



Faculty of Computer Science and Information Technology

**STEMVERSE:
GAMIFIED INTERACTIVE LEARNING IN STEM EDUCATION**

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Bachelor of Software Engineering with Honours

Ijazah Sarjana Muda Kejuruteraan Perisian dengan Kepujian

2025

**STEMVERSE:
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This project is submitted in partial fulfilment of the
requirements for the degree of
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2025

**STEMVERSE:
PENDEKATAN PEMBELAJARAN STEM BERASASKAN GAMIFIKASI**

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Project ini merupakan salah satu keperluan untuk
Ijazah Sarjana Muda Kejuruteraan Perisian dengan Kepujian

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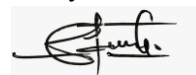
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ABSTRACT

Access to quality education is essential for fostering student engagement and enhancing learning outcomes, particularly in Science, Technology, Engineering, and Mathematics (STEM) fields. However, traditional teaching methods that are widely used in Malaysia often fail to captivate students' interest, and the lack of interactive learning tools contributes to a decline in motivation and retention rates. To address this issue, a gamified interactive STEM learning platform, STEMVerse is proposed. The platform integrates game-based elements such as badges and leaderboards to make STEM education more engaging and enjoyable for primary school students. The system will provide curriculum-aligned content, hands-on activities, and real-world problem-solving tasks while enabling teachers to manage learning materials. The expected outcome of this project is to develop an interactive and engaging educational tool that improves students' interest, comprehension, and retention in STEM subjects while providing teachers with effective tools for managing and enhancing the learning experience. The platform's impact will be evaluated based on user engagement, learning outcomes, and its ability to foster long-term interest in STEM.

ABSTRAK

Akses kepada pendidikan berkualiti amat penting bagi memupuk penglibatan pelajar dan meningkatkan hasil pembelajaran, terutamanya dalam bidang Sains, Teknologi, Kejuruteraan dan Matematik (STEM). Namun begitu, kaedah pengajaran tradisional, seperti yang diamalkan di Malaysia sering kali gagal menarik minat pelajar dan kekurangan alat pembelajaran interaktif turut menyumbang kepada pengurangan motivasi serta keupayaan untuk mengingat apa yang telah dipelajari dalam kalangan pelajar. Bagi menangani isu ini, satu platform pembelajaran STEM interaktif yang digamifikasi, iaitu STEMVerse telah dicadangkan. Platform ini menggabungkan elemen gamifikasi seperti '*badges*' dan '*leaderboard*' untuk menjadikan pembelajaran STEM lebih menarik dan menyeronokkan bagi pelajar sekolah rendah. Sistem ini akan dilengkapi dengan kandungan berlandaskan kurikulum, aktiviti praktikal, dan tugas penyelesaian masalah dunia sebenar, di samping membolehkan guru mengurus bahan pembelajaran. Hasil yang dapat diperolehi daripada projek ini ialah satu alat pendidikan yang interaktif dan menarik untuk meningkatkan minat, kefahaman, dan keupayaan untuk mengingat oleh pelajar dalam subjek STEM, serta menyediakan guru dengan alat yang berkesan untuk mengurus dan mempertingkatkan pengalaman pembelajaran. Keberkesanan platform ini akan dinilai berdasarkan penglibatan pengguna, pencapaian pembelajaran, dan keupayaannya dalam memupuk minat jangka panjang terhadap STEM.

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LIST OF ABBREVIATIONS

CSS	Cascading Style Sheets
HTML	HyperText Markup Language
PHP	Hypertext Preprocessor
STEM	Science, Technology, Engineering & Mathematics
UI	User Interface
URL	Uniform Resource Locator
UX	User Eperience

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

In Malaysia, the Ministry of Education has actively promoted STEM learning in primary and secondary schools, recognizing its importance in preparing students for the skills needed in a technology-driven future. However, Malaysia is currently facing a critical shortage of engineering talent, highlighting the importance of early education in STEM fields to address this gap (Loheswar, 2024).

Existing educational solutions frequently rely on traditional teaching methods, such as textbooks, which may not resonate with the digital native population. While some projects have used technology in the classroom, many still fall short of meaningfully engaging pupils. Standard e-learning platforms, for example, may deliver information but lack interactive components to pique students' interest and motivation. Furthermore, these platforms frequently do not employ gamification tactics, which have been found to improve learning outcomes by making education more interesting and rewarding. As a result, there is still a huge shortage in effective educational resources designed specifically for Malaysian primary school kids.

The STEMVerse platform seeks to fill this gap by offering a comprehensive educational platform specifically designed for primary school students in Malaysia. Implementing gamification features in a digital learning platform can improve behavioural, motivational, and cognitive learning outcomes (Sailer & Homner, 2020). Studies have shown that incorporating elements such as achievement badges, points, and challenges can improve students' interest. These elements help foster a sense of accomplishment and provide students with the incentive to actively participate in the learning process (Hellín et al., 2023). By incorporating gamification techniques, such as achievement rewards and interactive lessons, STEMVerse encourages active participation and enhances students' learning experience. In addition to gamification, the platform will feature educational videos, interactive quizzes, and structured learning modules. Adopting a block-learning approach, it allows students to progress through content in manageable units, reinforcing understanding step-by-step. The platform covers core STEM subjects, with each module designed to engage students through diverse formats that build both foundational knowledge and critical thinking skills.

1.2 PROBLEM STATEMENT

Despite the growing emphasis on STEM education, many students, especially in younger age groups, face challenges in engaging with and understanding complex STEM concepts due to traditional teaching methods. STEM education in Malaysia has been characterized by traditional, teacher-centred approaches that focus on rote learning and passive consumption of information (Azahar, 2023). These techniques lack interactivity, resulting in low interest, motivation, and insufficient skill development in critical thinking, problem-solving, and creativity among students. Motivation is crucial in the learning process, as it guides learners toward specific objectives and influences the amount of effort and energy that they put into reaching those goals (Bakar, 2014). Since the teaching techniques were too theoretical, 70% of Malaysian students are not interested in pursuing STEM topics (Aspin et al., 2022). The 2022 PISA report shows that Malaysian students performed lower than the OECD average in reading, mathematics, and science (OECD, 2023). Consequently, the enrolment rates in STEM streams remain low, with only about 45% of students opting for science-related subjects at the secondary level (Adam, 2024). Thus, the main problem that this project aims to solve is the lack of interest among primary school students in pursuing STEM subjects. To address this gap, STEMVerse is a web-based STEM learning platform designed to equip Malaysian primary school students with STEM knowledge through interactive, gamified features.

1.3 AIM AND OBJECTIVES

The aim of this project is to develop a gamified, interactive web-based learning platform in STEM education. According to the problem statement, the objectives of the project are listed below:

1. To investigate the requirements for developing the gamified STEM web-based platform.
2. To design and develop interactive, gamified web-based platform with educational content, ensuring relevance to classroom learning.
3. To evaluate the effectiveness of the developed system through user acceptance testing and analysis of feedback.

1.4 BRIEF METHODOLOGY

Agile methodology encourages continuous improvement, adaptation, and regular feedback, making it an ideal approach for developing a dynamic learning platform like STEMVerse. This

project, specifically, will use the Agile methodology with a focus on the Scrum framework to manage the development of the STEMVerse learning platform. Agile methodology consists of 6 phases, which are requirements gathering, design, develop, testing, deployment, and maintenance. These phases will be further explained in Chapter 3. Focusing on Scrum, which is typically designed for teams, it will be adapted for solo development in this project by customizing the framework to suit individual workflow in order to maintain focus, structure and efficiency throughout the development process.

At the start of each sprint, specific tasks or user stories will be identified, such as developing modules, implementing gamification, or refining lessons. Solo developer can prioritize tasks, focusing on high-value features, and reducing the risk of being overwhelmed by a large workload. Daily stand-ups will involve self-assessing progress and identifying any issues. Meanwhile, at the end of each sprint, completed work will be reviewed against project goals and user needs. Retrospectives will focus on what worked, what could be improved, and adjustments for the next sprint.

The project backlog will contain all required features and improvements, prioritized based on project goals. Informal feedback sessions with users (teachers and students) will be conducted at key milestones, and feedback will be integrated into the backlog. After the STEMVerse project release, a survey will be conducted to evaluate user satisfaction.

1.5 SCOPE

The project's scope focuses on increasing the motivation and interest in STEM subjects among primary school students in Malaysia, while also enhancing their knowledge in these areas. STEMVerse will offer interactive lessons across key STEM subjects (Science, Technology, Engineering, and Mathematics). These lessons will incorporate multimedia elements like videos and quizzes to enhance student learning. Furthermore, the platform will integrate gamified features, such as achievement rewards to motivate students and encourage active participation.

The target audience is as show below:

1. Primary School Students in Malaysia

The platform will specifically cater to Malaysian primary school students, focusing on grade 5 for its initial prototype.

2. Primary School Teachers

The platform provides them with a tool to guide and support students' learning.

1.6 SIGNIFICANCE OF PROJECT

The significance of the STEMVerse platform lies in its potential to transform STEM education for primary school students in Malaysia, fostering a generation of young learners who are motivated and equipped to succeed in these critical fields. STEMVerse aims to spark early interest in STEM subjects by targeting primary school students. Early exposure to STEM subjects can cultivate curiosity and lay the foundation for future academic and career pursuits in fields critical to economic growth, such as engineering, technology, and environmental science. STEMVerse provides an interactive, gamified platform that aims to make learning STEM both fun and meaningful, addressing the gap in effective teaching tools and student engagement. STEMVerse empowers educators by providing them with a platform to facilitate student learning. This reduces the burden on teachers to create interactive and engaging lesson plans, making it easier for them to implement STEM activities in their classrooms.

1.7 PROJECT SCHEDULE

The figure below shows the project schedule for STEMVerse. A Gantt chart is used to illustrate the chronology and milestones of the project schedule for the creation of the STEMVerse learning platform. The Gantt chart helps monitor project progress by giving a clear picture of the main tasks and their due dates.

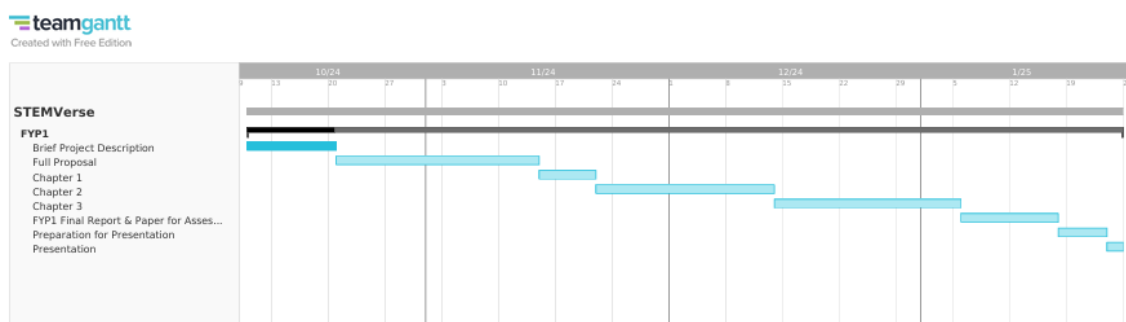


Figure 1.1 Gantt Chart of STEMVerse Project Schedule

1.8 EXPECTED OUTCOMES

The project will offer an online learning platform for students, enabling teachers to explain STEM concepts in an interactive way during lessons. The expected outcome is:

1. To develop a platform designed to boost student engagement and improve STEM knowledge and critical thinking skills by integrating gamified learning and interactive modules.

1.9 PROJECT OUTLINE

The following three chapters will comprehensively detail the various aspects of the STEMVerse project from its foundation to its implementation and outcomes.

Chapter 1: Introduction

Chapter 1 of the STEMVerse project lays the foundation by introducing the project concept, its purpose, and its relevance to STEM fields. It begins with an introduction that provides an overview of the project and its context, followed by a problem statement that highlights the specific challenges or issues the project seeks to address. The chapter then defines the aim and objectives, clarifying the project's goals and the steps to achieve them. A brief methodology outlines the approach and strategies to be employed during the project. The scope describes the target audiences and extent of the work, while the significance of project underscores its importance and potential impact. Additionally, the chapter presents a project schedule, offering a timeline of key activities in Gantt Chart, and concludes with the expected outcomes, detailing the anticipated results and contributions of the project.

Chapter 2: Literature Review

Chapter 2 emphasizes the importance of fostering interest and engagement in STEM education among primary school students through interactive and gamified experiences. Moreover, it also includes a review and analysis of existing online STEM education and/or gamified learning platforms that focus on learning, providing insights into their strengths, weaknesses, and unique features. By critically analysing these platforms, this chapter identifies gaps and opportunities that the STEMVerse project can address, ensuring the proposed solution is both relevant and impactful. A comparative analysis highlights areas for improvement and ensures the development of a system that is user-friendly, effective, and aligned with current educational needs.

Chapter 3: Requirement Analysis and Design

Chapter 3 outlines the detailed approach and framework for designing the STEMVerse platform. It delves into the project's methodology, emphasizing the steps required to translate conceptual ideas into a functional and engaging gamified system.

1.10 CHAPTER SUMMARY

This chapter introduces the STEMVerse project, a web-based learning platform designed to engage primary school students in STEM education through gamification. The platform aims to create an interactive experience that enhances understanding of science, technology, engineering, and mathematics concepts. The chapter outlines the project's objectives, scope, and expected outcomes, setting the stage for the development of a dynamic learning tool that complements the Malaysia curricular.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

Gamification, or the integration of game features into non-game environments, has emerged as a popular e-learning method for increasing student engagement and motivation. E-learning systems have always faced issues such as student disengagement and high dropout rates, limiting their effectiveness (Abdulaziz Alsubhi et al., 2020). Gamification solves these challenges by introducing game mechanics such as points, badges, leaderboards, and prizes, which make learning more engaging and fun. Gamification's significance stems from its capacity to transform passive learning into an engaging experience, enabling learners to actively explore knowledge and achieve goals.

This chapter outlines existing solutions for learning platforms, focusing on the development of an engaging STEM education system through gamification. The review of three established systems will also be emphasized in this chapter. The systems include Duolingo, Brilliant.org, and Science Kids. Two frameworks will be used to conduct benchmark analysis. This approach establishes suitable evaluation criteria to assess and refine the functionalities and effectiveness of the proposed system. A comparison between these systems and the proposed platform will also be conducted. This analysis aims to identify best practices and gaps to guide the development of an optimized solution.

2.2 BENCHMARK ANALYSIS

To develop a gamified STEM education website aligned with established benchmarks for effectiveness, the conceptual framework for integrated STEM education by Kelley and Knowles (2016), Khan's eight-dimensional framework (2001, as cited in Abu-Shawar, 2014), and the conceptual framework for designing and evaluating Web-Based Learning Resources (WBLRs) by Hadjerrouit (2010) were utilized. These frameworks provided the foundation for establishing benchmarks and identified key features critical to the success of a learning platform.

1. Conceptual Framework for Integrated STEM Education

The framework emphasizes the need for interdisciplinary connections and real-world applications to foster student engagement and skill development. This framework is particularly relevant to gamified learning systems as it encourages inquiry-based and problem-solving approaches, aligning well with the immersive and interactive elements of gamification.

Just as pulleys work together to lift a load efficiently, the different STEM disciplines, which are science, technology, engineering, and mathematics combine their strengths to solve complex problems. The load being lifted symbolizes the real-world challenges students tackle. Additionally, project-based methodologies outlined in this framework can guide feature development, such as integrating collaborative projects that reflect real-world problem-solving scenarios. For instance, in a "stratospheric mission" project utilizing weather balloons, students demonstrated enhanced engagement and comprehension of STEM subjects through collaborative and practical problem-solving approaches (Connolly et al., 2023).

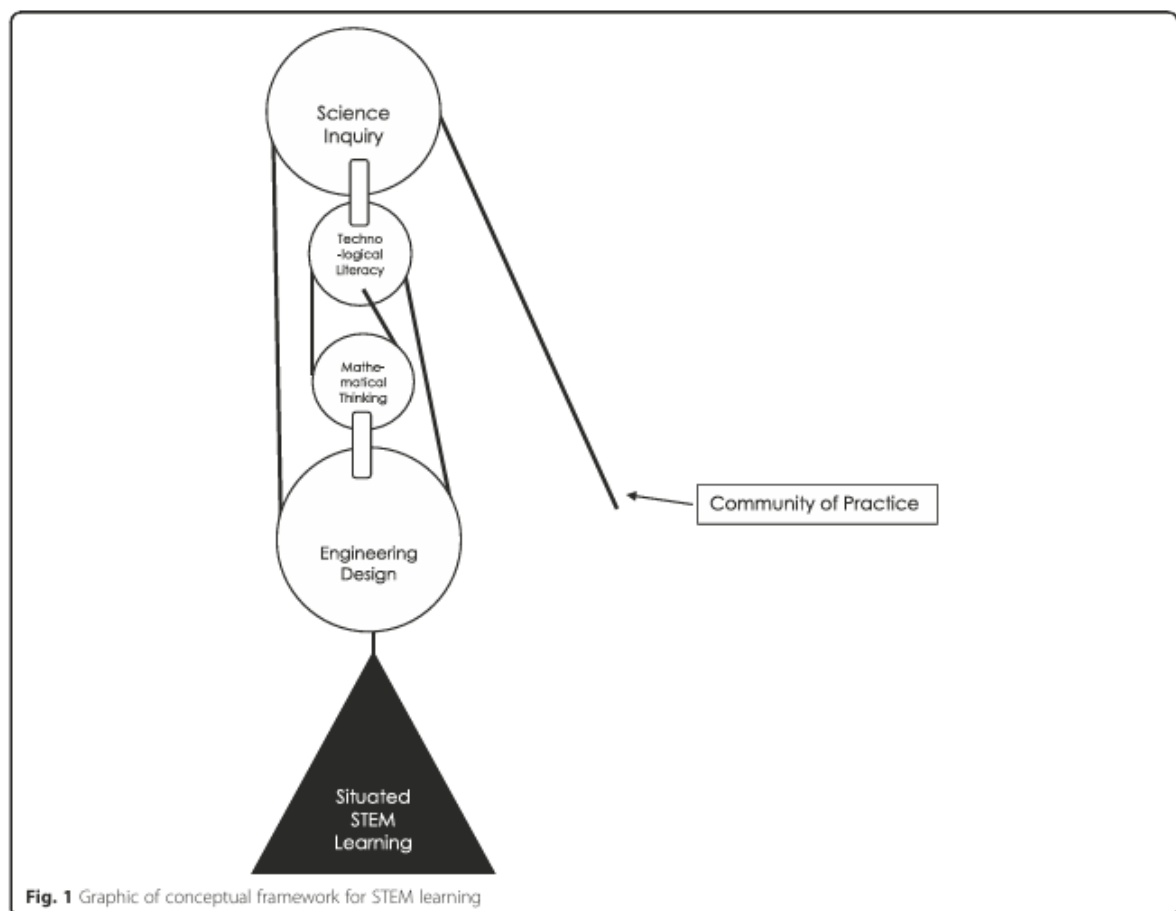


Figure 2. 1 Graphic of Conceptual framework for integrated STEM learning

Note. Sourced from Kelley and Knowles (2016).

2. Conceptual Framework for Designing and Evaluating Web-Based Learning Resources (WBLRs)

This framework is a comprehensive model that addresses the creation and assessment of educational web resources to optimize their pedagogical value and usability. The framework

integrates pedagogical, technical, and usability considerations that influence the effectiveness of web-based learning in educational settings. An evaluation study using this framework found that tools developed with both pedagogical goals and usability in mind were better received by educators and students, leading to increased engagement and comprehension (Hadjerrouit, 2010). Thus, this framework is valuable to maximize the educational impact of web-based tools.

3. Khan's Framework

Khan (2001, as cited in Abu-Shawar, 2014) proposed an eight-dimensional e-learning framework that institutions can use to plan, design, implement, and evaluate their e-learning programs. This framework will be used in this project to determine the suitable features in developing STEMVerse. Figure below shows the Khan's framework, consisting of eight factors.



Figure 2. 2 Eight-Dimensional E-Learning Framework

Note. Sourced from Abu-Shawar (2014).

Choosing only the most relevant features for this project, the framework can guide the development of STEMVerse as shown below:

1. Pedagogical: Curriculum-Aligned Content, Interactive Learning Materials (hands-on experiments, etc), Gamified Learning Paths, and Learning Outcome Focus (assessments linked to gamified activities to ensure learning objectives are met.).

2. Technological: Robust Infrastructure, Cross-Platform Compatibility, Data Security, Gamification Engine.
3. Interface Design: Intuitive User Interface, Visual Appeal, Accessibility
4. Evaluation: Built-In Assessment Tools (quizzes integrated with gamification), Feedback Mechanisms (instant feedback on quizzes).
5. Management: Staff Management.
6. Ethical: Diversity Inclusion
7. Institutional: Teacher Resources (training for educator to manage content).

By analysing these frameworks, the benchmark analysis provides a robust foundation for designing a gamified STEM learning platform. However, only the suitable factors from these frameworks will be considered in developing STEMVerse. Hence, based on the benchmark analysis, the standard features for a gamified STEM Learning platform should include project-based learning, pedagogical, technological, interface design, evaluation, management, ethical and institutional factors.

2.3 REVIEW SIMILAR EXISTING SYSTEM

In this section, comprehensive review of the three existing systems that are similar to the proposed system will be provided.

2.3.1 DUOLINGO

Duolingo is a widely used gamified language-learning platform, covering vocabulary, grammar, listening, speaking, and reading comprehension. Recently, it has expanded into basic math education as well. Duolingo can be used for self-study or in classrooms through “Duolingo for Schools,” which allows teachers to track student progress.

The system is organized around levels, with bite-sized lessons and interactive exercises like translation tasks, matching, pronunciation guides, and conversation simulations for language learning. Users earn rewards as they complete lessons and progress through stages. The platform is designed to be accessible and user-friendly, with an interface that incorporates both learning content and game elements in a seamless way.

One of the key mechanisms in Duolingo is its gamified approach to language learning, which includes various features such as leaderboards, XP (experience points), and badges. Leaderboards foster competition and badges recognize achievements, providing motivation and milestones. On the other hand, XP (Experience Points) track a learner’s progress and

encourage consistent practice by rewarding them for completing language lessons, exercises, or skill practices.

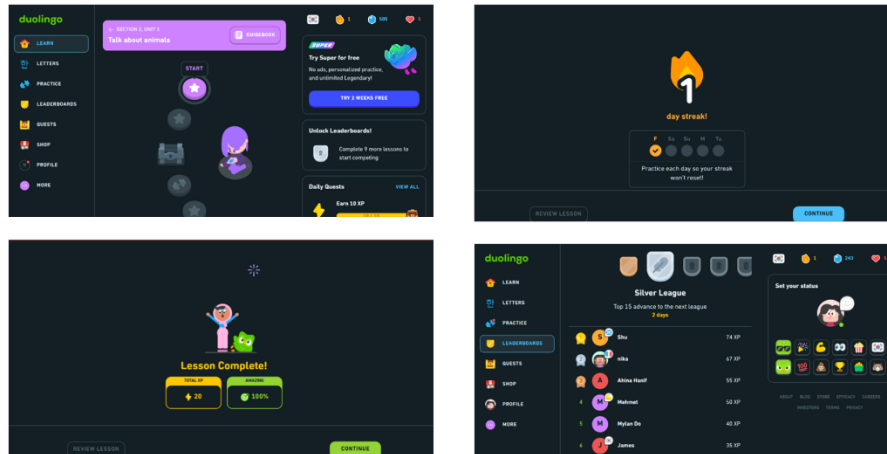


Figure 2. 3 Duolingo Webpages

The gamification of Duolingo is refined to ensure that the balance between effort and reward remains motivating without causing frustration. This is where the concept of "game refinement value" comes into play. According to the study by Huynh, Zuo, and Iida (2016), game refinement in Duolingo assesses how well the system balances tasks and rewards. The ideal refinement value keeps learners engaged by offering a mix of challenges and achievable rewards, motivating them to continue their studies without overwhelming them. The analysis revealed that Duolingo's game refinement is particularly suited for its educational goals, as it promotes regular practice while maintaining user interest. The attractiveness of Duolingo's badges also plays a significant role in the platform's gamification strategy. However, the attractiveness of badges diminishes over time as users advance. To maintain engagement, other elements like leaderboards and streaks become more prominent. Mathematically, the game refinement value can be expressed as the following formula:

$$\text{Game Refinement Value} = \text{Reward}/\text{Effort}$$

Where:

- Reward represents the gamified achievements such as badges and XP (experience points).
- Effort refers to the task or lesson difficulty that the learner needs to complete in order to earn the reward.

The formula ensures that the reward is proportionate to the effort exerted by the user, thus maintaining a motivating balance.

Duolingo's strengths lie in its ability to integrate gamification effectively into the learning process, offering rewards, competition, and recognition that keep users engaged. The combination of a user-friendly interface, progress tracking, and gamified elements makes it an attractive choice for learners of all levels. Additionally, the platform's adaptability allows it to cater to users at various stages of their learning journey.

2.3.2 BRILLIANT.ORG

Brilliant.org is an online learning platform designed to enhance understanding in mathematics, science, and computer science through interactive problem-solving and conceptual challenges. To cater to a wide range of learners, it offers a variety of courses, including science, advanced math, and programming.

Brilliant.org employs interactive learning mechanisms, where users progress through modules by solving problems and receiving detailed explanations. Each module breaks down concepts into manageable pieces. In other words, this platform provides step-by-step interactive lessons and practices for each topic. The platform also features subtle gamification, such as streaks to motivate consistency.

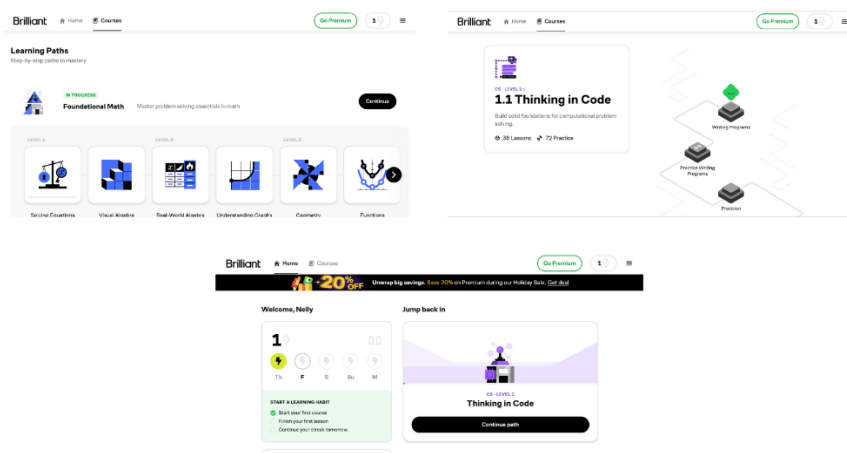


Figure 2. 4 Brilliant.org Webpages

One of the platform's greatest strengths is its focus on deep learning, making it highly effective for STEM education. It emphasizes skill-building in critical areas such as logical reasoning, problem-solving, and analytical thinking, which are vital for STEM-related careers. According to a research study by Puente and Perez (2021), students said that Brilliant.org made it easier for them to comprehend challenging concepts and relate them to real-life situations. In conclusion, Brilliant.org is a powerful tool for self-paced learning and STEM education, offering a balance of interactive content and real-world applications.

2.3.3 SCIENCE KIDS

Science Kids is a free, comprehensive educational platform aimed at introducing science concepts to young learners, primarily targeting students from 1st to 8th grade. The platform encourages exploration and active participation, offering projects that combine creativity with scientific inquiry, activity-based lessons, and experiments with clear instructions and explanations. A research study by Mateos-Núñez et al. (2020) supports the previous findings regarding the effectiveness of hands-on learning in enhancing student retention of concepts and academic achievement.

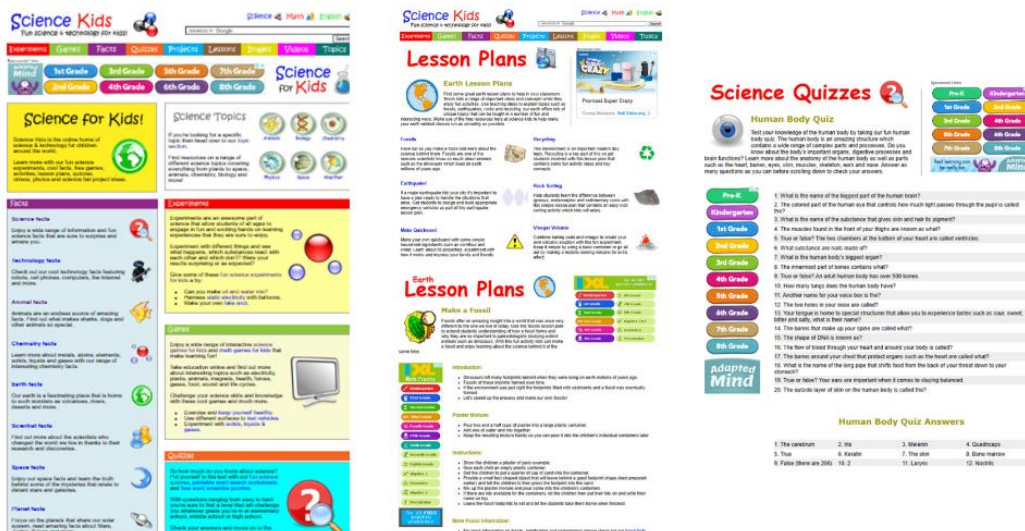


Figure 2. 5 Science Kids – Main Page, Lesson Plans Pages and Quizzes Page

Science Kids also features online games to make learning engaging, quizzes to assess knowledge, and facts that spark curiosity about the natural world. Moreover, the platform also provided multimedia resources such as images and videos. These features are categorized by sub-topics, covering a broad spectrum of scientific disciplines, making it versatile for self-

paced learning or supplementary educational use. There is a dedicated page that listed all available subjects, making navigation simple and intuitive for young users. Despite its strengths, Science Kids has a dated user interface (UI), which might not appeal to tech-savvy students accustomed to modern designs. In addition, the platform is limited to introductory-level content and lacks depth for more advanced learners. However, its rich content makes it a valuable resource for introducing STEM concepts, fostering curiosity, and making science fun for younger audiences.

2.4 COMPARISON BETWEEN EXISTING SYSTEMS & PROPOSED SYSTEM

Table below shows the competitive analysis between existing systems, which are Duolingo, Brilliant.org and Science Kids with the proposed system, STEMVerse.

Table 2. 1 Table of Comparison

	Duolingo	Brilliant.org	Science Kids	STEMVerse
Project-Based Learning	✗	✗	✓✓	✓✓
Curriculum-Aligned Content	✓	✓✓	✓	✓✓
Interactive Learning Materials	✗	✓✓	✓✓	✓✓
Gamified Learning Paths	✓✓	✓	✗	✓✓
Learning Outcome Focus	✓✓	✓✓	✗	✓✓
Robust Infrastructure	✓✓	✓✓	✗	✓✓
User-Centric Design	✓✓	✓✓	✗	✓✓
Accessibility	✓✓	✓✓	✓	✓✓
Built-in Assessment Tools	✓✓	✓✓	✗	✓✓

Staff Management	✓✓	✓✓	✗	✓✓
Teacher Resources	✓✓	✓✓	✗	✓✓

Note:

- ✓✓ : Feature fully implemented.
- ✓ : Feature present but with limitations.
- ✗ : Feature absent

Based on the comparison above, STEMVerse filled in the gaps among all the other existing systems. In terms of project-based learning, Science Kids fulfil this feature with its implementation of activity-based lessons and experiments that encourages collaboration. Science Kids lacks in terms of design and gamification elements compared to the rest. Brilliant.org has a gamification element, which is streak, but it is not considered enough compared to Duolingo that provides not only streaks, but also leaderboard and badges. Last but not least, Brilliant.org might globally cater to the school curricular, but STEMVerse aims to cater to the Malaysian syllabus according to the textbooks and incorporates local examples to make the lessons more relatable for Malaysian young learners.

2.5 TOOLS TO DEVELOP PROPOSED SYSTEM

This section outlines the tools, specifically the software used for the development of the proposed gamified STEM learning platform, STEMVerse.

2.5.1 SOFTWARE

2.5.1.1 VISUAL STUDIO CODE



Figure 2. 6 Visual Studio Code's Logo

Visual Studio Code (VS Code) is a versatile, open-source code editor, ideal for software development tasks such as coding, debugging, and integrating version control. Its

comprehensive environment supports multiple programming languages, making it an excellent choice for developing the interactive features of gamified STEM platforms. VS Code facilitates the iterative development process with features like Git integration, ensuring an efficient workflow for team and individual developers alike. Moreover, the integrated terminal in Visual Studio Code allows for multiple windows, enabling developers to efficiently manage tasks like running applications and executing tests simultaneously (Blumer,2017). Thus, VS Code is a suitable open-source code editor to develop this project as it supports PHP, HTML, and Javascript that will be primarily used to build STEMVerse.

2.5.1.2 FIGMA



Figure 2. 7 Figma's Logo

Figma is an advanced UI/UX design tool, particularly effective for prototyping and collaborative design. It enables designers to create interactive prototypes and wireframes for website and mobile application, ensuring intuitive navigation. Its collaborative features allow simultaneous editing for seamless teamwork, enabling multiple designers and developers to work on the same project (Ibrahim et. al, 2023). While working solo, these features enable efficient sharing of designs with stakeholders or educators for feedback, fostering a more refined and user-centered platform. Moreover, Figma increases efficiency in creating contents through reusable components and design libraries, which are particularly useful for maintaining consistency across multiple screens and features.

2.5.1.3 CANVA



Figure 2. 8 Canva Logo

Canva is a graphic design tool with simple drag-and-drop features. Fonts, template designs, graphics, and elements are available in this platform (Gehred, 2020). It allows users to create visually appealing designs quickly and easily, even without prior design experience. Hence, Canva can be used in the designing of badges for STEMVerse due to its versatility.

2.6 SUMMARY

Chapter 2 explores existing research and theories relevant to the project. It establishes a foundational understanding of the subject by examining scholarly articles and related projects. Key findings from the literature include the identification of gaps in current systems and the evaluation of tools that can be used to develop the system. This chapter also highlights best practices and the limitations of previous work, ensuring the project builds on proven methods while addressing identified shortcomings. By synthesizing insights from the literature, Chapter 2 lays a solid foundation for developing a robust and informed methodology in the next chapter.

CHAPTER 3: REQUIREMENT ANALYSIS AND DESIGN

3.1 INTRODUCTION

Chapter 3 highlights the methodology used in developing the proposed system, STEMVerse, which is Agile methodology. It will start from the requirements gathering and continue with the designing of the prototype for the proposed system, development, testing and deployment.

3.2 AGILE METHODOLOGY

Agile methodology is chosen to be used in developing the proposed system because its iterative and flexible approach ensures that the needs and requirements of stakeholders are continuously addressed throughout the development process.



Figure 3. 1 Agile Methodology

Note. Sourced from Milne (2024).

