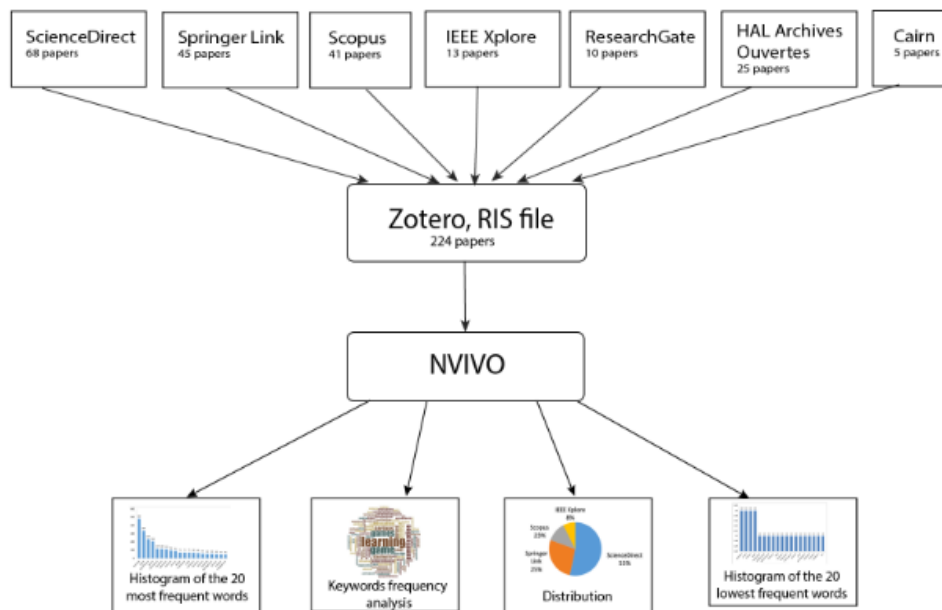Figure 2.4.4 Process and step

Figure 2.4.5 Description of data analysis methods.

Lastly, follow by the increasing of games and game-like components in nowadays. So, it brings out that the field of education must adapt to a new educational environment characterized. The learning process need to add new environment characterized such as gamification. The research paper [17] is research about the Gamification Teaching based on ARCS model. The authors have developed the Web Page Production and Practical Training by using gamification based on the ARCS model and implements in practical classroom. The authors use the Questionnaire Reliability and Validity Analysis method to collect the data from the students and teachers. After collect the data, the authors use the alpha reliability coefficient method in SPSS software to analyse the results. First, the Validity Test have shown that the results of the pre-test questionnaire were consistent with the studies. Next, the result has shown the satisfaction of the students have 89% which it can say that compare with the traditional classroom teaching, the gamified teaching mode based on the ARCS motivation model will be more helpful for students to learn the knowledge. It brings out the conclusion

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that using this teaching mode will stimulate students' interest in learning and help the students to understand of knowledge.

2.5 Limitation of Previous Studies

In the Previous studies [3] did not cover on how the institutions can do to control the negative activities like cheating, plagiarism and copy and paste the answer when the students are using the E-learning platform to do their test or quiz. Not only that, the result of research [3] might get effect by other factor such as user-friendly design, the cybersecurity for the system or is the website is device-agnostic because of if the students did not have the laptop or desktop, they can't access to the system to use the web-based learning system. Next, the limitation of the [12] research paper is the most study used self-reported data such questionnaires, interviews and students' reflective writing to measure other outcomes like motivation and attitudes. It might not be reflective of the research on the application of the ARCS model. The limitation for [17] is the ARCS motivational model cannot help a part of the students to have a better understand and access to knowledge because those students cannot adapt quickly in the short term.

2.6 Proposed Solutions

This project aims to propose an environment that efficient, simple, and fast to UTAR students to gain the network security knowledge. the project should add an influence factor of E-learning service quality such as web service quality. As mentioned by [6], online learning service quality can also be measured through service quality and website quality despite from system quality and information quality. The web-based learning should be design and develop as user-friendly for the UTAR students. Next, Web-based learning will provide engaging content with interactive elements such puzzle game to attract the students. The reasons the project use the ARCS model are because that ARCS model have the potential to take the attention for students and inspire them to put more effort at using the Web-Based Learning to acquire new knowledge.

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2.7 Table of Compare the previous work

Research paper	Method	Result/outcome
Web 2.0 Technologies Use in ARCS Motivational Model-Based Online Learning on Student Performance in STIPAK Malang [19]	- Used the quantitative method for ex post facto-correlational study	- The Web 2.0 technologies in ARCS motivational model-based learning exerted have affect 51.4% student performance - The rest of 48.6 % have been affect by other factor such as interaction with friends or teachers, students' engagement in the learning and suitability of learning strategies.
Using the ARCS model to improve undergraduates' perceived information security protection motivation and behaviour [18]	- Research design - Questionnaire - Open-ended questions and interviews	- Use ARCS model will improve student learning outcomes
Research on Gamification Teaching Based on ARCS Motivation Model—Taking the Mid-Level "Web Page Production and Practical Training" as an Example [17]	- Using gamification teaching on ARCS model	- 89 % students feel satisfaction than traditional teaching method - 50% students cannot adapt quickly in short term

Table 2.7.1 Compare the previous work

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Based on the Table above, it has shown the 3 comparisons for the research paper. By the comparison, it shown that the ARCS model has the significant influence such as attention, relevance, confidence and satisfaction on a students' interest and engagement to learn the new knowledge by using the Web-Based Learning. The students have more satisfaction on using Web-Based Learning compared to use the traditional method to learn knowledge.

2.8   Summary for Literature Review

In the summary of the literature review, Web-Based Learning should use the ARCS model to improve student motivation and learning outcomes. Which the ARCS model is implemented the four components such as attention, relevance, confidence and satisfaction on a student to improve the student learning process.

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Chapter 3
System Methodology/Approach OR System Model

Proposed Method

The processes of the project were categorized into different phases in the development, which were designing, developing, implementing, and evaluating effective online learning experiences. Next, apply the four components of ARCS model which are Attention, Relevance, Confidence, and Satisfaction on the website to increase the student interest about learning the knowledge. For example, having a clear understanding layout for attract the student's attention, use the learning materials connected with the student's goals which is learn the network security knowledge. Not only that, the web-based learning will have an interesting engagement to let the student learn the knowledge by play quiz or other mini game which will make the student feel more confidence and satisfaction when they complete play the mini game.

3.1 Methodology

3.1.1 Software Development Life Cycle model (SDLC)

The Software development life cycle is a structured process that is used to design, develop, and test good-quality software. It also is a methodology that defines the entire procedure of software development step by step.

3.1.2 Agile model

Figure 3.2.1.1 Agile model

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This project has used the Software Development Life Cycle type of Agil model. Agile model is a software development methodology that emphasizes incremental, iterative development with a strong focus on collaboration and customer feedback. Agile model will be used for this project is:

I) **Adaptability**

    a. Agile development processes adapt quickly to changes and enable ongoing enhancements based on user input and feedback. This is important when using the ARCS model to optimize learner engagement.

II) **Continuous Improvement**

    a. Keep improve the ongoing enhancements in both functionality and security measures, ensuring the system remains up-to-date and effective.

III) **User Participation**

    a. Collaboration with user ensures that both educational and interface are consistently met with user expectations.

IV) **Early Detection of Issues**

    a. At the testing and reviews during the testing phase facilitates early detection and resolution of security vulnerabilities and usability issues.

3.1.3 Phase for Agile model

The first phase for the project is plan phase, in this phase I will define the project scope, objectives and goals. Also, I will gather the requirement that can help the project to hit the goals. After defining the project goals, prioritize tasks and features to be developed. Lastly, I will start to establish timelines to help me manage time and resources needed by the project.

The second phase for the project is design phase, the purpose of this phase is to outline how the web-based learning and features will work, including architecture and user interfaces. I will create the prototypes such as the wireframes and define the system architecture for the web-based learning. After that, the design will be review to students to make sure it can be satisfied and met the student's requirement.

The third phase for the project is develop phase, in this phase the web-based learning will be build based on the designs and the requirements that review by students. I will use the Visual Studio Code to write code for the website layout, features and functional for the website.

The fourth phase for the project is test phase, in this phase the demonstration of web-based learning will be done one time by myself. After self-test, the web-based learning will be sent

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to few students to do the testing to conduct user acceptance testing which to make sure the web-based learning features work as expected and meet the requirements and to validate that the web-based learning meets the criteria defined in the plan phase.

The fifth phase for the project is deploy phase, in this phase the web-based learning will fully release to public. First, will deploy the web-based learning code and ensure all configuration are set correctly. After that, monitor the deployment for any issues or bug. Lastly, make the web-based learning available to students.

The last phase for the project is review phase, in this phase is to assess the performance and outcomes of the web--based learning. Firstly, gather feedback from the students review the feedback to know the outcomes against the plan phase goals. After reviewing, improve the web-based learning or fix any error based on the feedback.

3.2 System Requirement

3.2.1 Hardware

The hardware involved in this project is laptop. The laptop used for development the website. Also, the laptop used for deployment, host and test the website.

Description	Specifications
Model	Asus ROG Strix G15 G513I-HHN044T
Processor	AMD Ryzen™ 7 4800H
Operating System	Windows 10
Graphic	NVIDIA GeForce GTX1650 DDR4 3200 8G
Memory	8GB DDR4-3200 SO-DIMM RAM
Storage	512GB M.2 NVMe™ PCIe® 3.0 SSD

Table 3.2.1 Specifications of laptop

3.2.2 Software

Visual Studio Code will be used as development platform for the Web-Based Learning system. HTML, CSS and JavaScript will be the programming language in developing the Web-Based Learning system. The Firebase will be used for the user authentication, database and hosting for the Web-Based Learning system.

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3.3 Function Requirements

To Ensure the functionality of the project, the function have been listed below:

1) User Registration – User should be able to use their email address to register an account and users allow to choose the role as Student or Lecturer. This enables the user to access Web-Based Learning.

2) Access Learning Material –Users who as student should be able to browse and access learning materials by the system

3) Access Tools – Users who as student should be able to use the tools that provide in the system.

4) Global Chat – Users who as student or lecturer should be able to chat with other user for information exchange in real-time.

5) Mini Game – Users who as student should be able to access the mini game section to play to learn about the subject.

6) Questionnaire – Users who as student should be able to answer questionnaire to review the Web-Based Learning effectiveness for them. On the other side, users who as lecturer can review the Questionnaire that is answered by students.

7) Forum – Users should be able to access the forum to post the question to ask other user for help.

8) Quiz – Users who as student should be able to answer the quiz that created by the lecturer and get their result, However, users who as lecturer can create new quiz or manage the existing quiz.

9) User Profile – Users allow to view their username, role, email address and rest passwords in their profile.

3.4 Project Milestone

3.4.1 Project I Timeline

This section is to shows the timeline of project I and project II with its milestone
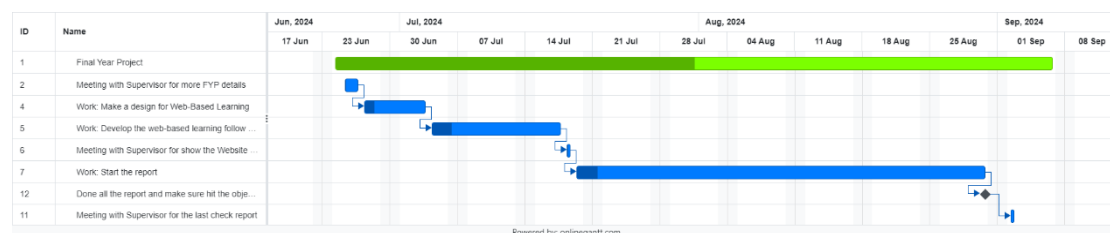
Figure 3.4.1 Gantt Chart timeline for Project I timeline

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Figure 3.4.1 shows the timeline for the project. The total time for this project is 12 weeks. First, I start meeting with my Supervisor for more FYP 1 details on week 2. After that, I used 1 week to make a design for Web-Based Learning and the other 2 week for developing Web-Based Learning with some basic features. After doing the basic development, I met the Supervisor again to show the prototype for Web-Based Learning and ask some questions about the Final Year Project report. Next, the report is used for 7 weeks because of the need to search for some research paper and do research for articles. After doing the report, check the report and make sure that the project has hit the milestone which is the project objective. Lastly, meet the Supervisor for a last check for the report and submit it.

3.4.2 Project II Timeline
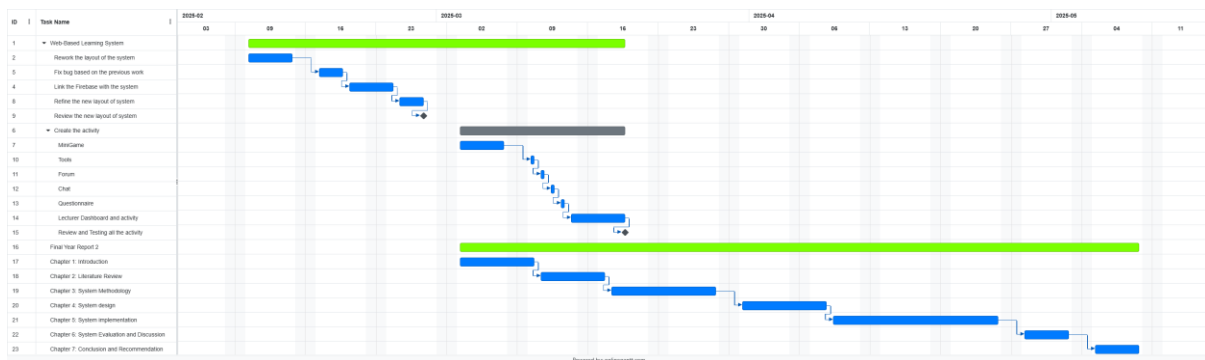
Figure 3.4.2 Gantt Chart timeline for Project II timeline

According to Figure 3.4.2, it shows at the first month focus on reworking the layout of the system because to improve the visual aesthetics for Web-Based Learning, fix the previous work bug and link up the Web-Based Learning with the firebase.

In March to improve the Web-Based Learning system I keep developing the activity for Web-Based Learning such as Mini Game, Tools, Forum, Chat, Questionnaire and Lecturer Dashboard. After the development, the review and testing for the activity has been done.

While focusing on developing, the progress of the final year project report II also has started. At the same time as March, the first three chapters, introduction, literature review and system methodology were completed. After March the remaining chapters such system design, implementation, evaluation, and conclusion with recommendations will be done at 09 May 2025.

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3.5 Cost estimates

The Web-Based Learning system uses hardware, which is laptops and software which are Firebase and Visual Studio Code. For software, Visual Studio Code is a free integrated development environment tools which can download anytime from its official website, thus no cost is needed. Additionally, Firebase has provided some features in their free plan such as Authentication, Realtime Database, Cloud Firestore and hosting which for real-time updates and user authentication for the system. These two tools have provided zero-expense development experience. For hardware, using own laptop to run the web browser, so there is no additional purchase needed. In conclusion, the cost estimate of the Web-Based Learning system is zero Ringgit Malaysia.