According to Alsaqqa et al. (2020), agile is more effective for small and medium-sized projects than other traditional development methods. This is because it can adapt to changes, deliver

incremental results, and involve stakeholders actively at every phase. Therefore, the use of agile methodology is suitable in small-scale project like STEMVerse.

3.3 REQUIREMENTS GATHERING

Requirements gathering is a phase to conduct a survey from general or specific group of people, which is important to gain their opinions on the existing system and the proposed system. This first phase helps identify the needs, challenges, and expectations of users, ensuring that the proposed system aligns with their requirements.

3.3.1 QUESTIONNAIRES

To gather requirements for this project, a questionnaire-based approach will be utilized. This method ensures the collection of structured feedback from respondents, allowing for a deeper understanding of user needs and expectations. The questionnaire will consist of 4 sections, covering key areas such as demographics, current challenges and experiences, perspectives on value and key features as well as gamification features and UI/UX design. The survey in Google Forms will be distributed to 45 respondents, consisting of 25 students from specific field of study (STEM or education) and 20 educators, ensuring the insights gathered are relevant and actionable.

3.3.1.1 DEMOGRAPHICS

3.3.1.1.1 EDUCATORS' BACKGROUND

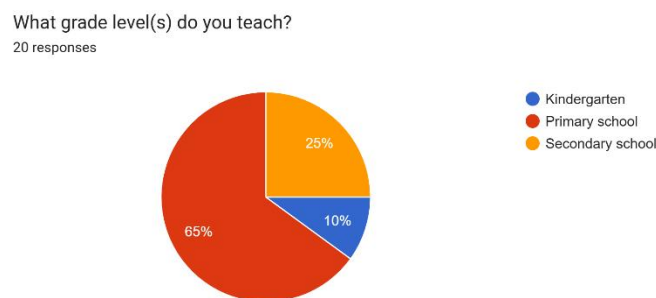


Figure 3. 2 Grade Level(s) Teach by the Educators

Do you teach STEM subjects (Science, Technology, Engineering, Mathematics)?
20 responses

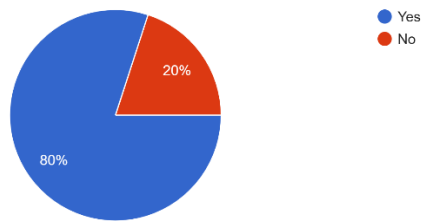


Figure 3. 3 Subjects Teach by Educators

The educators came from different backgrounds, where 65% teachers primary school students, 25% teaches primary school and 10% teaches kindergarten. In addition, 80% of these teachers teaches STEM subjects reflecting a high concentration of STEM-focused education among the respondents.

Does the school you're teaching at encourages the use of online resources to teach students?
20 responses

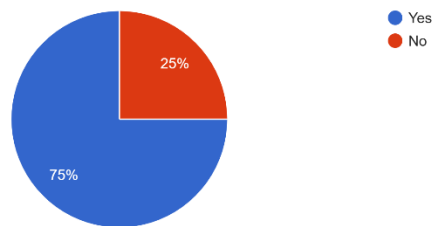


Figure 3. 4 School Encouragement regarding the Use of Online Resources

In terms of encouragement by the school to use the online resources to teach students, 75% of the teachers voted “Yes”. The result indicates strong support for the use of online resources in their schools, which suggests that most educators feel their schools are fostering a digital learning environment, possibly through access to online tools and much more.

Would you like to use a gamified learning platform to teach your students?
20 responses

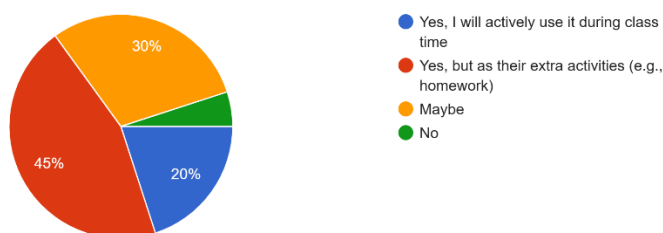


Figure 3. 5 Educators' Opinions on the use of Gamified Learning Platform for Teaching Purposes

45% of teachers (the majority) expressed a preference for using gamified learning platforms as extra activities rather than integrating them into their regular teaching. This indicates a cautious but positive attitude toward gamification, where educators see its potential as a supplementary tool rather than a primary teaching method. On the other hand, 30% of respondents answered “maybe”, suggesting that while there is interest, some teachers may require more evidence of effectiveness or guidance on how to implement these platforms effectively. However, 20% of teachers expressed a strong willingness to use gamified platforms actively during class time, signaling a smaller but enthusiastic group ready to integrate gamification into their curriculum fully. These teachers likely see the value in gamification for enhancing engagement and learning outcomes. Finally, 5% of teachers indicated they would not use gamified platforms. This minority could reflect concerns about feasibility, effectiveness, or alignment with their teaching styles or subject matter. Overall, while there is a clear interest in gamified learning, most teachers prefer to incorporate it gradually or in a supportive role. To address this, the development of the platform should focus on incorporating flexible tools that can adapt to both supplementary and primary teaching roles while providing training and evidence to build teacher confidence in their effectiveness.

3.3.1.1.2 STUDENTS' BACKGROUND

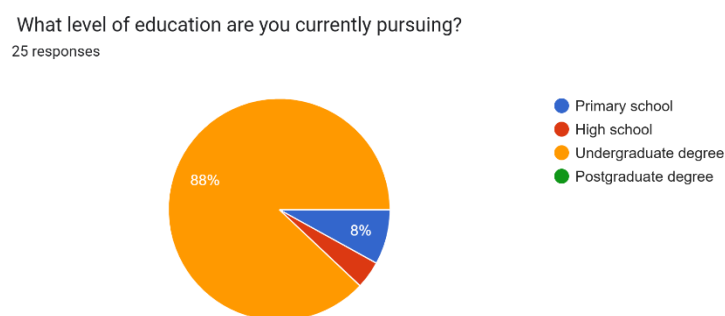


Figure 3. 6 Students' Level of Education

Most of the student respondents are university students, while 8% are from primary school, indicating a predominantly higher education demographic.

What is your field of study?

25 responses

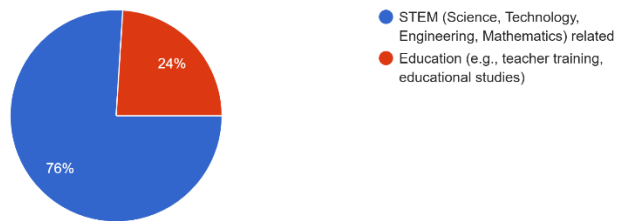


Figure 3. 7 Field of Study

76% of the students are studying in STEM fields, while 24% are pursuing studies in education, showing a strong representation of STEM backgrounds among the respondents.

Have you studied or worked with primary school students as part of your coursework or experience?

25 responses

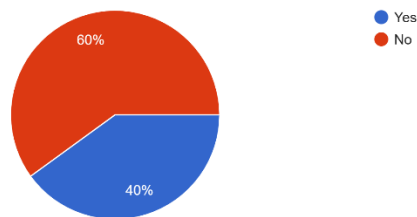


Figure 3. 8 Experience Teaching Primary School Students

60% of the students have either studied or worked with primary school students as part of their coursework or professional experience, highlighting a significant level of familiarity with younger learners.

3.3.1.2 CURRENT CHALLENGES AND EXPERIENCES

Have you used any educational platforms (e.g., Khan Academy, Duolingo, etc.) ?

45 responses

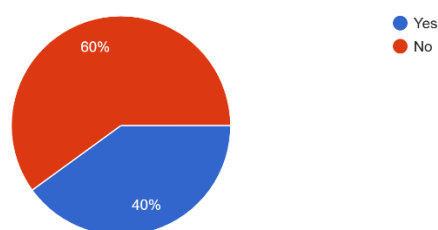


Figure 3. 9 Educational Platforms' Familiarity

60% majority of the respondents shows that they do not use educational platforms, suggesting limited adoption or awareness of such tools among the surveyed group.

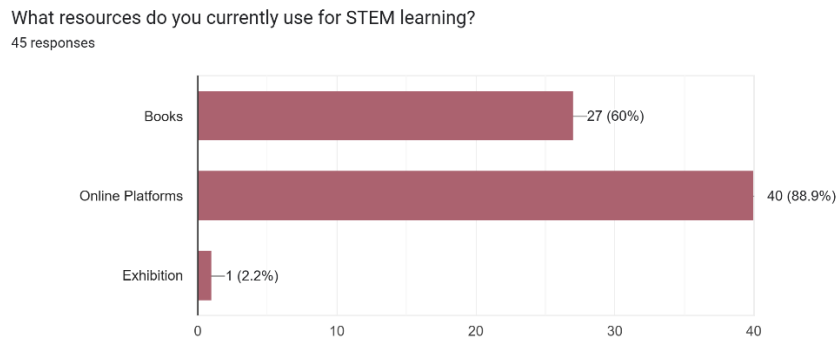


Figure 3. 10 Resources Used for STEM Learning

40 respondents (the majority) utilize online platforms for STEM learning, showcasing a strong preference for digital resources. 27 respondents rely on books, reflecting a continued significance of traditional materials in STEM education. Only 1 respondent mentioned exhibitions, indicating that hands-on or experiential learning opportunities are rarely utilized.

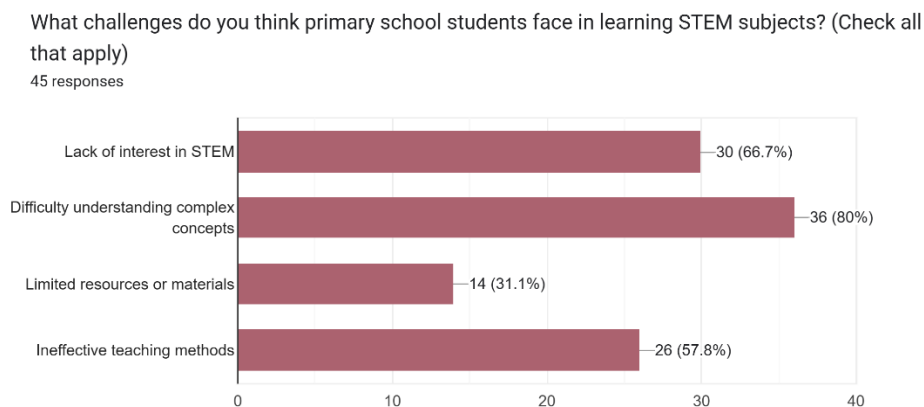


Figure 3. 11 Challenges Faced by Primary School Students

The majority (80%) believe the biggest challenge is difficulty in understanding complex concepts, emphasizing the need for simplified explanations and interactive teaching methods. 66.7% identified a lack of interest among students, pointing to the importance of engaging and relatable content. Ineffective teaching methods were cited by 57.8%, highlighting the need for teacher training and innovative approaches. Finally, 31.1% noted limited resources and

materials, indicating that access to quality educational tools and infrastructure remains a challenge for some primary schools.

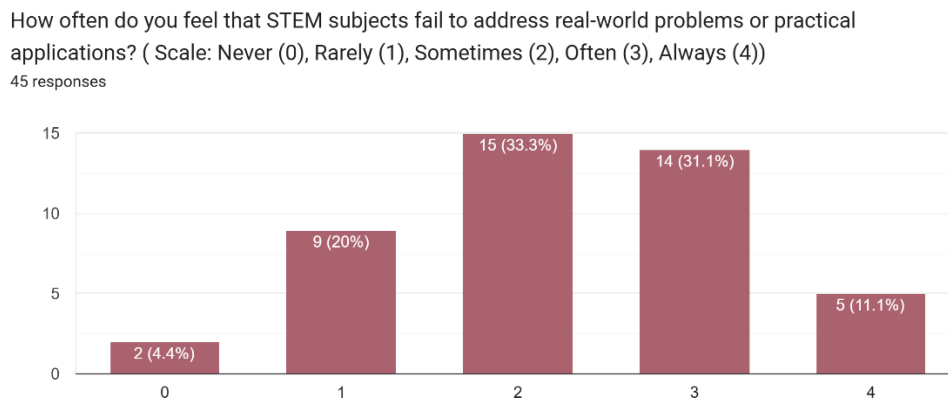


Figure 3. 12 Opinions on STEM subjects in Addressing Real-World Applications

Most respondents selected “Sometimes” (2) on the scale, indicating that many feel STEM subjects only occasionally connect to real-world problems or practical applications. This suggests room for improvement in making STEM education more relevant and relatable. 14 respondents chose “Often” (3), showing that a significant portion believes STEM subjects frequently fail to address practical applications. This highlights a perception that there is a consistent gap in bridging theoretical knowledge with real-world problem-solving.

3.3.1.3 PERSPECTIVES ON VALUES AND KEY FEATURES

The figure below shows the features considered important for a STEM educational platform for primary school students. The most favored feature is gamification elements, with 71.1% of respondents emphasizing their importance, reflecting the need for engaging and motivating tools to capture young learners’ interest. 60% voted for hands-on experiments or activities, underscoring the significance of experiential learning for primary school students. 53.3% value real-world problem-solving tasks, highlighting the importance of connecting STEM education to practical applications. 51.1% prioritized interactive lessons with videos, showing a preference for multimedia resources that cater to diverse learning styles. Last but not least, Collaborative tools received the least votes, indicating that while important, collaboration may be considered secondary to other features for this age group.

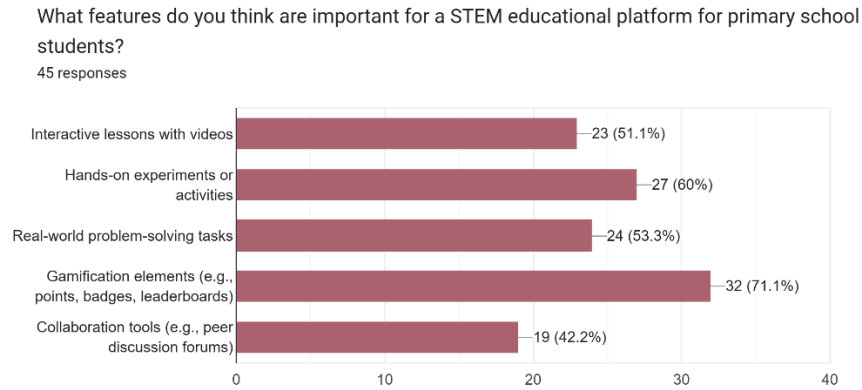


Figure 3. 13 Important Features for STEM Platform

Preferences for Learning Modes in a STEM Platform

Do you prefer a STEM platform to provide theoretical lessons or practical exercises (or a mix of both)?

45 responses

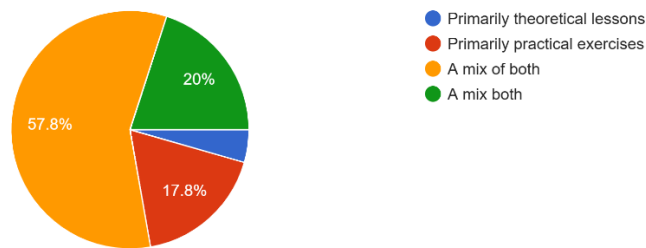


Figure 3. 14 Opinions on Theoretical vs Practical Lessons

57.8% of the respondents agreed that a mix of both theoretical and practical lessons is important in an educational platform, specifically STEM education. This indicates a strong belief in the value of balancing foundational knowledge with hands-on learning to enhance comprehension and engagement. Experiment section can be added into the system as a way to support this balance.

3.3.1.4 GAMIFICATION FEATURES AND UI/UX

How frequently should rewards or achievements be given to maintain students' motivation?

45 responses

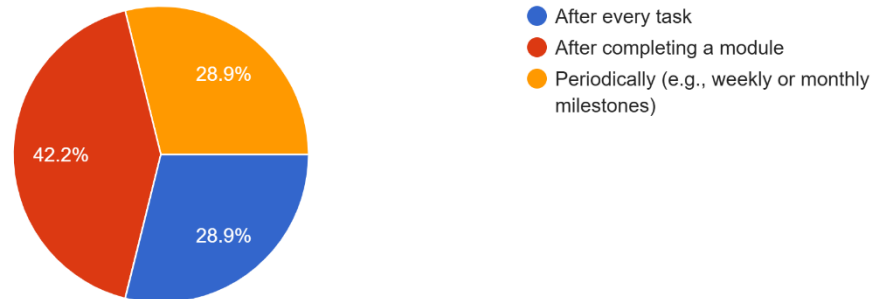


Figure 3. 15 Frequency of Rewards-Giving

Based on the pie chart above, most of the respondents agreed that the rewards should be awarded to the students after every task to maintain their motivation. Not only that this approach encourages continuous engagement, but students will also learn to associate accomplishment with progress, fostering positive learning experience. This can be done upon completion of each lesson in the learning modules.

How important is it for the platform to have a user-friendly interface and design? Scale: Not important (1) - Very Important (5)

45 responses

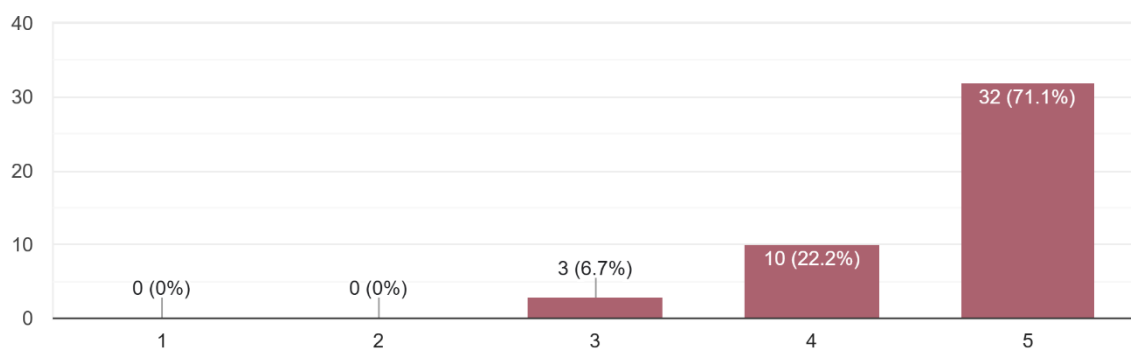


Figure 3. 16 Opinions on UI/UX

71.5% of the respondents agreed that it is important for the educational platform that aims primary school students to have a user-friendly UI/UX. It is important to gain their interest and keep them motivated through well-designed interface.

3.4 DESIGN

Design is the second stage of the Agile process. During this stage, the software architecture of the proposed system will be designed. This part will also include use case diagrams, sequence diagrams, activity diagrams, class diagrams, and a prototype.

3.4.1 SOFTWARE ARCHITECTURE

The software architecture of the proposed system provides a blueprint of how the platform's components are organized and interacted. The components consist of users (teachers and students), frontend (also known as client-side), and backend (web server, database, and file system). The frontend interface is accessible through tablet, personal laptop or computer. Figure below shows the software architecture of STEMVerse which highlights the interaction between the components mentioned previously.

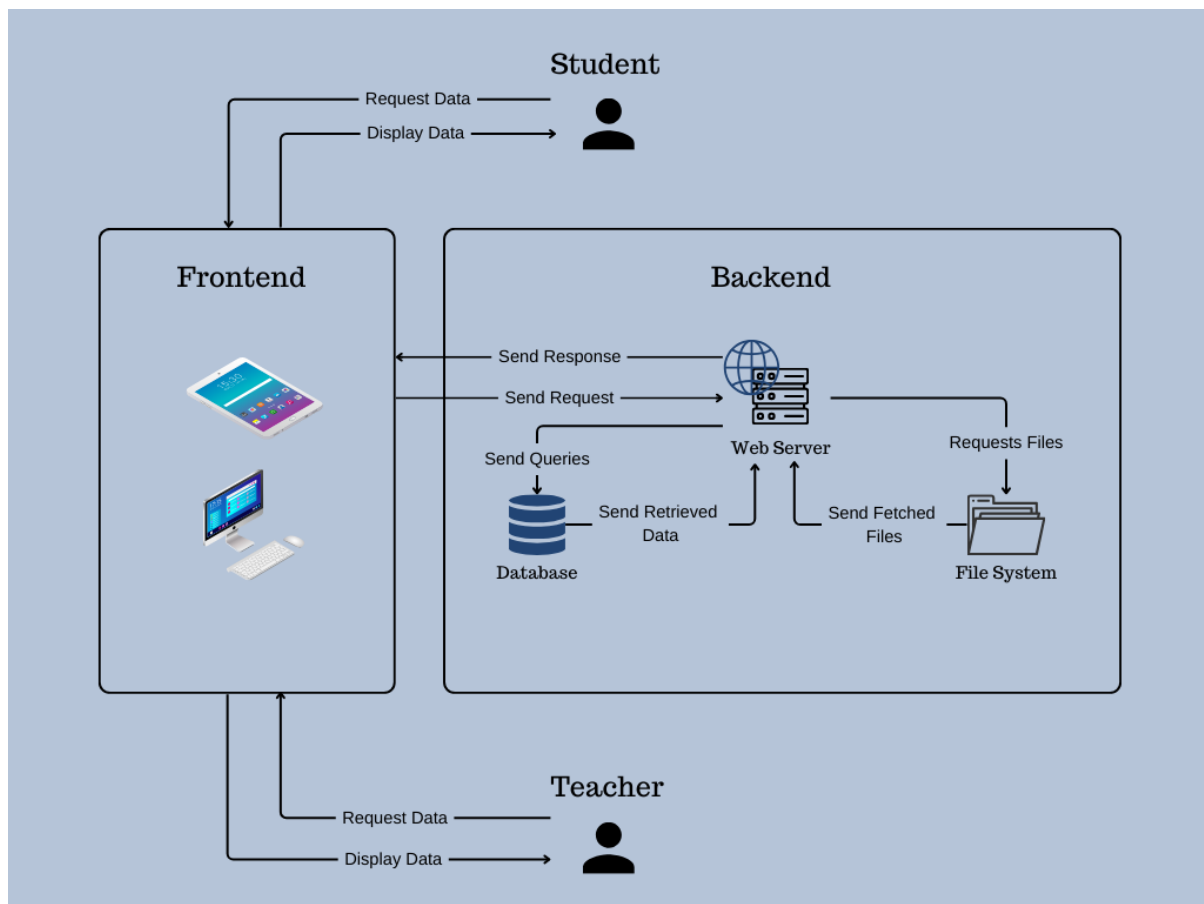


Figure 3. 17 Software Architecture of STEMVerse

In this software architecture, the users, which are students and teachers will access the web-based platform through interaction with the frontend interface on devices such as tablet or computer. Student interface will enable them to access to courses, quizzes, and gamification elements. On the other hand, the teacher interface provides dashboard to manage quizzes. The backend (server side) handles requests from users and communicates with database and file system through web server. Database stores and retrieves structured data such as user profiles. The file system stores multimedia content including the video lessons, images, and quizzes submissions.

3.4.2 FLOW CHART DIAGRAM

Figure 3.18 below shows the flowchart of the proposed system.

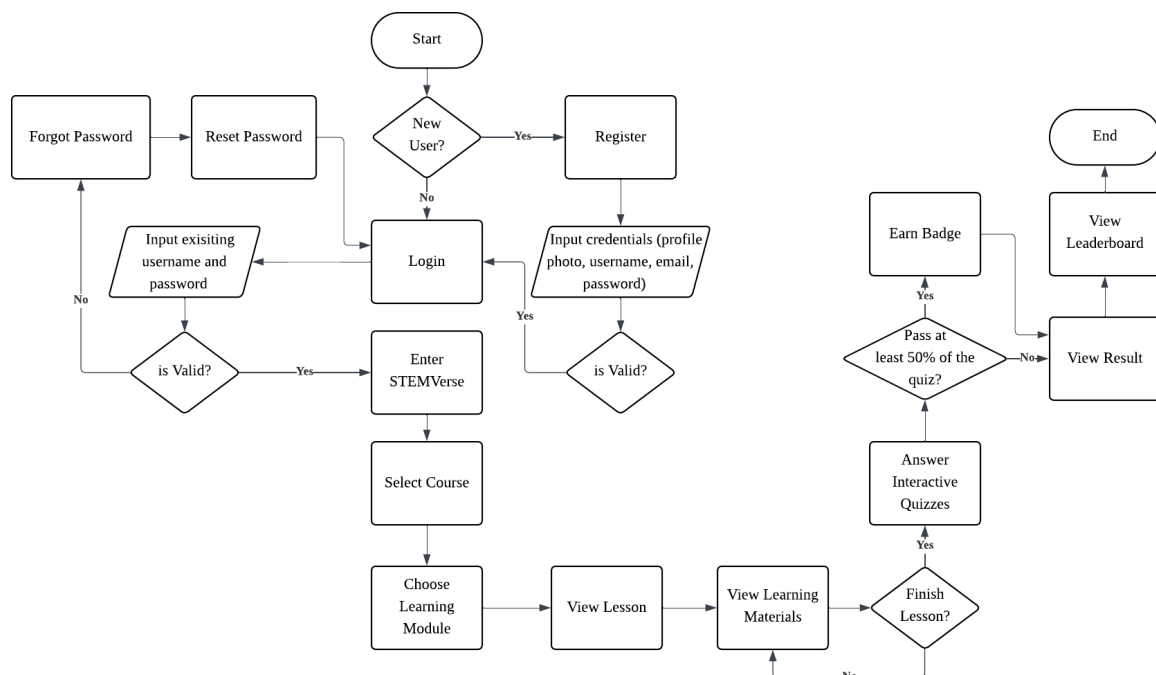


Figure 3. 18 Flowchart of STEMVerse for Student

3.4.3 USE CASE DIAGRAM



Figure 3. 19 Use Case Diagram

3.4.3.1 USE CASE DESCRIPTION

The tables under this section specified the description for the use case in Figure 3.19. In the above use case diagram, teacher can act as administrator.

Table 3. 1 Use Case Description for Create Account

Use Case ID	1
Use Case Name	Register
Brief Description	User can create new account to access the website.
Actor(s)	Student

Pre-condition	1. User must visit STEMVerse's home page through the website URL. 2. User must click the "Register" button on the navigation bar to be redirected to the register account page.
Post-condition	User will be able to view the create new account form and fill in their details.
Main Flow	1. User enters the website URL in browser. 2. User views the home page. 3. User clicks "Register" button. 4. User views the create account page. 5. User fills in credentials (profile photo, username, email and password)
Alternative Flow	N/A
Exception Flow	1. User submits invalid or missing input, such as invalid email format. a. The field will be highlighted with error. b. Appropriate error message will pop up. c. Submission will be prevented until corrected. 2. User submits existing username or email. a. User will be notified with a message. b. User will be suggested to log in.

Table 3. 2 Use Case Description for Login

Use Case ID	2
Use Case Name	Log in
Brief Description	User can log in with their account upon registering.
Actor(s)	Student, Teacher
Pre-condition	User must have existing account.
Post-condition	User will be able to view the platform's contents, such as leaderboard for students and dashboard for teachers.
Main Flow	1. User clicks on "Log In" button on the navigation bar. Users input their credentials in normal log in page, meanwhile

	teachers (admin) must enter through ‘Admin Login’ button at the bottom of the form. 2. User fills in the correct username and password. 3. User clicks on ‘Login’ to enter the platform.
Alternative Flow	N/A
Exception Flow	1. User submits wrong username or password. a. Error message will pop up. b. User will be prompted to try again or click on “Forgot Password” to reset their password through email.

Table 3. 3 Use Case Description for Select Course

Use Case ID	3
Use Case Name	Select Course
Brief Description	User can select available courses to view the respective lessons and learning materials.
Actor(s)	Student
Pre-condition	User must log in.
Post-condition	User can view and select course.
Main Flow	1. User logged in with their registered account. 2. User views available courses. 3. User clicks on “Start” to select any courses.
Alternative Flow	N/A
Exception Flow	N/A

Table 3. 4 Use Case Description for Choose Learning Modules

Use Case ID	4
Use Case Name	Choose Learning Modules
Brief Description	User can choose learning module in the respective course.
Actor(s)	Student
Pre-condition	User is able to view list of available learning modules.
Post-condition	User can select any module to view the respective lessons.

Main Flow	1. User clicks on any course available. 2. User will be directed to learning modules page.
Alternative Flow	N/A
Exception Flow	N/A

Table 3. 5 Use Case Description for View Lesson

Use Case ID	5
Use Case Name	View Lesson
Brief Description	User can view lesson to view the learning materials.
Actor(s)	Student
Pre-condition	User must select a course and a specific learning modules.
Post-condition	User can select lesson.
Main Flow	1. User clicks on the learning module. 2. User views the displayed list of lessons. 3. User selects lesson.
Alternative Flow	N/A
Exception Flow	N/A

Table 3. 6 Use Case Description for View Learning Materials

Use Case ID	6
Use Case Name	View Learning Materials
Brief Description	User can view learning material such as video and experiment instructions.
Actor(s)	Student, teacher
Pre-condition	User must select a lesson to view the learning materials.
Post-condition	User can engage with the learning materials, such as watching the video or downloading the experiment instructions' pdf file.
Main Flow	1. User selects a lesson from a course. 2. User views learning materials.
Alternative Flow	N/A
Exception Flow	N/A

Table 3. 7 Use Case Description for Start Quiz

Use Case ID	7
Use Case Name	Start Quiz
Brief Description	User can answer quiz to test their STEM knowledge.
Actor(s)	Student
Pre-condition	User must view all learning materials available.
Post-condition	User can answer quiz.
Main Flow	1. User engages with learning materials. 2. User clicks on “To Final Quiz” button to test knowledge. 3. User obtains badge upon completion (must pass at least 50% to gain participation badge).
Alternative Flow	N/A
Exception Flow	N/A

Table 3. 8 Use Case Description for View Leaderboard

Use Case ID	8
Use Case Name	View Leaderboard
Brief Description	User can view rankings in the leaderboard.
Actor(s)	Student
Pre-condition	User must log into the system and answer at least one quiz to participate.
Post-condition	User views the leaderboard.
Main Flow	1. User clicks “Leaderboard” on the navigation bar. 2. User views the leaderboard.
Alternative Flow	N/A
Exception Flow	N/A

Table 3. 9 Use Case Description for View Badges

Use Case ID	9
Use Case Name	View Badges
Brief Description	User can view badges once it pop up on their screen upon finishing the quiz with participation completion.
Actor(s)	Student
Pre-condition	User must log into the system.
Post-condition	User views the badges in their 'My Profile' section.
Main Flow	1. User passes final quiz. 2. User views the badge obtained.
Alternative Flow	N/A
Exception Flow	N/A

Table 3. 10 Use Case Description for Review Quiz

Use Case ID	10
Use Case Name	Review Quiz
Brief Description	User can review quiz to know the correct answers.
Actor(s)	Student
Pre-condition	User must log into the system and answer the final quiz beforehand.
Post-condition	User review the answers for the quiz.
Main Flow	1. User completes final quiz. 2. User clicks on 'Review Quiz' button.
Alternative Flow	N/A
Exception Flow	N/A

Table 3. 11 Use Case Description for Manage Quizzes

Use Case ID	11
Use Case Name	Manage Quizzes
Brief Description	User can manage the contents of the quizzes.

Actor(s)	Teacher
Pre-condition	User must logged into the system.
Post-condition	User can view, add, edit, or delete the quizzes' contents.
Main Flow	1. User clicks on 'Manage Quiz' on the navigation bar. 2. User views the list of available quizzes. 3. User chooses to add, edit or delete quiz.
Alternative Flow	N/A
Exception Flow	N/A

Table 3. 12 Use Case Description for Manage Profile

Use Case ID	12
Use Case Name	Manage Profile
Brief Description	User can manage their own profile.
Actor(s)	Student
Pre-condition	User must logged into the system.
Post-condition	User can view or edit their profile photo, username, email and change password. User can view achievement badges obtained.
Main Flow	1. User clicks on 'My Profile' on the navigation bar. 2. User views the My Profile page. 3. User chooses to edit credentials or change password.
Alternative Flow	N/A
Exception Flow	N/A

Table 3. 13 Use Case Description for View Admin Dashboard

Use Case ID	13
Use Case Name	View Admin Dashboard
Brief Description	User can view the admin dashboard page.
Actor(s)	Teacher
Pre-condition	User must logged into the system through admin log in button.
Post-condition	User can view the dashboard contents and navigate through it.

Main Flow	1. User enters the admin dashboard upon successful log in attempt. 2. User views the list of sections on the left side navigation bar and the score report display. 3. User chooses to navigate to the desired section.
Alternative Flow	N/A
Exception Flow	N/A

Table 3. 14 Use Case Description for View Students' Progress Tracker

Use Case ID	14
Use Case Name	View Students' Progress Tracker
Brief Description	User can view and track the progress of students in the final quiz.
Actor(s)	Teacher
Pre-condition	User must logged into the system.
Post-condition	User can sort the list of students' progress according to course, lesson, or quiz.
Main Flow	1. User clicks on 'Students Progress Tracker' on the left side navigation bar. 2. User views the list of students' progress.
Alternative Flow	N/A
Exception Flow	N/A

Table 3. 15 Use Case Description for View Score Report

Use Case ID	15
Use Case Name	View Score Report
Brief Description	User can view the average score report of the points obtained by students in the final quizzes by course.
Actor(s)	Teacher
Pre-condition	User must logged into the system.
Post-condition	User can hover their cursor on the bar of the graph to view the specific average score for that certain course.

Main Flow	1. User views the score report graph.
Alternative Flow	N/A
Exception Flow	N/A

Table 3. 16 Use Case Description for Manage Users

Use Case ID	16
Use Case Name	Manage Users
Brief Description	User can manage the list of users using the system, specifically the students.
Actor(s)	Teacher
Pre-condition	User must logged into the system.
Post-condition	User can view, add, edit, or delete the users.
Main Flow	1. User clicks on ‘User Management’ on the left side navigation bar. 2. User views the list of registered users. 3. User chooses to add, edit or delete user.
Alternative Flow	N/A
Exception Flow	N/A

Table 3. 17 Use Case Description for Manage Admin Settings

Use Case ID	16
Use Case Name	Manage Admin Settings
Brief Description	User can manage their profile by changing username, email or change password.
Actor(s)	Teacher
Pre-condition	User must logged into the system.
Post-condition	User can view or edit their profile credentials.
Main Flow	1. User clicks on ‘Admin Settings’ on the left side navigation bar. 2. User views the profile credentials. 3. User chooses to edit the credentials.
Alternative Flow	N/A

Exception Flow	N/A
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3.4.4 SEQUENCE DIAGRAM

Figure below shows the sequence diagram for student.

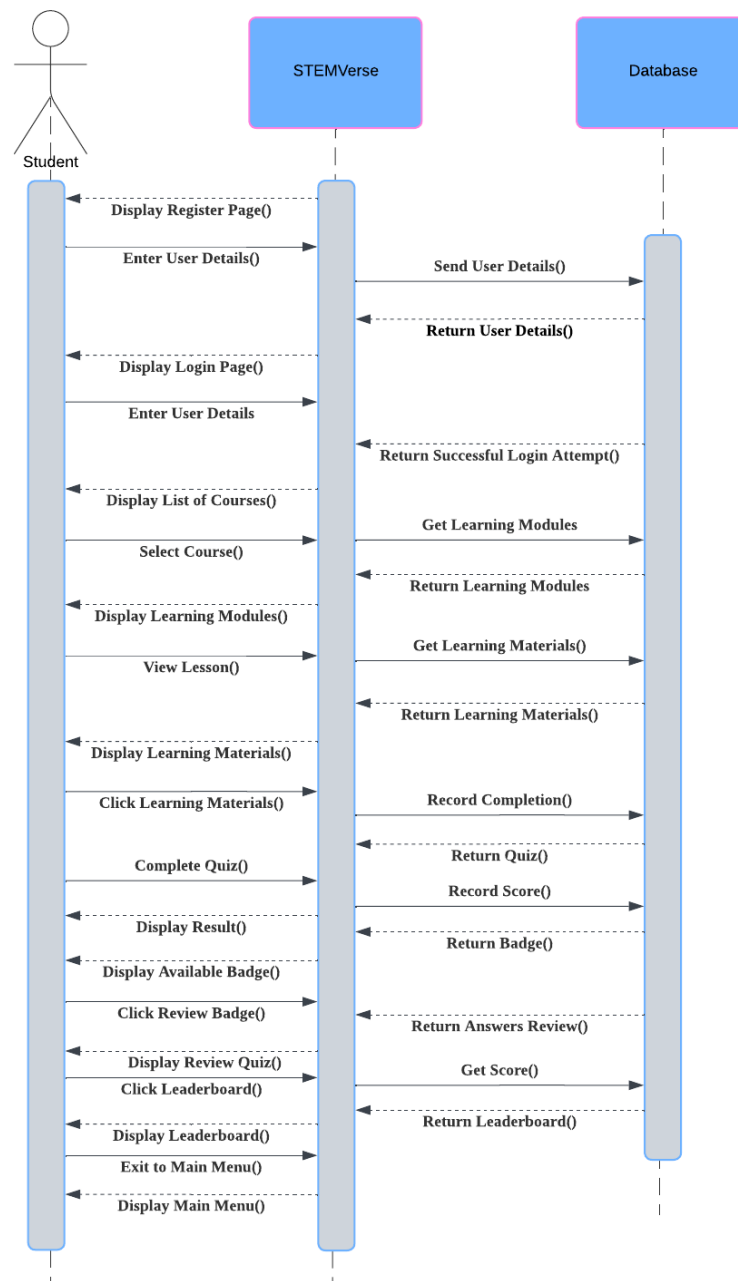


Figure 3. 20 Sequence Diagram for Student

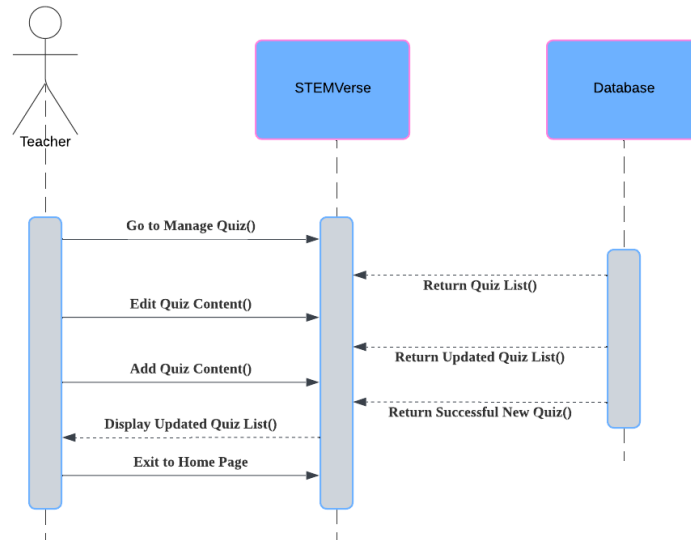


Figure 3. 21 Sequence Diagram for Teacher to Manage Quiz

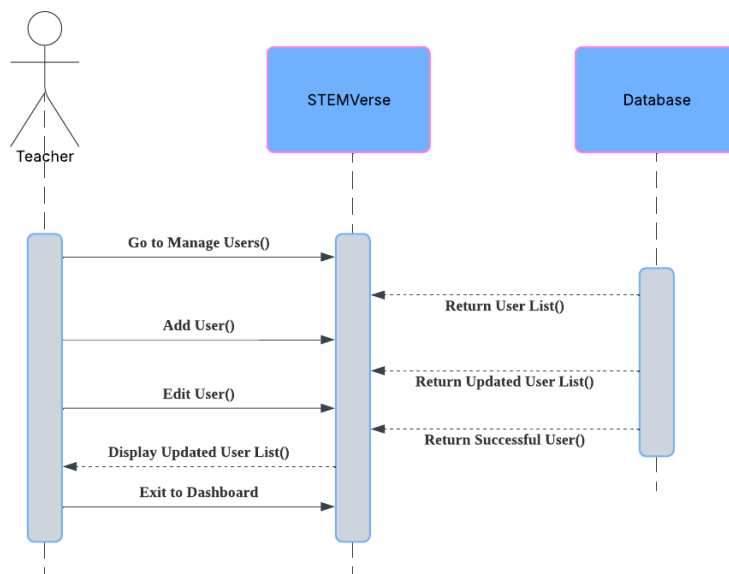


Figure 3. 22 Sequence Diagram for Teacher to Manage User

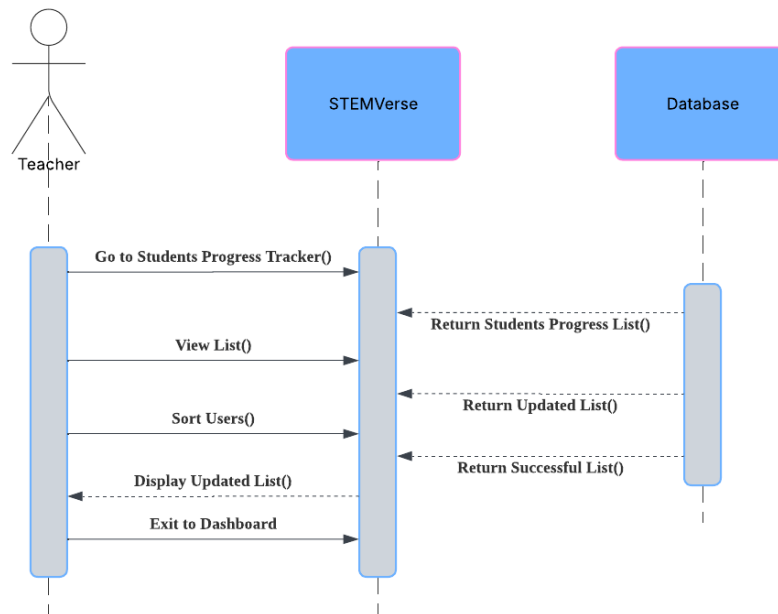


Figure 3. 23 Sequence Diagram for Teacher to Track Students' Progress

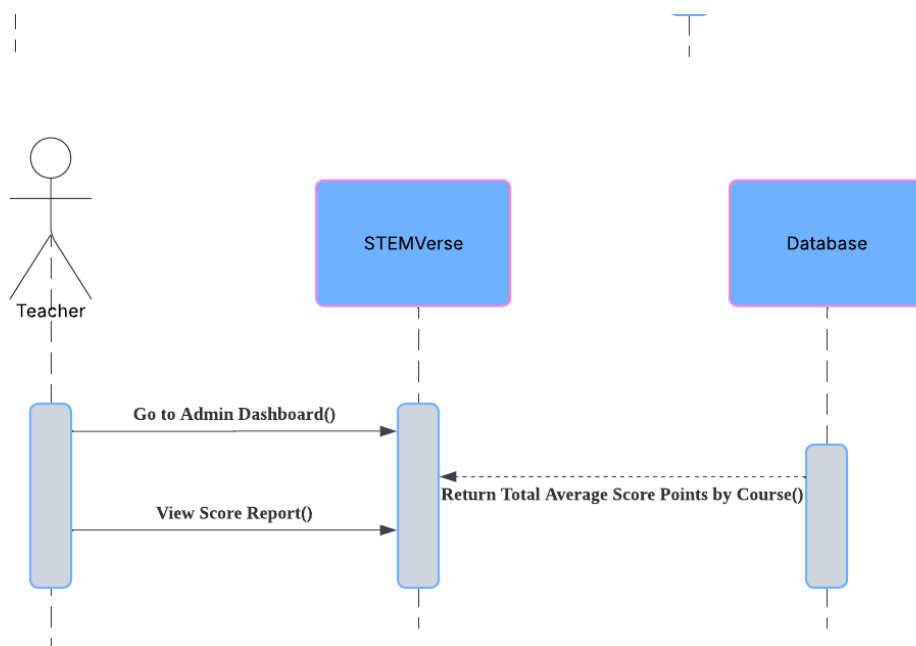


Figure 3. 24 Sequence Diagram for Teacher to View Score Report

3.4.5 ACTIVITY DIAGRAM

The activity diagram for the proposed system, STEMVerse is shown below.

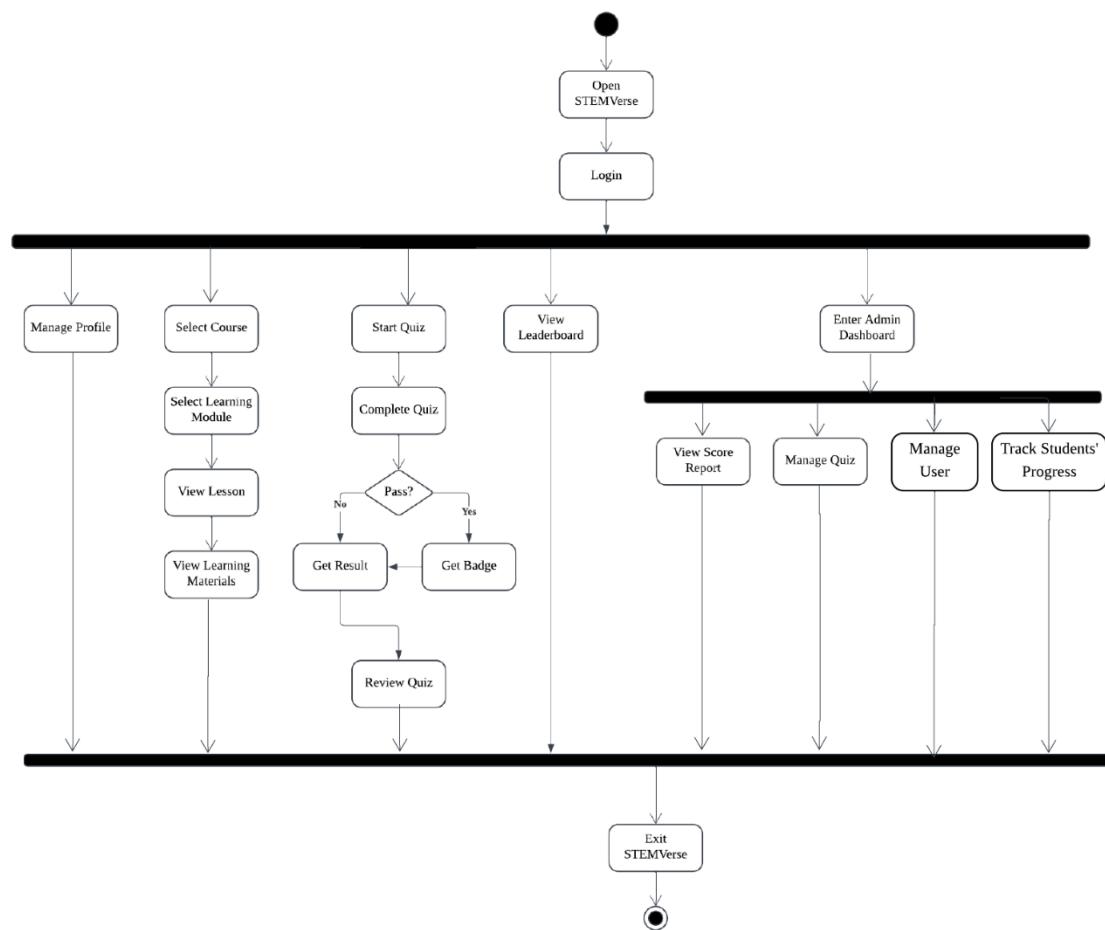


Figure 3. 25 Activity Diagram

3.4.6 CLASS DIAGRAM

The class diagram of STEMVerse is shown below.

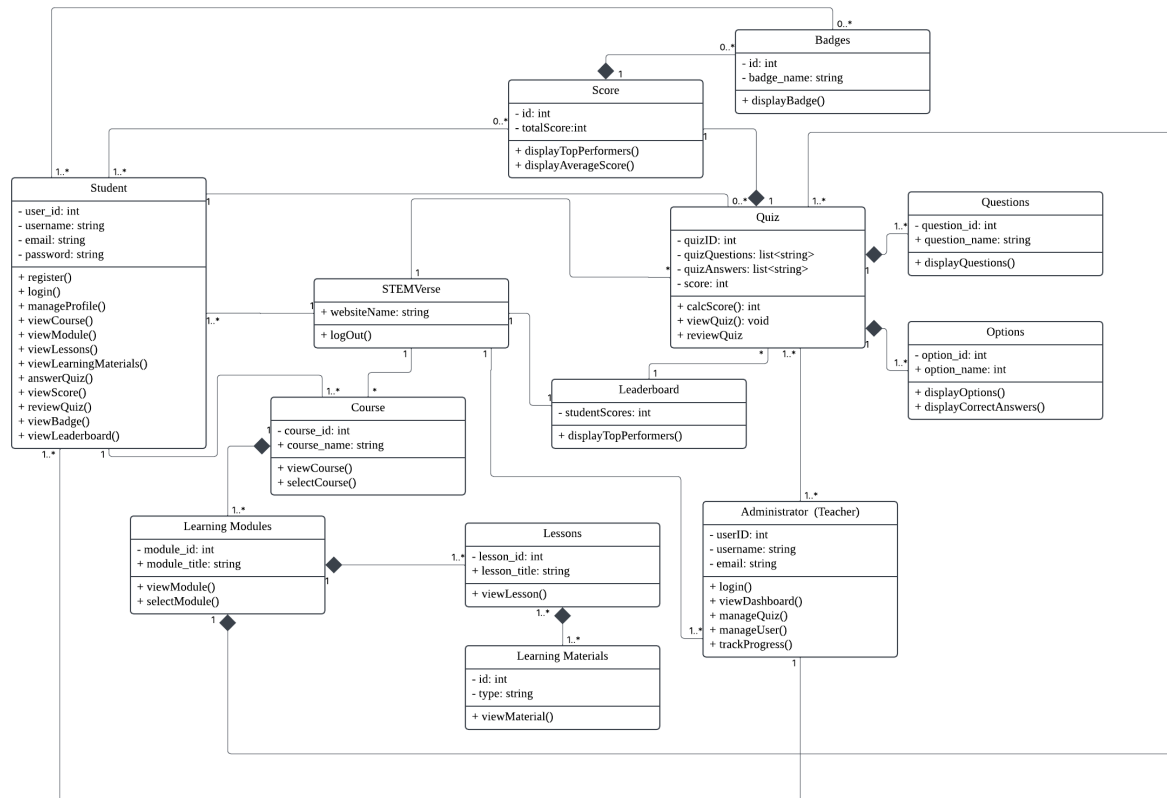


Figure 3. 26 Class Diagram

3.4.7 USER INTERFACE DESIGN

This section of the chapter will showcase the wireframe design of STEMVerse. The prototype is designed using Figma, highlighting the expectation on how the product will look like based on the requirements.

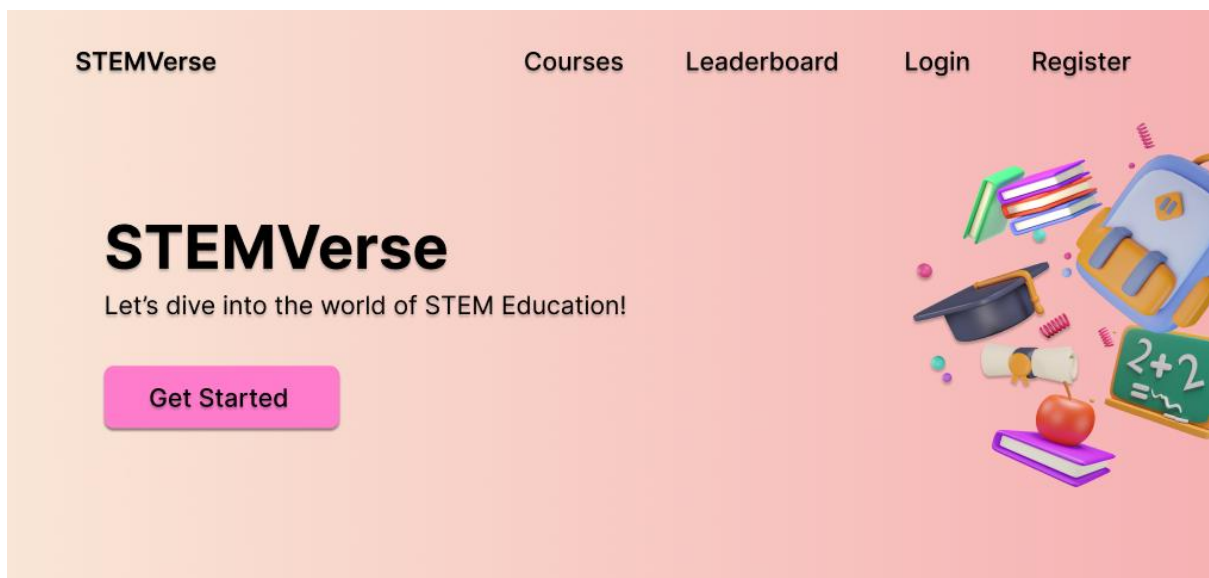


Figure 3. 27 Home Page

Figure above shows the home page of STEMVerse. In this page, the navigation bar consists of “Courses”, “Leaderboard”, “Log In” and “Register”. Upon clicking any of these options, user will be redirected to the respective page. Moreover, clicking “Get Started” button will redirect the user to the register page.

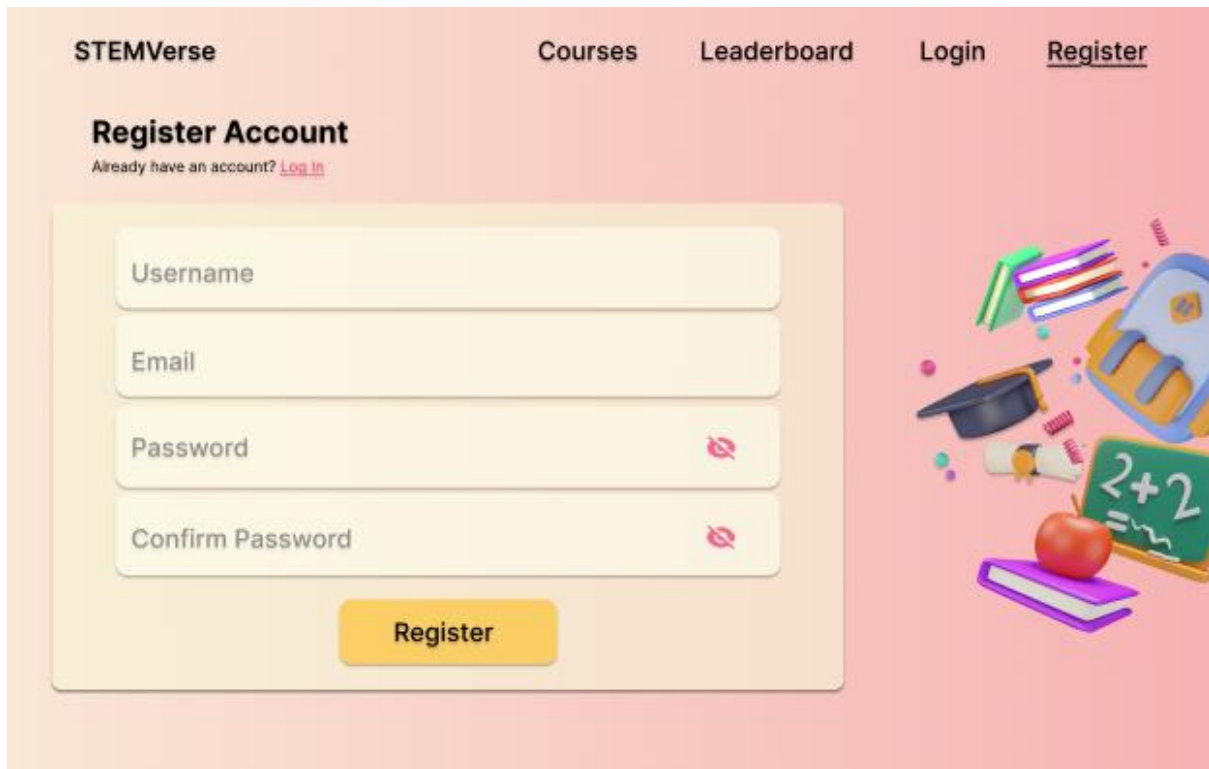
The image shows the 'Register Account' page of the STEMVerse website. The page has a light pink background. At the top, there is a navigation bar with the text 'STEMVerse' on the left and 'Courses', 'Leaderboard', 'Login', and 'Register' on the right. Below the navigation bar, the title 'Register Account' is displayed in bold black text. Underneath the title, there is a link that says 'Already have an account? Log in'. The main part of the page features a registration form with four input fields: 'Username', 'Email', 'Password', and 'Confirm Password'. The 'Password' and 'Confirm Password' fields have a small red eye icon to the right of the input box. Below the form is a yellow 'Register' button. To the right of the form, there is a colorful illustration of school supplies including books, a graduation cap, a calculator, a green chalkboard with the equation '2+2=4', and a red apple.

Figure 3. 28 Register Page

Students are required to register new account into the website by entering their username, email, and password.

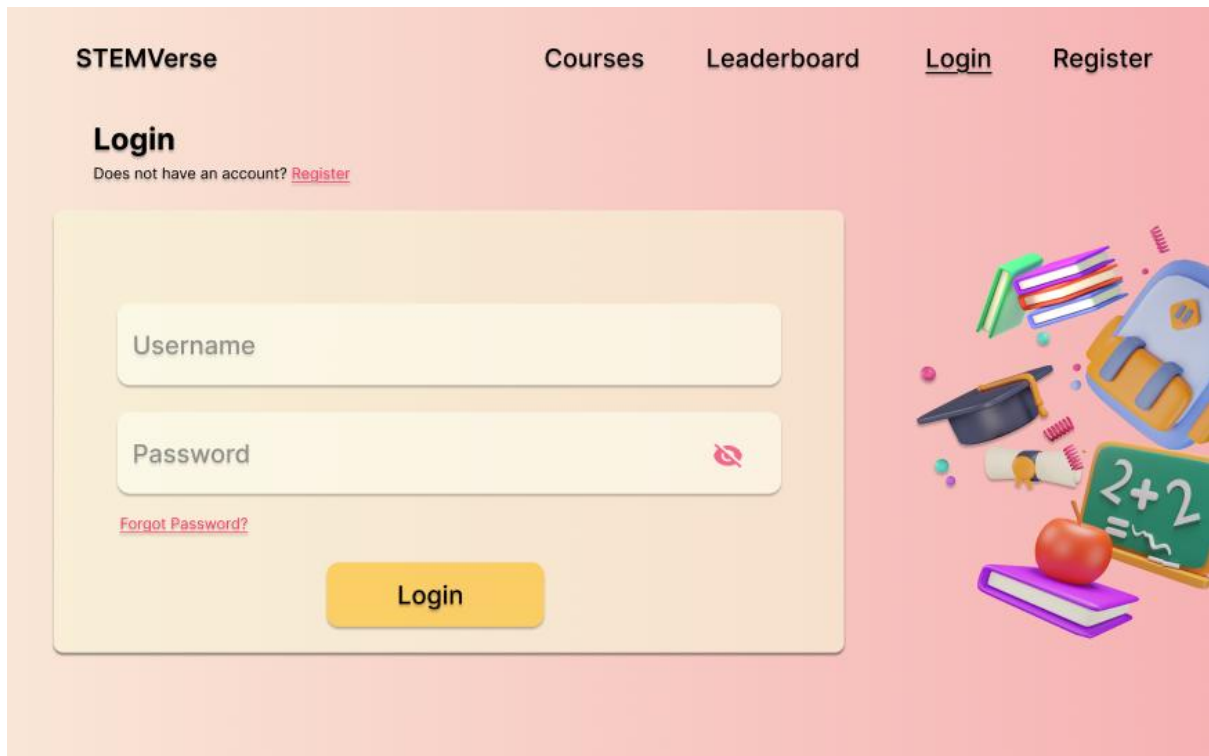


Figure 3. 29 Log In Page

The log in page will require the users to enter their username and password. Administrators (teachers) and students will be able to access their own respective page.

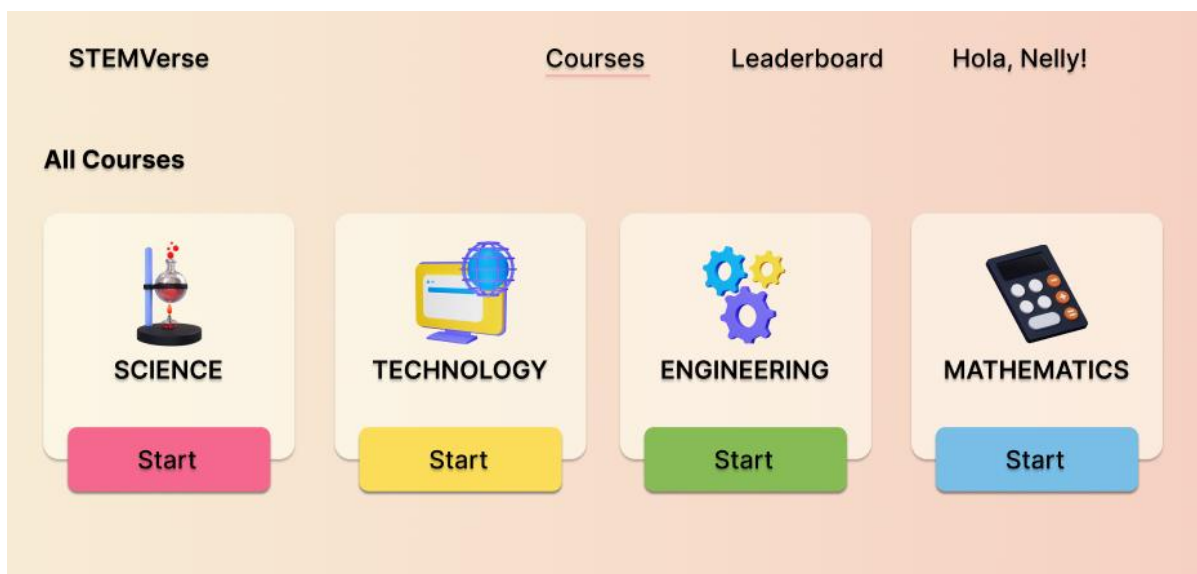


Figure 3. 30 Courses Page

The above page showcases the Courses page of STEMVerse, consisting of science, technology, engineering, and mathematics. Clicking “Start” button on each of these courses will redirect the student to the page containing learning modules for the respective course.

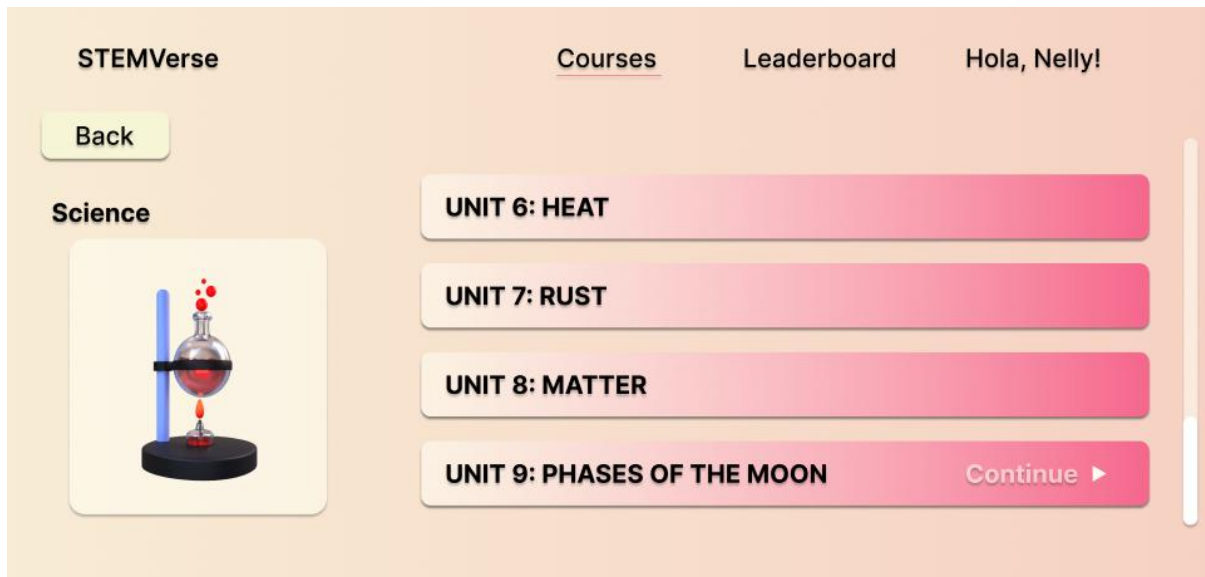


Figure 3. 31 Learning Modules Page

Next, students are redirected to the Learning Modules page that contains available learning units, with options to view detailed lessons upon clicking any of them.



Figure 3. 32 Lessons Page

The lessons page will showcase the available lessons for a particular learning module. Students can select the lesson to view the learning materials.

STEMVerse
Courses
Leaderboard
Hola, Nelly!

Back

UNIT 9: PHASES OF THE MOON
MOONLIGHT



Experiment: Moon Phases with Oreos
Download PDF

Objective:
To learn about the different phases of the moon and how they appear in the sky.

Materials Needed:

- Oreo cookies (or similar sandwich cookies)
- A plastic knife or spoon
- A printed chart or drawing of the moon phases
- Paper and pencil (optional for drawing the phases)

Steps:

1. Prepare oreos
2. Shape the cream

QUIZ

Figure 3. 33 Learning Materials Page

An example of one of the learning materials pages is for Learning Unit 9 in the Science subject. This page includes a video and an experiment that students can perform with their classmates. Additionally, students can download a PDF of the experiment instructions, allowing them to access the material offline if needed.



Figure 3. 34 Quiz Page

Upon completion of the specific lesson, students will be prompted to answer quiz questions to test their knowledge. If the students click on the wrong answer, the system will provide feedback by displaying the correct answer.



Figure 3. 35 Lesson Completion & Badge

Figure above shows the lesson completion badge that can be obtained by the students. Students will earn badge upon lesson or quiz completion.



Figure 3. 36 Leaderboard

Students earn points for completing lessons and achieving high quiz scores. The leaderboard displays rankings, showcasing top-performing students and motivating others to improve.

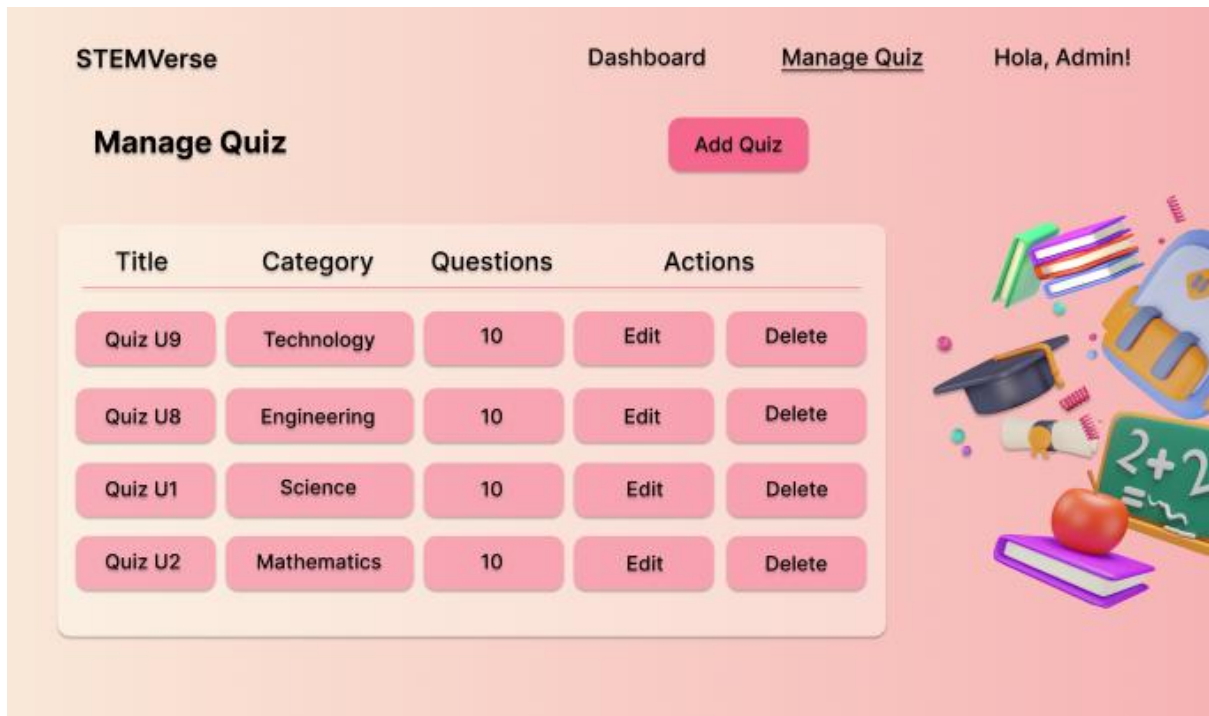


Figure 3. 37 Manage Quiz Page

This page is only accessible to administrators (teachers), who can manage the quiz content for each subject. It shows a collection of quizzes with their titles, categories, and number of questions. Administrators can update and delete quizzes directly from this interface.

STEMVerse Dashboard Manage Quiz Hola, Admin!

Add Quiz

Quiz Title

Category: Select Category ▾

Questions

Option A: Option C: Correct Answer:

Option B: Option D:

[+ Add Question](#)

[Save](#)

Figure 3. 38 Add Quiz Page

Clicking the “Add Quiz” button will redirect administrator to the “Add Quiz” page. In this page, admin can insert the quiz title, select category from the dropdown menu, and enter the questions and answer options, along with the specific correct answer for that question. “Add Question” button will allow them to add more questions in the quiz.