3.6 Conclusion remark

The Web-Based Learning system has used the Agile methodology which emphasizes incremental, iterative development with a strong focus on collaboration and customer feedback. By using Visual Studio Code and Firebase as software, it has brought out that the system has been designed to be effective and budget friendly.

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Chapter 4
System Design

4.1 System Block Diagram
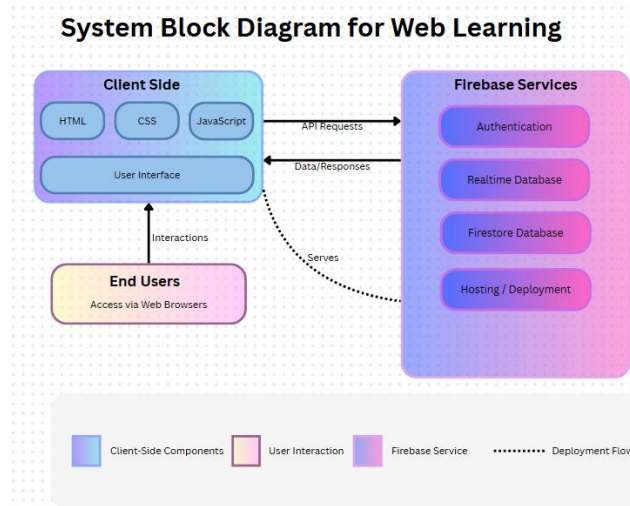
Figure 4.1.1 System Block Diagram for Web Learning

The block diagram illustrates how users interact with the front-end of the system through a web browser. The authentication, Realtime Database, Firestore Database and Hosting is managed by Firebase Service. The Realtime Database will store the message and question for the forum. Data such as quizzes, questionnaires, and user profile are stored and retrieved from Firestore. The entire website is hosted on Firebase Hosting for public access.

4.2 System Components Specifications

This section provides an overview of software components used to develop the web-based learning.

    1) Development Environment

- **Visual Studio Code:** The main development tools that used for writing, editing and organizing the front-end code. It also used for configuring to run Firebase CLI command and manage project files.

- **Node.js and npm:** Node.js is required to install to use Firebase CLI tools via npm which enables deployment and local testing.

    2) Client-side Components

- **HTML, CSS, JavaScript:** The learning platform's user interface is created and constructed using these front-end technologies, JavaScript manages the presentation and

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interactivity of dynamic content, CSS fashions the visual layout, and HTML creates the page's framework.

- **Web Browser:** Modern web browsers that support Firebase SDKs and JavaScript can access the system.

   3) Back-End Components (Firebase Services)

- **Firebase Authentication:** Provide user login and registration features using email and password to ensure that only authenticated users can access the content.

- **Firebase Realtime Database:** Used for features that require real-time data updates, such as live messaging which to ensure the low-latency communication between users.

- **Firebase Cloud Firestore:** Stored structured and scalable data like user profile, quiz data, quiz results and questionnaire**.** It supports advanced querying and improve the performance.

- **Firebase Hosting:** Used to deploy and host the web application at local or cloud which it provides a fast, global content delivery network.

   4) Other Tools

- **Firebase CLI:** Command-line tool used to initialize Firebase in the project, configure hosting and deploy the website to the cloud or local.

4.3 System Architecture Diagram

The Figure 3.3.1 below illustrates the system architecture for the Network Security Web-Based Learning have include Student and Student's interface which is the page for the student when sign in the Web-Based Learning platform, Lecturer and Lecturer's interface which is the page only for admin to fix the Web-Based Learning platform bug. After that, Internet will receive the data from Student and Lecturer interface and send it to website server and lastly the website server will send the new information to database to update the new information.
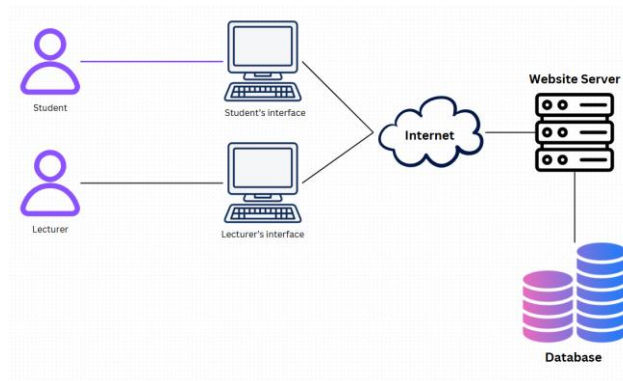
Figure 4.3.1 System Architecture Diagram for Network security Web-Based Learning

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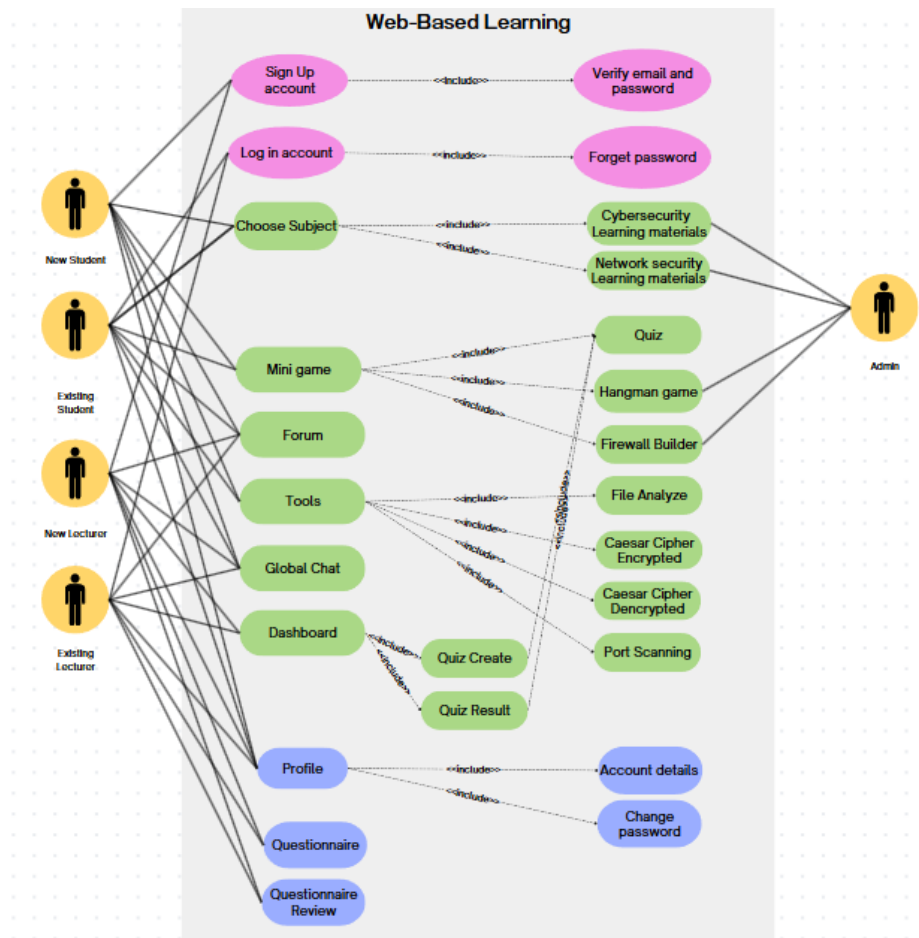
4.4   Use Case Diagram

Figure 4.4.1 Use Case diagram for the Project

The Figure 4.4.1 above illustrates the users can communicate in various ways with the Web-Based Learning platform. Based on Figure 4.4.1 it has helps to focus on the functional requirements of the system from the student's perspective. In the Web-Based Learning platform, students can sign up to create their own account before use the Web-Based Learning, log in, select the different subjects of learning materials to learn, play mini game such as quiz, hangman or firewall builder, view their own profile, have global chat to chat with other user, forum to ask or answer other user question, tools section that let user to use it and answer the questionnaire to improve the effectiveness of Web-Based Learning. Next, it has also had some features for lecturers which can sign up, login, chat with other users, answer forum, same as students. The difference between students and lecturers is that lecturers can create a quiz to students answer and manage the result of the quiz. Also, lecturers will be able to see the students' questionnaire. Lastly, the admin is the one who builds the Mini game like Hangman and Firewall builder

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4.5 System Flowchart

In this part, the flowchart of each activity for the Web-Based Learning system will be shown.

4.5.1 Login and Sign-Up Activity (Student and Lecturer Interface)
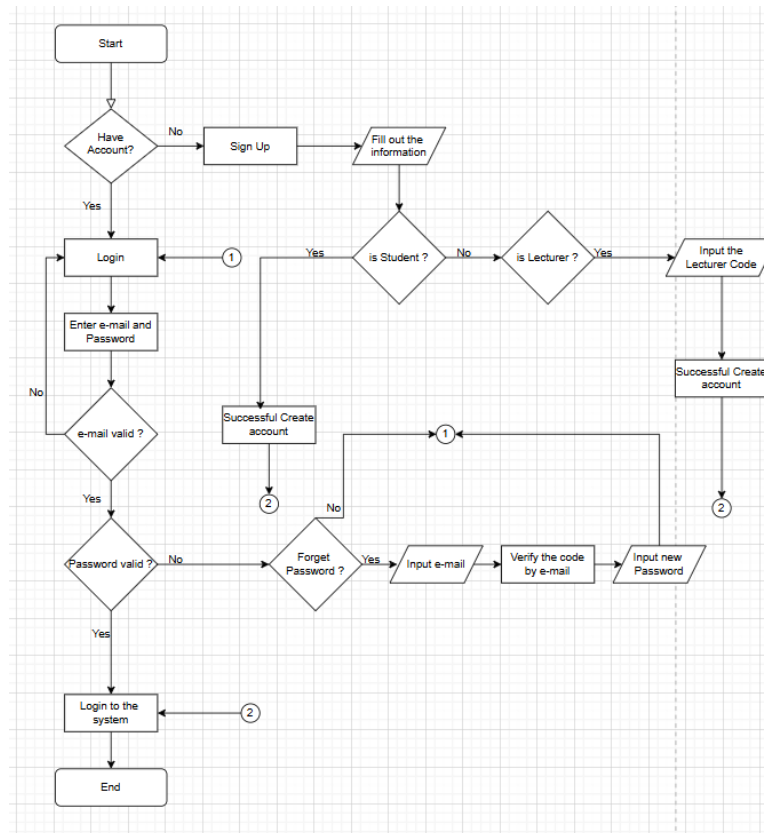
Figure 4.5.1 Flowchart of Login and Sign-Up Activity

The Figure 4.5.1 shown the flowchart of Login and Sign-Up Activity, when the user access to the Web-Based Learning. It will require the user to login with their email and password, if the user did not have the account there will have Sign-up to let the user fill out the information to create the account. It also will let the user to choose which role is the user. If the user chooses the lecturer role, user will require to enter the lecturer code to sign up as lecturer. After, the account has been created, the user can enter their email and password if the email and password is valid the user will login to the Web-Based Learning. If the user forgets the password, user can use the forget password to change the password. It will send the reset password link by through user e-mail to change the password. After change the password, it will go back to the login page.

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4.5.2 Choose Subject Activity (Student Interface)
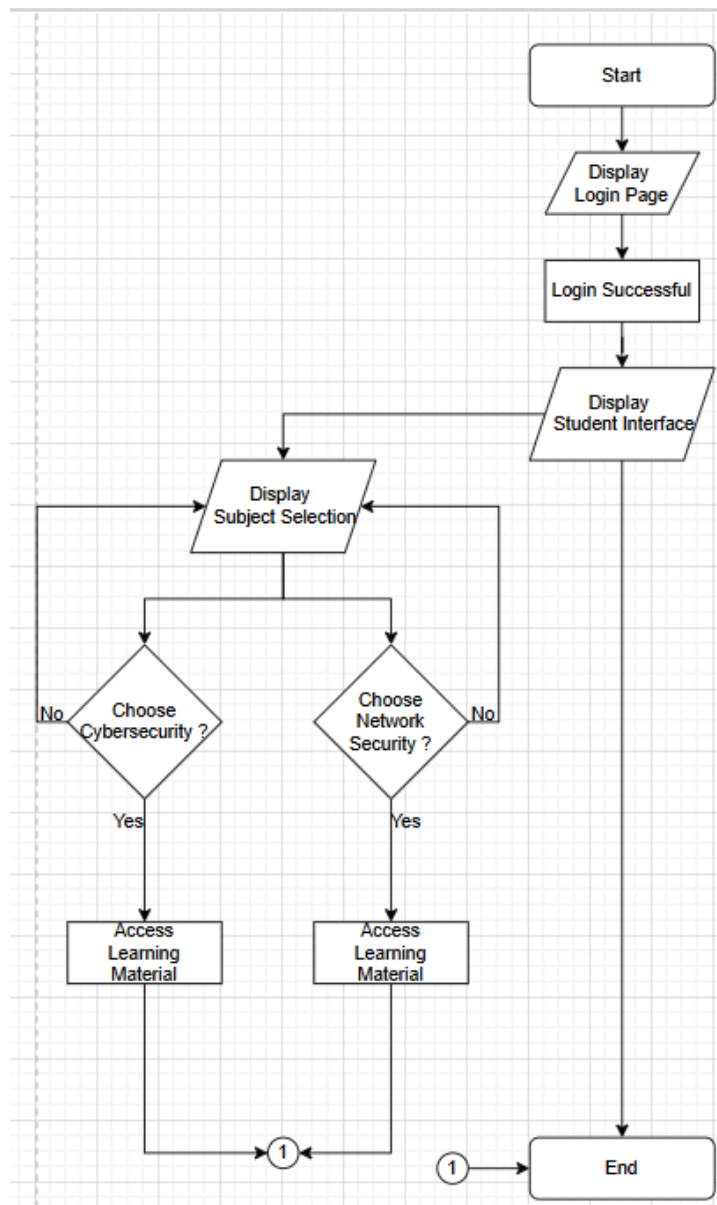
Figure 4.5.2 Flowchart of Choose Subject Activity

The Figure 4.5.2 shown the flowchart of Choose Subject Activity. When the user successfully login to the Web-Based Learning, it will display the Main page to the user and the user can choose the subject at the Main page which having the two subjects are Cybersecurity and Network Security. After choosing the subject, user will access to the learning materials for the choose subject.