3.5. DEVELOPMENT

The development stage is the third phase. During this phase, the gamified STEM learning platform will be developed using the Visual Studio Code. Once the front-end design is complete, the next step involves developing the functional back end, ensuring seamless integration between the user interface and system logic. Moreover, the database is carefully designed to support efficient queries and scalability, ensuring optimal performance during operations. At this stage, both front-end and back-end components are connected and tested to ensure smooth communication. To maintain high-quality code, the codebase is periodically cleaned and refactored, following each sprint or development milestone. Refactoring ensures that the system remains maintainable and scalable while improving overall readability. This structured and iterative approach ensures that the implementation phase delivers a robust, user-friendly system aligned with the project’s goals.

3.6 TESTING

Testing is a critical phase in system development, ensuring that the application meets its functional and non-functional requirements while providing a seamless user experience. The testing process begins with the design of test cases based on system requirements and user scenarios, covering both the front-end and back-end functionalities. During testing, various methods are employed, including unit testing, integration testing, and system testing. Unit testing focuses on individual components or functions, ensuring they work as intended in isolation. By evaluating the interface between two software units, integration testing finds errors in the way integrated units interact (Uddin & Anand, 2019). Finally, system testing evaluates the application, validating its behavior under real-world conditions. Throughout the testing phase, bugs and issues are documented, prioritized, and addressed in subsequent iterations. This iterative approach aligns with Agile principles, allowing for continuous refinement and immediate feedback loops. At the end of the testing phase, a user acceptance test (UAT) is conducted to validate the system’s readiness based on user feedback, specifically teachers and year 5 primary school students.

3.7 DEPLOYMENT

The deployment phase is the culmination of the system development lifecycle, in which the tested and finalized application is delivered to the end users. It includes several steps to ensure a smooth transition from development to the production environment. However, in this project, deployment will not happen because the project will be hosted but not for public use, only small amount of people will be using this prototype, specifically year 5 primary school students.

3.8 SUMMARY

In particular, the chapter emphasizes the significance of structured execution, from requirement gathering and design to development, testing, and deployment. Each phase is meticulously planned and implemented to ensure the proposed system aligns with user needs and project goals. By adopting Agile principles, the methodology fosters flexibility and iterative improvement, ensuring that any challenges encountered during development are addressed promptly. The focus on thorough testing and careful deployment further guarantees a reliable, user-friendly platform, paving the way for a successful implementation of the STEM gamified learning system, STEMVerse.

CHAPTER 4: IMPLEMENTATION

4.1 INTRODUCTION

In this chapter, the focus is mainly on the implementation of the proposed system, STEMVerse using the software mentioned in Chapter 2. The steps taken to develop and integrate each component of the system, including the tools, technologies, and methods used. The implementation process is guided by the design specifications presented in earlier chapter, ensuring that the system meets the intended objectives and can functions effectively.

4.2 FEATURE IMPLEMENTATION

Before developing the proposed system, it is essential to install and configure all necessary software development tools. Ensuring these tools are properly set up is crucial for the smooth operation of the application. Each system component used in building the project must be correctly installed and configured to support the full functionality and successful implementation of the system. For the front-end implementation, Visual Studio Code serves as the development environment. MYSQL handles database management, while PHP and the Apache HTTP Server manage server-side scripting and web hosting. Figma is used to design the website's background image and some icons, whereas Canva is utilized to design the badges. Some of the resources used as part of the interactive learning materials are videos from YouTube and games from Scratch.

4.2.1 VISUAL STUDIO CODE

Visual Studio Code is utilized to write PHP code that supports server-side scripting for the proposed system. Additionally, HTML, CSS and JavaScript are employed for developing the front-end, with Bootstrap integrated to enhance the design and responsiveness of the website.

INSTALLATION OF VISUAL STUDIO CODE

Download Visual Studio Code as shown in Figure 4.1 below using this link: "<https://code.visualstudio.com/Download>". Next, select installer depending on the OS.



Figure 4. 1 Visual Studio Code Official Website

SETUP OF VISUAL STUDIO CODE

Click the “I accept the agreement” as shown in the Figure 4.2 below.

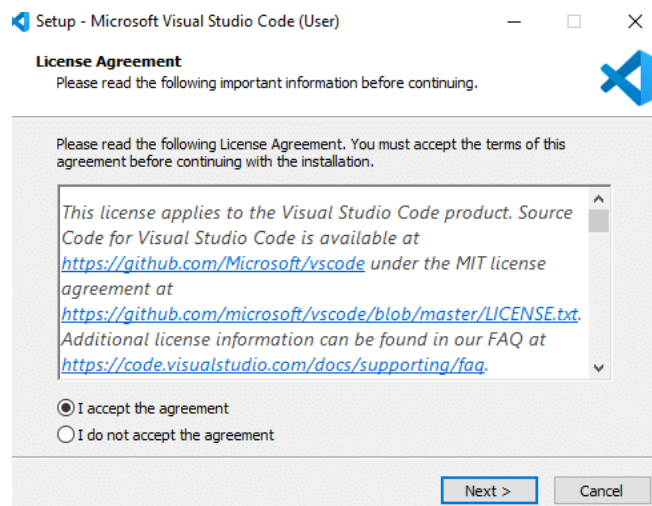


Figure 4. 2 Visual Studio Code’s License Agreement

Next, continue with default path in the placeholder or select a different folder by clicking on ‘Browse...’. Select the necessary options along the way by clicking in the checkbox respectively.

After everything is done, click ‘Install’ and launch Visual Studio Code by clicking ‘Finish’. After launching Visual Studio Code, click ‘New File’ to open a new file and start coding.

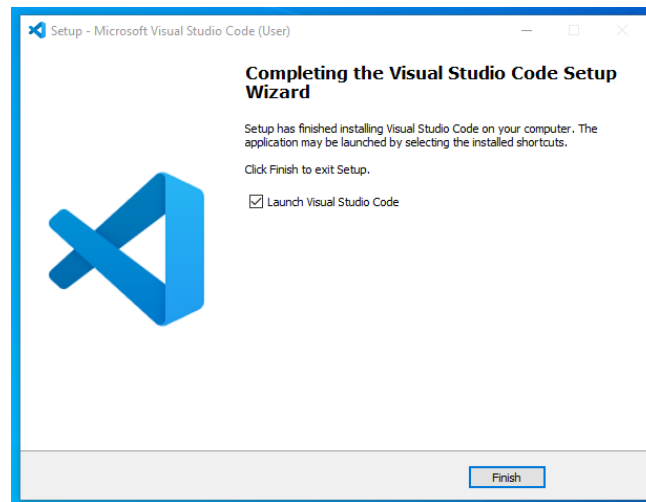


Figure 4. 3 Setup Completion of Visual Studio Code

Users can click ‘New File’ to create a new file and then select desired language, such as PHP or open existing folder using ‘Open Folder’.

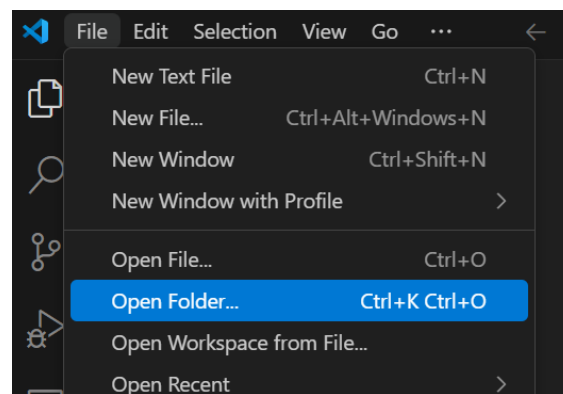


Figure 4. 4 Open Existing Folder

4.2.2 XAMPP

XAMPP is a free and easy-to-use software package that allows user to run a local web server on computer. It includes everything needed to develop and test websites or web applications offline, such as Apache (the web server), MySQL (the database system), and interpreters for PHP and Perl.

XAMPP can be downloaded for Windows, Linux or OS X using the provided link: <https://www.apachefriends.org/> as shown in Figure 4.5 below. Upon finish downloading, users need to double click the file to launch the installer. On the welcome screen, click ‘Next’ button, and if prompted by User Account Control, click ‘Yes’. Select all required components and click ‘Next’. Keep the default settings, choose the installation folder and proceed by clicking ‘Next’.

Installation process will begin shortly. Once the installation completes, click Finish to close the setup wizard. XAMPP is now successfully installed.



Figure 4. 5 Download XAMPP

After successfully launching XAMPP, users can click ‘Start’ for both Apache and MySQL, which will be used for the development of STEMVerse.

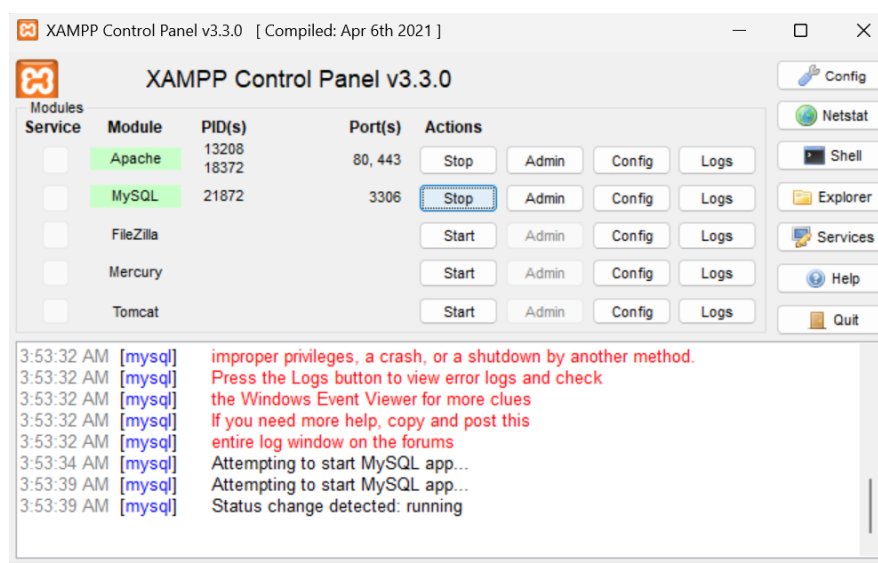


Figure 4. 6 Start Apache and MySQL in XAMPP

The button ‘Admin’ next to the ‘Start/Stop’ button of MySQL will redirect users to PHPMyAdmin landing page as shown in Figure 4.7 where users can create and manage the database for their websites.

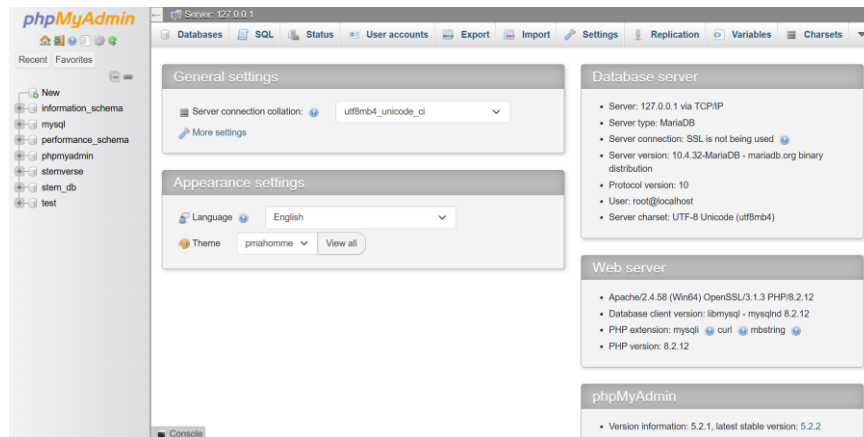


Figure 4. 7 PHPMYAdmin Landing Page

To create a new database, go to the ‘Databases’ tab and use the ‘Create database’ section by entering a name. Alternatively, users can create a database by writing an SQL query in the ‘SQL’ tab. To add a table, first select the database and click ‘New’. In the ‘Create table’ section, input the table name and the number of columns before clicking ‘Go’ as shown in Figure 4.8. The column names along with their other inputs can be filled in afterwards before clicking ‘Save’. Users can also export or import databases in the form of SQL files through the ‘Export’ and ‘Import’ tabs in PHPMYAdmin.

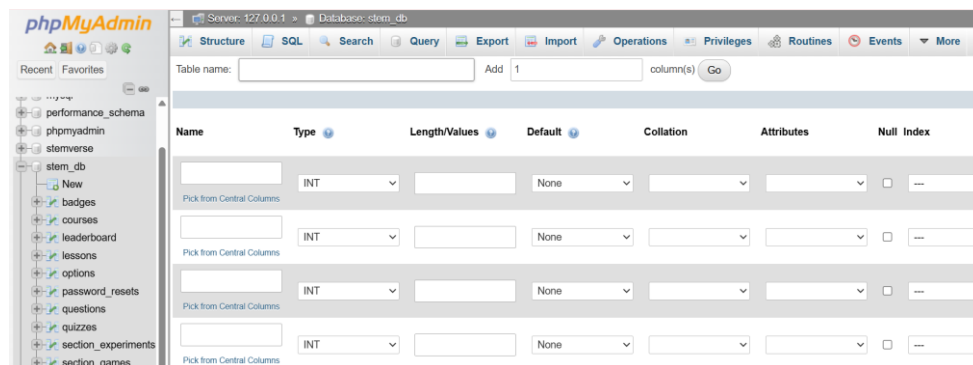


Figure 4. 8 Create table for a database

Upon clicking on any of the database in the left sidebar of the PHPMYAdmin landing page, each of their tables will be displayed respectively.

Figure 4.7 shows the list of tables in a database, specifically stem_db database used for STEMVerse.

Table	Action	Rows	Type	Collation	Size	Overhead
badges	Browse Structure Search Insert Empty Drop	0	InnoDB	utf8mb4_general_ci	32.0 K	-
courses	Browse Structure Search Insert Empty Drop	4	InnoDB	utf8mb4_general_ci	16.0 K	-
leaderboard	Browse Structure Search Insert Empty Drop	4	InnoDB	utf8mb4_general_ci	48.0 K	-
lessons	Browse Structure Search Insert Empty Drop	4	InnoDB	utf8mb4_general_ci	32.0 K	-
options	Browse Structure Search Insert Empty Drop	76	InnoDB	utf8mb4_general_ci	32.0 K	-
password_resets	Browse Structure Search Insert Empty Drop	0	InnoDB	utf8mb4_general_ci	16.0 K	-
quizzes	Browse Structure Search Insert Empty Drop	19	InnoDB	utf8mb4_general_ci	32.0 K	-
questions	Browse Structure Search Insert Empty Drop	4	InnoDB	utf8mb4_general_ci	48.0 K	-
section_experiments	Browse Structure Search Insert Empty Drop	1	InnoDB	utf8mb4_general_ci	48.0 K	-
section_games	Browse Structure Search Insert Empty Drop	1	InnoDB	utf8mb4_general_ci	48.0 K	-
section_notes	Browse Structure Search Insert Empty Drop	6	InnoDB	utf8mb4_general_ci	64.0 K	-
section_quick_checks	Browse Structure Search Insert Empty Drop	2	InnoDB	utf8mb4_general_ci	48.0 K	-
section_videos	Browse Structure Search Insert Empty Drop	1	InnoDB	utf8mb4_general_ci	48.0 K	-
subtopics	Browse Structure Search Insert Empty Drop	2	InnoDB	utf8mb4_general_ci	64.0 K	-
users	Browse Structure Search Insert Empty Drop	2	InnoDB	utf8mb4_general_ci	64.0 K	-

Figure 4. 9 PHPMyAdmin page consisting of tables in stem_db database used in the development of STEMVerse.

4.2.3 FIGMA

Figma is a cloud-based design and prototyping tool used mainly for user interface (UI) and user experience (UX) design. It offers features like vector editing, interactive prototyping, and design systems support. Figma can be accessed through browser, simply by clicking on the link provided, <https://www.figma.com/login>.

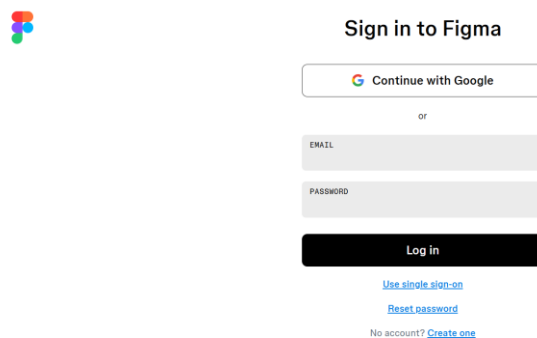


Figure 4. 10 Figma Log In Page

Figure below shows the screenshot of background images designed using Figma for STEMVerse.

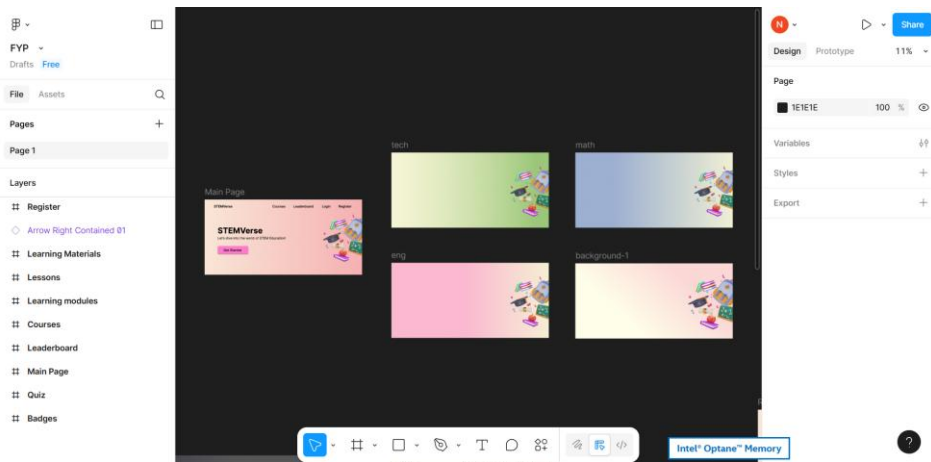


Figure 4. 11 Screenshot of background images created using Figma

4.2.4 CANVA

Canva is an online design tool to create visually appealing graphics with ease drag-and-drop interface. It also provides users with a wide selection of templates, fonts, and images.

To access Canva, the user needs to sign up or log in using Google account, Facebook or email through this link: <https://www.canva.com/login/>. There are some other ways to continue using Canva as well. User can explore the options by clicking ‘Continue another way’.

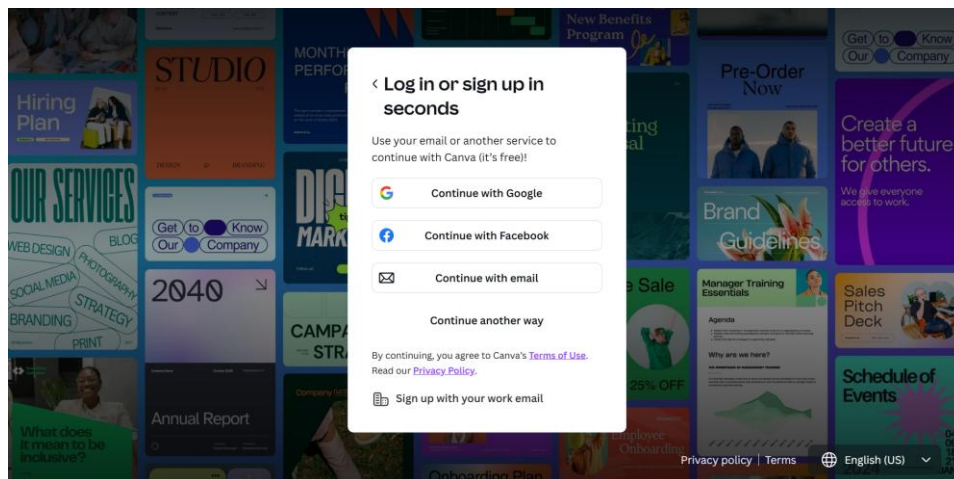


Figure 4. 12 Canva Log In Page

Below shows the screenshots of the creation of the badges for STEMVerse website.

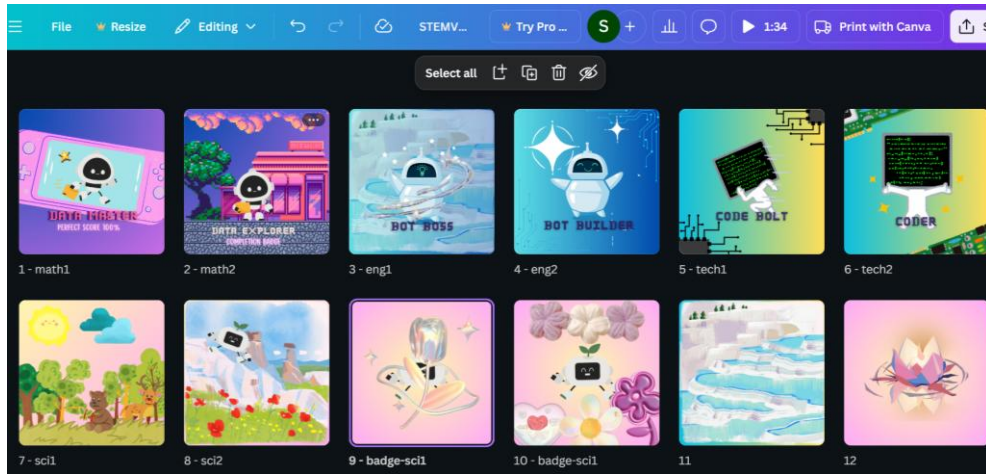


Figure 4. 13 Screenshot of Badges for STEMVerse in Canva

4.3 PROPOSED SYSTEM IMPLEMENTATION

This section provides an overview of the various sections and features within the educational website. Each section is uniquely designed to enhance user engagement and support different aspects of the learning process. The User Interface (UI) is thoughtfully structured to guide both students and teachers smoothly through the platform from browsing STEM courses and lesson modules to accessing interactive subtopics, quizzes, and achievements.

The website integrates multiple forms of media and interactive elements, including embedded videos, educational games, and real-time quizzes, all aimed at making learning more dynamic and enjoyable. The gamified components, such as badges and leaderboards, are seamlessly incorporated into the user experience to motivate learners and encourage participation. The entire platform is web-based and optimized for modern browsers, ensuring accessibility across devices.

4.3.1 LANDING PAGE

The figure below showcases the landing page of STEMVerse platform, consisting of the ‘Get Started’ button. Upon clicking on the button, users will be redirected to the log in page. Alternatively, users can click on the ‘Log In’ displayed in the navigation bar to be redirected to the log in page as well. Clicking ‘Register’ next to ‘Log In’ in the navigation bar will redirect users to the Register page instead.

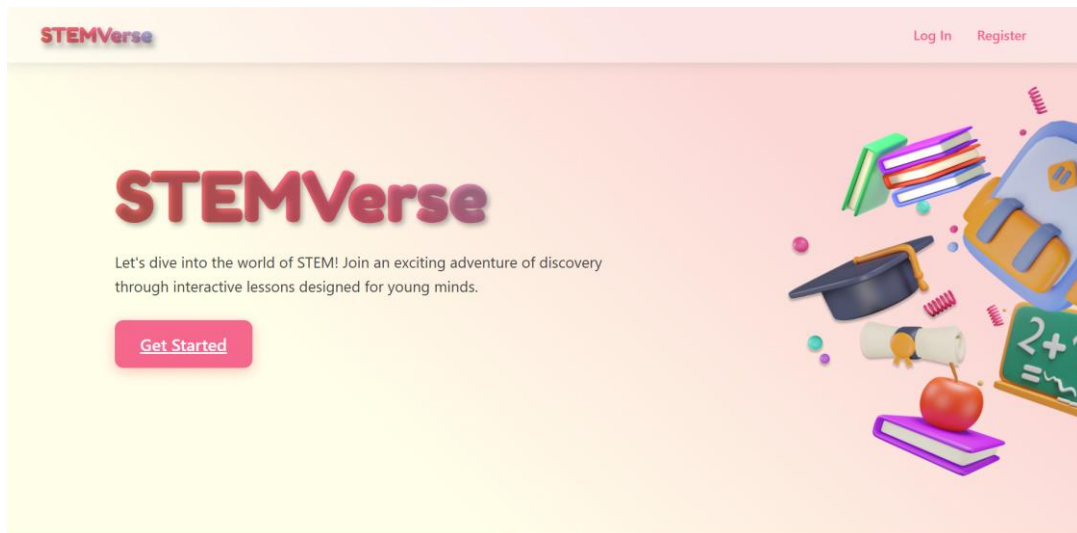


Figure 4. 14 STEMVerse Landing Page

```

index.php
7   <head>
20   .page-header h1 {
24       text-shadow: 3px 3px 6px rgba(0,0,0,0.3);
25       margin-bottom: 15px;
26       background: linear-gradient(45deg, #f6678d, #fff69b4, #87ceeb);
27       -webkit-background-clip: text;
28       -webkit-text-fill-color: transparent;
29       background-clip: text;
30       animation: rainbow 3s ease-in-out infinite;
31   }
32   </style>
33 </head>
34 <body>
35   <!-- Navigation bar -->
36   <?php include 'navbar.php'; ?>
37
38   <!-- Main hero section -->
39   <section class="hero">
40       <div class="hero-content">
41           <div class="page-header">
42               <h1 class="fw-bold">STEMVerse</h1>
43               <p>Let's dive into the world of STEM! Join an exciting adventure of discovery through interactive lessons designed for young mi
44               <a href="login.php" class="btn-get-started">Get Started</a>
45           </div>
46       </section>
47
48   <!-- Bootstrap JS Bundle with Popper -->
49   <script src="https://cdn.jsdelivr.net/npm/bootstrap@5.3.0-alpha1/dist/js/bootstrap.bundle.min.js"></script>
50 </body>
51 </html>

```

Figure 4. 15 Code snippet of STEMVerse Landing Page

The features outlined below are specifically designed for the students.

4.3.2.1 REGISTER

Figure 4.16 showcases the register page for STEMVerse platform. Users are only able to access the course contents on the website by becoming part of the registered members. First, users can upload a profile picture with the maximum size of 5MB as per mentioned in the form. The files accepted are gif, png, and jpg. When it comes to inputting the credentials, users must enter a unique username. The platform will be able to detect existing username and email. The username can include letters and numbers. Next, users must enter a valid email address in the correct format. Password must be at least 6 characters long with a mix of special characters,

numbers, uppercase and lowercase letters. After filling in all the required fields, users can click on the ‘Register’ button to successfully register as a member. Failure in filling even one of the fields will hinder the users from registering with a pop-up message to notify them. However, users are still able to retry registering.

If users already have an account, they can log in instead by clicking on the ‘Log In’ link.

Figure 4. 16 Register Page for STEMVerse

```

register.php
9  if ($_SERVER['REQUEST_METHOD'] === 'POST') {
55  if (strlen($password) < 6 || !preg_match('/[A-Za-z]/', $password) || !preg_match('/[0-9]/', $password)) {
56      $errors[] = "Password must be at least 6 characters long and include both letters and numbers.";
57  }
58
59  if (empty($errors)) {
60      // Check if username or email already exists
61      $stmt = $conn->prepare("SELECT * FROM users WHERE username = ? OR email = ?");
62      $stmt->bind_param("ss", $username, $email);
63      $stmt->execute();
64      $result = $stmt->get_result();
65
66      if ($result->num_rows > 0) {
67          $errors[] = "Username or email already taken.";
68      } else {
69          // Hash password
70          $hashedPassword = password_hash($password, PASSWORD_DEFAULT);
71
72          // Insert user with profile picture
73          if ($profilePicture) {
74              $stmt = $conn->prepare("INSERT INTO users (username, email, password, profile_image) VALUES (?, ?, ?, ?)");
75              $stmt->bind_param("ssss", $username, $email, $hashedPassword, $profilePicture);
76          } else {
77              $stmt = $conn->prepare("INSERT INTO users (username, email, password) VALUES (?, ?, ?)");
78              $stmt->bind_param("sss", $username, $email, $hashedPassword);
79          }
80          $stmt->execute();

```

Figure 4. 17 Code Snippet for Register Page

4.3.2.2 LOG IN

Figure below illustrates the log in page of the system. In the log in page, users must enter their existing username and password correctly. If the users input incorrect credentials, the website will inform users with 'Wrong username or password' and prompt them to try again. The website can also validate that neither of the username and password fields should be left empty upon clicking the 'Log In' button. Upon successful authentication after clicking 'Log In', users will be navigated to the Course page.

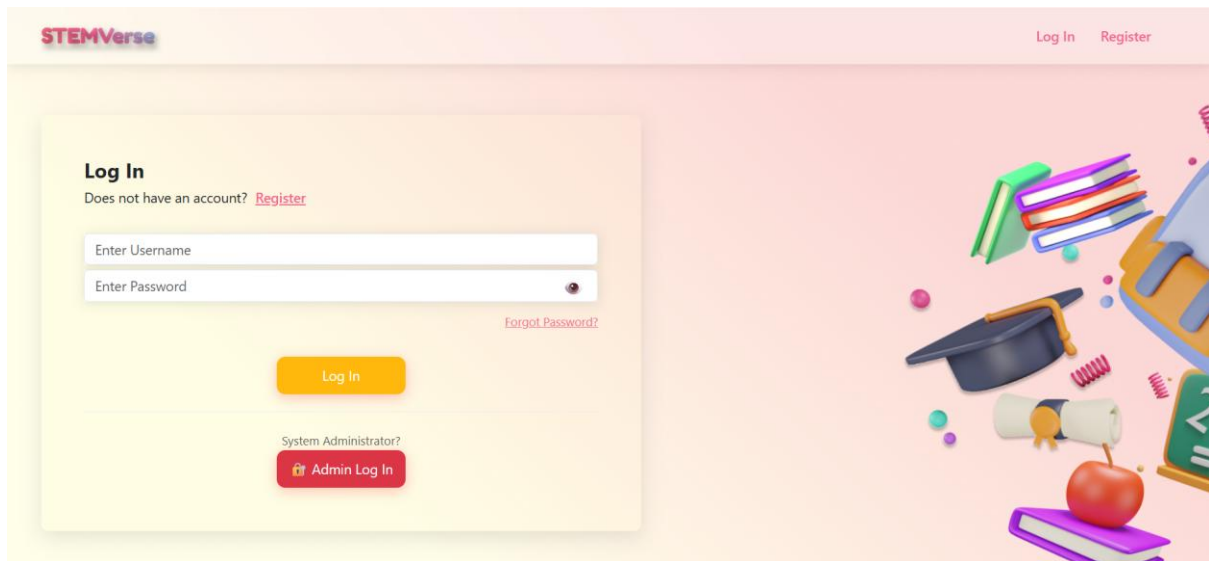


Figure 4. 18 Log In Page for STEMVerse

```

<body>
  <section class="login-container">
    <div class="login-box">
      <a href="register.php" class="register-text">Register</a>

      <?php if (!empty($errors)): ?>
        <div class="alert alert-danger">
          <?php foreach ($errors as $error) echo "<div>$error</div>"; ?>
        </div>
      <?php endif; ?>

      <form id="loginForm" class="form-container" action="login.php" method="POST">
        <input type="hidden" name="csrf_token" value="<?php echo $_SESSION['csrf_token']; ?>" />
        <div class="form-group">
          <input type="text" name="username" class="form-control" placeholder="Enter Username" />
        </div>

        <div class="form-group">
          <div class="password-container">
            <input type="password" name="password" id="password" class="form-control" placeholder="Enter Password" />
            <button type="button" class="password-toggle" onclick="togglePassword('password')" />
          </div>
        </div>

        <div class="forgot-password-container">
          <a href="forgot-password.php" class="forgot-password">Forgot Password?</a>
        </div>

        <button type="submit" class="btn-login">Log In</button>
      </form>

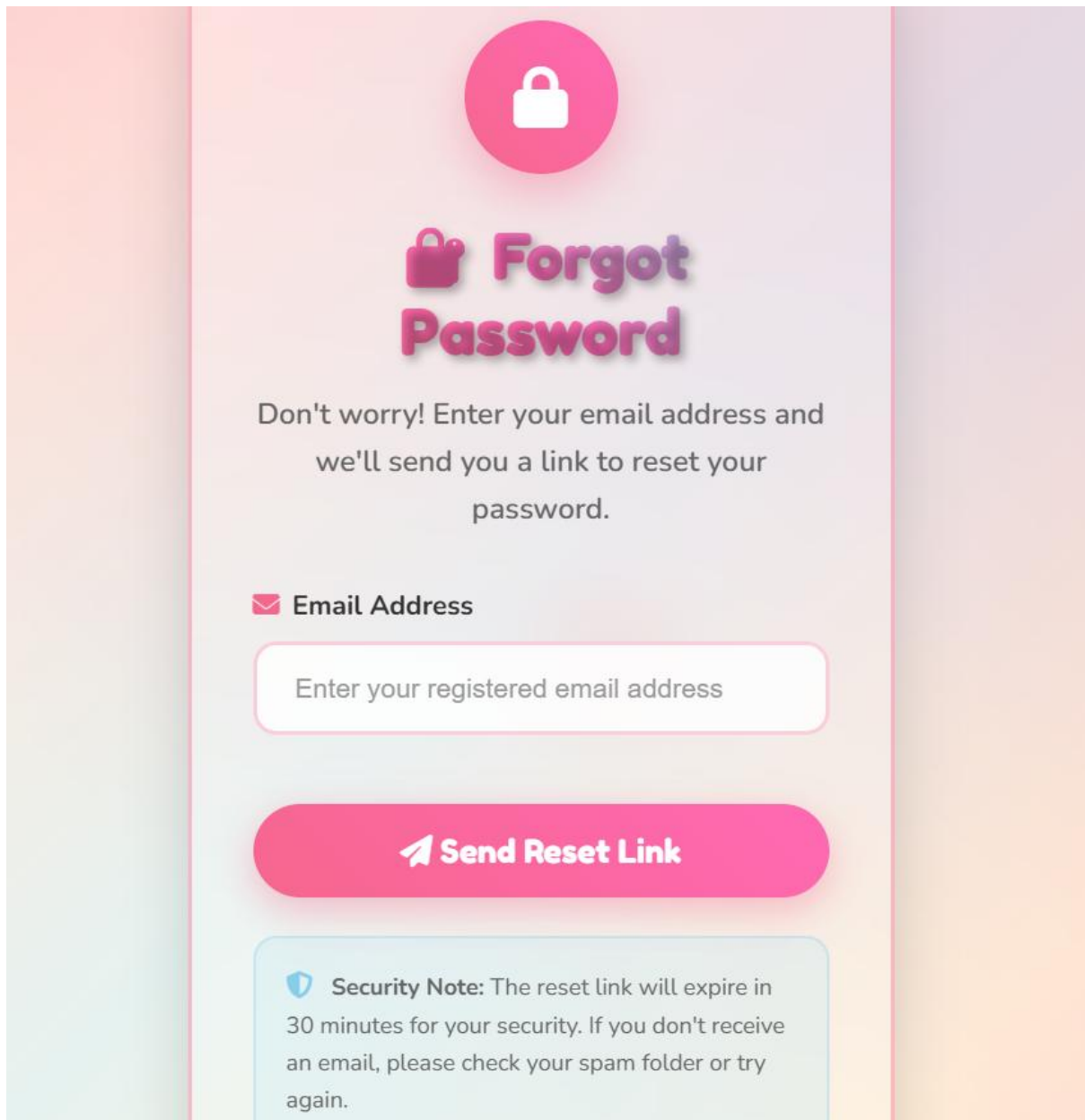
      <!-- Admin Access Section -->
    </div>
  </section>

```

Figure 4. 19 Code Snippet for Log In Page

4.3.2.3 FORGOT AND RESET PASSWORD

In the case where the users forgot their password, they can click on ‘Forgot Password’ at the bottom of the login form and enter their registered email address. The website could detect if the email existed in the database as well as if the formatting is wrong. After clicking the ‘Send Reset Link’ and the website has confirmed that the email is registered, users will receive reset link in their email, where they can reset their password afterwards.