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4.5.3 Mini Game Activity (Student Interface)
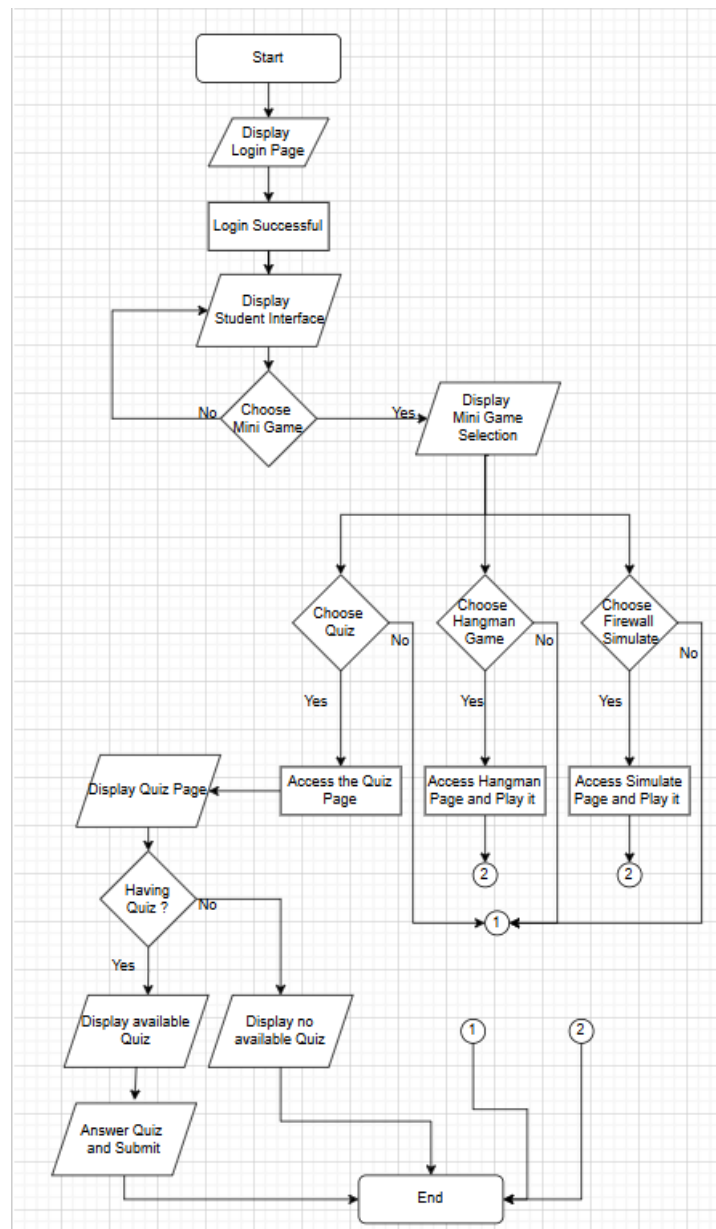
Figure 4.5.3 Flowchart of Mini Game Activity

The Figure 4.5.3 shown the flowchart of Mini Game Activity, when the user login the Web-Based Learning students can choose which mini game they wanted to play to learn knowledge. If the user chooses the Hangman, it will access to the Hangman page and the students can play the Hangman. However, if the students choose the quiz, it will show the available quiz that create by Lecturer. The students can attend the available quiz that created by the Lecturer. If the students choose the firewall simulator. Student can learn how to prevent the attacker to attack their device by play the simulator.

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4.5.4 Profile Activity (Student and Lecturer Interface)
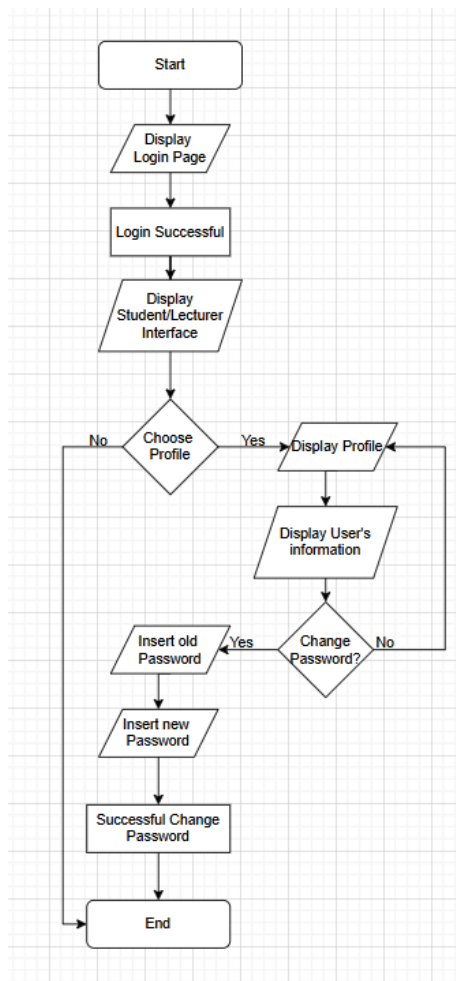
Figure 4.5.4 Flowchart of Profile Activity

The Figure 4.5.4 shown the flowchart of profile Activity, when login successful the user can access to the display profile to see their own information such as username, email and role at the profile. Also, the user can change their password at the Profile page. After successful change the password, the user can use the new password to access their account.

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4.5.5 Tools Activity (Student Interface)
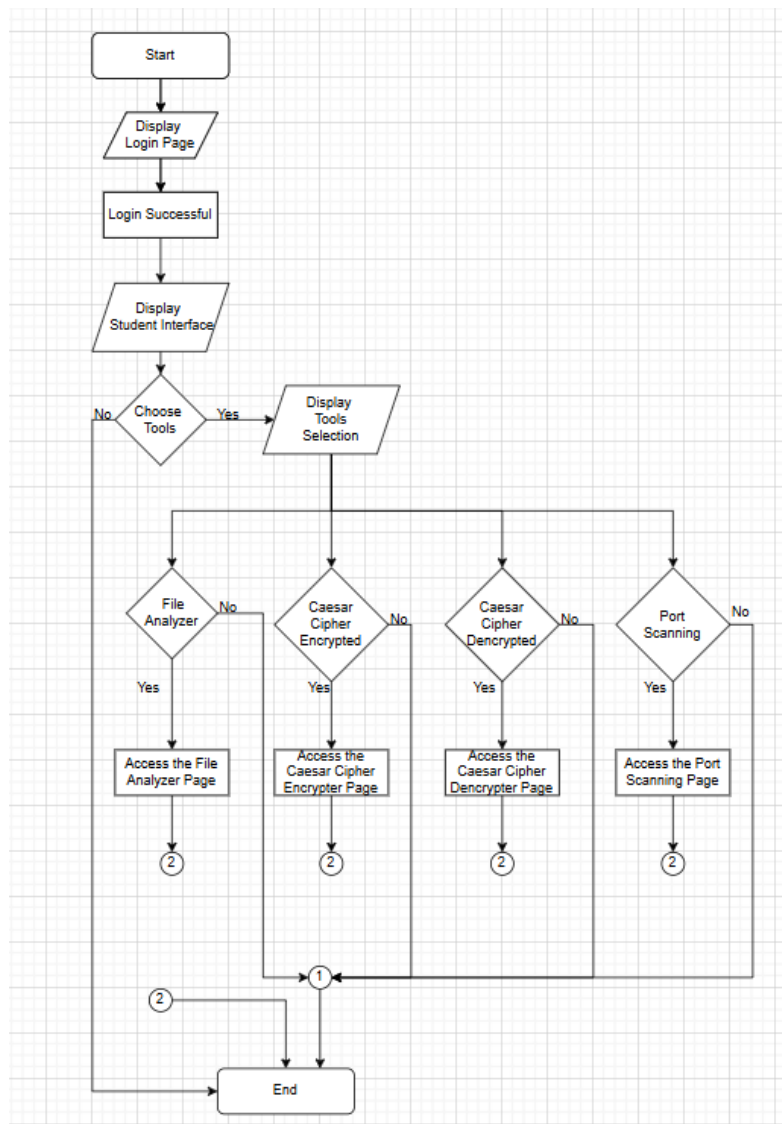
Figure 4.5.5 Flowchart of Tools Activity

The Figure 4.5.5 shown the flowchart of Tools Activity for students' interface, when the students successfully login into the website they can access the "Tools" section from the navigation bar. In the Tool's selection, it will have 4 options available to let students to choose it which are File Analyzer, Caesar Cipher Encrypted, Caesar Cipher Decrypted and Port Scanning.

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4.5.6 Global Chat Activity (Student and Lecturer Interface)
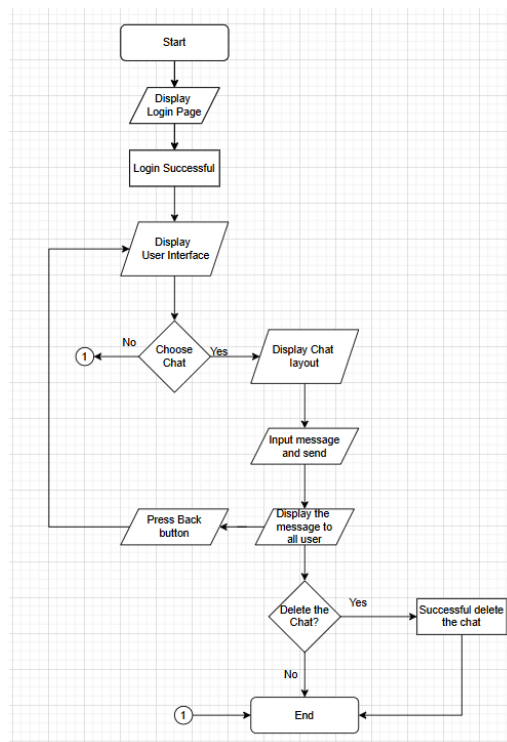
Figure 4.5.6 Flowchart of Global Chat Activity

The Figure 4.5.6 shows the flowchart of Global Chat Activity, when the user successfully login to the main page user can choose the Global Chat at navigation bar. After the user choose the Global Chat, it will redirect user to the Global Chat webpage and the user can chat with other user real-time at the Global Chat webpage. When the user has sent the message out, they also could delete the message if they wanted.

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4.5.7 Forum Activity (Student and Lecturer Interface)
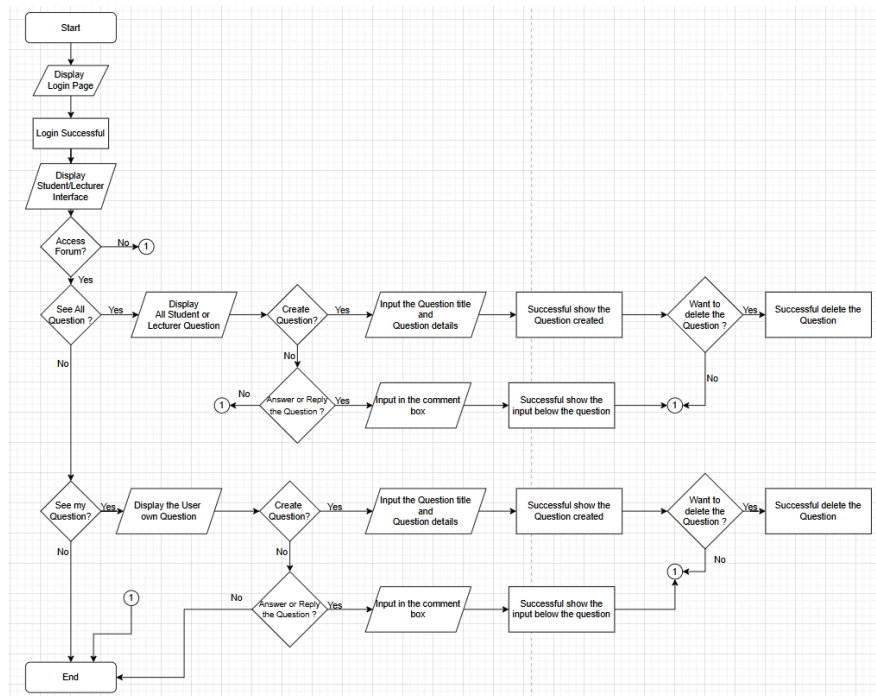
Figure 4.5.7 Flowchart of Forum Activity

Figure 4.5.7 show the flowchart of Forum Activity, when user successfully login to the main page they can access the forum section using the navigation bar at the main page. In the Forum page, users can choose to see all the questions for other user posted, see their own questions, other user that reply to their question or reply to other users' question. Also, it would have the delete button for users, if they wanted to delete their question. When the users publish their question or delete their question it will have a alert box show the users it have successful publish or delete.

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4.5.8 Questionnaire Activity (Student Interface)
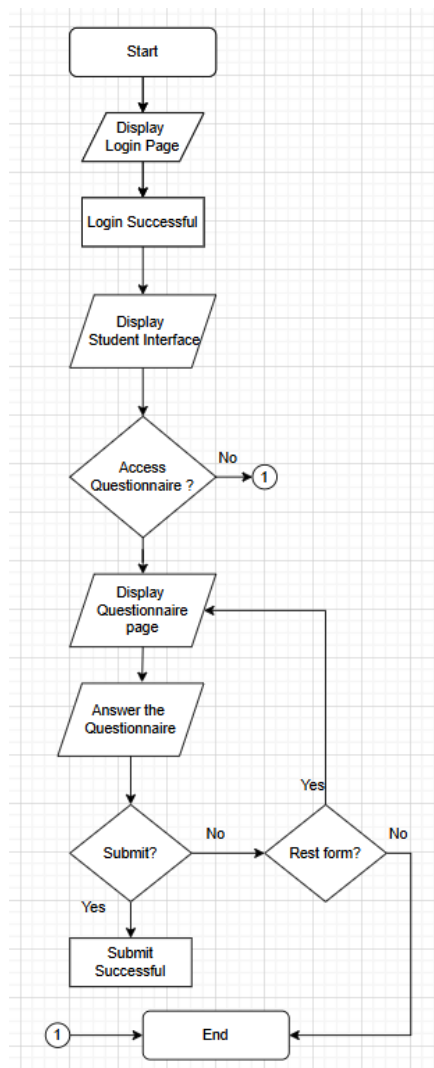
Figure 4.5.8 Flowchart of Questionnaire Activity

Figure 4.5.8 show the flowchart of Questionnaire Activity, when the students successfully login to the website they are allowed to access the Questionnaire by clicking the navigation bar. After students access the Questionnaire page, they can do some questionnaire to help develop to improve the website and see that is the website have the effectiveness of helping the students in studying cybersecurity and network security subject.