The image shows a 'Forgot Password' page with a pink and white color scheme. At the top, there is a pink circle containing a white padlock icon. Below this, the title 'Forgot Password' is displayed in a large, bold, pink font, with a small padlock icon to the left of the word 'Forgot'. The text 'Don't worry! Enter your email address and we'll send you a link to reset your password.' is centered in a dark grey font. Underneath, there is a section labeled 'Email Address' with a pink envelope icon. Below this label is a white input field with a pink border and rounded corners, containing the placeholder text 'Enter your registered email address'. A large, rounded pink button with a white paper plane icon and the text 'Send Reset Link' is positioned below the input field. At the bottom, there is a light blue rounded rectangle containing a shield icon and the text 'Security Note: The reset link will expire in 30 minutes for your security. If you don't receive an email, please check your spam folder or try again.'



Forgot Password

Don't worry! Enter your email address and we'll send you a link to reset your password.

 **Email Address**

Enter your registered email address

 **Send Reset Link**

 **Security Note:** The reset link will expire in 30 minutes for your security. If you don't receive an email, please check your spam folder or try again.

Figure 4. 20 Forgot Password Page

```

70 // Handle Form Submission
71 if ($_SERVER['REQUEST_METHOD'] === 'POST') {
72     if (!isset($_POST['csrf_token']) || !hash_equals($_SESSION['csrf_token'], $_POST['csrf_token'])) {
73         $message = 'Invalid request token.';
74         $messageType = 'error';
75     } else {
76         $email = trim($_POST['email']);
77         if (!filter_var($email, FILTER_VALIDATE_EMAIL)) {
78             $message = 'Invalid email address.';
79             $messageType = 'error';
80         } else {
81             $stmt = $pdo->prepare("SELECT user_id FROM users WHERE email = ?");
82             $stmt->execute([$email]);
83             $user = $stmt->fetch();
84
85             if ($user) {
86                 $token = generateToken();
87                 $hashedToken = hash('sha256', $token);
88                 $expires = date('Y-m-d H:i:s', time() + TOKEN_EXPIRY);
89                 $ip = getClientIP();
90
91                 // Save token
92                 $stmt = $pdo->prepare("INSERT INTO password_resets (email, token, expires_at, used, ip_address, created_at) VALUES (?, ?, ?, ?, ?, ?)");
93                 $stmt->execute([$email, $hashedToken, $expires, $ip]);
94
95                 // Send email
96                 if (sendResetEmail($email, $token)) {
97                     $message = 'Reset email sent. Please check your inbox.';
98                     $messageType = 'success';
99                 }
100             }
101         }
102     }
103 }

```

Figure 4. 21 Code Snippet Forgot Password

4.3.2.4 COURSE

The course page will consist of the four courses in STEMVerse, which are Science, Mathematics, Technology, and Engineering. Clicking 'Enter' will redirect users to their modules and lessons with interactive learning materials. The navigation bar shows the username and profile picture of the user along with a drop down menu where users can navigate easily across different sections of the website.

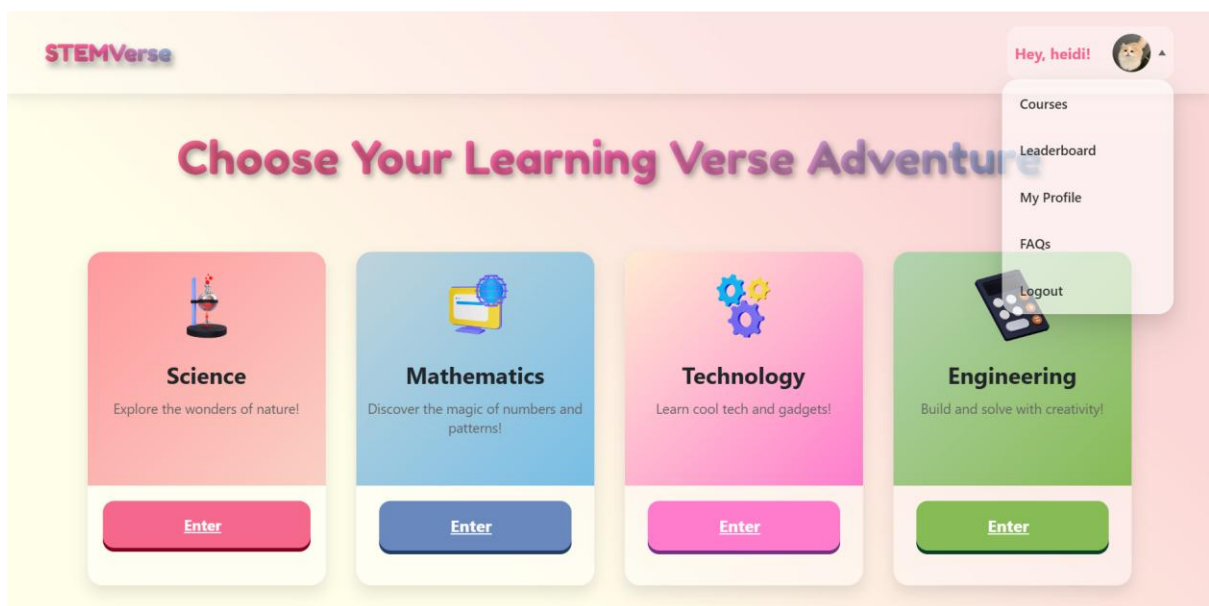


Figure 4. 22 Course Page

```

];

if ($result->num_rows > 0) {
    // Loop through each course and display it
    while($row = $result->fetch_assoc()) {
        $course_id = (int)$row['course_id'];
        $course_name = htmlspecialchars($row['course_name'], ENT_QUOTES, 'UTF-8');
        $description = htmlspecialchars($row['description'], ENT_QUOTES, 'UTF-8');

        $style = isset($courseStyles[$course_id]) ? $courseStyles[$course_id] : $courseStyles['default'];

        echo '<div class="subject-card">
            <div class="card-header ' . htmlspecialchars($style['class'], ENT_QUOTES, 'UTF-8') . '">
                <img src="" . htmlspecialchars($style['image'], ENT_QUOTES, 'UTF-8') . '" alt="Course Image" class="avatar">
                <div class="subject-content">
                    <h3 class="subject-title">' . $course_name . '</h3>
                    <p class="subject-desc">' . $description . '</p>
                </div>
            </div>
            <a href="lessons.php?course_id=' . $course_id . '&token=' . urlencode($_SESSION['csrf_token']) . '" class="" . html
            <span class="btn-text">' . htmlspecialchars($style['action_text'], ENT_QUOTES, 'UTF-8') . '</span>
        </a>
    </div>';
    }
}

```

Figure 4. 23 Code Snippet for Course Page

4.3.2.5 MODULES

In STEMVerse, each course page displays modules. Clicking ‘Start’ button on a module reveals lessons (also known as subtopics). The figure below only shows one module available for the Mathematics course now.

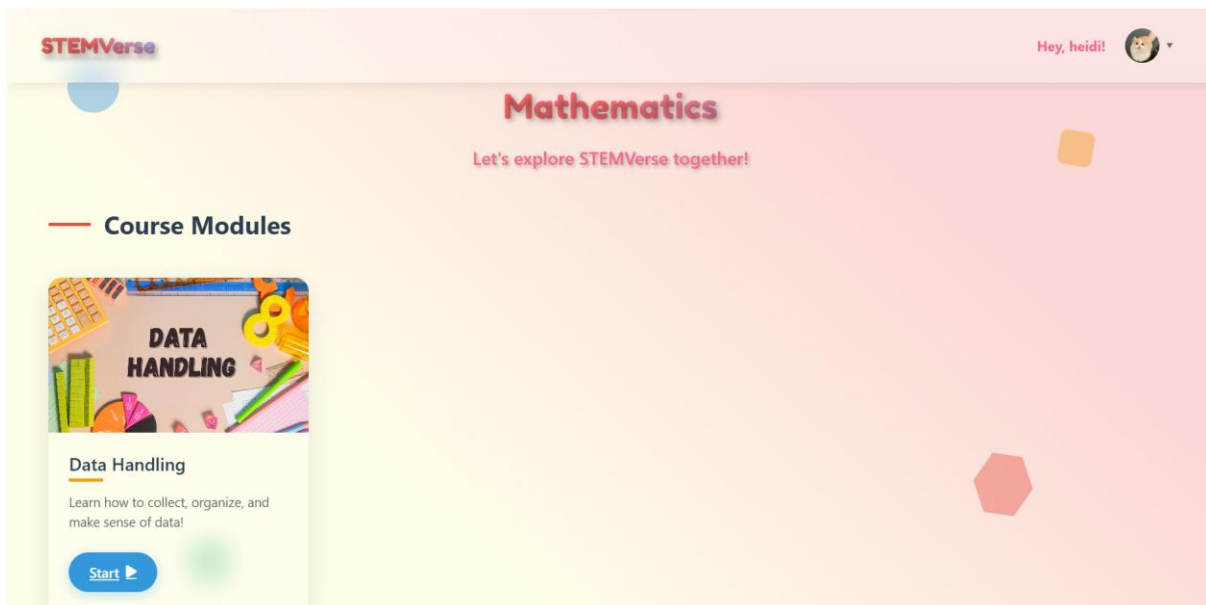


Figure 4. 24 Modules Page

```
body>
<div class="course-modules">
  <?php else: ??
    <?php else: ??
      <?php foreach ($lessons as $index => $lesson): ??

        // Fetch the first subtopic for the lesson
        $subtopic_sql = "SELECT subtopic_id FROM subtopics WHERE lesson_id = ? ORDER BY subtopic_id";
        $subtopic_stmt = $conn->prepare($subtopic_sql);
        $subtopic_stmt->bind_param("i", $lesson['lesson_id']);
        $subtopic_stmt->execute();
        $subtopic_result = $subtopic_stmt->get_result();
        $first_subtopic = $subtopic_result->fetch_assoc();
        $first_subtopic_id = $first_subtopic ? (int)$first_subtopic['subtopic_id'] : null;

      <?php
    <div class="module-card" data-aos="fade-up" data-aos-duration="800" data-aos-delay="<?php echo
      <div class="module-image" style="background: <?php echo $gradient; ?>;">
        <?php if (!empty($imagePath) && file_exists($imagePath)): ??
          " />
        <?php else: ??
          <!-- Display a placeholder with first letter of lesson name if no image -->
          <div class="image-placeholder">
            <?php echo strtoupper(substr(htmlspecialchars($lesson['lesson_name'], ENT_QUOTES), 0, 1));
          </div>
        <?php endif; ??
      </div>
      <div class="module-content">
        <h3 class="module-title"><?php echo htmlspecialchars($lesson['lesson_name'], ENT_QUOTES);
        <p class="module-description"><?php echo htmlspecialchars($lesson['description'], ENT_QUOTES);
        <div class="module-bottom">

```

Figure 4. 25 Code Snippet of Modules Page

4.3.2.6 LESSONS

Entering one of the modules, user will come across the lessons page consisting of multiple learning materials, specifically arranged into 5 sections, which are video, notes, experiments/group activities, quick checks and games. The title of lesson will be displayed on top of the page along with its description.

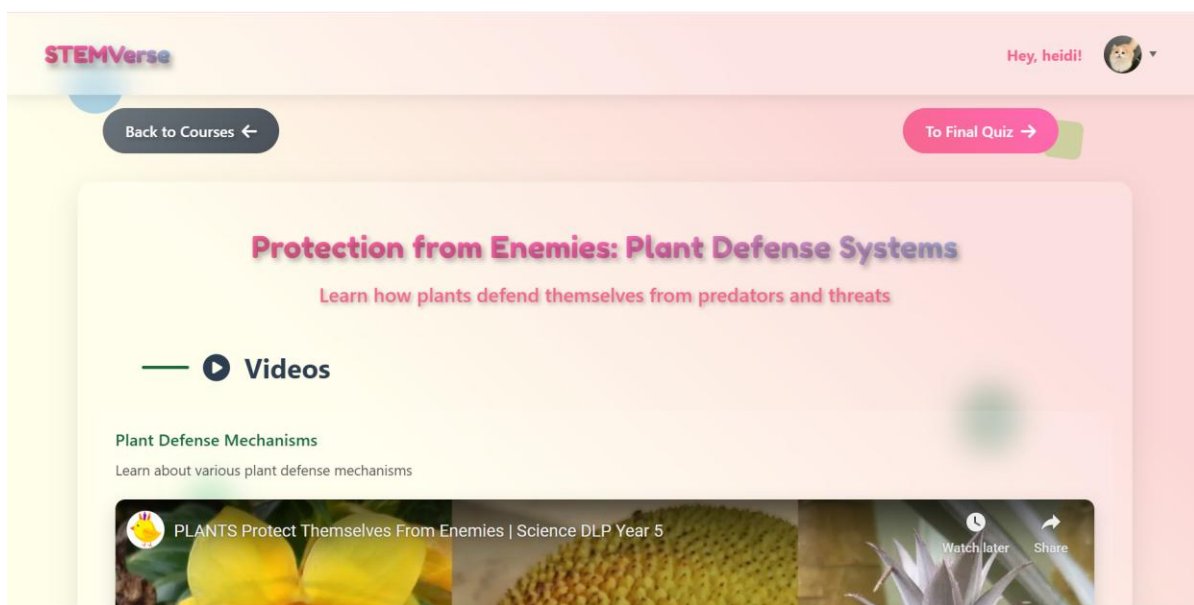


Figure 4. 26 Lessons Page

```

// Fetch the current subtopic
$current_subtopic_sql = "SELECT * FROM subtopics WHERE subtopic_id = ?";
$current_subtopic_stmt = $pdo->prepare($current_subtopic_sql);
$current_subtopic_stmt->bindParam(1, $subtopic_id, PDO::PARAM_INT);
$current_subtopic_stmt->execute();
$current_subtopic = $current_subtopic_stmt->fetch(PDO::FETCH_ASSOC);

// Fetch the next subtopic based on the current subtopic_order
$next_subtopic_sql = "SELECT subtopic_id FROM subtopics WHERE lesson_id = ? AND subtopic_order > ? ORDER BY s";
$next_subtopic_stmt = $pdo->prepare($next_subtopic_sql);
$next_subtopic_stmt->bindParam(1, $current_subtopic['lesson_id'], PDO::PARAM_INT);
$next_subtopic_stmt->bindParam(2, $current_subtopic['subtopic_order'], PDO::PARAM_INT);
$next_subtopic_stmt->execute();
$next_subtopic = $next_subtopic_stmt->fetch(PDO::FETCH_ASSOC);
$next_subtopic_id = $next_subtopic ? (int)$next_subtopic['subtopic_id'] : null;

// Fetch the previous subtopic based on the current subtopic_order
$prev_subtopic_sql = "SELECT subtopic_id FROM subtopics WHERE lesson_id = ? AND subtopic_order < ? ORDER BY s";
$prev_subtopic_stmt = $pdo->prepare($prev_subtopic_sql);
$prev_subtopic_stmt->bindParam(1, $current_subtopic['lesson_id'], PDO::PARAM_INT);
$prev_subtopic_stmt->bindParam(2, $current_subtopic['subtopic_order'], PDO::PARAM_INT);
$prev_subtopic_stmt->execute();
$prev_subtopic = $prev_subtopic_stmt->fetch(PDO::FETCH_ASSOC);
$prev_subtopic_id = $prev_subtopic ? (int)$prev_subtopic['subtopic_id'] : null;

// Fetch the maximum subtopic order for the current lesson
$max_order_sql = "SELECT MAX(subtopic_order) AS max_order FROM subtopics WHERE lesson_id = ?";
$max_order_stmt = $pdo->prepare($max_order_sql);
$max_order_stmt->bindParam(1, $current_subtopic['lesson_id'], PDO::PARAM_INT);

```

Figure 4. 27 Code Snippet of Lessons Page

4.3.2.7 VIDEO SECTION

The first section in a lessons page is the video section. The video loads automatically. If there is no video available, a message appears: “No video available for this topic yet.”. A back to top button will also appear whenever users scroll down the page to ease navigation.



Figure 4. 28 Video Section of Lessons Page

```

<?php if (!empty($videos)): ?>
<div class="section-title" data-aos="fade-right" data-aos-duration="800">
  <i class="fas fa-play-circle"></i> Videos
</div>

<?php foreach ($videos as $index => $video): ?>
<div class="video-item" data-aos="zoom-in" data-aos-duration="800" data-aos-delay="<?php echo $index">
  <?php if (!empty($video['video_title'])): ?>
  <h4 class="video-title"><?php echo htmlspecialchars($video['video_title']); ?></h4>
  <?php endif; ?>

  <?php if (!empty($video['video_description'])): ?>
  <p class="video-description"><?php echo htmlspecialchars($video['video_description']); ?></p>
  <?php endif; ?>

  <div class="video-container">
    <?php if (!empty($video['youtube_embed_id'])): ?>
    <iframe
      src="https://www.youtube.com/embed/<?php echo htmlspecialchars($video['youtube_embed_id']); ?>"
      title="<?php echo htmlspecialchars($video['video_title']) ?? 'Educational Video'; ?>"
      frameborder="0"
      allow="accelerometer; autoplay; clipboard-write; encrypted-media; gyroscope; picture-in-picture"
      allowfullscreen>
    </iframe>
  </div>
</div>
<?php endforeach; ?>

```

Figure 4. 29 Code Snippet for Video Section

4.3.2.8 NOTES SECTION

Figure below shows the notes section where it summarizes the key points of the lesson. It can be divided into different sections and boxes to avoid clustering and maintain website's clean look.

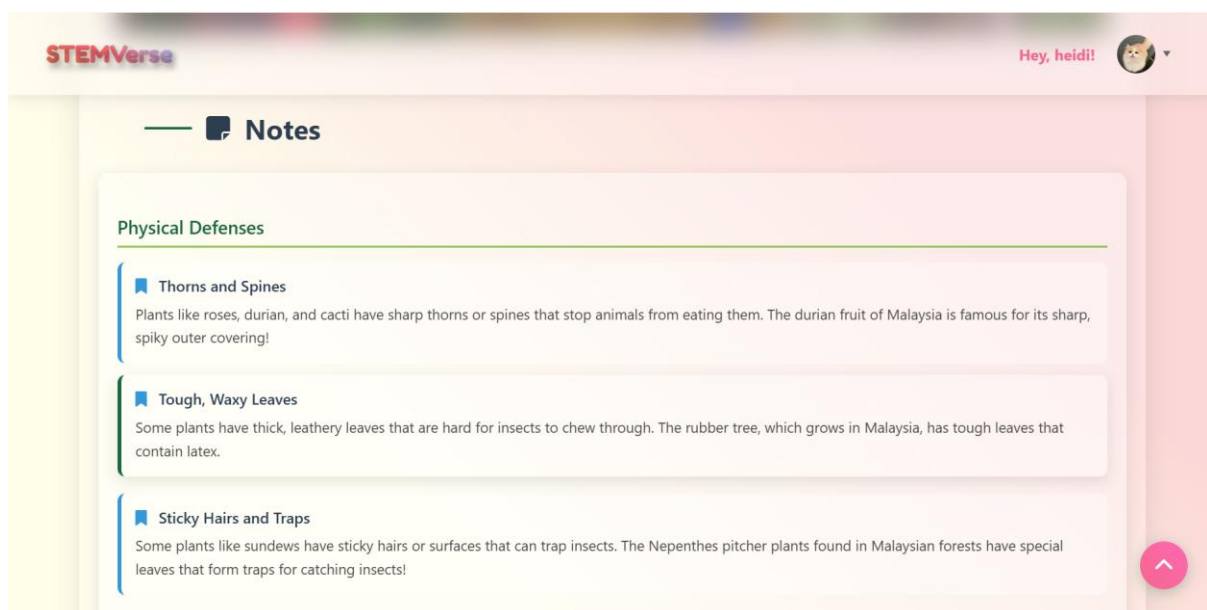


Figure 4. 30 Notes Section of the Lessons Page

```

<!-- NOTES SECTION -->
<?php if (!empty($notes)): ?>
<div class="section-title" data-aos="fade-right" data-aos-duration="800">
  <i class="fas fa-sticky-note"></i> Notes
</div>

<div class="notes-section" data-aos="fade-up" data-aos-duration="800">
  <?php foreach ($notesByCategory as $category => $categoryNotes): ?>
  <h4 class="note-category"><?php echo htmlspecialchars($category); ?></h4>

  <?php foreach ($categoryNotes as $index => $note): ?>
  <div class="note-item" data-aos="fade-up" data-aos-duration="600" data-aos-delay="<?php echo $index * 60; ?>">
    <?php if (!empty($note['note_title'])): ?>
    <h5 class="note-title">
      <i class="fas fa-bookmark" style="color: var(--accent); margin-right: 8px;"></i>
      <?php echo htmlspecialchars($note['note_title']); ?>
    </h5>
    <?php endif; ?>

    <div class="note-content">
      <?php echo nl2br(htmlspecialchars($note['note_content'])); ?>
    </div>
  </div>
  <?php endforeach; ?>
  <?php endforeach; ?>
</div>

```

Figure 4. 31 Code Snippet for Notes Section

4.3.2.9 EXPERIMENTS/GROUP ACTIVITIES SECTION

The third section provides group-based activities that students can complete either individually or in groups by following the instructions in the provided PDF. Allowing the PDF to be downloaded supports and encourages learning beyond the online platform.

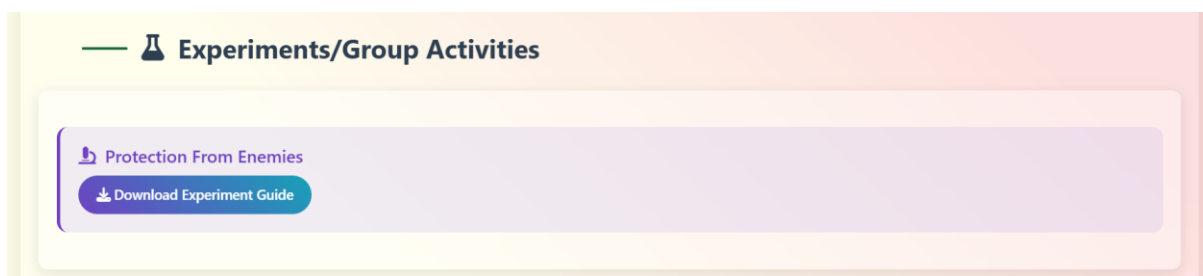


Figure 4. 32 Experiments/Group Activities Section

```

<!-- EXPERIMENTS SECTION -->
<?php if (!empty($experiments)): ?>
<div class="section-title" data-aos="fade-right" data-aos-duration="800">
  <i class="fas fa-flask"></i> Experiments/Group Activities
</div>

<div class="experiments-section" data-aos="fade-up" data-aos-duration="800">
  <?php foreach ($experiments as $index => $experiment): ?>
    <div class="experiment-item" data-aos="zoom-in" data-aos-duration="600" data-aos-delay="<?php echo $index">
      <h4 class="experiment-title">
        <i class="fas fa-microscope"></i>
        <?php echo htmlspecialchars($experiment['experiment_title']); ?>
      </h4>

      <?php if (!empty($experiment['experiment_description'])): ?>
        <p class="experiment-description"><?php echo htmlspecialchars($experiment['experiment_description']);
        <?php endif; ?>

        <?php if (!empty($experiment['file_path']) && !empty($experiment['file_name'])): ?>
          <a href="<?php echo htmlspecialchars($experiment['file_path']); ?>" class="download-btn" download="<?php echo htmlspecialchars($experiment['file_name']); ?>">
            <i class="fas fa-download"></i> Download Experiment Guide
          </a>
        <?php endif; ?>
      </div>
    <?php endforeach; ?>
  </div>

```

Figure 4. 33 Code Snippet for Experiments/Group Activities Section

4.3.2.10 GAME SECTION

Next, the games section offers fun activities that help students learn STEM in an engaging way. Each game is designed or picked to match the topic being studied and encourages students to apply what they've learned through quizzes, drag-and-drop and so much more. Most games can be played right on the website without downloading anything. Students are free to restart the game or make it into full screen with the buttons available. These games won't affect the badges or leaderboard in the website.

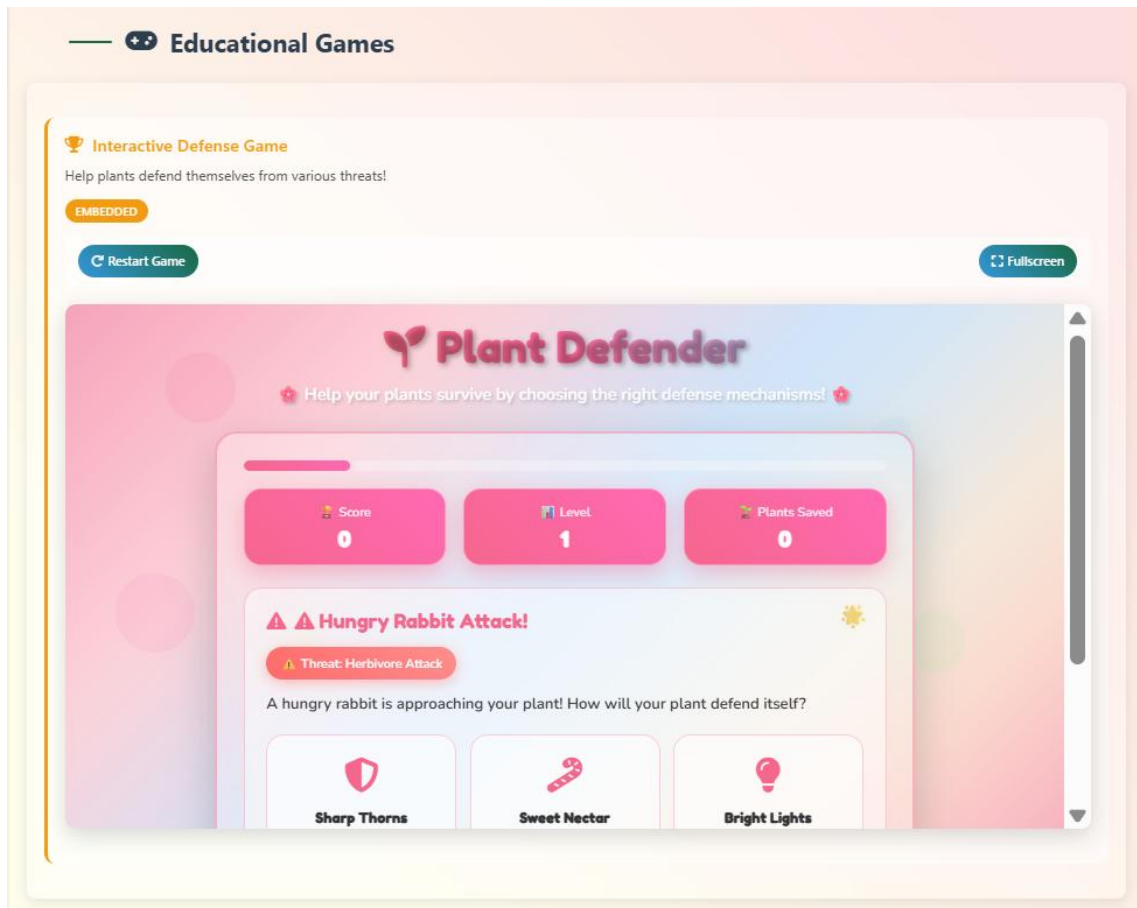


Figure 4. 34 Games Section for Lessons Page

```
<!-- GAMES SECTION -->
<?php if (!empty($games)): ?>
<div class="section-title" data-aos="fade-right" data-aos-duration="800">
  <i class="fas fa-gamepad"></i> Educational Games
</div>

<div class="games-section" data-aos="fade-up" data-aos-duration="800">
  <?php foreach ($games as $index => $game): ?>
    <div class="game-item" data-aos="zoom-in" data-aos-duration="600" data-aos-delay="<?php echo $index * 100">
      <h4 class="game-title">
        <i class="fas fa-trophy"></i>
        <?php echo htmlspecialchars($game['game_title']); ?>
      </h4>

      <?php if (!empty($game['game_description'])): ?>
        <p class="game-description"><?php echo htmlspecialchars($game['game_description']); ?></p>
      <?php endif; ?>

      <?php if (!empty($game['game_type'])): ?>
        <span class="game-type-badge"><?php echo htmlspecialchars($game['game_type']); ?></span>
      <?php endif; ?>

      <?php
        // Check if this is an embedded game (local HTML file)
        $gameUrl = $game['game_url'];
        $isEmbeddedGame = !empty($gameUrl) && (
          pathinfo($gameUrl, PATHINFO_EXTENSION) === 'html' ||
          strpos($gameUrl, '.html') !== false
        );
      </?php>
    </div>
  </?php>
</div>
```

Figure 4. 35 Code Snippet for Games Section

4.3.2.11 QUICK CHECKS SECTION

The ‘Quick Checks’ section allows students to test their understanding of each subtopic before moving on. These are short questions placed after key lessons to help students reflect and review. Students can try to answer each question on their own first. When they’re ready, they can click the ‘Show Answer’ button to check if they got it right. This feature encourages self-learning and helps build confidence before taking the final quiz.

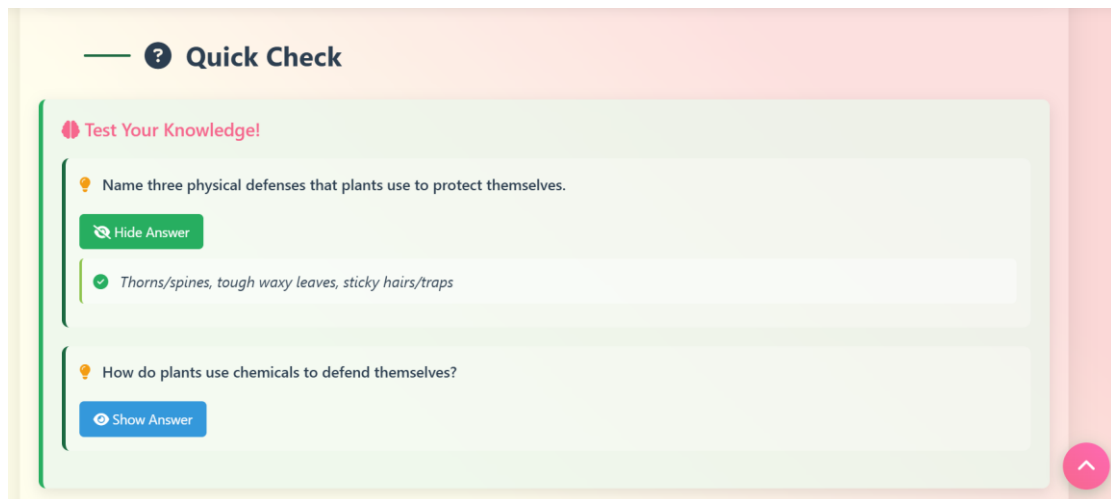


Figure 4. 36 Quick Checks Section in Lessons Page

```
<!-- QUICK CHECK SECTION -->
<?php if (!empty($quickCheckQuestions)): ?>
<div class="section-title" data-aos="fade-right" data-aos-duration="800">
  <i class="fas fa-question-circle"></i> Quick Check
</div>

<div class="quick-check" data-aos="fade-up" data-aos-duration="800">
  <h3><i class="fas fa-brain"></i> Test Your Knowledge!</h3>

  <?php foreach ($quickCheckQuestions as $index => $question): ?>
  <div class="question-container" data-aos="fade-up" data-aos-duration="600" data-aos-delay="<?php echo $i
    <div class="question-text">
      <i class="fas fa-lightbulb" style="color: var(--warning); margin-right: 8px;"></i>
      <?php echo htmlspecialchars($question['question_text']); ?>
    </div>

    <button class="show-answer-btn" onclick="toggleAnswer(<?php echo $index; ?>)">
      <i class="fas fa-eye"></i> Show Answer
    </button>

    <div id="answer-<?php echo $index; ?>" class="answer-container answer-hidden">
      <div class="answer-text">
        <i class="fas fa-check-circle" style="color: var(--success); margin-right: 8px;"></i>
        <?php echo htmlspecialchars($question['answer_text']); ?>
      </div>
    </div>
  </div>
  <?php endforeach; ?>
</div>
```

Figure 4. 37 Code Snippet for Quick Checks

4.3.2.12 FINAL QUIZ

The final quiz is designed to assess students' understanding at the end of each lesson. This quiz is timed and includes key features to ensure a smooth and fair experience:

At the top of quiz page:

- Time limit is displayed and counts down until the quiz auto-submits.
- Passing score percentage is shown so students know the minimum they need to pass.
- Number of questions helps students track their progress.
- Total points available gives a clear idea of how each question contributes to the final score.
- Points allocated for each question will also be displayed.

If students do not click 'Submit' before the timer ends, a pop-up message will appear informing them that the quiz will be submitted. The quiz is then submitted immediately, and the score is calculated. Other than that, if a student tries to leave or close the page while answering the quiz, a pop-up will warn them that their progress may not be saved. However, to avoid losing work, all answers are auto-saved as students complete them. Besides, refreshing the page will not reset the timer. The countdown continues from where it left off.

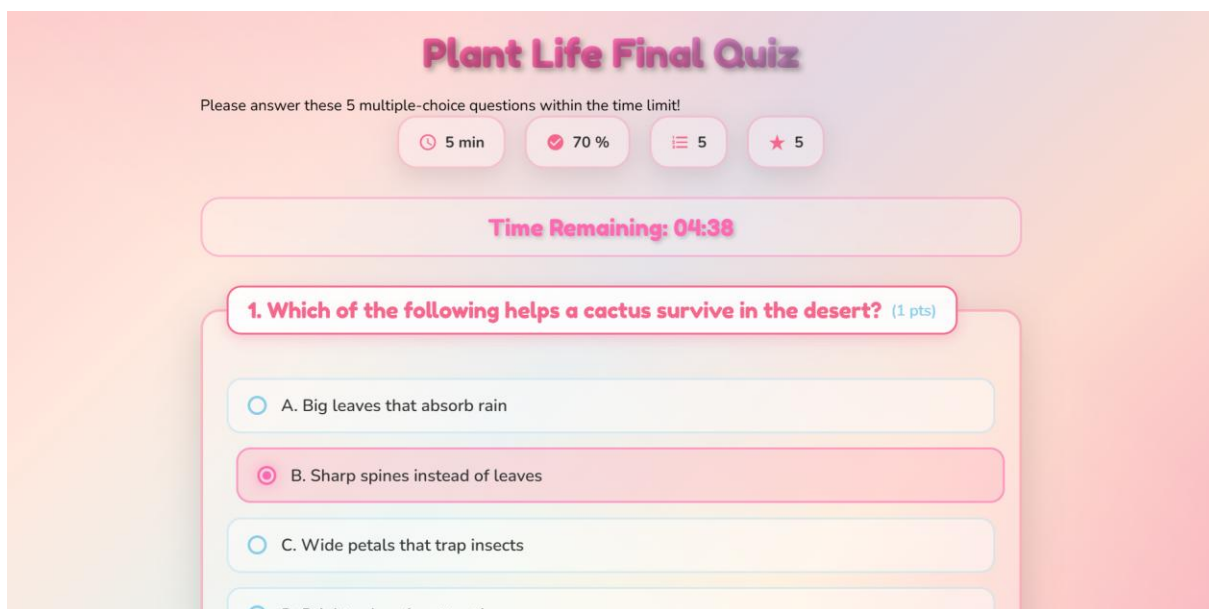


Figure 4. 38 Final Quiz

Once the quiz is completed, students who complete all questions but don't get 100% will receive a completion badge (unique to a certain lesson), meanwhile those who score a perfect

100% will earn a special perfect score badge. These badges can be in the form of images or gif. These badges are awarded automatically based on performance and are predefined in the database. This setup ensures that students are fairly assessed while keeping the experience smooth, secure, and rewarding.

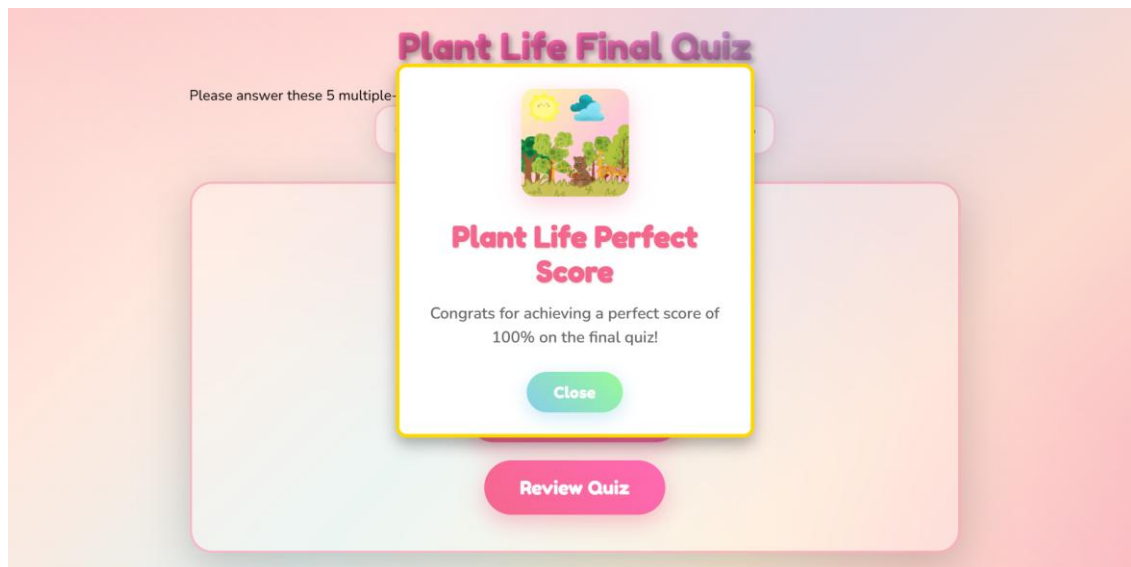


Figure 4.39 Badge Pop-up upon Quiz Completion

The quiz result message will also appear on the screen upon quiz completion. Their score and whether they've passed the quiz or not will be displayed. Clicking 'Review Quiz' will redirect them to Review Quiz page.

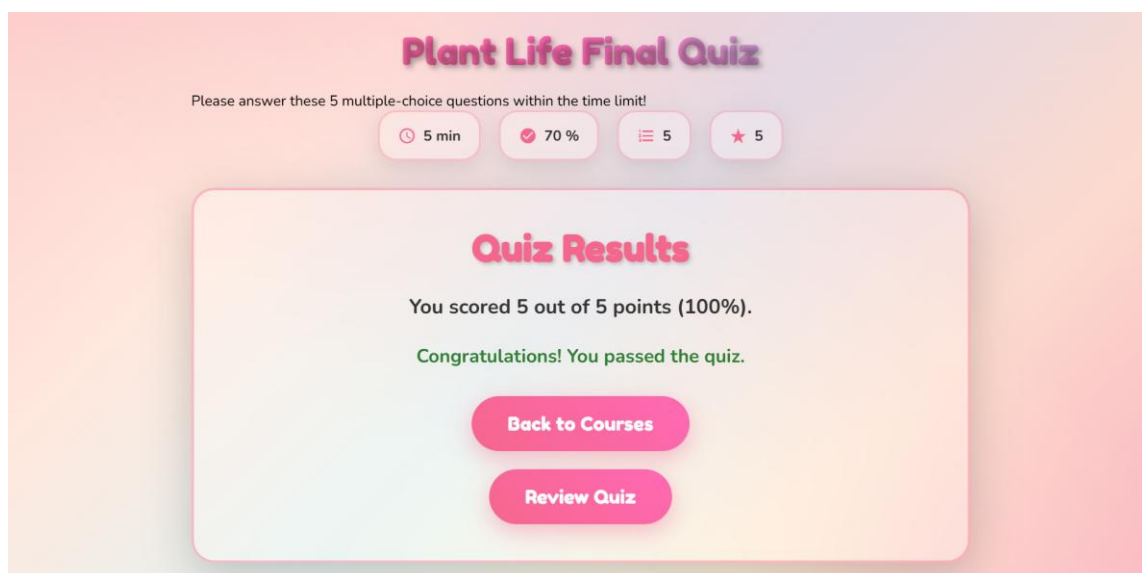


Figure 4.40 Quiz Results Message upon Quiz Completion

```

<body>
  <main class="container" role="main" aria-labelledby="quizTitle">
    <?php if (!$show_results): ?>
      <form method="post" id="quizForm" aria-describedby="quizTitle" novalidate>
        <?php foreach ($questions as $q_id => $q): ?>
          <fieldset>
            <legend>
              <? e($q['text']) ?>
              <span class="question-points"><? e($q['points']) ?> pts</span>
            </legend>
            <div class="options">
              <?php foreach ($q['options'] as $option): ?>
                <label class="option-label" for="option_<? $option['id'] ?>">
                  <input type="radio" id="option_<? $option['id'] ?>" name="question_<? $q_
                  <span class="custom-radio" aria-hidden="true"></span>
                  <? e($option['text']) ?>
                </label>
              <?php endforeach; ?>
            </div>
          </fieldset>
        <?php endforeach; ?>
        <button type="submit" class="submit-btn" aria-label="Submit Quiz">Submit Quiz</button>
      </form>
    <?php else: ?>
      <div class="results" role="region" aria-live="polite">
        <h2>Quiz Results</h2>
        <p class="score">You scored <? round($user_score, 2) ?> out of <? $total_points ?> points (<?
        <p class="congrats"><? $passed ? "Congratulations! You passed the quiz." : "Unfortunately, you
        <button class="submit-btn" onclick="window.location.href='course.php'" aria-label="Back to Cour
        <button class="submit-btn" onclick="window.location.href='review_quiz.php?quiz_id=<? $quiz_id

```

Figure 4. 41 Code Snippet for Final Quiz

4.3.2.13 REVIEW QUIZ

The Review Quiz section allows students to go back and revisit their completed quizzes at any time. This helps them understand what they got right or wrong and learn from their mistakes. In this page, students can see their previous answers, the correct answers, and their total score. Each question is clearly marked as correct or incorrect. Note that, no changes can be made here because there is no retake button.

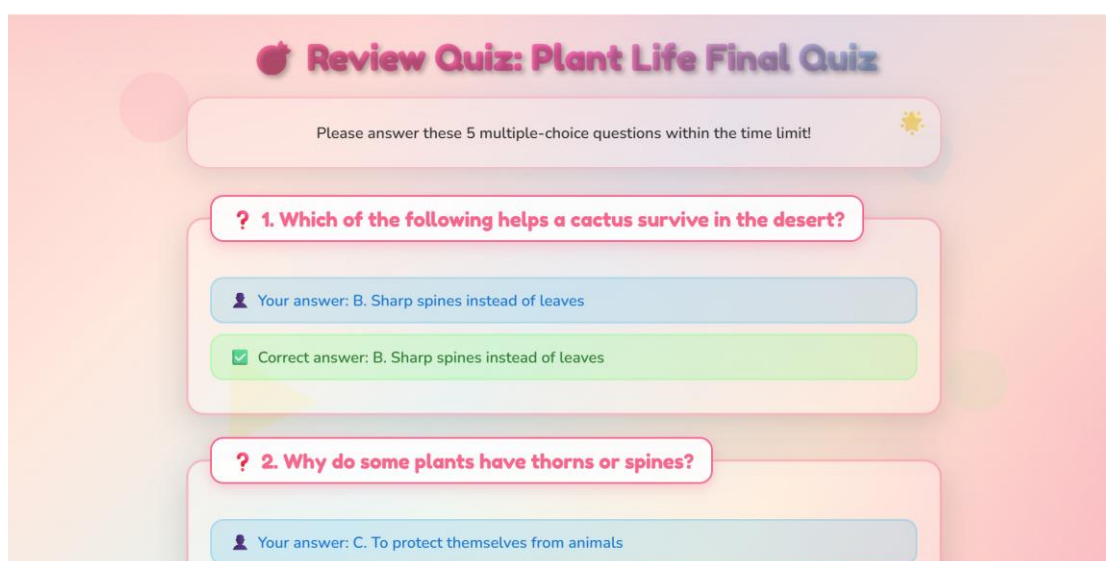


Figure 4. 42 Review Quiz Page

```

<main class="container">
  <h1> 🏆 Review Quiz: <?= htmlspecialchars($quiz['title']) ?></h1>

  <?php if (!empty($quiz['description'])): ?>
  <div class="quiz-description">
    <p><?= nl2br(htmlspecialchars($quiz['description'])) ?></p>
  </div>
  <?php endif; ?>

  <?php if ($error_message): ?>
    <div class="error-message">
      <?= htmlspecialchars($error_message) ?>
    </div>
  <?php else: ?>
    <div class="quiz-review">
      <?php foreach ($questions as $q_id => $question_text): ?>
  <fieldset>
    <legend> ? <?= htmlspecialchars($question_text) ?></legend>
    <div class="answer-section">
      <?php
      // Fetch the user's selected option text
      $user_option_id = $user_answers[$q_id] ?? null;
      $user_option_text = '';

      if ($user_option_id) {
        $stmt = $conn->prepare("SELECT option_text FROM options WHERE id = ?");
        $stmt->bind_param('i', $user_option_id);

```

Figure 4. 43 Code Snippet for Review Quiz

4.3.2.14 LEADERBOARD

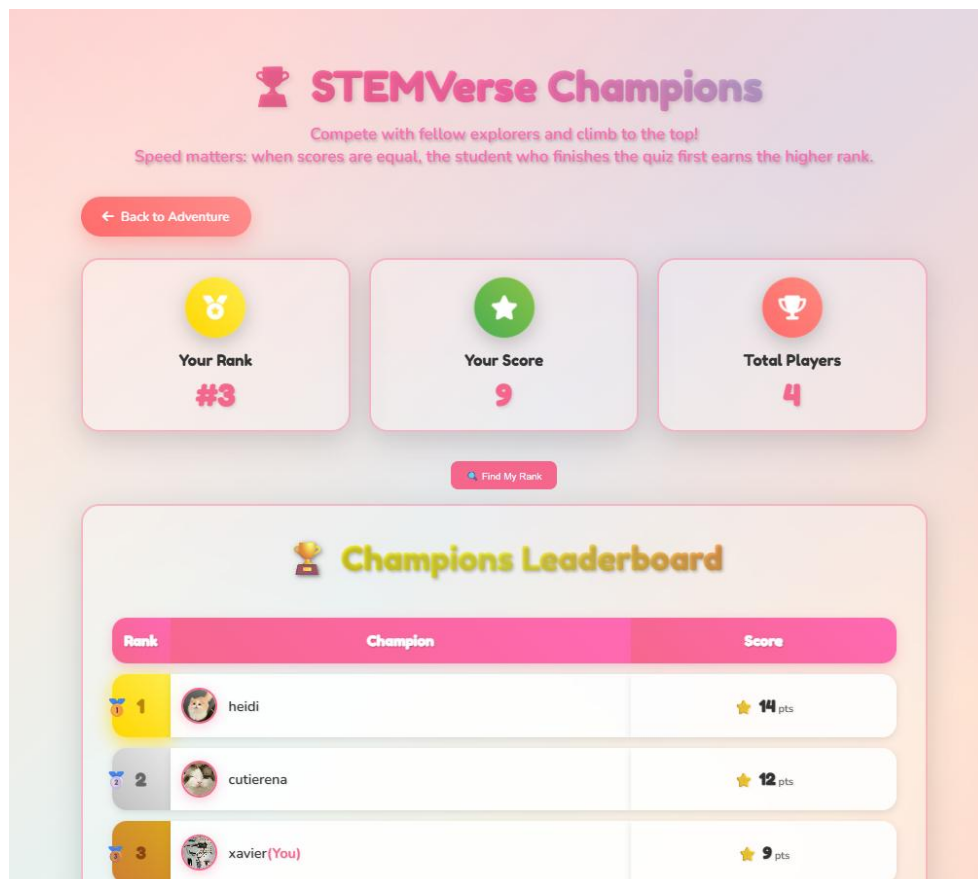


Figure 4. 44 Leaderboard

The leaderboard displays a real-time ranking of all students based on their total quiz points and achievements.

At the top of the page, each student will see:

- Your Rank
- Your Score
- Total Number of Players

Below that, a full leaderboard lists all students' names and scores in descending order. If students want to quickly see where they stand in the list, they can click the 'Find Your Rank' button. This will automatically scroll them to their exact spot in the leaderboard. To make them find their name easier to find, it will also show '(You)' next to their username. This feature helps students track their progress and feel recognized, even if they're not at the top yet.

```
ontainer">
s="leaderboard">
  if ($leaderboard_result->num_rows > 0): ?>
table class="leaderboard-table">
  // Reset result pointer and display all players
  $leaderboard_result->data_seek(0);
  while ($row = $leaderboard_result->fetch_assoc()):
    $rank_class = '';
    if ($row['rank'] == 1) $rank_class = 'gold';
    elseif ($row['rank'] == 2) $rank_class = 'silver';
    elseif ($row['rank'] == 3) $rank_class = 'bronze';
    $is_current_user = $row['username'] === $_SESSION['username'];
  ?>
  <tr>
    <td class="rank-cell <?= $rank_class ?>"><?= htmlspecialchars($row['rank']) ?></td>
    <td class="username-cell <?= $is_current_user ? 'current-user-row' : '' ?>">
      " class="profile-image">
      <?= htmlspecialchars($row['username']) ?>
      <?php if ($is_current_user): ?>
        <span style="color: #f6678d; font-weight: bold;">(You)</span>
      <?php endif; ?>
    </td>
    <td class="score-cell"><?= htmlspecialchars($row['score']) ?></td>
  </tr>
  <?php endwhile; ?>
</tbody>
</table>
```

Figure 4. 45 Code Snippet for Leaderboard

4.3.2.15 MY PROFILE

The My Profile page allows students to view and manage their personal information and track their progress on the platform.

At the upper section of the page, students can:

- View their profile picture, username, and email address
- Edit directly their username, email or profile picture
- After making changes, they must click 'Update My Profile' to save updates.

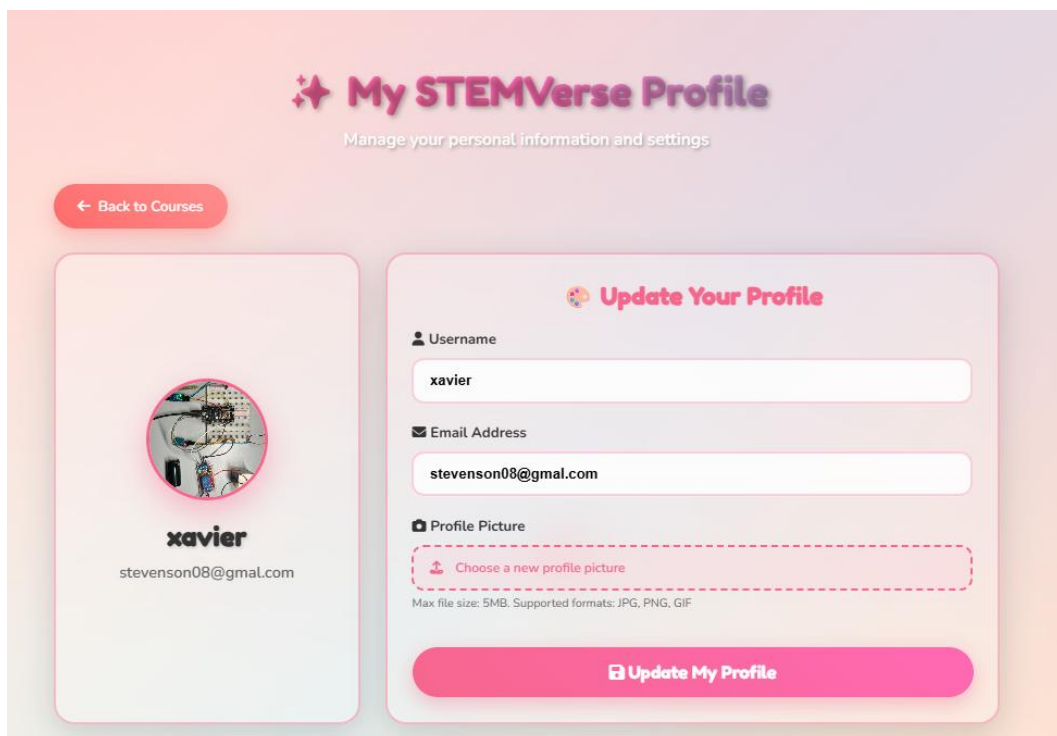


Figure 4. 46 My Profile Upper Section

For lower part of the page, there two sections, which are:

1. Achievement Badges
 - Clicking this button takes students to a page where they can view and zoom in on badges they've earned, along with descriptions of how they were achieved.
2. Account Security
 - Clicking this button redirects to the password change page, where students can update their password safely using a simple form.

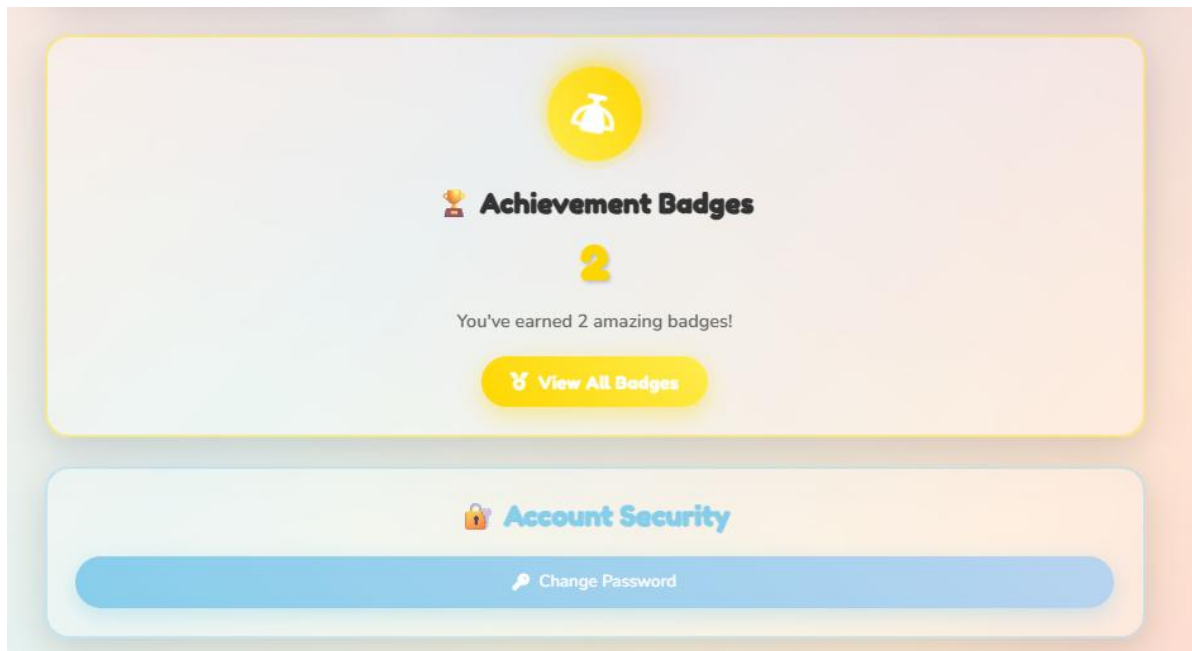


Figure 4. 47 My Profile Lower Section

```
<div class="profile-section">
  <div class="profile-card">
    <div class="profile-avatar">
      <?php if ($user['profile_image']): ?>
        
      <?php else: ?>
        <div class="default-avatar">
          <i class="fas fa-user"></i>
        </div>
      <?php endif; ?>
    </div>
    <div class="profile-info">
      <h2 class="profile-name"><?= htmlspecialchars($user['username']) ?></h2>
      <p class="profile-email"><?= htmlspecialchars($user['email']) ?></p>
    </div>
  </div>

  <div class="form-card">
    <h3><img alt="pencil icon" data-bbox="160 675 175 685"/> Update Your Profile</h3>
    <form method="POST" enctype="multipart/form-data">
      <div class="form-group">
        <label for="username" class="form-label">
          <i class="fas fa-user"></i> Username
        </label>
        <input type="text" id="username" name="username" class="form-control"
          value="<?= htmlspecialchars($user['username']) ?>" required>
      </div>
    </form>
  </div>
</div>
```

Figure 4. 48 Code Snippet for My Profile

4.3.2.16 CHANGE PASSWORD

The Change Password page helps students keep their accounts safe and secure with tips at the bottom of the page. To access it, students can go to 'My Profile' and click the 'Account Security' button. A simple form appears asking for current password, new password and confirm new password. Once filled out, students click 'Change Password' to save changes. A confirmation message will appear upon successful update. If users enter the wrong current password, there will be an error message and users need to try again.

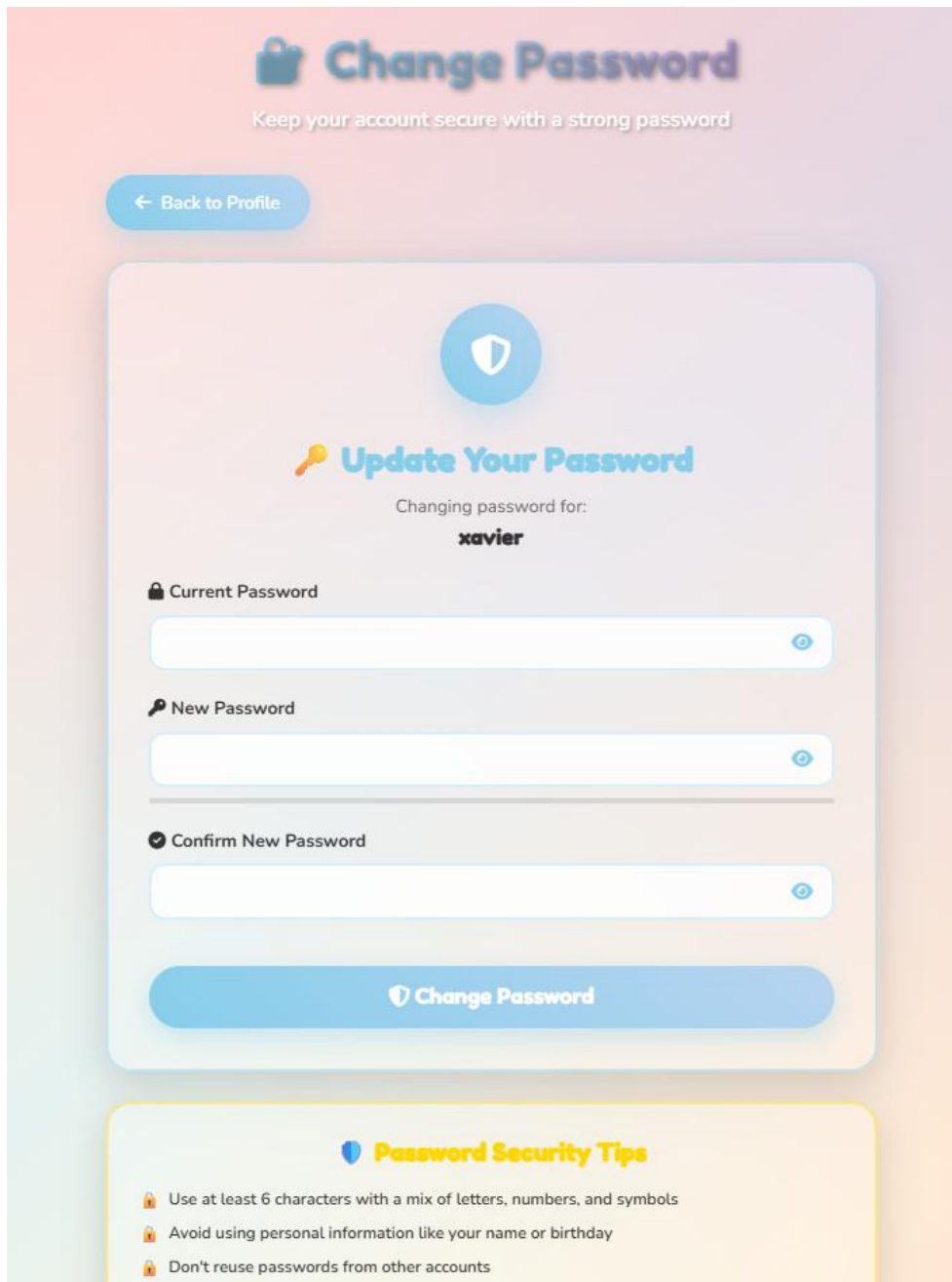
The image shows a 'Change Password' web form. At the top, there's a blue header with a lock icon and the text 'Change Password' and 'Keep your account secure with a strong password'. Below this is a blue button labeled 'Back to Profile'. The main form area has a light blue background with a shield icon and the text 'Update Your Password'. It specifies 'Changing password for: xavier'. There are three input fields: 'Current Password', 'New Password', and 'Confirm New Password', each with a toggle icon. A large blue button labeled 'Change Password' is at the bottom of the form. Below the form is a yellow box titled 'Password Security Tips' containing three tips: 'Use at least 6 characters with a mix of letters, numbers, and symbols', 'Avoid using personal information like your name or birthday', and 'Don't reuse passwords from other accounts'.

Figure 4. 49 Change Password Page

```

<div class="password-card">
  <div class="security-icon">
    <i class="fas fa-shield-alt"></i>
  </div>
  <h3>🔑 Update Your Password</h3>

  <div class="user-info">
    <p>Changing password for:</p>
    <div class="username-display"><?php echo htmlspecialchars($user['username']) ?></div>
  </div>

  <form method="POST" id="passwordForm">
    <div class="form-group">
      <label for="current_password" class="form-label">
        <i class="fas fa-lock"></i> Current Password
      </label>
      <div class="password-input-container">
        <input type="password" id="current_password" name="current_password"
          class="form-control" required>
        <button type="button" class="password-toggle" onclick="togglePassword('current_passwo
          <i class="fas fa-eye"></i>
        </button>
      </div>
    </div>

    <div class="form-group">
      <label for="new_password" class="form-label">
        <i class="fas fa-key"></i> New Password
      </label>
    </div>
  </form>
</div>

```

Figure 4. 50 Code Snippet for Change Password Page

4.3.2.17 VIEW ACHIEVEMENT BADGES

The Achievement Badges section celebrates student progress by showing the badges they've earned throughout their learning journey. Students can access it by going to “My Profile” and clicking the “Achievement Badges” button. The page displays a list of badges, each showing:

1. The badge name
2. A short description of how it was earned
3. The score
4. When it was earned
5. The category (Perfect or Participation)
6. Zoom feature that allows students to view badge designs up close

Types of badges include:

- Completion Badge - for finishing a quiz
- Perfect Score Badge - for scoring 100%

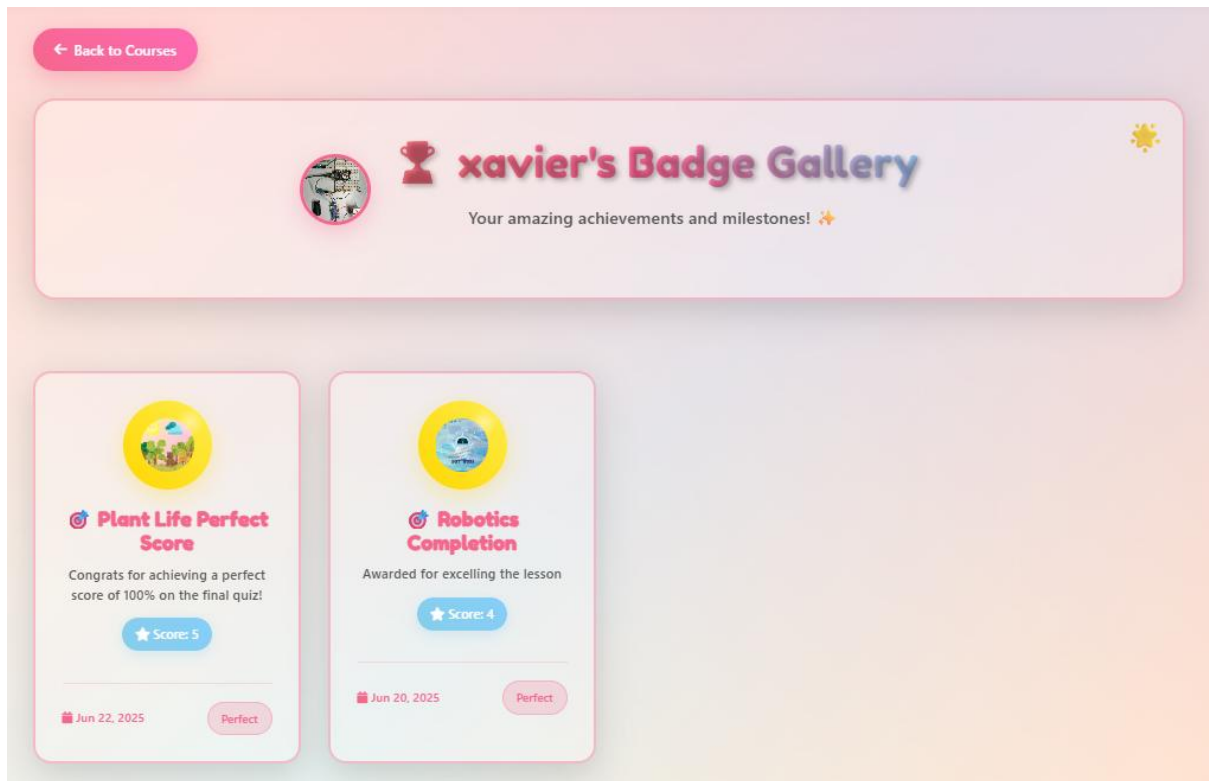


Figure 4. 51 View Achievement Badges

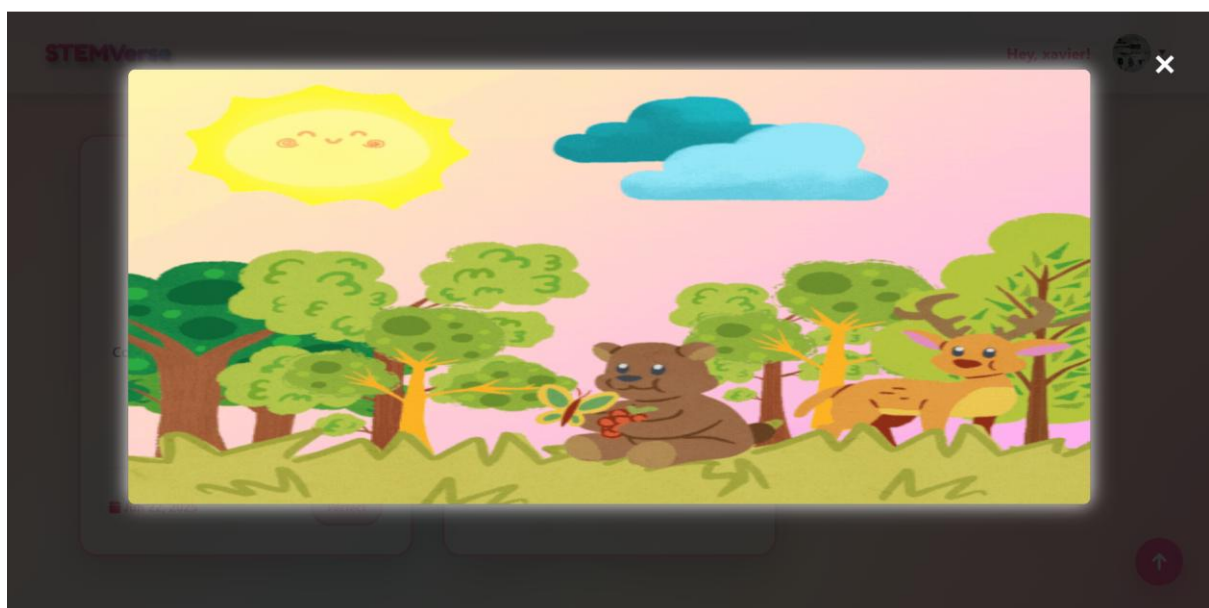


Figure 4. 52 Zoom in on a Badge

```

<?php include 'navbar-user.php'; ?>
<div class="container">
  <?php if (count($userBadges) > 0): ?>
    <div class="badges-grid">
      <?php foreach ($userBadges as $badge): ?>
        <div class="badge">
          <i class="<?php echo $typeIcons[$badge['badge_type']] ?? 'fas fa-award'; ?>">
            <?php endif; ?>
          <div class="badge-shine"></div>
        </div>
        <h3 class="badge-title"><?php echo htmlspecialchars($badge['badge_name']); ?></h3>
        <p class="badge-description"><?php echo htmlspecialchars($badge['badge_description']); ?>
        <?php if ($badge['score_achieved']): ?>
          <div class="score-badge">
            <i class="fas fa-star"></i>
            Score: <?php echo htmlspecialchars($badge['score_achieved']); ?>
          </div>
        <?php endif; ?>
        <div class="badge-meta">
          <span class="badge-date">
            <i class="fas fa-calendar"></i>
            <?php echo date('M d, Y', strtotime($badge['earned_at'])); ?>
          </span>
          <span class="badge-type">
            <?php echo htmlspecialchars($badge['badge_type']); ?>
          </span>
        </div>
      </div>
    </div>
  </div>
</div>

```

Figure 4. 53 Code Snippet for View Achievement Badges

4.3.2.18 FAQs & SUPPORT

The FAQs page provides answers to common questions about how to use the website. Students can access it from the top navigation bar. Questions are grouped into simple categories, such as account and profile, courses and learning as well as technical issues. Clicking a question reveals a short and easy-to-understand answer. They can also use search function to search for certain keyword. Email support is also provided at the bottom, where upon clicking, users will be redirected to email.