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4.5.9 Lecturer Dashboard Activity
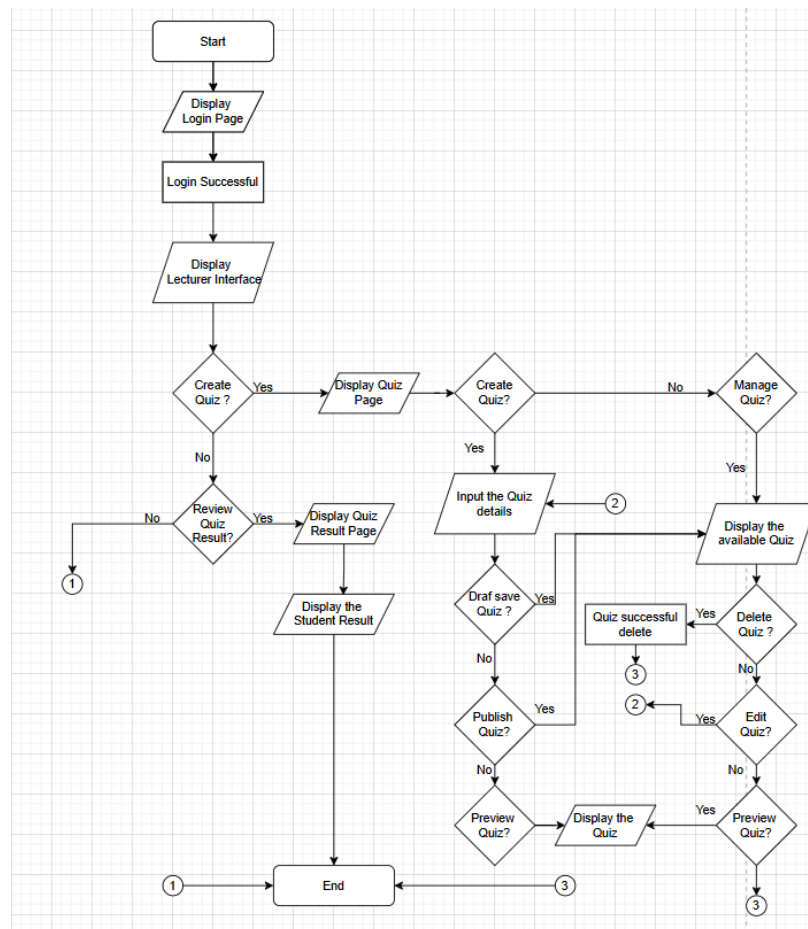
Figure 4.5.9 Flowchart of Lecturer Dashboard Activity

Figure 4.5.9 show the flowchart of Lecturer Dashboard Activity, when the lecturer successfully login to the website it will direct to lecturer dashboard. At the dashboard lecturer can choose to create quiz or review quiz result. If the lecturer chooses create quiz it will redirect lecturer to Quiz page which lecturer can choose to create or manage the quiz. However, if the lecturer chooses to review quiz result it will redirect lecturer to the Quiz Result page which will shows the students 'result.

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4.5.10 Review Questionnaire Activity (Lecturer Interface)
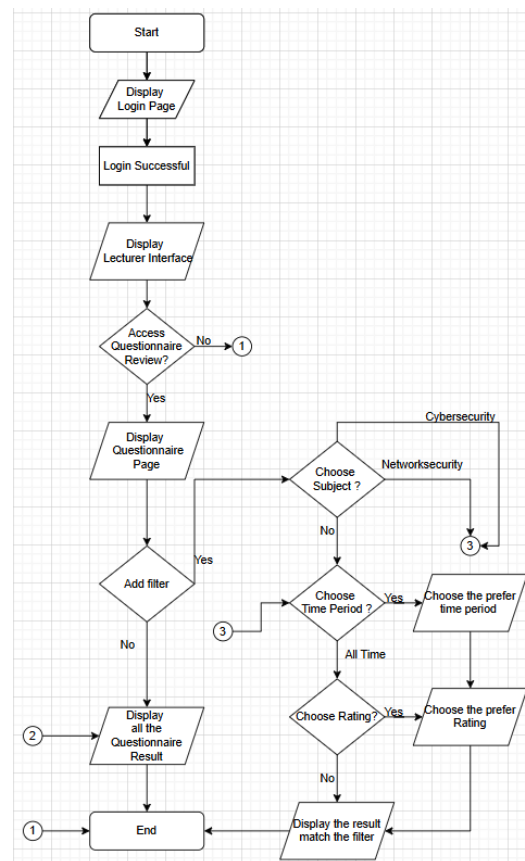
Figure 4.5.10 Flowchart of Review Questionnaire Activity

Figure 4.5.10 shows the flowchart of Review Questionnaire Activity, when Lecturers have successful access to the website, they click the Review Questionnaire at navigation bar to redirect them to the Review Questionnaire webpage. At the page, Lecturers can choose to add filter or not to review the Questionnaire that have been done by the students. This activity is for the developer who also assign as lecturer will gain the review result to improve the Web-Based Learning system based on the result to match the student's requirement.

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4.6 Database Design Diagram
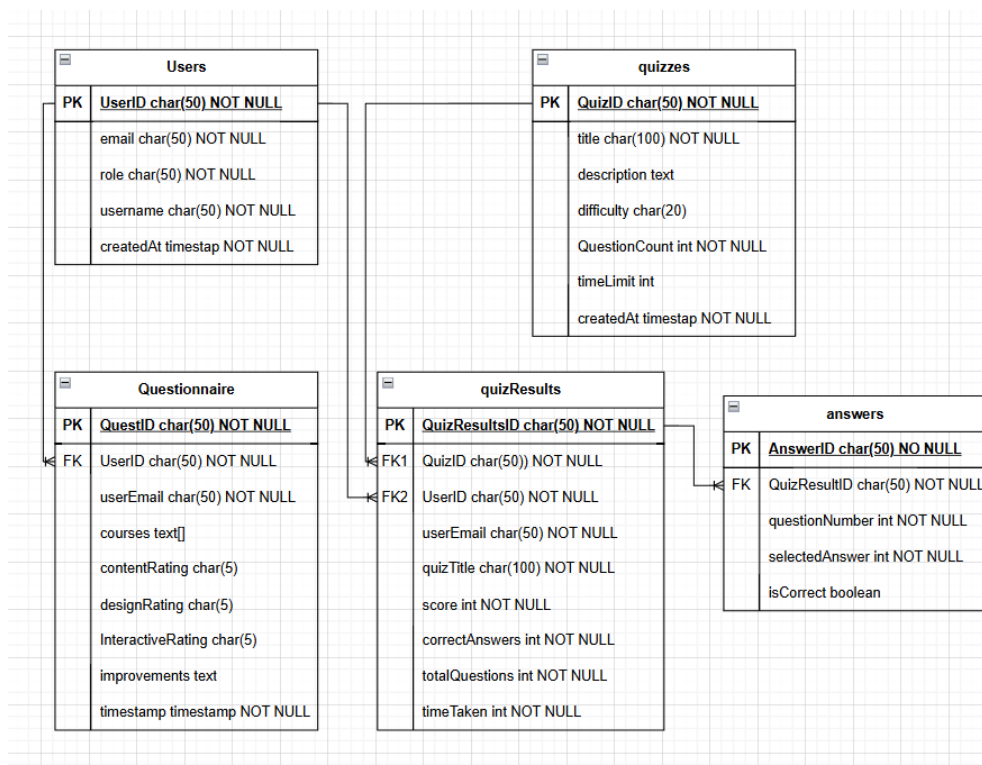
Figure 4.6.1 Database Design Diagram of Web-Based Learning System

The users table stores email, role, username and createdAt. Each user is uniquely identified by UserID. This table allow the system to manage user's authentication and security. This table is designed to stores the information about each registered user. The Questionnaire table linked with the user's table. It also stores userEmail, courses, contentRating, designRating, InteractiveRating, improvements and timestamp. This table is designed to collect the feedback and ratings from the users.

The quizzes table stores title, description, difficulty, QuestionCount, timeLimit and createdAt. This table has a link with the quizResult table, this table is designed to represents the quizzes available in the system. The quizResult table having a link with the two table which are Users and quizzes table. The quizResult table also have stores userEmail, quizTitle, score, correctAnswers, totalQuestions and timeTaken. This table is designed to stores the quiz result that taken by the user. The table answers have link with quizResult, it also has stores questionNumber, selectedAnswer and isCorrect. This table is designed to stores each quiz answer that submit by lecturer when they create the quiz.

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4.7 Activity Diagram
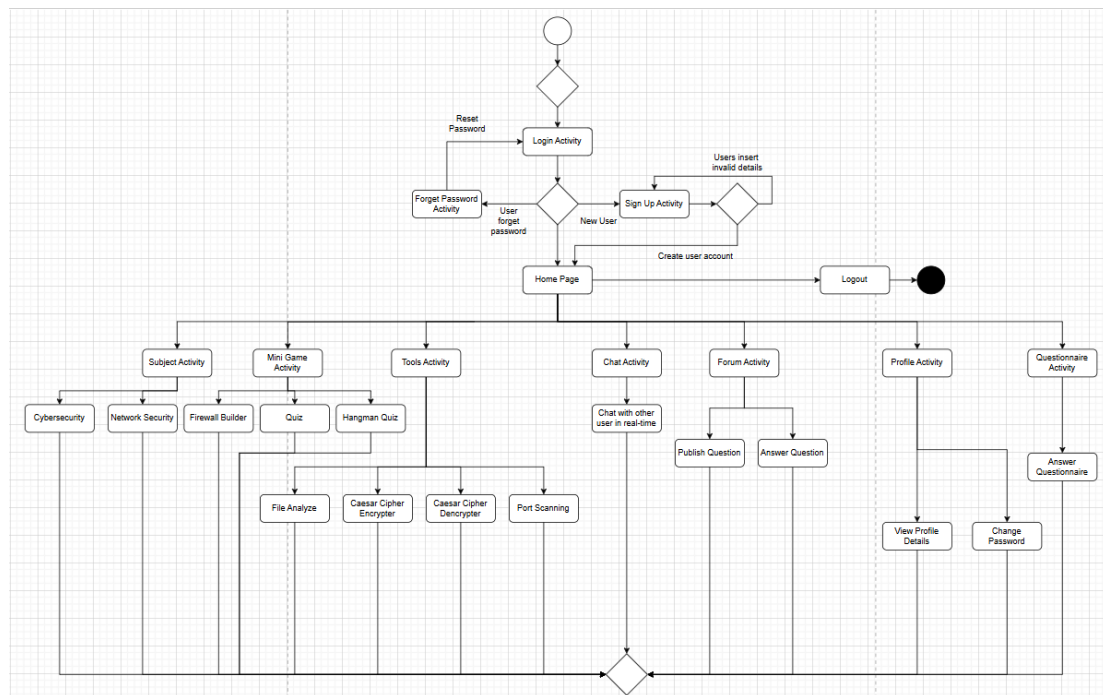
Figure 4.7.1 Activity Diagram for student

Based on Figure 4.7.1, users who are student will be required to login account to access the system. In the login activity, users will need to input their personal credential to access the system. If the users are new for the system, users are required to signup an account at Sign Up activity. After successful login or sign up, users will be redirected to Main page. In the Main page there have several activities provide to users which are Subject Activity, Mini Game Activity, Tools Activity, Chat Activity, Forum Activity, Profile Activity and Questionnaire Activity.

Users can choose two subjects, which are Cybersecurity or Network Security to get the learning material at Subject Activity. Next, users can choose to play to learn the knowledge such Firewall Builder, Hangman Quiz or Quiz at Mini Game Activity. Besides, Tools Activity has provided four useful tools which are File analyze, Caeser Cipher Encryption, Caeser Cipher Decryption and Port Scanning to user to learn or explore more by using the tools. In the Forum and Chat Activity, users can exchange their knowledge with other users by publishing questions at Forum Activity or chat with other users at real-time by using Chat Activity. The Profile Activity allows users to view their details like username, email and roles. It also allows users to change their password. Lastly, the users also enable to answer the questionnaire to help the admin collect some feedback about the system to improve the system in future.

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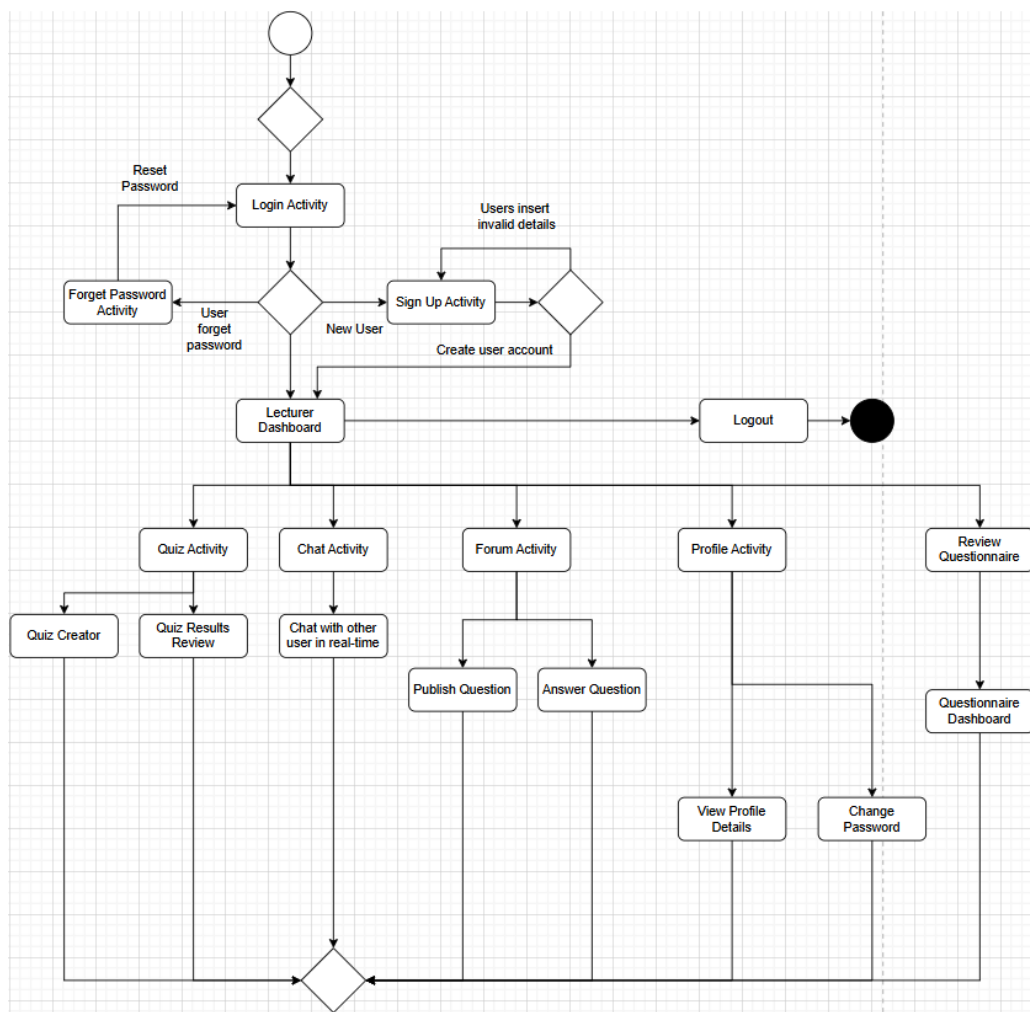
Figure 4.7.2 Activity Diagram for Lecturer

Based on Figure 4.7.2, if the user is login as a lecturer or sign up as a lecturer, it will redirect the user to lecturer dashboard. For Lecturer users there will be provided five activity which are Quiz Activity, Chat Activity, Forum Activity, Profile Activity and Review Questionnaire Activity.

In Quiz Activity, Lecturer can choose to create the quiz or review the result of quiz that the students done. Next, the Chat and Forum Activity are the same function as the students which also chat with other users and reply to the questions that are published by other users. Profile allows users to view their profile details and change their password. Lastly, Review Questionnaire allows lecturers to view the Questionnaire that answer by students to collect the students feedback of the system.