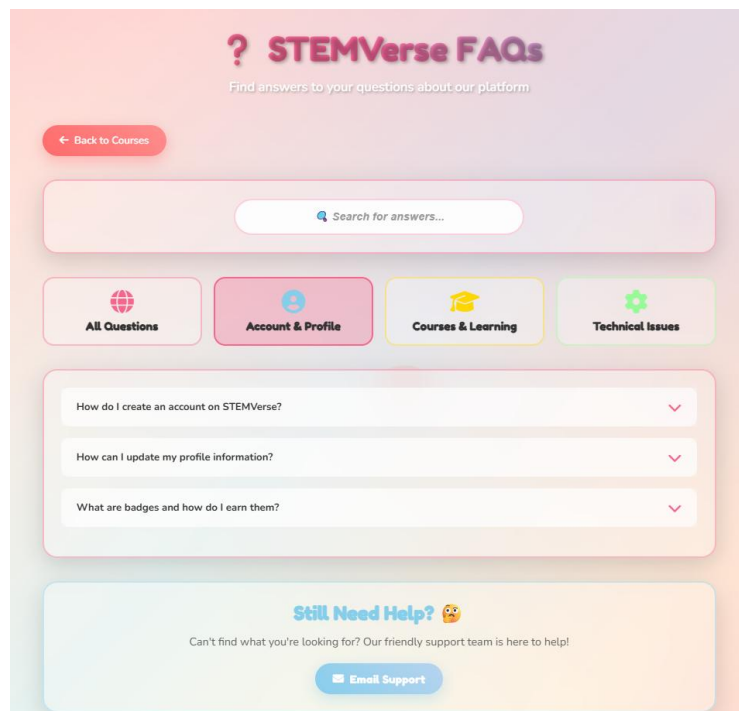


Figure 4. 54 FAQs Page

```

<a href="course.php" class="back-btn">
  <i class="fas fa-arrow-left"></i>
  Back to Courses
</a>

<div class="search-box">
  <input type="text" id="searchInput" class="search-input" placeholder="🔍 Search for answers...">
</div>

<div class="categories">
  <div class="category-btn active" data-category="all">
    <i class="fas fa-globe category-icon" style="color: #f6678d;"></i>
    <div class="category-name">All Questions</div>
  </div>
  <div class="category-btn" data-category="account">
    <i class="fas fa-user-circle category-icon" style="color: #87ceeb;"></i>
    <div class="category-name">Account & Profile</div>
  </div>
  <div class="category-btn" data-category="courses">
    <i class="fas fa-graduation-cap category-icon" style="color: #ffd700;"></i>
    <div class="category-name">Courses & Learning</div>
  </div>
  <div class="category-btn" data-category="technical">
    <i class="fas fa-cog category-icon" style="color: #98fb98;"></i>
    <div class="category-name">Technical Issues</div>
  </div>
</div>

```

Figure 4. 55 Code Snippet for FAQs

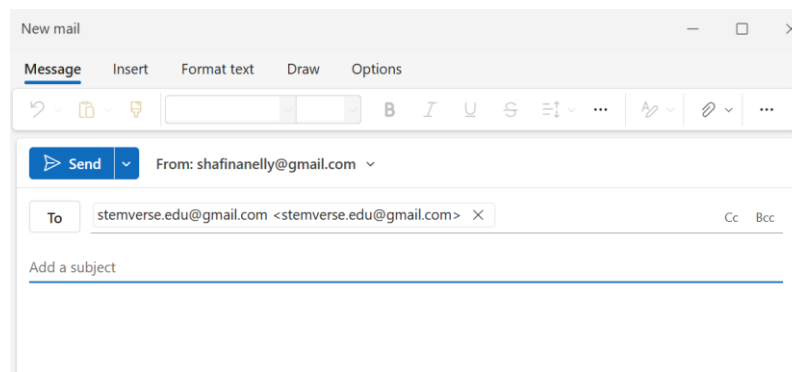


Figure 4. 56 Email to STEMVerse

4.3.2.19 LOGOUT

Users can click on logout button at the navigation bar to logout.

4.3.2.20 FOOTER

The footer of the website includes a copyright notice to indicate ownership and protect the content and branding of the platform. It is displayed as shown in Figure 3. This footer appears at the bottom of every page and serves as a standard copyright statement, showing that all materials within the platform are owned by STEMVerse behind the development of the platform. It reinforces the identity of the website and helps establish professional presentation.

© 2025 STEMVerse - Making Learning Fun for Young Explorers!

Figure 4. 57 Footer

The features outlined below are specifically designed for the administrators (mainly, teachers).

4.3.3.1 ADMIN LOG IN

The admin login page is the access point for administrators to enter the backend of the platform. Admins are required to enter their registered email and password to log in. Upon successful login, they are redirected to the Admin Dashboard.

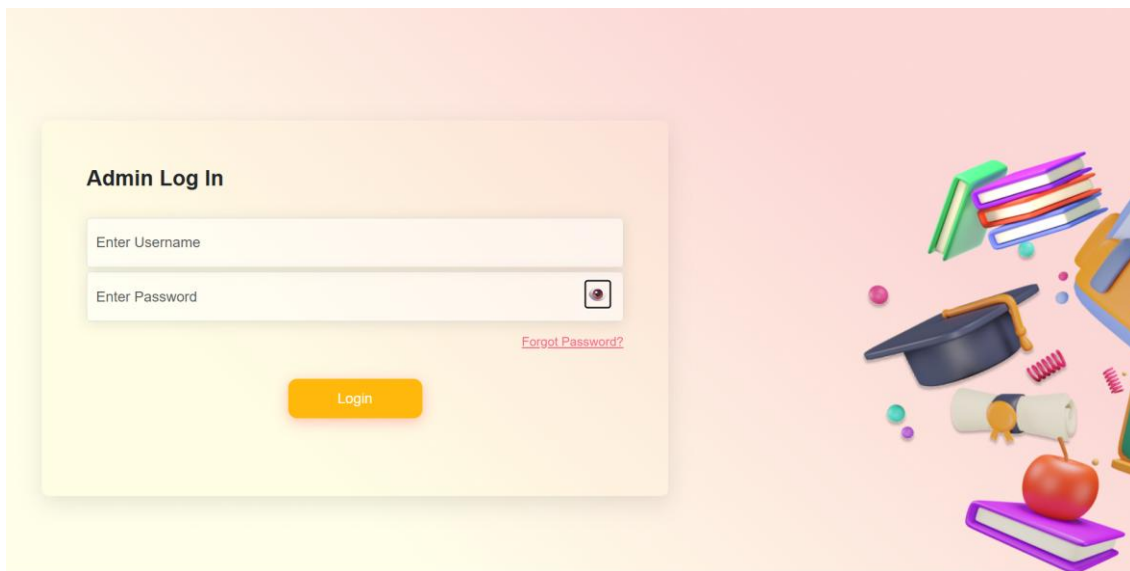


Figure 4. 58 Admin Log In Page

```
<body>
  <section class="login-container">
    <div class="login-box">
      <h3 class="login-title">Admin Log In</h3>

      <?php if (!empty($errors)): ?>
        <div class="alert alert-danger">
          <?php foreach ($errors as $error) echo "<div>$error</div>"; ?>
        </div>
      <?php endif; ?>

      <form id="loginForm" class="form-container" action="admin-login.php" method="POST">
        <div class="form-group">
          <input type="text" name="username" class="form-control" placeholder="Enter Username" required />
        </div>

        <div class="form-group">
          <div class="password-container">
            <input type="password" name="password" id="password" class="form-control" placeholder="Enter Password" />
            <button type="button" class="password-toggle" onclick="togglePassword('password')"></button>
          </div>
        </div>

        <div class="forgot-password-container">
          <a href="forgot-password.php" class="forgot-password">Forgot Password?</a>
        </div>

        <button type="submit" class="btn-login">Login</button>
      </form>
    </div>
  </section>
</body>
```

Figure 4. 59 Code Snippet of Admin Log In Page

4.3.3.2 ADMIN DASHBOARD & SCORE REPORT

The Admin Dashboard serves as the central hub for all administrative controls. On the left side of the screen, a navigation bar provides access to key sections including Manage Quiz, User Management, Student Progress Tracker, Account Settings, and Logout. The layout is clean and structured for ease of use, allowing quick access to each feature. Within the dashboard, administrators can view a score report represented as a bar chart. This report displays average scores across different courses. The graph helps visualize student performance trends and identify course that may need more attention or support.

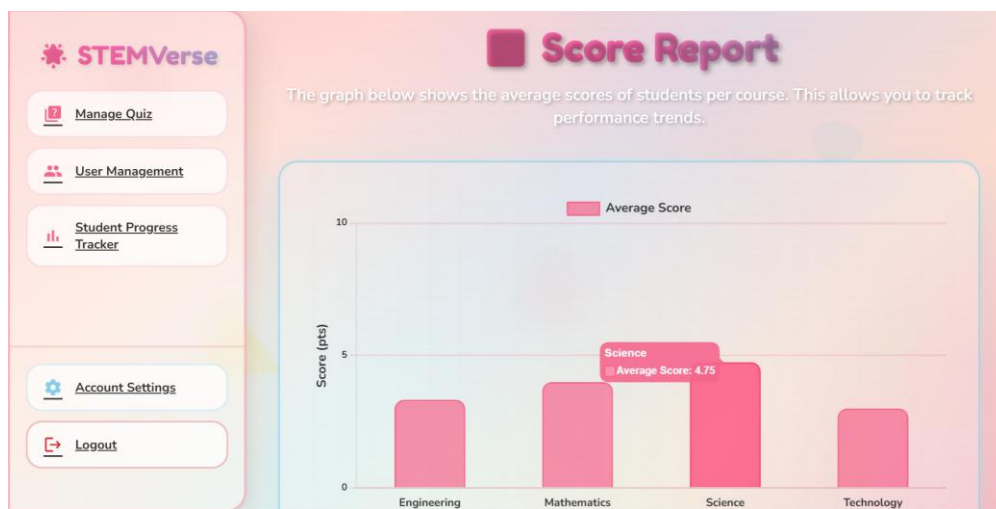


Figure 4. 60 Admin Dashboard

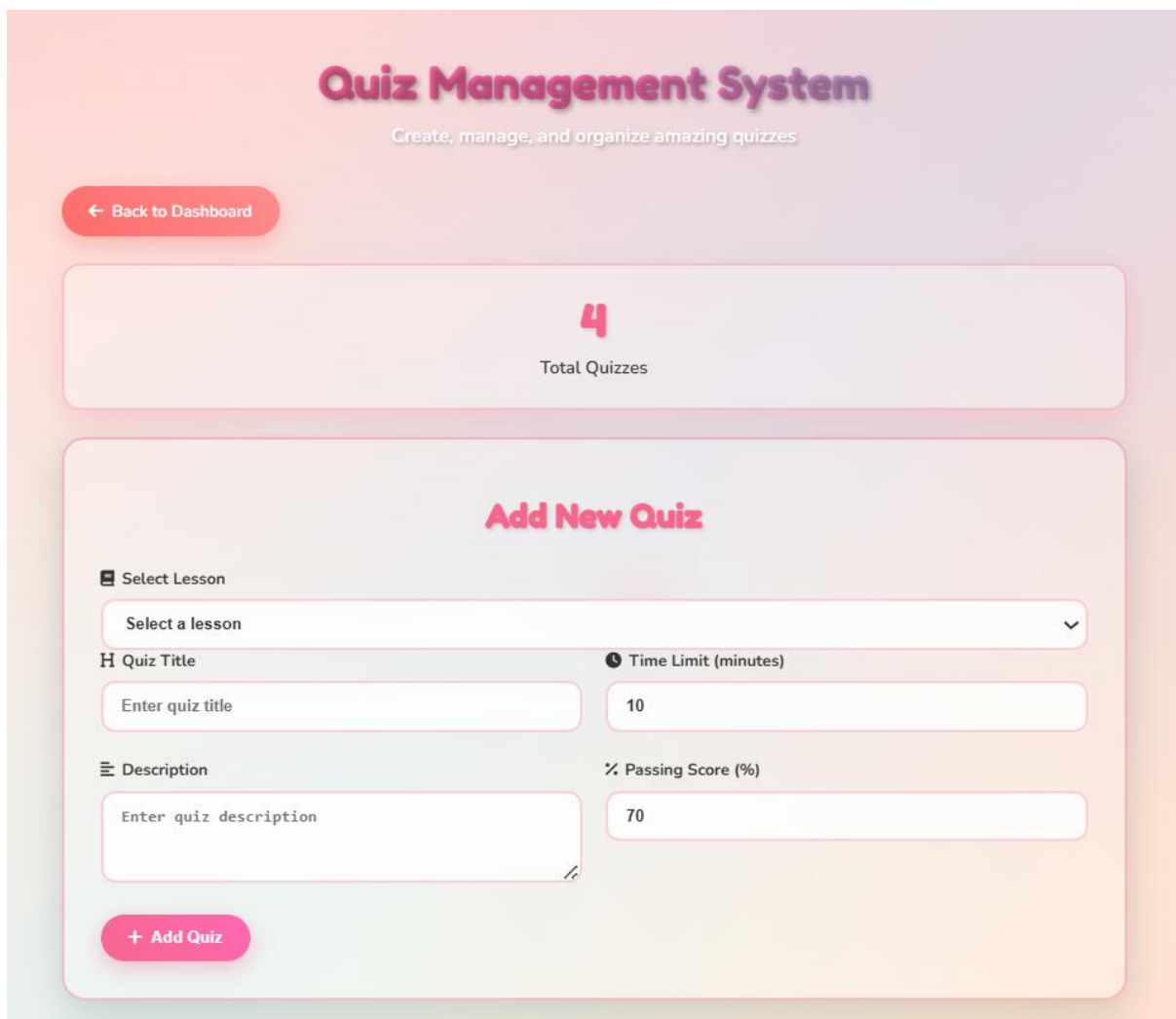
```
<div class="app-container">
  <aside class="sidebar" id="sidebar" aria-label="Sidebar Navigation">
    <div class="sidebar-header" tabindex="0"> STEMVerse</div>
    <nav class="nav-links" role="navigation" aria-label="Admin Menu">
      <a href="add_quiz.php" class="nav-item" tabindex="0">
        <span class="material-icons md-24">quiz</span>
        Manage Quiz
      </a>
      <a href="user_management.php" class="nav-item" tabindex="0">
        <span class="material-icons md-24">group</span>
        User Management
      </a>
      <a href="student_progress.php" class="nav-item" tabindex="0">
        <span class="material-icons md-24">bar_chart</span>
        Student Progress Tracker
      </a>
    </nav>
    <div class="sidebar-bottom">
      <a href="admin_settings.php" class="nav-item settings-btn" tabindex="0">
        <span class="material-icons md-24">settings</span>
        Account Settings
      </a>
      <a href="logout.php" class="nav-item logout-btn" tabindex="0" onclick="return confirm('Are you sure you want to logout?')">
        <span class="material-icons md-24">logout</span>
        Logout
      </a>
    </div>
  </aside>
  <main class="main-content">
    <div class="score-report">
      <h3>Score Report</h3>
      <p>The graph below shows the average scores of students per course. This allows you to track performance trends.</p>
      <img alt="Bar chart showing average scores for Engineering, Mathematics, Science, and Technology. Science has the highest score at 4.75." data-bbox="355 395 795 550"/>
      <table border="1">
        <thead>
          <tr>
            <th>Course</th>
            <th>Average Score</th>
          </tr>
        </thead>
        <tbody>
          <tr>
            <td>Engineering</td>
            <td>3.5</td>
          </tr>
          <tr>
            <td>Mathematics</td>
            <td>4.0</td>
          </tr>
          <tr>
            <td>Science</td>
            <td>4.75</td>
          </tr>
          <tr>
            <td>Technology</td>
            <td>3.0</td>
          </tr>
        </tbody>
      </table>
    </div>
  </main>
</div>
```

Figure 4. 61 Code Snippet of Admin Dashboard

4.3.3.4 QUIZ MANAGEMENT

This section allows admins to create, update, and delete quizzes. Each quiz can be assigned to a specific lesson. The form includes fields for entering questions, answer options, and the correct answer. A confirmation message appears after each successful action, such as saving or deleting a quiz.

First, the top of the page will display total quizzes. Admins need to add new quiz by selecting a lesson, then type the title, time limit in minutes, description and passing score. Clicking ‘Add Quiz’ will add the quiz into the database.



The screenshot displays the 'Quiz Management System' interface. At the top, the title 'Quiz Management System' is centered in a bold, pink font, with the subtitle 'Create, manage, and organize amazing quizzes' below it. A pink button labeled '← Back to Dashboard' is positioned on the left. Below this, a large pink box shows the number '4' in a large font, with 'Total Quizzes' written underneath. The main section is titled 'Add New Quiz' in a bold, pink font. It contains four input fields: 'Select Lesson' (a dropdown menu with 'Select a lesson' and a downward arrow), 'Quiz Title' (a text input field with 'Enter quiz title'), 'Time Limit (minutes)' (a text input field with '10'), and 'Description' (a text input field with 'Enter quiz description'). Below these fields is a pink button labeled '+ Add Quiz'. The background of the page is a light pink gradient.

Figure 4. 62 Add New Quiz Page

Afterwards, the successful entry will be listed at the lower section of the page along with the other available quizzes.

# No.	HTitle	Description	Time Limit	%Passing Score	Lesson	Actions
1	Robotics Final Quiz!	Do you know robotics well? Let's find out.	10s	40%	Robotics Engineering	Questions Edit Delete
2	Scratch Quiz!	Please answer these questions within time limit.	10s	40%	Scratch Coding Adventures	Questions Edit Delete
3	Data Handling Quiz	Please answer these 5 questions before time's up!	10s	50%	Data Handling	Questions Edit Delete
4	Plant Life Final Quiz	Please answer these 5 multiple-choice questions within the time limit!	15s	70%	Plant Life	Questions Edit Delete

Figure 4. 63 List of Available Quizzes

If admins want to make any changes on the newly added quiz or other available quizzes, they can click on the edit button and the quiz will be displayed at the upper section. Adjust the amendments necessarily and click 'Update Quiz' once ready. Otherwise, to add questions and answers into the quiz, admins must click on the 'Questions' button to be redirected to Questions Management.

[← Back to Dashboard](#)

4

Total Quizzes

Edit Quiz

Select Lesson

Robotics Engineering

H Quiz Title

Robotics Final Quiz!

Time Limit (minutes)

10

Description

Do you know robotics well? Let's find out.

% Passing Score (%)

40

[Update Quiz](#)
[XCancel](#)

# No.	HTitle	Description	Time Limit	%Passing Score	Lesson	Actions
1	Robotics Final Quiz!	Do you know robotics well? Let's find out.	10s	40%	Robotics Engineering	Questions Edit Delete

Figure 4. 64 Edit Quiz

```

<tbody>
  <tr>
    <td><span class="badge bg-primary"><?php echo $sequentialNumber; ?></span></td>
    <td><strong><?php echo htmlspecialchars($quiz['title']); ?></strong></td>
    <td><?php echo htmlspecialchars(substr($quiz['description'], 0, 100)) . (strlen($quiz['description']
    <td><span class="badge bg-info"><?php echo $quiz['time_limit']; ?></span></td>
    <td><span class="badge bg-success"><?php echo $quiz['passing_score']; ?></span></td>
    <td>
      <?php
        // Fetch lesson name for the quiz
        $lessonStmt = $conn->prepare("SELECT lesson_name FROM lessons WHERE lesson_id = ?");
        $lessonStmt->bind_param("i", $quiz['lesson_id']);
        $lessonStmt->execute();
        $lessonStmt->bind_result($lessonName);
        $lessonStmt->fetch();
        echo htmlspecialchars($lessonName);
        $lessonStmt->close();
      ?>
    </td>
  </tr>

```

Figure 4. 65 Code Snippet for Quiz Management

Admins can add new questions by filling in all the fields as shown in figure below. Total quizzes, questions and current quiz will be displayed at the top page. Next, they can fill in all of the options and mark one that is the correct answer.

Figure 4. 66 Questions Management

The screenshot shows a user interface titled "Answer Options". It contains four numbered input fields, each with a "Correct Answer" radio button and a text input area labeled "Enter option 1" through "Enter option 4". At the bottom left, there is a pink button labeled "+ Add Question".

Figure 4. 67 Add Questions and Answers

Figure below shows the list of questions and answers for each of the questions. Admins can edit and delete these questions by clicking on the available buttons next to the questions.

The screenshot shows a quiz interface titled "Data Handling Quiz" with a subtitle "Please answer these 5 questions before time's up!". It displays a table of 4 questions, each with a number, a question text, a points value, and action buttons for edit and delete.

# No.	? Question	★ Points	⚙️ Actions
1	In a pie chart, the sector for "Books" is larger than "Toys", "Games", and "Snacks". What does this ...	1	
2	What is the mode of the following set of numbers? 3, 4, 6, 4, 7, 4, 5	1	
3	Find the range of the data set: 12, 8, 15, 10, 9	1	
4	Find the median of these numbers: 6, 9, 3, 5, 8	1	

Figure 4. 68 List of Questions and Answers in Respective Quizzes

```

<div class="row">
  <div class="col-md-8">
    <div class="mb-3">
      <label for="quiz_id" class="form-label">
        <i class="fas fa-list me-2"></i>Select Quiz
      </label>
      <select class="form-select" name="quiz_id" id="quiz_id" required>
        <option value="">Choose a quiz...</option>
        <?php foreach ($questions_by_quiz as $quiz_data): ?>
          <option value="<?php echo $quiz_data['quiz']['id']; ?>"
            <?php echo ($selected_quiz_id == $quiz_data['quiz']['id']) ? 'selected' : ''; ?>
            <?php echo htmlspecialchars($quiz_data['quiz']['title']); ?>
          </option>
        <?php endforeach; ?>
      </select>
    </div>
  </div>
</div>

```

Figure 4. 69 Code Snippet for Add Questions

To edit quiz question, admin can just fill in necessary adjustments in question details or mark a different correct answers for answer options section. Clicking update question button will update the changes and cancelling it will do otherwise.

Figure 4. 70 Edit Questions

```

<!-- Edit Question Form -->
<div class="form-card">
  <h3><i class="fas fa-edit me-2"></i>Edit Question</h3>
  <form method="POST" id="editQuestionForm">
    <div class="row">
      <div class="col-md-8">
        <div class="mb-4">
          <label for="question_text" class="form-label">
            <i class="fas fa-question me-2"></i>Question Text
          </label>
          <textarea class="form-control" name="question_text" id="question_text"
            rows="3" placeholder="Enter your question here..." required><?php echo htmlspecialchars($question['question_text']); ?>
          </div>
        </div>
      <div class="col-md-4">
        <div class="mb-4">
          <label for="points" class="form-label">
            <i class="fas fa-star me-2"></i>Points
          </label>
          <input type="number" class="form-control" name="points" id="points"
            value="<?php echo htmlspecialchars($question['points']); ?>" min="1" max="10" required>
          </div>
        </div>
      </div>
    </div>
  </form>
</div>

```

Figure 4. 71 Code Snippet for Edit Questions

4.3.3.5 USER MANAGEMENT

The User Management section provides a list of all registered students. Admins can view user details including usernames and email addresses. They can also add and edit user profiles, reset passwords, or remove users from the system. All changes are saved immediately after submission. This feature is provided to aid students who have difficulty registering on their own.

User Management
Admin Dashboard - Manage System Users

[← Back to Dashboard](#)

+ Add New User

Email Address

Username

Password

+ Add User

↑

Figure 4. 72 User Management

Current Users

NO.	EMAIL	USERNAME	ACTIONS
1	naomi12@gmail.com	naomina	Edit Delete
2	stevenson08@gmail.com	xavier	Edit Delete
3	sara12@gmail.com	sara12	Edit Delete
4	serena@gmail.com	cutierena	Edit Delete

↑

Figure 4. 73 Lists of Current Users

```
// Handle form submissions
if ($_SERVER['REQUEST_METHOD'] === 'POST') {
    if (isset($_POST['action'])) {
        switch ($_POST['action']) {
            case 'add':
                $email = mysqli_real_escape_string($conn, $_POST['email']);
                $username = mysqli_real_escape_string($conn, $_POST['username']);
                $password = password_hash($_POST['password'], PASSWORD_DEFAULT);

                $sql = "INSERT INTO users (email, username, password) VALUES ('$email', '$username', '$password')";
                if (mysqli_query($conn, $sql)) {
                    $success = "User added successfully!";
                } else {
                    $error = "Error adding user: " . mysqli_error($conn);
                }
            }
        }
    }
    break;
}
```

Figure 4. 74 Code Snippet for User Management

4.3.3.6 TRACK STUDENTS PROGRESS

In the Track Students' Progress section, admins can monitor individual student activity. This includes viewing last answered, completed quizzes, quiz scores, and badges earned. Progress is displayed in a clear and organized format, helping admins assess student engagement and overall learning progress. They can search by filter based on course, lessons and quiz.

Student Progress Tracker

Monitor student achievements and quiz performance

[← Back to Dashboard](#)

Course

Lesson

Quiz

All Courses

All Lessons

All Quizzes

 **heidi**
heidi@gmail.com

Quiz	Lesson	Course	Questions	Last Answered	Score	Badge
Plant Life Final Quiz	Plant Life	Science	5	2025-06-20 09:01:52	5	Plant Life Perfect Score
Data Handling Quiz	Data Handling	Mathematics	4	2025-06-20 09:28:55	4	Data Handling Perfect Score
Scratch Quiz!	Scratch Coding Adventures	Technology	4	2025-06-20 09:29:56	3	Scratch Completion

 **cutierena**
serena@gmail.com

Quiz	Lesson	Course	Questions	Last Answered	Score	Badge
Plant Life Final Quiz	Plant Life	Science	5	2025-06-20 09:44:58	5	Plant Life Perfect Score
Scratch Quiz!	Scratch Coding Adventures	Technology	4	2025-06-20 11:03:45	3	Scratch Completion
Robotics Final Quiz!	Robotics Engineering	Engineering	4	2025-06-20 09:45:14	4	Robotics Completion

Figure 4. 75 Students Progress Tracker Page

```

// Handle filter values
$filter_course = $_GET['course'] ?? '';
$filter_lesson = $_GET['lesson'] ?? '';
$filter_quiz = $_GET['quiz'] ?? '';

// Fetch dropdown filter options based on current selection
$courses = mysqli_query($conn, "SELECT course_id, course_name FROM courses");

// Filter lessons by course (if selected)
$lesson_query = "SELECT lesson_id, lesson_name FROM lessons";
if ($filter_course !== '') {
    $course_id_safe = mysqli_real_escape_string($conn, $filter_course);
    $lesson_query .= " WHERE course_id = '$course_id_safe'";
}
$lessons = mysqli_query($conn, $lesson_query);

// Filter quizzes by lesson (if selected)
$quiz_query = "SELECT id, title FROM quizzes";
if ($filter_lesson !== '') {
    $lesson_id_safe = mysqli_real_escape_string($conn, $filter_lesson);
    $quiz_query .= " WHERE lesson_id = '$lesson_id_safe'";
}
$quizzes = mysqli_query($conn, $quiz_query);

// Fetch all students
$sql = "SELECT user_id, username, email, profile_image FROM users WHERE role != 'admin'";
$users_result = mysqli_query($conn, $sql);

```

Figure 4. 76 Code Snippet for Students Progress Tracker Page

4.3.3.7 ADMIN SETTINGS

The admin settings page displays the username and email of the administrator. In this page, admin can update their username and password accordingly. The account security section consisting of ‘Change Password’ has the similar functionality, UI and flow as user’s change password page. The ‘Back to Dashboard’ button will redirect them back to the admin dashboard.

Figure 4. 77 Admin Settings Page

```

<div class="container">
  <div class="admin-section">
    <div class="admin-card">
      </div>
      <div class="admin-info">
        <h2 class="admin-name"><?= htmlspecialchars($admin['username']) ?></h2>
        <p class="admin-email"><?= htmlspecialchars($admin['email']) ?></p>
        <span class="admin-role">Administrator</span>
      </div>
    </div>

    <div class="form-card">
      <h3><img alt="gear icon" data-bbox="345 178 358 191"/> Update Admin Profile</h3>
      <form method="POST">
        <div class="form-group">
          <label for="username" class="form-label">
            <i class="fas fa-user"></i> Admin Username
          </label>
          <input type="text" id="username" name="username" class="form-control"
            value="<?= htmlspecialchars($admin['username']) ?>" required>
        </div>

        <div class="form-group">
          <label for="email" class="form-label">
            <i class="fas fa-envelope"></i> Admin Email
          </label>
          <input type="email" id="email" name="email" class="form-control"
            value="<?= htmlspecialchars($admin['email']) ?>" required>
        </div>
      </form>
    </div>
  </div>
</div>

```

Figure 4. 78 Code Snippet for Admin Settings

4.3.3.9 ADMIN LOGOUT

Admin can click on the ‘Logout’ link on the left side navigation bar to log out of the platform.

4.4 WEBSITE ASSETS

4.4.1 BADGES

To further enrich the student’s learning journey and foster motivation, the platform incorporates a badge system designed to recognize and reward student achievements. These badges are thoughtfully created using Canva, a user-friendly design tool that allows for the creation of visually appealing and consistent assets. Drawing inspiration from educational themes and gamification strategies, the badges are designed to be colourful, thematic, and easy to associate with specific milestones or tasks. By using Canva, it becomes easier to maintain a cohesive visual identity across all badge designs, enhancing both the aesthetic appeal and user engagement on the platform. As discussed in earlier sections, integrating these well-designed visual rewards not only helps to acknowledge students’ progress but also encourages continued participation and effort. Hence, selecting the right design approach and tools like Canva plays a crucial role in shaping a visually stimulating and motivating learning environment.

4.5 SUMMARY

This chapter presented the detailed implementation of the educational website, highlighting the development process and the tools used to bring the platform to life. The implementation began

with the setup and configuration of essential software, including the integration of front-end technologies (HTML, CSS, JavaScript) and back-end functionalities using PHP and MySQL. The chapter outlined the modular structure of the system, showcasing how different features, such as the courses, lesson modules, subtopics, interactive games, videos, quizzes, badge system and leaderboard work together to deliver a cohesive and engaging learning experience.

Each component was implemented to support a gamified approach to STEM education for young learners, with emphasis on user interaction and accessibility. Screenshots and interface walkthroughs were included to visually represent the developed features, ensuring a clear understanding of their functions and navigation. Additionally, admin-specific features such as quiz management, user tracking, and report visualization were described to illustrate the platform's support for both learners and educators. With the prototype now fully developed, the next chapter involves comprehensive testing to ensure reliability, usability and overall effectiveness of the system.

CHAPTER 5: TESTING

5.1 INTRODUCTION

Testing is a pivotal phase in the software development lifecycle as it ensures that the system performs as expected and meets the specified requirements. For this project, both functional and non-functional testing methods were applied to validate the correctness, reliability, and performance of the system. Functional testing focuses on verifying that each function of the system operates according to the defined specifications. It involves testing user interactions, database operations, and system processes to ensure that the system behaves correctly under normal and abnormal conditions. On the other hand, non-functional testing evaluates aspects of the system that are not related to specific behaviours or functions but are essential for user experience and system performance. These include performance, usability, reliability, and compatibility.

5.2 TESTING OBJECTIVES

The objectives of conducting testing to the target users (grade 5 students and teacher) are:

1. To evaluate the usability and navigation flow of the STEMVerse platform from a young learner's perspective.
2. To measure the level of engagement and motivation during interaction with gamified features such as quizzes, badges, and games.
3. Assess the clarity and accessibility of lesson content, interactive sections, and learning activities.
4. Gather feedback from students and teachers to identify any areas that may cause confusion or difficulty.

5.3 FUNCTIONAL TESTING

Functional testing focuses on confirming that the core features of the website behave as planned based on the original design goals. This phase examines whether each function of the system responds correctly to user actions and delivers accurate results. Rather than just checking the code, this testing validates that the system aligns with how users are expected to interact with it.

Two key methods were used in this project: unit testing and integration testing. These tests were done manually using prepared test cases, ensuring that every section of the system reacts properly under different conditions and that the overall platform functions as a unified whole

5.3.1 UNIT TESTING

Unit testing breaks the system down into its smallest part, such as individual forms, buttons, or data inputs and checks each one in isolation. Any errors found in these basic elements are corrected before they can affect the rest of the platform.

5.3.1.1 Test Cases for the Proposed System

Table 5.1 shows the test case for the unit testing for Register page in STEMVerse.

Table 5. 1 Unit Test Case for Register

Test Case ID: 1		Module Name: Register			
Description: To test register page functionality					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S01	Open the website and click 'Get Started'.	Click on the 'Register' link in the Login page.	The Register page is displayed on the screen.	As expected	Pass
UT-S02	Enter a valid profile photo, username, email address, and password.	Profile photo: cat.jpg, Username: user123, Email: user@example.com , Password: Test@123	User account is created, and a message "Registration successful! Please log in to enter the STEMVerse." Is displayed.	As expected	Pass
UT-S03	Use existing email for registration	Username: newuser, Email: existing@test.com, Password: Test123!	Error message "Username or email already taken."	As expected	Pass
UT-S04	Use existing username for registration	Username: existinguser, Email: new@test.com Password: Test123!	Error message "Username or email already taken."	As expected	Pass
UT-S05	Enter different passwords in password and confirm password fields.	Username: user456, Password: Test123!, Confirm Password: Test456!	Error message "Passwords do not match"	As expected	Pass

UT-S06	Enter invalid email format	Username: user101, Email: invalid-email-format, Password: Test123!	Error message "Invalid email format"	As expected	Pass
UT-S07	Enter weak password	Username: user202, Email: user202@test.com , Password: 123	Error message "Password must be at least 6 characters long and include both letters and numbers."	As expected	Pass
UT-S08	Leave required fields empty	Username: (empty), Email: (empty), Password: (empty)	Error messages for all required fields displayed.	As expected	Pass

Table 5.2 shows the test case for the unit testing for Log In page in STEMVerse.

Table 5. 2 Unit Test Case for Log In

Test Case ID: 2		Module Name: Login			
Description: To test login page functionality					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S09	Enter valid credentials and click login	Username: user202, Password: Test123!	User successfully logged in and redirected to Course page	As expected	Pass
UT-S10	Leave password field empty	Username: user202, Password: (empty)	Error message "Please fill out this field"	As expected	Pass
UT-S11	Enter username not in system	Username: notfound Password: test123!	Error message “User does not exist. Please register first.”	As expected	Pass
UT-S12	Click "Register" link	None	Redirected to Register page	As expected	Pass

Table 5.3 shows the test case for the unit testing for Course page in STEMVerse.