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Chapter 5
System Implementation

5.1 Hardware Setup
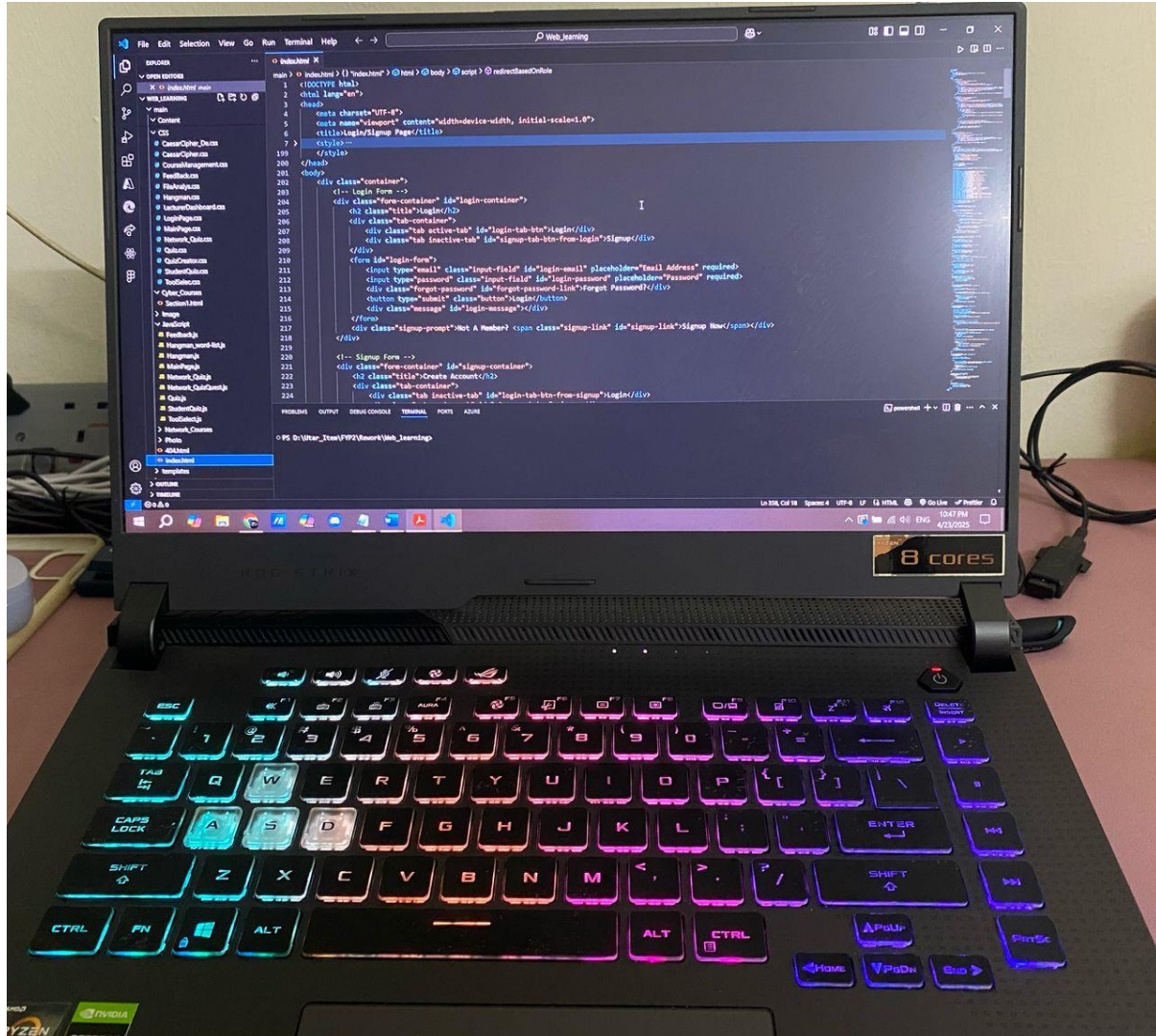
Figure 5.1.1 The Hardware require

This Final Year Project does not require a complex hardware setup, as the application is hosted online using Firebase Hosting. Once the application deployed via firebase deploy, it is accessible from any device with an internet connection and web browser. So, it can say the hardware setup for this Final Year Project has been designed for simplicity and efficiency which the only hardware component during development and maintenance is a personal laptop shows at Figure 5.1.1.

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5.2 Software Setup

I.   Visual Studio Code

- Visual Studio Code is the source-code editor developed that developed by Microsoft. The project will use the Visual Studio Code as the Source Code Editor to do the coding of the website which can download at https://code.visualstudio.com/. The program language will use in the project are JavaScript, HTML and CSS.

II.   Firebase

- Firebase is a Backend-as-a-Service (BaaS) platform developed by Google. It has provided a wide range of tools for web. Firebase has played the important role by offering essential backend services without the need to manage a traditional server. For example, Firebase have the service like hosting the website, authentication that let user login and Realtime database which provides real-time data syncing and flexible document-based storage.

III.   Google Chrome

- Google Chrome is a web browser developed by Google. The google chrome is the web browser that can use to do the demo and test run before the website have been developed which can download at https://www.google.com.my/chrome/. So that, this browser can make sure that the function on the website is complete and fully operational when the website is announced

5.3 Setting and Configuration

5.3.1 Setting for the project

The setting in this project is need to setup the firebase, install nodejs and setup the project in the Visual Studio Code.

Firstly, I will open a folder or create a new folder for the project at Visual Studio Code. After that, all the setup of the firebase will be done in the terminal at Visual Studio Code. Secondly, go to https://nodejs.org/en/download to install the nodejs before setup the firebase because the Firebase CLI is built by nodejs.

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Figure 5.3.1.1 Install the firebase-tools

Based on the Figure 5.3.1.1 to setup the firebase needs to use "npm install -g firebase-tools" to install Firebase CLI (Command Line Interface) which will let me use the command for firebase such firebase deploy, firebase serve, firebase login, etc., from the terminal.

Figure 5.3.1.2 Login to Firebase account

The Figure 5.3.1.2 shows that use the command "firebase login" to login to the firebase account.

Figure 5.3.1.3 Setup the Firebase

After login to the firebase account, next step is to use the command "firebase init hosting" to initialize the Firebase project to our folder. After that, in project setup just need to select the

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existing project and select the Firebase project that wanted to be in this folder. Next in hosting setup, name the public directory as "main". After name the public directory it will automatically create 2 html which is "main/404.html" and "main/index.html".

5.3.2 Configure for the project

The configure for the project is Firebase's SDK, Database setting, Authentication setup and the deploy the website.
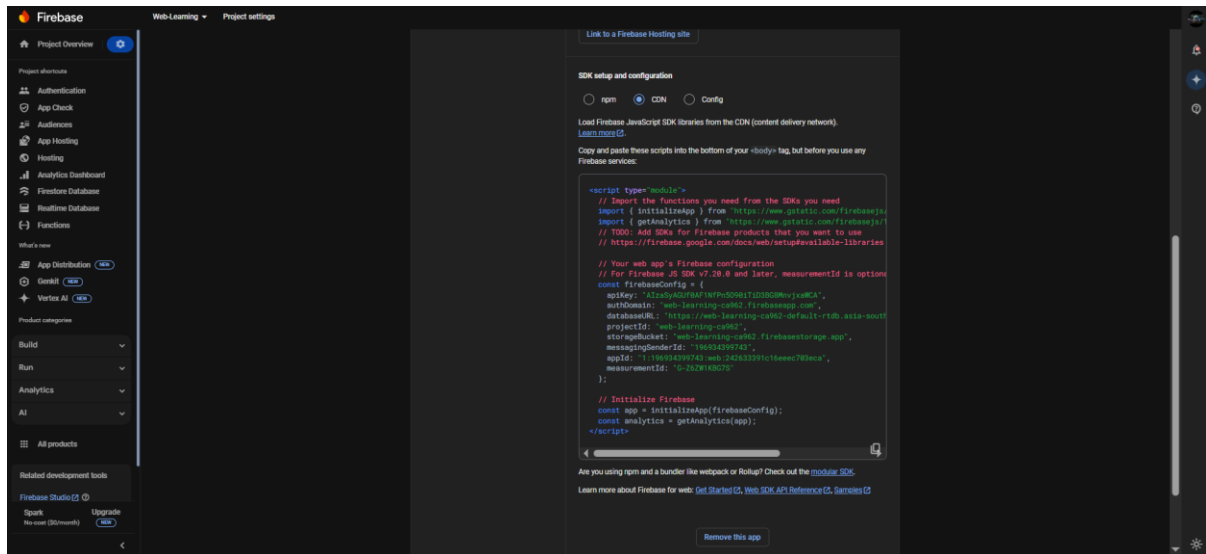
Figure 5.3.2.1 The SDK for the Firebase

At Firebase Project setting show as Figure 5.3.2.1 copy the JavaScript and paste it to the JavaScript file in the Visual Studio Code which shows as below Figure 5.3.2.2. The JavaScript is used to load Firebase JavaScript SDK libraries from the CDN (content delivery network).

Figure 5.3.2.2 The JavaScript file for Visual Studio Code

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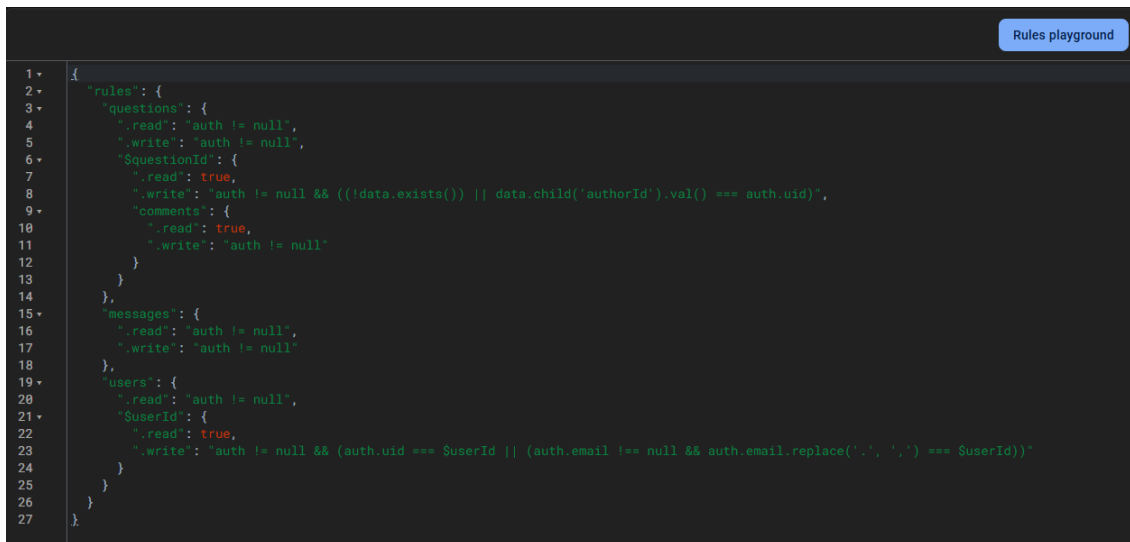
Figure 5.3.2.3 Setup Rule for Real-Time Database

The rules configuration of the Real-Time Database, the rule is to let logged-in users can interact with the system and only can edit their own data such as question from Forum or their own profile data.
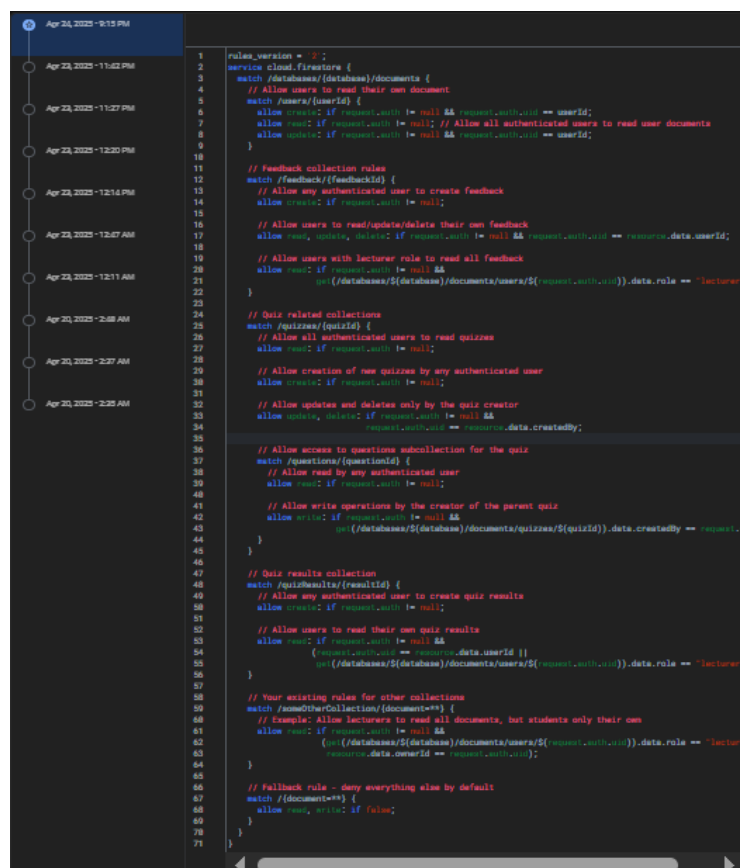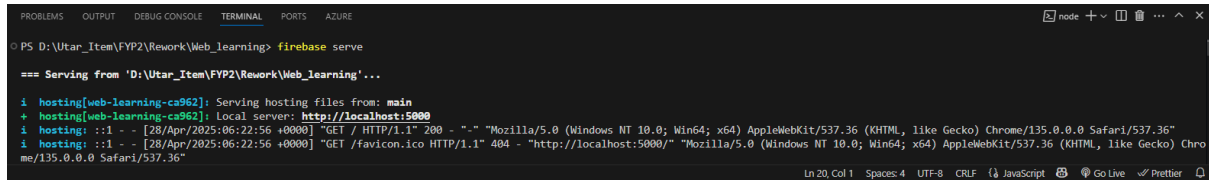
Figure 5.3.2.4 The Rule for Firestore Database

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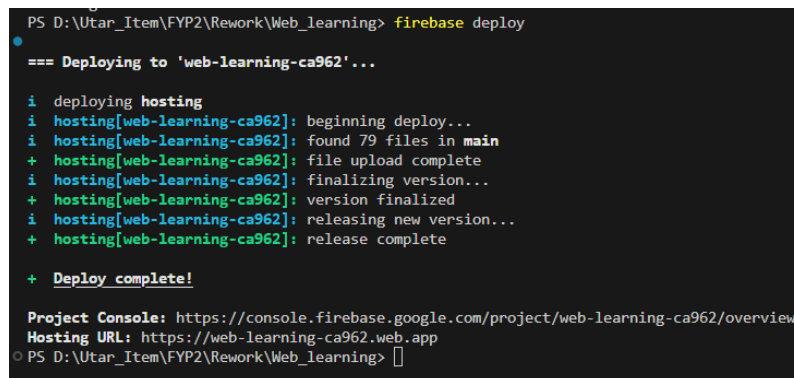
The rules configuration of the Firestore Database, the rule is to let logged-in users access the database. The students can manage their own data, and the lecturer will have special permissions to review more information.

Figure 5.3.2.5 Deploy the Website at local

Figure 5.3.2.6 Deploy the Website at Firebase Cloud

After doing the setting and configuration the last step is to deploy the website which has two ways to deploy shows as Figure 5.3.2.5, it is deploy the website as local server. The second way shows Figure 5.3.2.6 which is deployed to the Firebase cloud which everyone with the URL would be able to access to the website.

5.4 System Operation

5.4.1 Login Activity
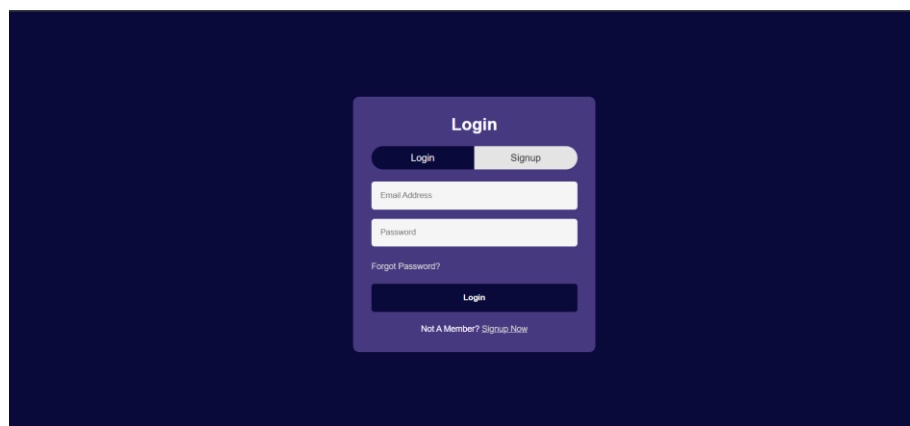
Figure 5.4.1.1 Login Activity

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Figure 5.4.1.2 Register Activity

Figure 5.4.1.3 Reset Password Activity

The Figure 5.4.1.1 and 5.4.1.2 have shown that the Login and Register Activity. If the users are the existing user, they can enter their email and password to access the website. Also, if the users forget the password, they will be redirected to Figure 5.4.1.3 to enter their email to get the reset password link by receiving the email. If the users are new users, they can click the signup to register an account. In the register form user can choose their role such student or lecturer. If the user chooses a lecturer, they will need the lecturer access code such as "LECTURE2025" to create a lecturer account. However, if the user chooses student as their role, they do not need to enter any access code to create an account.

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5.4.2 Main Page Activity
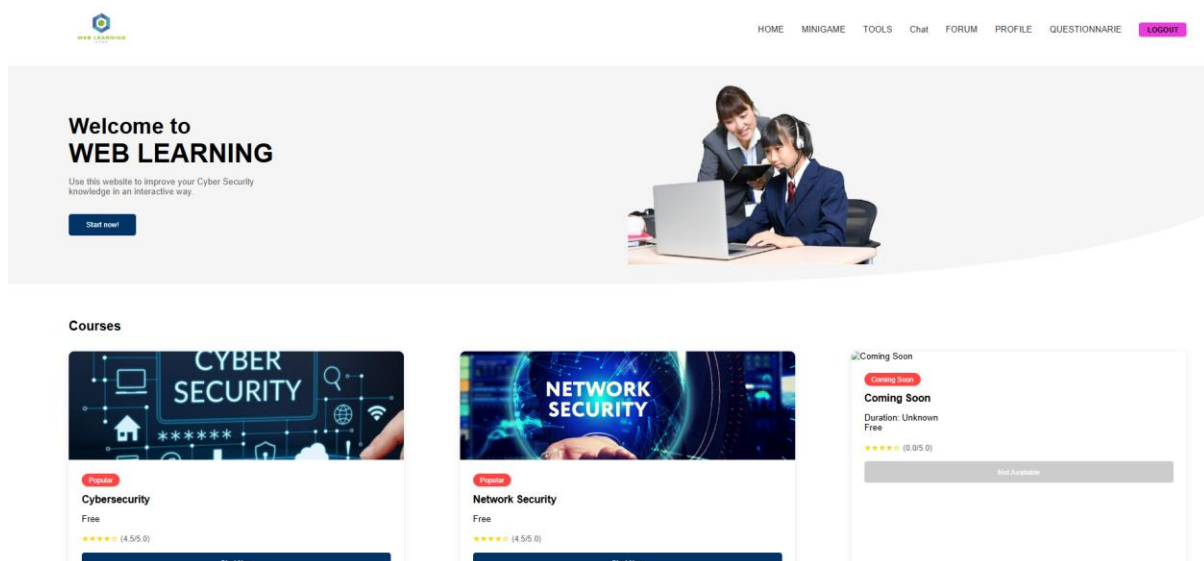
Figure 5.4.2.1 Main Page for Student Interface

After logging into the website, Students will see the webpage which shows as the Figure 5.4.2.1 at this page students can click the "Start Now" button to access the learning materials. However, if the students did not want to access the learning materials. They also can go to the top right navigation bar to choose other functions such as minigame, tools, chat, forum, profile or questionnaire.
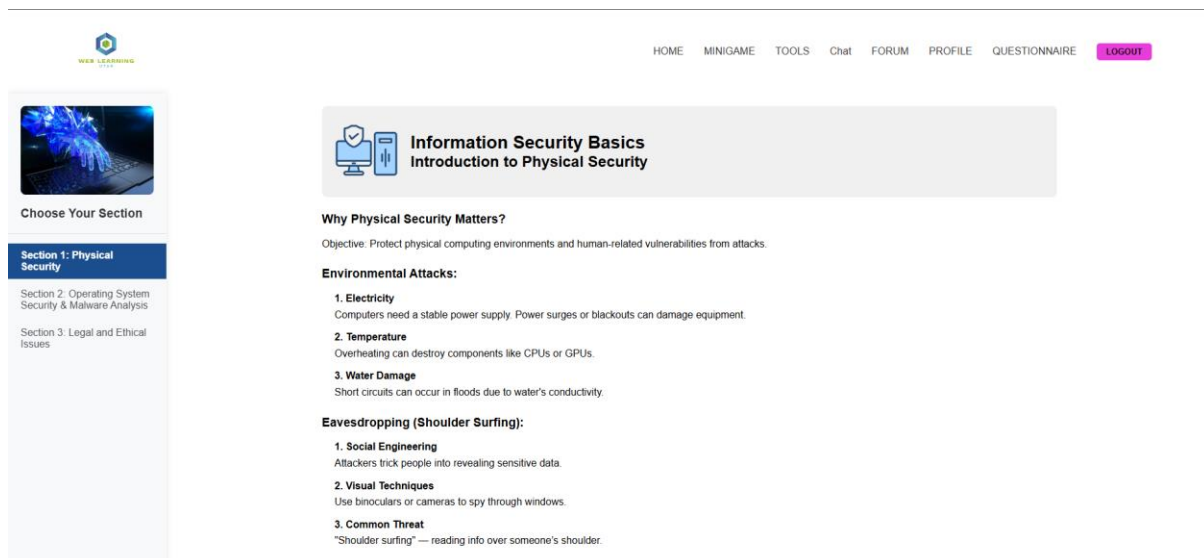

Figure 5.4.2.2 Cybersecurity Learning material for Student Interface

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Figure 5.4.2.3 Network Security Learning material for Student Interface

Figure 5.4.2.4 Learning material of DES, Triple DES and AES for Student Interface

Figure 5.4.2.5 Learning material of EI Gamma for Student Interface

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At the Main Page users can choose to access Cybersecurity or Network Security courses to access the learning material shows such as Figure 5.4.2.2 and 5.4.2.3. In the Network Security there have other 2 Webpage which are about AES and EI Gamma which are the additional learning material. When the users click it, it will redirect users to Figure 5.4.2.4 or 5.4.2.5 to let user learn the specific algorithm.

5.4.3 Minigame Selection Activity
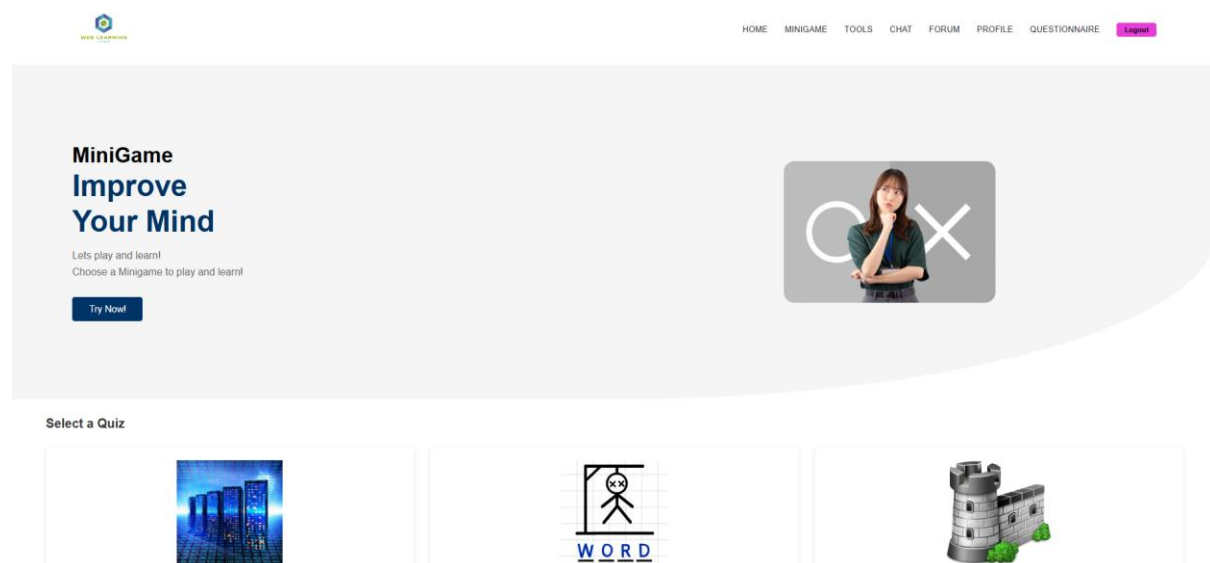
Figure 5.4.3.1 Mini Game for Student Interface
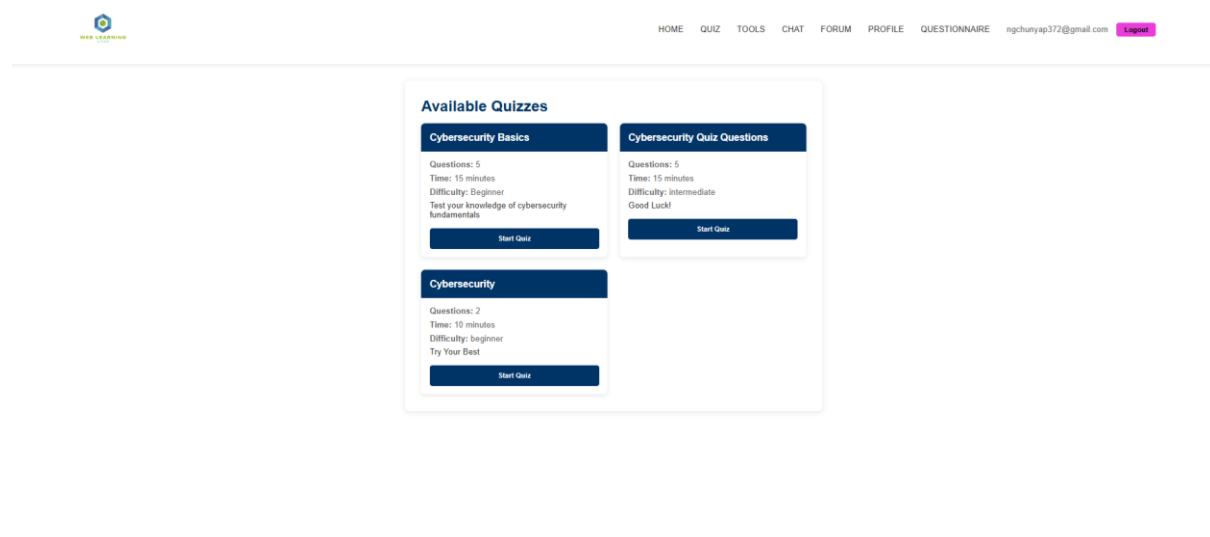
Figure 5.4.3.2 Quiz for Student Interface

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HANGMAN GAME : GUESS THE CYBER SECURITY TERM

— — — — — — — —

Hint: A decoy system set up to attract and detect attackers.

Incorrect guesses: 0 / 6

A	B	C	D	E	F	G	H	I
J	K	L	M	N	O	P	Q	R
S	T	U	V	W	X	Y	Z

Figure 5.4.3.3 Hangman game for Student Interface
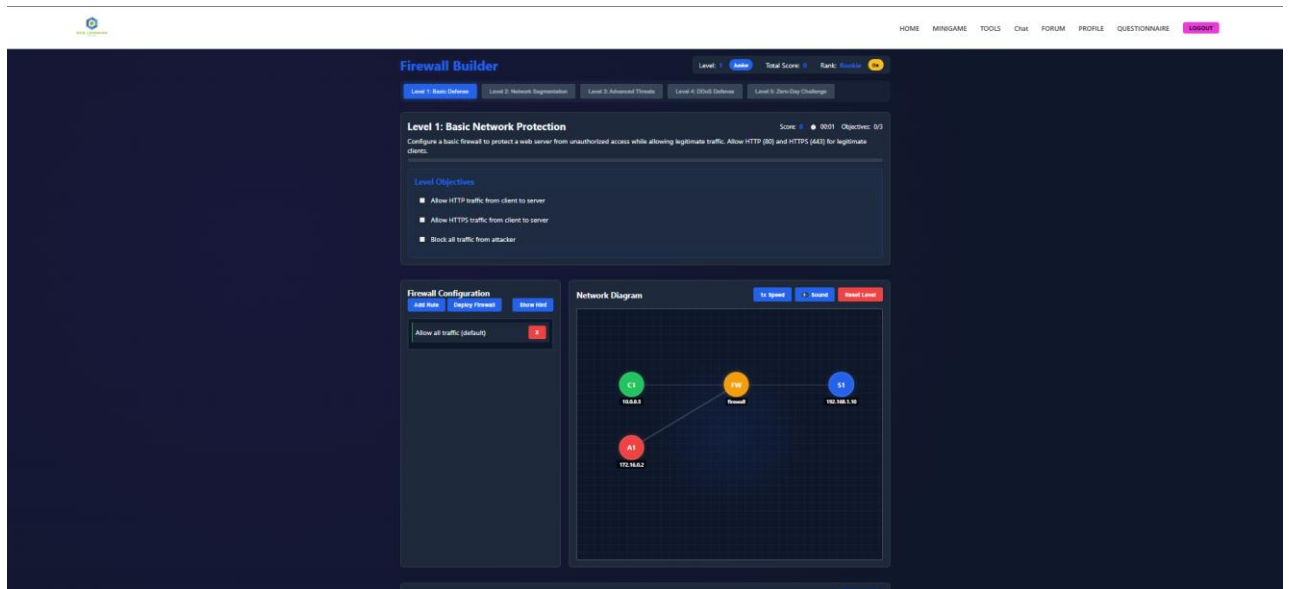
Figure 5.4.3.4 Firewall Builder for Student Interface

Next, the users can access the Mini Game webpage at the top navigation bar. When the users click the Mini Game, it will redirect users to Mini Game interface which shows as Figure 5.4.3.1. In the Mini Game interface there are 3 games to let the users choose which are the Quiz, Hangman Game and Firewall Builder. Each game has a different interface which shows Figure 5.4.3.2, 5.4.3.3 and 5.4.3.4. The primary goal of the Mini Game section is to let the users learn the knowledge by playing the game.

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5.4.4 Tools Selection Activity
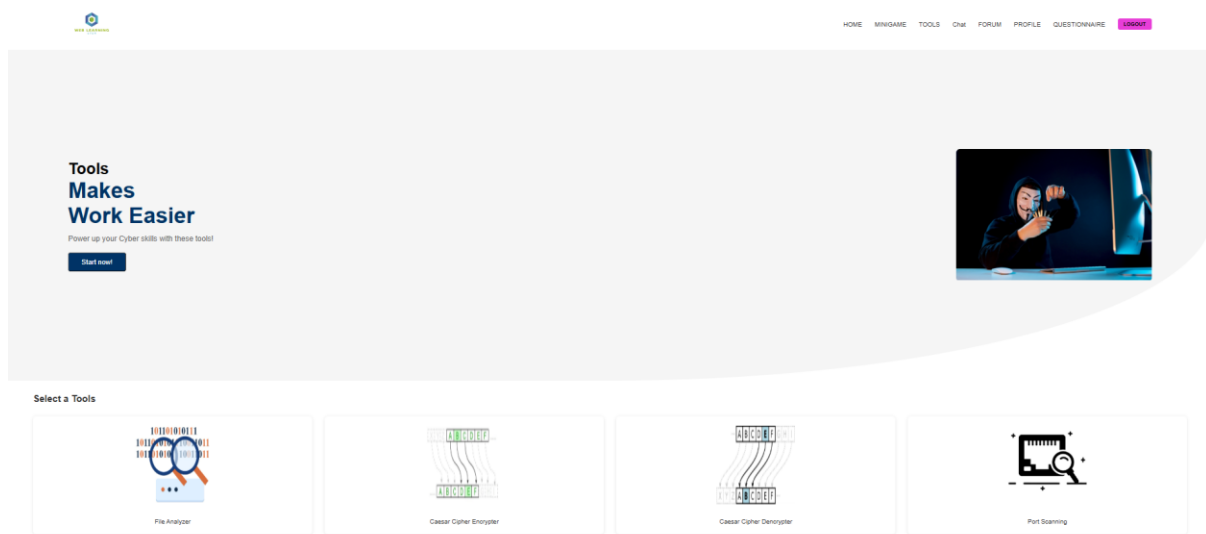
Figure 5.4.4.1 Tools for Student Interface
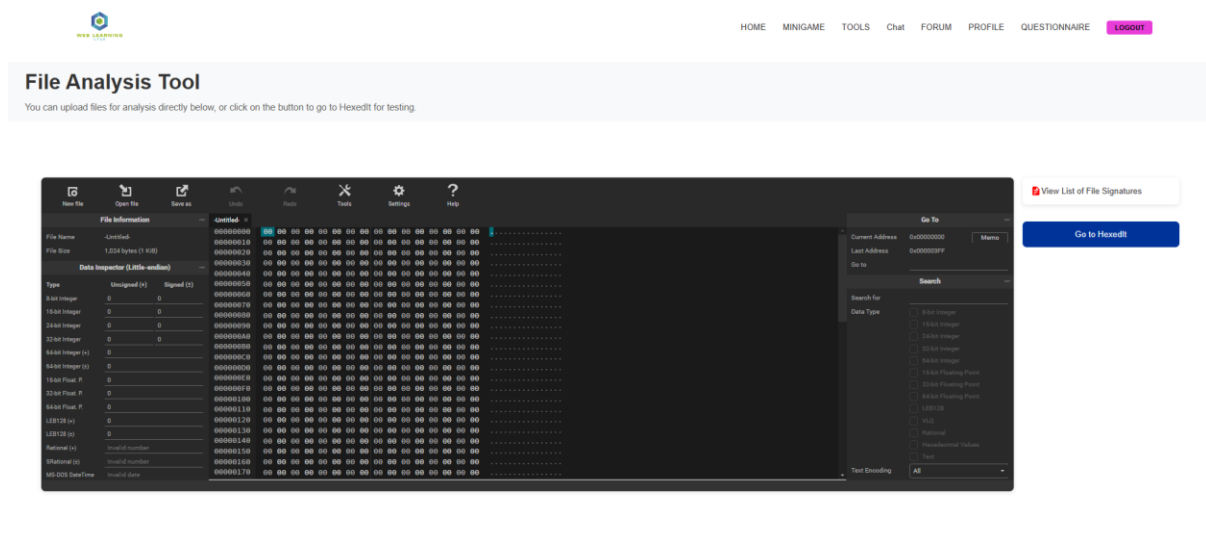
Figure 5.4.4.2 File Analyzer for Student Interface
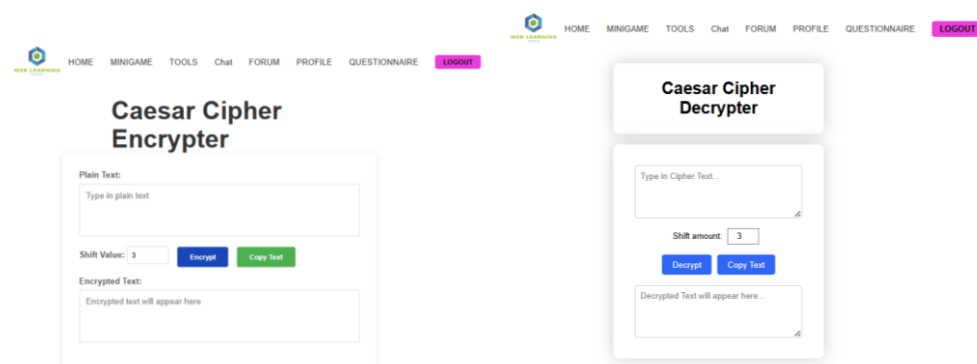
Figure 5.4.4.3 Caesar Cipher for Student Interface

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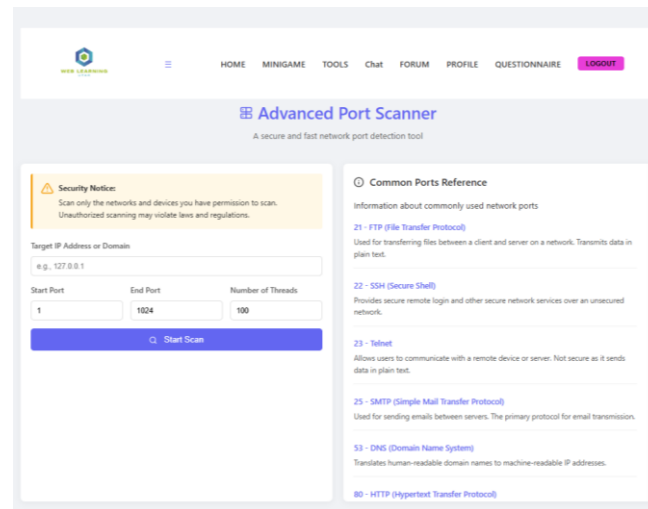
Figure 5.4.4.4 Port Scanning for Student Interface

Next, users are allowed to use the tools at the navigation bar when users click it will redirect to tools interface which shows Figure 5.4.4.1. Inside the tools interface, there are four tools to let users use them, which are File analyze, Caesar Cipher Encrypt and Decrypt and Port Scanning. Based on Figures 5.4.4.2, 5.4.4.3 and 5.4.4.4 have shown the interface for those tools.

5.4.5 Chat Activity
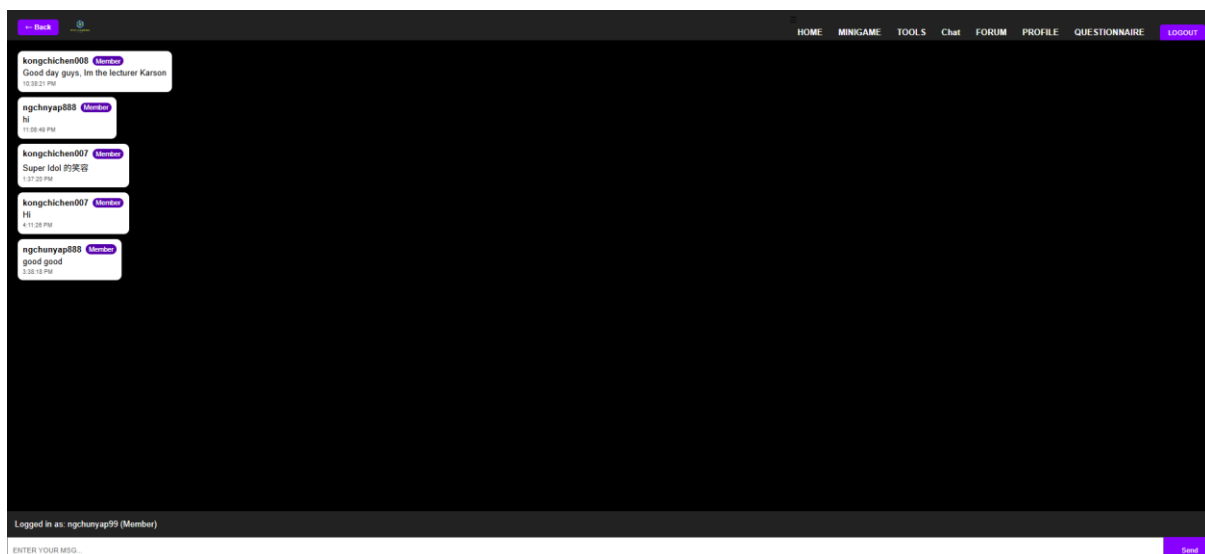
Figure 5.4.5.1 Chat Interfaces

There also is a chat function for users at the navigation bar, users can go to the chat interface by clicking the chat at the navigation bar. Figure 5.4.5.1 has shown the Chat interface, the primary goal for the chat is to let the users chat with other users in real-time which can let the user share their knowledge with other users or just chit chat with other users to create a comfortable environment.

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5.4.6 Forum Activity

Figure 5.4.6.1 Forum Interfaces

Next, users can use the forum button at the navigation bar. When users click the forum, it will redirect users to forum interfaces. Based on Figure 5.4.6.1 it shows the forum interfaces which the users can ask questions or answers. It brings out that users can use this feature to exchange their knowledge with other users.

5.4.7 Profile Activity

Figure 5.4.7.1 Profile Interfaces

There also has a profile to let the user check their details such as the username, role and email. Also, the users can change their account password to their profile

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5.4.8 Questionnaire Activity

Figure5.4.8.1 Student Feedback Questionnaire

Figure5.4.8.2 Review of Feedback Questionnaire

Next, users can click on the Questionnaire at top navigation bar which will redirect user to questionnaire interfaces shows as Figure 5.4.8.1. Users will be able to answer the questionnaire to help admin to improve the system. Besides, the users who are Lecturer will able to review the feedback questionnaire answer by students which will list down the overall statics shows as Figure 5.4.8.2.

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5.4.9 Quiz Create Activity
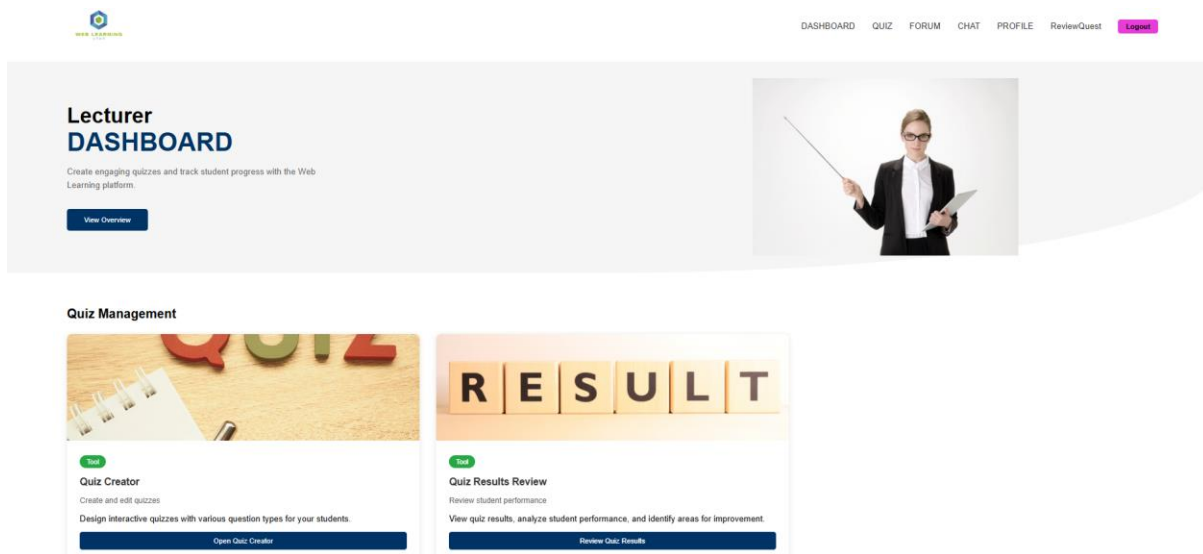
Figure 5.4.9.1 Lecturer Dashboard
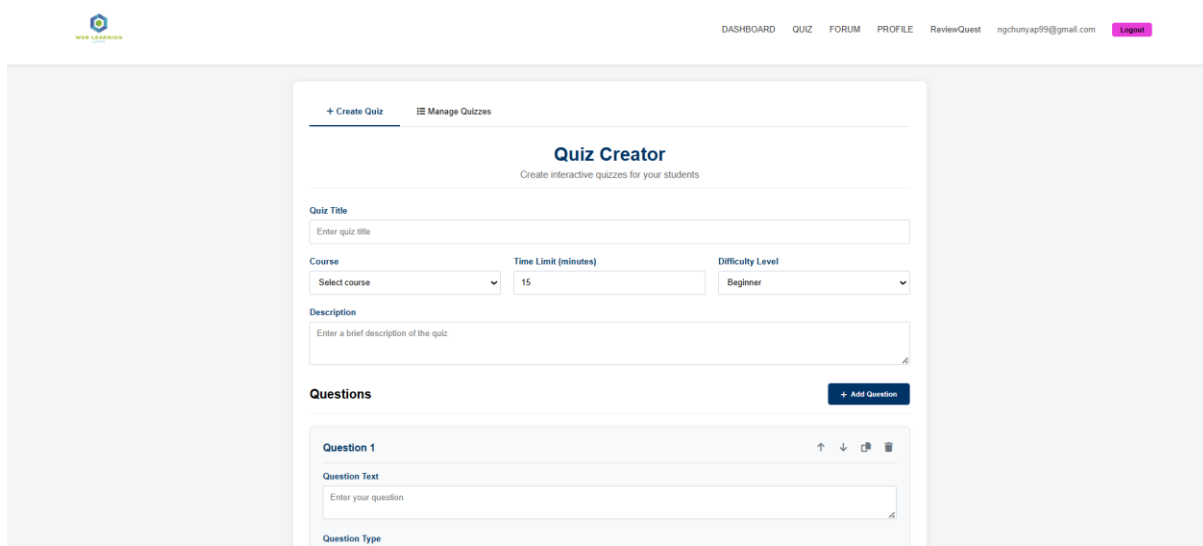
Figure 5.4.9.2 Quiz Creator

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+ Create Quiz   ≣ Manage Quizzes

Manage Quizzes

View, edit and manage your existing quizzes

🔍 Search quizzes by title or course...

Title	Course	Questions	Created	Status	Actions
Cybersecurity	cybersecurity	2	4/23/2025	Published	👁 View ✎ Edit 🗑 Delete

Figure 5.4.9.3 Quiz Manage

Quiz
RESULTS

Review student performance on quizzes and identify areas for improvement.

Student Results

| All Quizzes ▾ | All Time ▾ | 🔍 Search by student name... |

Student Name	Quiz	Date	Time Taken	Score	Action
kongchichen007@gmail.com	Cybersecurity Quiz Questions	5/4/2025	0:26	100%	View Details
kongchichen007@gmail.com	Cybersecurity Quiz Questions	5/4/2025	0:10	20%	View Details
kongchichen007@gmail.com	Cybersecurity	5/3/2025	0:11	100%	View Details
ngchunyap372@gmail.com	Cybersecurity	5/3/2025	0:06	50%	View Details
ngchunyap372@gmail.com	Cybersecurity	5/3/2025	0:19	0%	View Details

Figure 5.4.9.4 Quiz Result

If the user is the lecturer role, they will redirect to the lecturer dashboard which shows at Figure 5.4.9.1. Users can choose to click "Quiz Creator" or "Quiz Result Review". If users choose Quiz Creator it will redirect users to Quiz Creator interface shows as Figure 5.4.9.2, not only that in the Quiz Creator interface users can also manage the quiz created by them which shows as Figure 5.4.9.3. Next, users can click the Quiz Result Review at the lecturer dashboard to go to the Quiz Result Review interface. In the Quiz Result Review, users can see the quiz result for the user who is students.

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5.5 Project Challenges

Some technical challenges were encountered during implementation of the system, Firstly, Firebase integration issues such as Authentication, Firestore and Realtime Database. Inaccurate setup and out-of-date package versions caused issues in the first efforts, requiring careful debugging and consulting Firebase documentation. Secondly, there were challenges with user authentication, specifically with making sure that only users who were registered and authorized could access certain services. By setting up Firebase Authentication and applying the correct security rules, it will need to take several try to function correctly. Next, using Firestore and Realtime databases at the same time will cause issues. Because inappropriate use could end up in inconsistent data or ineffective performance, careful planning was necessary when deciding which types of data should be stored in each database.

5.6 Concluding Remark

In implementation phase of the system have provide how the front-end and back-end integration using Firebase services. The system was built and deployed successfully despite several difficulties, including the configuration of authentication and data processing between Realtime Database and Firestore. The project's main goal was to provide a useful and engaging platform for students to connect with online learning resources and tests that have been met. Using Firebase improved the system's scalability and real-time capabilities while also making backend maintenance easier.

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Chapter 6
System Evaluation and Discussion

In this chapter, an evaluation will be conducted to the system for testing purposes. Also, it will discuss the project objectives have been achieved.

6.1 Result of the questionnaire
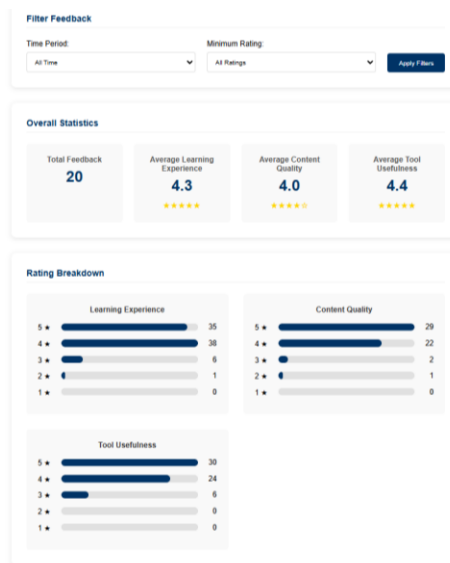
Figure 6.1.1 Total Feedback

To know the system provided learning experience, tool usefulness and content quality have good effectiveness for students. The system has a built-in questionnaire to let students answer which is to collect the data about effectiveness for students after using the system.

Based on Figure 6.1.1, there are 20 students who have attempted to the feedback questionnaire which the system has getting a good result as the average learning experience has reached 4.3/5 rating, average content quality has 4/5 rating and average tool usefulness has 4.4/5 rating.

By looking at the three average statics, users will more likely the tool feature for the system because the rating of the tool are higher compared with learning experience and content quality. But it also will not affect that user from rating the other two statics high. This is because the overall results show that users rated all three statistics half as highly.

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6.2 Testing Setup and Result

6.2.1 Login Activity

Test Case	Expected Result	Actual Result	Status
Login with empty email field, password field filled	Show "Please fill out this field"	Show "Please fill out this field"	Pass
Login with email field filled and empty password field	Show "Please fill out this field"	Show "Please fill out this field"	Pass
Press "show eye" icon	Show password	Show password	Pass
Press "hide eye" icon	Hide password	Hide password	Pass
Login with accounts do not exist	Show "Error (auth/invalid credential)"	Show "Error (auth/invalid credential)"	Pass
Login with accounts exist	Show "Login successful"	Show "Login successful"	Pass
Press "Signup Now"	Redirect to Sign Up activity	Redirect to Sign Up activity	Pass
Press "Forget Password"	Show reset password alert box	Show reset password alert box	Pass

Table 6.2.1 Login Activity's Test Case

6.2.2 Sign Up Activity

Test Case	Expected Result	Actual Result	Status
Sign up with one field (username, email, password) remain empty	Show "Please fill out this field"	Show "Please fill out this field"	Pass
Sign up with invalid email format	Show "please include @"	Show "please include @"	Pass

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Sign up with the exist email	Show "Error (auth/email-already-in-use)"	Show "Error (auth/email-already-in-use)"	Pass
Press "show eye" icon	Show password	Show password	Pass
Press "hide eye" icon	Hide password	Hide password	Pass
Sign up with new email	Redirect to Main Activity	Redirect to Main Activity	Pass

Table 6.2.2 Sign Up Activity's Test Case

6.2.3 Subject Activity

Test Case	Expected Result	Actual Result	Status
Choose the "cybersecurity" subject	Redirect to Cybersecurity Page	Redirect to Cybersecurity Page	Pass
Choose the "Network Security" subject	Redirect to Network Security Page	Redirect to Network Security Page	Pass

Table 6.2.3 Subject Activity's Test Case

6.2.4 Mini Game Activity

Test Case	Expected Result	Actual Result	Status
Select Quiz	Redirect to Quiz Interface	Redirect to Quiz Interface	Pass
Select Cybersecurity Hangman Quiz	Redirect to Cybersecurity Hangman Quiz	Redirect to Cybersecurity Hangman Quiz	Pass
Select Firewall Builder	Redirect to Firewall Builder	Redirect to Firewall Builder	Pass
Select the Quiz wanted to attempt	Shows the assign quiz	Shows the assign quiz	Pass
Score 80% above	Show "Excellent! You have a great	Show "Excellent! You have a great	Pass

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	understanding of the subject."	understanding of the subject."	
All Quiz Wrong	Show "Keep practicing! Review the material and try again."	Show "Keep practicing! Review the material and try again."	Pass
Score 60 % above	Show "Good job! You have a solid grasp of the material"	Show "Good job! You have a solid grasp of the material"	Pass
Answer incorrect Hangman Quiz	Show "Game Over" in alert box and display the correct answer	Show "Game Over" in alert box and display the correct answer	Pass
Answer correct Hangman Quiz	Show "Congratulations" in alert box and display the correct answer	Show "Congratulations" in alert box and display the correct answer	Pass
Deploy Firewall in Firewall builder	Show the packet move in the network diagram	Show the packet move in the network diagram	Pass
Add Rule in Firewall Builder	Show the form interface that can create the rule	Show the form interface that can create the rule	Pass
Fail to block the attack packet	Score will show -20 for each attack packet that fail to block	Score will show -20 for each attack packet that fail to block	Pass
Success to block and receive the legitimate packet	Score will +5 for each legitimate packet receive	Score will +5 for each legitimate packet receive	Pass
Hit the require objectives	Win the level and open next level	Win the level and open next level	Pass

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Table 6.2.4 Mini Game Activity's Test Case

6.2.5 Tools Activity

Test Case	Expected Result	Actual Result	Status
Select File Analyze	Redirect to File Analyze Interface	Redirect to File Analyze Interface	Pass
Select Caesar Cipher Encrypted	Redirect to Caesar Cipher Encrypted Interface	Redirect to Caesar Cipher Encrypted Interface	Pass
Select Caesar Cipher Decrypted	Redirect to Caesar Cipher Decrypted Interface	Redirect to Caesar Cipher Decrypted Interface	Pass
Select Port Scanning	Redirect to Port Scanning Interface	Redirect to Port Scanning Interface	Pass
Insert file to file analyze	Show the file format in Hex	Show the file format in Hex	Pass
Click the view list of File Signature	Redirect to PDF file	Redirect to PDF file	Pass
Key in Plain text and shift value in Caesar Cipher Encrypter	Show the encrypted text	Show the encrypted text	Pass
Key in Ciphertext and shift value in Caesar Cipher Decrypter	Show the decrypted text	Show the decrypted text	Pass
Key in a target IP address or domain and start	Show the port for the target IP and the status of it	Show the port for the target IP and the status of it	Pass

Table 6.2.5 Tools Activity's Test Case

6.2.6 Chat Activity

Test Case	Expected Result	Actual Result	Status
Click back button	Redirect to the previous page	Redirect to the previous page	Pass

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Send a message	Display at the page with time	Display at the page with time	Pass
Click cross icon	Delete the message	Delete the message	Pass

Table 6.2.6 Chat Activity's Test Case

6.2.7 Forum Activity

Test Case	Expected Result	Actual Result	Status
All Question	Show all the question posted	Show all the question posted	Pass
Enter title and Question details, press post	Display the question at the forum interface	Display the question at the forum interface	Pass
Click my question	Show the question created by you own	Show the question created by you own	Pass
Answer below other users' question	Display the reply below the question	Display the reply below the question	Pass

Table 6.2.7 Forum Activity's Test Case

6.2.8 Profile Activity

Test Case	Expected Result	Actual Result	Status
Change the password	Successful Change the password	Successful Change the password	Pass

Table 6.2.8 Profile Activity's Test Case

6.2.9 Questionnaire Activity

Test Case	Expected Result	Actual Result	Status
Answer all the questionnaires and submit the form	Show "Thanks you"	Show "Thanks you"	Pass
Click the reset form	Clean all the answer	Clean all the answer	Pass
Submit the blank form	Show alert box "Please complete all questions before submitting"	Show alert box "Please complete all questions before submitting"	Pass

Table 6.2.9 Questionnaire Activity's Test Case

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6.2.10 Quiz Management Activity

Test Case	Expected Result	Actual Result	Status
Select Create Quiz	Redirect to Quiz Creator Interfaces	Redirect to Quiz Creator Interfaces	Pass
Publish an empty Quiz	Show "Please enter a quiz title"	Show "Please enter a quiz title"	Pass
Enter the title left question empty	Show "Please enter question 1"	Show "Please enter question 1"	Pass
Add Question	Adding other question to create	Adding other question to create	Pass
Click Preview Quiz	Show the Quiz with the correct answer	Show the Quiz with the correct answer	Pass
Delete all the question	Show needs at least 1 question in the quiz	Show needs at least 1 question in the quiz	Pass
Select Manage Quizzes	Show the Title, Course, Questions, Created time and status of the quiz	Show the Title, Course, Questions, Created time and status of the quiz	Pass
Click edit in Manage Quizzes	Can edit the selecting quiz	Can edit the selecting quiz	Pass
Delete in Manage Quizzes	The quiz successful deleted	The quiz successful deleted	Pass

Table 6.2.10 Quiz Management Activity's Test Case

6.2.11 Questionnaire Review

Test Case	Expected Result	Actual Result	Status
Search specific username	Show the username feedback	Show the username feedback	Pass
Filter the Time period	Show only show the feedback match with the choose time	Show only show the feedback match with the choose time	Pass
Filter the minimum rating	Show the choose rating feedback	Show the choose rating feedback	Pass

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Click user feedback	Show the full feedback of the user	Show the full feedback of the user	Pass

Table 6.2.11 Questionnaire Review Activity's Test Case

6.3 Object Evaluation

Objective	Evaluation	Conclusion
Enhancing learning experiences	The system has a questionnaire which allows users to rate their learning experience. So that, can collect subjective evaluations	Achieved
Increasing engagement by using interactive elements	The system has provided mini games to increase the user's engagement such as having Reinforcement like quiz game for cybersecurity, Motivation like Firewall builder has some sound effect to increase motivation and enjoyment for users	Achieved
Facilitating knowledge sharing among students and improve students' understanding of network security	The system allows real-time chat among users and also have provide a forum feature where the user can publish questions or answer other users' question.	Achieved

Table 6.3.1 Objective Evaluation

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Chapter 7
Conclusion and Recommendation

In this section, a summary of Web-Based Learning system project and recommendations for future improvements based on the knowledge gained from out thorough study and development plan

7.1 Conclusion

This report has provided a clean analysis and development plan for Web-Based Learning system. The limitation for existing system has been explores which are students feel isolation, student's attitude, the system relevance to the students and students will become addicted in Mini Game. The motivation of the project was to address limitations of traditional methods by offering flexibility, interactive content, and more cost-effective approach for the Web-Based Learning system. The objective of the project were enhancing learning experiences, increasing engagement by using interactive elements and facilitating knowledge sharing among students and improve students' understanding of network security. The project scope and direction of the system have been mapped, contributions of the system also have been highlighted.

In the literature review study, the relevant previous works on Web-Based Learning systems. The reviews have identified out the gaps in existing systems, inspiriting for developing improved solutions. The system methodology and approach were highlighted by providing the system requirements, functional requirement, project milestone, cost estimate and conclusion remarks for methodology phase. After the methodology phase, the system design has including system block diagram, system components specifications, architecture diagram, use case, system flowchart, database design and activity diagram. The system implementation phase detailed the hardware and software setup, setting and configuration, system operation, and challenges facing during the implementation phase. System evaluation has discussion in the result of questionnaire, testing and objective evaluation.

In the conclusion, the "Web-Based Learning using ARCS model System" has effectively resolved the difficulties encountered by students in learning cybersecurity and network security courses and provide a user-friendly learning environment for students.

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7.2 Recommendation

Based on the experience and outcome of this project, the first recommendation can be made for the future improvement are implementing advanced features such as progress tracking gamification, and performance analysis would increase user engagement and provide better insights for educators.

Second recommendation is improving the chat feature by implementing a private chat system, which would allow users to communicate directly with each other rather than relying solely on global chat. This would enhance user privacy and provide a more personalized communication experience.

In conclusion, implementing advance features and private chat system can enhance the user engagement and having a better learning experience for the Web-Based Learning system.

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