Table 5. 3 Unit Test Case for Course

Test Case ID: 3		Module Name: Course			
Description: Display available courses					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status

UT-S13	Navigate to courses page	None	List of available courses displayed	As expected	Pass
UT-S14	Click on a specific course	Course ID: 1	Enters Learning Modules page for the specific course	As expected	Pass

Table 5.4 shows the test case for the unit testing for learning modules page in STEMVerse.

Table 5. 4 Unit Test Case for Learning Modules

Test Case ID: 4 Module Name: Learning Modules					
Description: Display available modules					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S13	Open a lesson	Lesson ID: L001	List of modules are displayed	As expected	Pass

Table 5.5 shows the test case for the unit testing for lessons page in STEMVerse.

Table 5. 5 Unit Test Case for Lessons

Test Case ID: 5 Module Name: Lessons					
Description: Display available lessons					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S14	View lessons	None	Lesson is displayed with the learning materials in it.	As expected	Pass
UT-S15	Navigate between sections	Section numbers: 1, 2, 3	Each section displays correct content and navigation works	As expected	Pass
UT-S16	Navigate between lessons	Lesson ID: L01, L02, ...	Each lesson displays correct content and navigation works	As expected	Pass

Table 5.6 shows the test case for the unit testing for learning materials page in STEMVerse.

Table 5. 6 Unit Test Case for Learning Materials

Test Case ID: 6 Module Name: Learning Materials					
Description: View interactive sections					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status

UT-S17	Play video	Video URL available	Video plays smoothly with controls	As expected	Pass
UT-S18	Interact with educational game	Game inputs/clicks	Game responds to interactions, provides feedback	As expected	Pass
UT-S19	View notes	Notes available	Notes are displayed.	As expected	Pass
UT-S20	Download experiments/group activities pdf	Click on 'Download Experiment Guide'	PDF is downloaded.	As expected	Pass
UT-S21	Navigate to quick checks	None	Questions displayed with answer options being hidden.	As expected	Pass
UT-S22	Click "Show Answer" button	None	Correct answer revealed with explanation	As expected	Pass

Table 5.7 shows the test case for the unit testing for final quiz page in STEMVerse.

Table 5. 7 Unit Test Case for Final Quiz

Test Case ID: 7		Module Name: Final Quiz			
Description: To test final quiz functionality					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S23	Start final quiz	None	Timer starts and displays correctly	As expected	Pass
UT-S24	Navigate between questions	Question numbers: 1-10	Can scroll down between questions, answers retained	As expected	Pass
UT-S25	Let timer reach zero	Timer = 00:00	Quiz automatically submitted with pop up message informing the user.	As expected	Pass
UT-S26	Reload page	None	Answers are saved and timer still running despite pop up message warning just in case the answers won't be saved.	As expected	Pass

UT-S27	Try to submit empty answers	Click 'Submit' button in the browser	Pop-up message appear: 'Please answer all questions before submitting'.	As expected	Pass
UT-S28	Click submit button	All questions answered	Confirmation dialog appears	As expected	Pass
UT-S29	Submit completed quiz	8/10 correct answers	Score calculated as 80%	As expected	Pass
UT-S30	Complete quiz with passing score (predetermined)	Score $\geq$ passing threshold	Badge award popup displays	As expected	Pass
UT-S31	View results	Quiz score: 85%	Results message with score and performance feedback	As expected	Pass

Table 5.8 shows the test case for the unit testing for review quiz page in STEMVerse.

Table 5. 8 Unit Test Case for Review Quiz

Test Case ID: 8		Module Name: Review Quiz			
Description: To test review quiz functionality					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S32	Navigate to review section for a specific lesson	None	Quiz questions, selected answer vs correct answer, and scores displayed	As expected	Pass

Table 5.9 shows the test case for the unit testing for badges page in STEMVerse.

Table 5. 9 Unit Test Case for Badges

Test Case ID: 9		Module Name: Badges			
Description: To test badges functionality					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S33	Complete required activity	Final quiz completion with 50% of passing score	Badge awarded automatically	As expected	Pass
UT-S34	Navigate to my profile page	None	All earned badges displayed with details	As expected	Pass
UT-S35	Click on a badge	Badge ID: B001	Badge will be zoomed in.	As expected	Pass

Table 5.10 shows the test case for the unit testing for leaderboard page in STEMVerse.

Table 5. 10 Unit Test Case for Leaderboard

Test Case ID: 10		Module Name: Leaderboard			
Description: To test leaderboard functionality					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S36	Navigate to leaderboard	None	Top users displayed with ranks and scores	As expected	Pass
UT-S37	Click “Find Your Rank”	None	User's position highlighted in leaderboard	As expected	Pass
UT-S38	Check ranking order	Various user scores	Users ranked correctly by score	As expected	Pass

Table 5.11 shows the test case for the unit testing for profile page in STEMVerse.

Table 5. 11 Unit Test Case for My Profile

Test Case ID: 11		Module Name: My Profile			
Description: To test My Profile functionality					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S39	Navigate to profile page	None	User details and badges displayed	As expected	Pass
UT-S40	Update profile details	Username: Jaehyun12	Profile updated successfully	As expected	Pass

Table 5.12 shows the test case for the unit testing for change password page in STEMVerse.

Table 5. 12 Unit Test Case for Change Password

Test Case ID: 12		Module Name: Change Password			
Description: To test Change Password functionality					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S41	Enter valid password data	Current: oldPass123, New: newPass456, Confirm: newPass456	Password changed successfully	As expected	Pass
UT-S42	Enter wrong current password	Current: wrongPass, New: newPass456	Error message "Current password incorrect"	As expected	Pass

UT-S43	Enter mismatched new passwords	New: newPass456, Confirm: differentPass	Error message "Passwords do not match"	As expected	Pass
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Table 5.13 shows the test case for the unit testing for admin log in page in STEMVerse.

Table 5. 13 Unit Test Case for Admin Log In

Test Case ID: 13		Module Name: Admin Log In			
Description: To test admin log in functionality					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S44	Enter valid admin credentials	Username: admin202, Password: AdminPass123!	Admin logged in, redirected to dashboard	As expected	Pass
UT-S45	Enter invalid credentials	Username: admin202, Password: wrongpass!	Error message "Wrong password"	As expected	Pass
UT-S46	Access admin features	None	Admin-specific features accessible	As expected	Pass

Table 5.14 shows the test case for the unit testing for admin dashboard page in STEMVerse.

Table 5. 14 Unit Test Case for Admin Dashboard

Test Case ID: 14		Module Name: Admin Dashboard			
Description: To test admin dashboard functionality					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S47	View dashboard	None	All admin menu items displayed in sidebar	As expected	Pass
UT-S48	Click menu items	Menu item: Manage Users	Navigate to corresponding page	As expected	Pass
UT-S49	View dashboard stats	None	Score report stats displayed	As expected	Pass

Table 5.15 shows the test case for the unit testing for quiz management page in STEMVerse.

Table 5. 15 Unit Test Case for Quiz Management

Test Case ID: 15		Module Name: Quiz Management			
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Description: To test quiz management functionality					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S50	Create quiz assigned to lesson with details	Title: Math Quiz, Description: Basic math, Passing: 70%, Time: 30min	Quiz created successfully	As expected	Pass
UT-S51	Modify quiz details	Updated title: Advanced Math Quiz	Quiz details updated	As expected	Pass
UT-S52	Delete quiz	Quiz ID to delete	Quiz deleted, confirmation message shown	As expected	Pass
UT-S53	Add new question	Question text, options A-D, correct answer: B	Question added to quiz	As expected	Pass
UT-S54	Modify question details	Updated question text and options	Question updated successfully	As expected	Pass
UT-S55	Remove question from quiz	Question ID: Q001	Question deleted from quiz	As expected	Pass

Table 5.16 shows the test case for the unit testing for user management page in STEMVerse.

Table 5. 16 Unit Test Case for User Management

Test Case ID: 16		Module Name: User Management			
Description: To test user management functionality					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S56	Navigate to user management	None	List of all student accounts displayed	As expected	Pass
UT-S57	Modify user details by clicking edit button	Updated username, email or password	User information updated	As expected	Pass
UT-S58	Delete user account	User ID to delete	User account deleted, data removed	As expected	Pass

Table 5.17 shows the test case for the unit testing for students progress tracker page in STEMVerse.

Table 5. 17 Unit Test Case for Students Progress Tracker

Test Case ID: 17 Module Name: Students Progress Tracker					
Description: To test the functionality of students progress tracker					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S59	View the ‘all’ lists	None	The screen display the list of students and their progresses.	As expected	Pass
UT-S60	Apply module filter	Course: Mathematics	Progress filtered to show only math activities	As expected	Pass

Table 5.18 shows the test case for the unit testing for score report page in STEMVerse.

Table 5. 18 Unit Test Case for Score Report

Test Case ID: 18 Module Name: Score Report					
Description: To test the functionality of score report					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S61	View score reports	None	Bar chart showing average performance displayed	As expected	Pass

Table 5.19 shows the test case for the unit testing for admin account settings page in STEMVerse.

Table 5. 19 Admin Account Settings

Test Case ID: 19 Module Name: Admin Account Settings					
Description: To test the functionality of admin account settings					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S62	Update password	Current: oldAdminPass, New: newAdminPass123	Admin password changed successfully	As expected	Pass
UT-S63	Modify profile details	Username: jaehyun12, Email: newadmin@test.com	Admin profile updated	As expected	Pass

Table 5.20 shows the test case for the unit testing for FAQs page in STEMVerse.

Table 5. 20 Unit Test Case for FAQs Page

Test Case ID: 20		Module Name: FAQs			
Description: To test the functionality of FAQs.					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
UT-S64	Navigate to FAQs page	None	FAQ questions and answers displayed	As expected	Pass
UT-S65	View support contact details	Click ‘Email Support’ button	Support email displayed clearly by redirecting users to email	As expected	Pass
UT-S66	Search for specific topic	Search term: “password”	Relevant FAQs filtered and displayed	As expected	Pass

5.3.2 INTEGRATION TESTING

Integration testing looks at how the small parts connect and work together. For example, after a user submits information, this test ensures that the data flows smoothly into the database and can be retrieved correctly by other users or pages. During this stage, input-output behaviour is carefully monitored to confirm that the actual outcomes match what was intended.

Table 5.21 shows the test case for the student learning flow integration.

Table 5. 21 Integration Test Cases for student learning flow

Test Case ID: 21		Module Name: Student learning flow integration			
Description: Ensure student learning flow runs smoothly					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
IT-S01	Login and navigate to modules	Login credentials and module selection	Successful login leads to module access	As expected	Pass
IT-S02	Navigate module to lesson to complete quiz	Module ID, Lesson ID, Quiz answers	Progress tracked through entire path	As expected	Pass
IT-S03	Complete quiz, earn badge, check leaderboard	Passing quiz score	Badge awarded, leaderboard updated	As expected	Pass
IT-S04	View profile with badges	None	Profile shows accurate badges	As expected	Pass

Table 5.22 shows the test case for the admin management flow integration.

Table 5. 22 Integration Test Cases for admin management flow

Test Case ID: 22		Module Name: Admin management flow			
Description: Ensure admin management flow runs smoothly					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
IT-A01	Login and manage users	Admin credentials and user actions	Complete admin user management flow	As expected	Pass
IT-A02	Create quiz, assign to lesson, student takes quiz	Quiz details and student attempt	End-to-end quiz lifecycle	As expected	Pass
IT-A03	Track progress and generate score reports	Student activities	Accurate reporting of student performance	As expected	Pass

Table 5.23 shows the test case for the system-wide integration.

Table 5. 23 Integration test case for system-wide

Test Case ID: 23		Module Name: System-wide			
Description: To ensure system-wide integration works well					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
IT-G01	Test access controls	Different user roles	Appropriate access levels enforced	As expected	Pass
IT-G02	Perform actions across modules	Various CRUD operations	Data remains consistent across modules	As expected	Pass
IT-G03	Test session timeout and management	Extended inactivity	Sessions handled appropriately	As expected	Pass
IT-G04	Navigate between all modules	Navigation actions	Smooth transitions	As expected	Pass

Table 5.24 shows the test case for the performance integration.

Table 5. 24 Integration test case for performance

Test Case ID: 24		Module Name: Performance			
Description: To ensure the performance of the system runs smoothly					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status

IT-P01	Perform CRUD operations across modules	Various data operations	All data operations complete successfully	As expected	Pass
IT-P02	Upload/download videos, images	Various file types	Files handled correctly across modules	As expected	Pass

Table 5.25 shows the test case for the security integration.

Table 5. 25 Integration test case for security

Test Case ID: 25		Module Name: Security			
Description: To ensure that the website is secure.					
Test ID	Test Case	Input Data	Expected Result	Actual Result	Status
IT-SEC01	Test password requirements	Various password formats	Consistent password policies enforced	As expected	Pass
IT-SEC02	Attempt unauthorized access	Cross-role access attempts	Access properly restricted by role	As expected	Pass
IT-SEC03	Test input validation across modules	Various input types including malicious	All inputs properly validated and sanitized	As expected	Pass

5.4 NON-FUNCTIONAL TESTING

Non-functional testing examines how a system operates rather than what it does. Unlike functional testing, which targets specific features and actions, non-functional testing assesses the overall performance and user experience of an application. It ensures that the system can sustain its operations under various conditions and align with user expectations regarding responsiveness and ease of use.

5.4.1 USABILITY TESTING

User Acceptance Testing (UAT) was conducted to evaluate the effectiveness, ease of use, and overall user experience of the proposed educational platform in a real classroom setting. For this purpose, a sample size of 16 students was engaged in the UAT. This number was determined to be sufficient and appropriate for several key reasons, aligning with best practices in qualitative user research and usability evaluation. Unlike quantitative studies that aim for statistical generalizability to a large population, qualitative testing seeks to uncover insights

and problems. In this context, it is widely recognized that a relatively small number of participants can yield a significant amount of actionable feedback (Nielsen, 2000).

While Jakob Nielsen's influential "5-user rule" suggests that testing with approximately five users can reveal around 85% of usability problems through an iterative testing process (Nielsen, 2000), this project approach involved a single, more comprehensive UAT phase. For such qualitative evaluations as in this project, a sample size in the range of 12 to 15 participants is frequently recommended for studies with relatively homogenous populations and narrowly defined objectives (Wynter, n.d.). The sample of 16 students for this project falls within this effective range, providing a robust dataset for identifying a high percentage of issues and ensuring that diverse feedback from the target user group was captured. Therefore, the sample size of 16 students was deemed sufficient to effectively evaluate the system's effectiveness by uncovering key user experience challenges and validating the system's ability to meet its educational objectives.

In addition to the student interface, the administrator interface of the STEM educational system, intended for use by teachers, also underwent UAT. Given the specialized nature of administrative tasks and the generally smaller, more expert user base for such functionalities, a sample of 5 teachers was engaged for this testing phase. This sample size is well-supported by principles of usability evaluation, particularly the "5-user rule" as well. For expert users and specific functionalities like those found in an administrator interface, testing with a small, focused group is highly efficient in identifying significant issues. Given that the teachers represent a more homogenous population with specific roles and objectives for the administrative backend, testing with 5 participants was highly effective in identifying critical usability challenges and ensuring the system met their operational needs.

The testing was carried out in a controlled classroom environment to simulate actual usage conditions. Participants were given access to the STEMVerse platform and were guided through various tasks, including navigating the website, accessing learning modules, completing interactive quizzes, and engaging with the gamified elements such as badges and leaderboards. On the other hand, the teachers accessed the platform's features for managing learning materials and monitoring student progress.

During the session, observations were made to identify any usability challenges, such as navigation issues, confusion in task execution, or difficulties in understanding content layout. After the hands-on session, feedback was collected through a structured questionnaire focusing

on user satisfaction, interface design, content clarity, and the effectiveness of gamification elements. The feedback was then analysed to identify patterns, highlight areas of improvement, and ensure that the platform meets the users' expectations. This process allowed for a comprehensive assessment of the system's usability and provided valuable insights to refine the platform for better user experience and engagement.

5.4.1.1 ANALYSIS ON USER ACCEPTANCE TESTING

The analysis of the user acceptance survey responses provides insights into the platform's usability, user experience, and overall effectiveness in delivering gamified STEM education.

5.4.1.1.1 EASE OF USE AND NAVIGATION

Most students (93.8%) reported that the website was easy to use, while only 6.3% experienced slight difficulty, suggesting minor areas for improvement but overall confirming that the system successfully meets its goal of being user-friendly and accessible to its target audience. They can register a new account and login using the existing account easily. Besides, they also found it easy to navigate between different features such as courses and leaderboard through navigation bar.

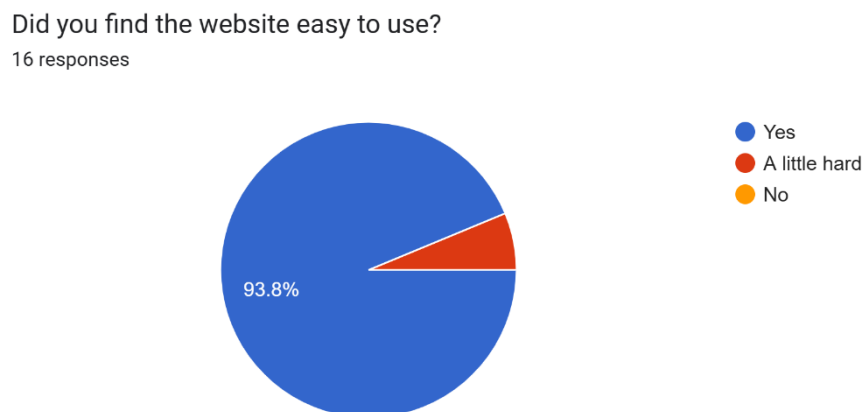


Figure 5. 1 Ease of Use

In terms of navigation, 75% of the respondents agreed that the website was not confusing, indicating a generally intuitive user interface. Most of the respondents know how to navigate between different pages of lessons and subtopics using the provided buttons in each page with ease. These results suggest that the platform's structure effectively support young learners in exploring and engaging with the educational content.

Could you find your lessons and subtopics without getting confused?
16 responses

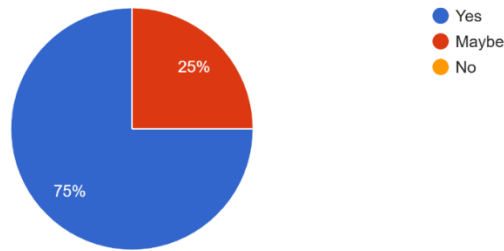


Figure 5. 2 Ease of Navigation

5.4.1.1.2 DESIGN AND VISUAL APPEAL

As part of the user acceptance testing, participants were asked whether the text on the website was big and clear enough to read as shown in Figure 5.3. The results showed that 93.8% of users responded positively. This high percentage suggests that the website's font size effectively support readability for young learners, helping them navigate and engage with the content more comfortably and confidently.

Was the text big and clear enough for you to read?
16 responses

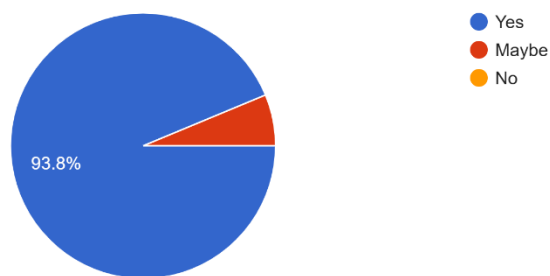


Figure 5. 3 Website's Font

A strong positive response was recorded regarding the website's visual design, with 87.5% of students expressing that they liked the overall look and feel of the site. This suggests that the visual elements of the platform are effective in capturing interest and enhancing engagement, which is especially important for sustaining the attention of young learners.

Did you like the design of the website?
16 responses

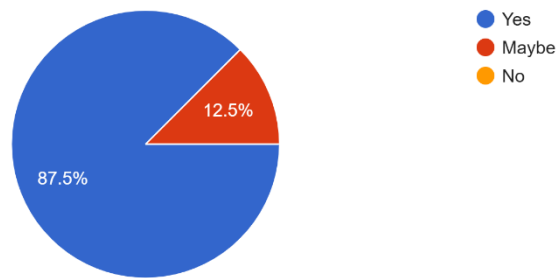


Figure 5. 4 Website's Design

5.4.1.1.3 GAMIFICATION AND ENGAGEMENT

The gamified features received overwhelmingly positive feedback. 100% students agreed that earning badges motivated them to continue exploring the lessons and quizzes. This suggests that the reward system successfully encourages ongoing participation and reinforces learning progress.

Did earning badges make you want to keep learning?
16 responses

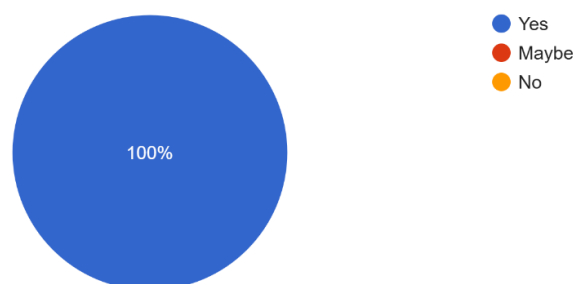


Figure 5. 5 Badge Motivation

In addition, 81.3% of respondents positively upon seeing their names displayed on the leaderboard, indicating that this feature adds an element of excitement and personal recognition. Only a small number of students felt otherwise, indicating that the competitive element is generally well-received.

Did you like seeing your name on the leaderboard?
16 responses

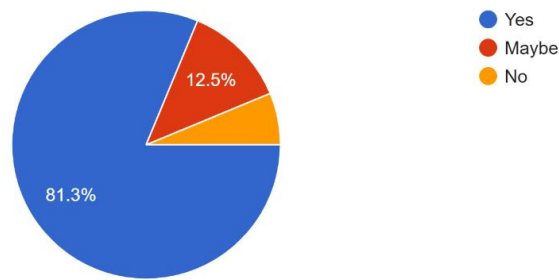


Figure 5. 6 Leaderboard

Furthermore, 93.8% of students found the final quiz enjoyable to complete, particularly when it was presented as a competitive challenge. This supports the idea that combining assessment with gamified design can make learning activities more appealing and less intimidating.

Was the final quiz fun or exciting to complete while competing with friends?
16 responses

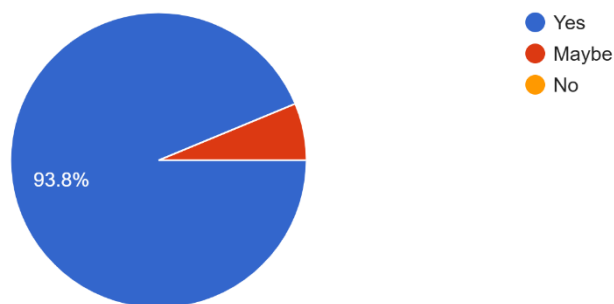


Figure 5. 7 Competitiveness

5.4.1.1.4 LEARNING IMPACT

The user acceptance testing findings also reflected the platform's educational effectiveness. A total of 68.8% of students strongly agreed that the website made complex topics easier to understand. This suggests that the platform's structured design, visual aids, and interactive content effectively support comprehension among young learners.

I find it to be easier to understand complex topics using the website.

16 responses

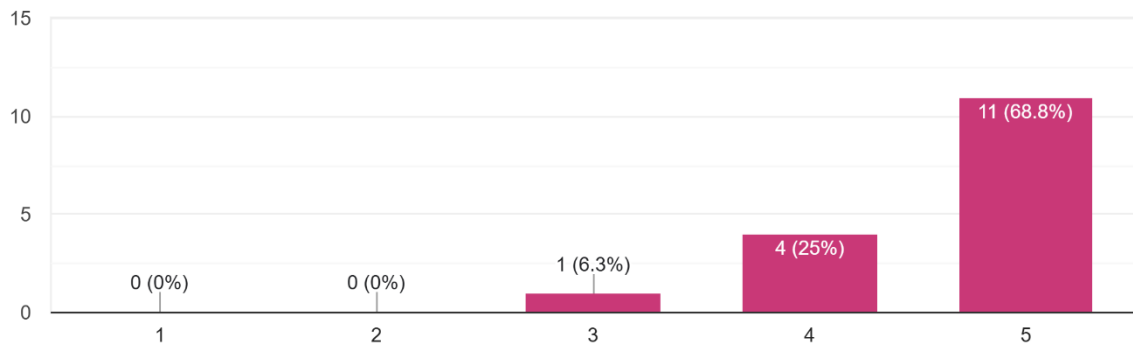


Figure 5. 8 Understanding Complex Questions

Similarly, 68.8% of students strongly indicated that using the website sparked greater interest in learning STEM subjects in the future. These results suggest that the platform not only engages users but also supports comprehension and long-term interest in STEM education.

The website makes you become more interested in learning STEM in the future.

16 responses

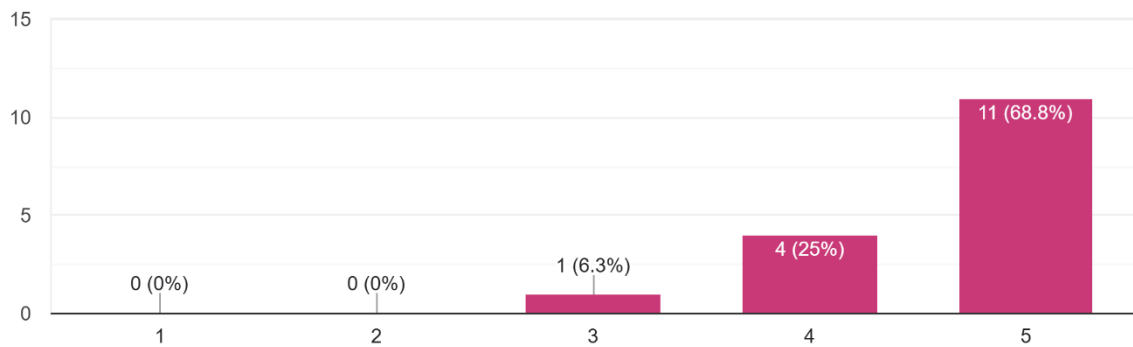


Figure 5. 9 Interest in learning STEM

5.4.1.1.5 ADMINISTRATOR'S FEEDBACK

In addition to gathering feedback from students, user acceptance testing was also conducted with administrators, mainly 5 primary school teachers to evaluate the platform's backend features and management tools. This section summarizes administrators' insights on the usability and effectiveness of the admin panel, including quiz management, user tracking, and reporting functions. Their feedback helps assess how well the system supports educators in managing content and monitoring student progress efficiently.

5.4.1.1.6 ADMIN FEATURES FUNCTIONALITY

A total of 60% of administrators agreed that it was easy to create, edit, or delete quiz questions, while 40% selected "maybe". This result suggests that although the core functionality is present and generally usable, some aspects of the quiz management interface may still be less intuitive or could benefit from clearer workflows or additional guidance. Addressing these areas could improve efficiency for admins when managing learning content.

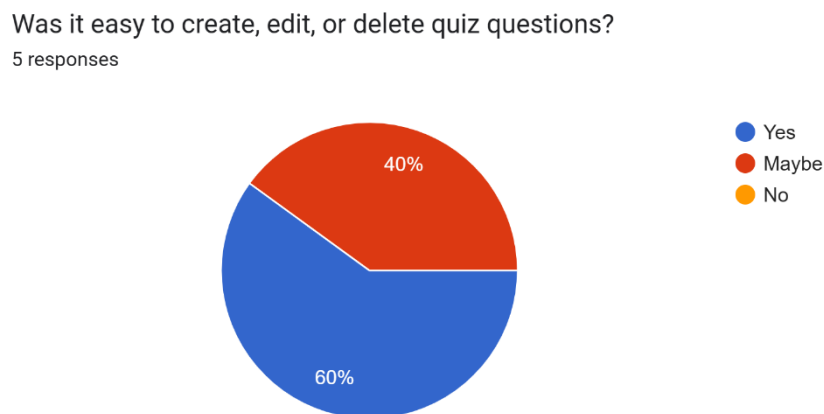


Figure 5. 10 Ease of Creating, Editing, or Deleting Quiz Questions

For the task of assigning quizzes, 80% of respondents confirmed they could do so without difficulty, whereas 20% chose "maybe". This indicates that while most administrators found the feature usable, there may be occasional uncertainty which potentially due to interface labelling, buttons placement, or navigation. Further refinement could help make this process completely straightforward.

Were you able to assign quizzes to the correct lesson or subtopic without difficulty?
5 responses

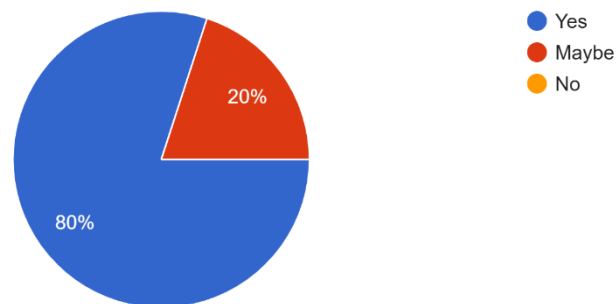


Figure 5. 11 Ease of Assigning Quizzes to the Correct Lesson or Subtopic

All administrators reported that they could easily view and manage student accounts, including editing and deleting user information. This strong positive result highlights the effectiveness and clarity of the user management interface, demonstrating that it meets its intended purpose well.

Could you view and manage student accounts easily (e.g., edit, delete)?
5 responses

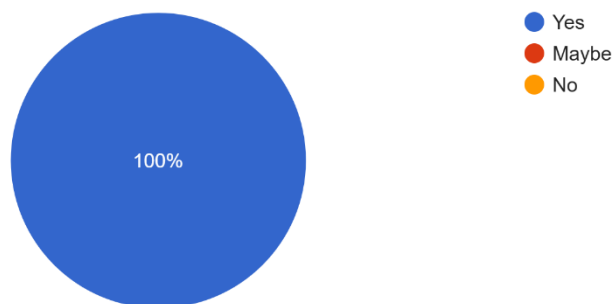


Figure 5. 12 Ease of Viewing and Managing Student Accounts

Every respondent (100%) confirmed that user details such as names, scores, and badges were clearly presented within both the user management and student progress tracking features. This reflects the success of the platform in presenting essential data in a clear and organized manner, making it easier for admins to oversee student activity.

Was the user information (e.g., names, scores, badges) clearly displayed in user management as well as student progress tracking features?

5 responses

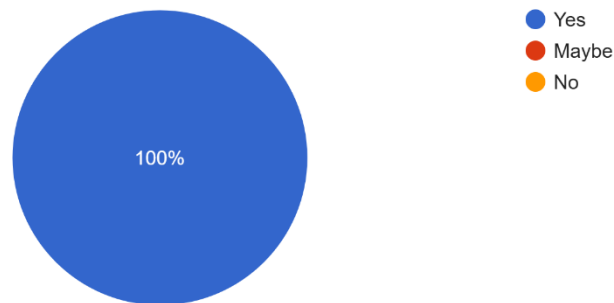


Figure 5. 13 Clear Display of User Information

Similarly, 100% of respondents agreed that they could easily track the progress of individual students. This shows that the platform's progress tracking tools are intuitive and provide clear, accessible data for administrators to monitor student learning outcomes.

Could you easily track the progress of individual students?

5 responses

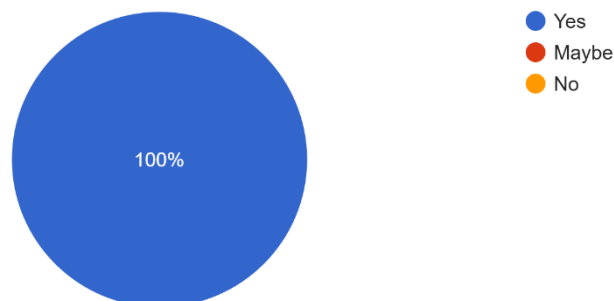


Figure 5. 14 Tracking Individual Student Progress

All administrators agreed that the average score report was displayed clearly in graphical form. This suggests that the reporting features are visually effective, allowing administrators to quickly interpret course performance trends and identify areas that might need further attention.

Was the average score report displayed clearly in graph form?
5 responses

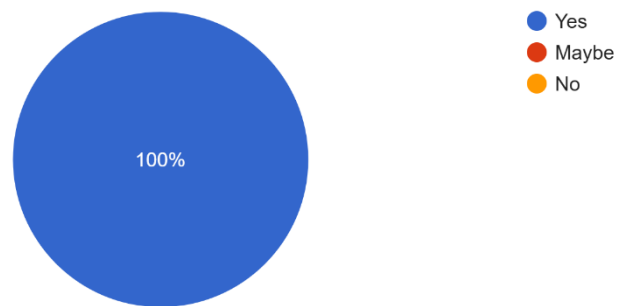


Figure 5. 15 Clarity of Average Score Report in Graph Form

5.4.1.1.7 CONTENT APPROPRIATENESS AND EDUCATIONAL ALIGNMENT

Most administrators agreed that the educational content provided by the platform is well aligned with classroom learning objectives. While the majority expressed clear satisfaction, the findings suggested there is still room for better alignment to fully support curriculum needs.

The educational content aligned with classroom learning goals.
5 responses

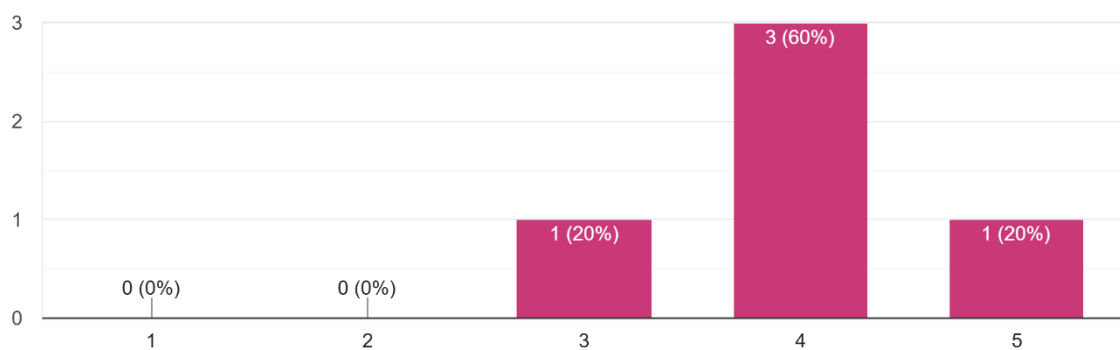


Figure 5. 16 Content Alignment with Classroom Learning Goals

The group activities and experiment sections were generally well received, with most administrators finding them effective in encouraging collaborative learning among students. However, some feedback indicated minor areas where these features could be made even more engaging or clearer to use.

The website encouraged group based learning through the implementation of experiments/group activities section.

5 responses

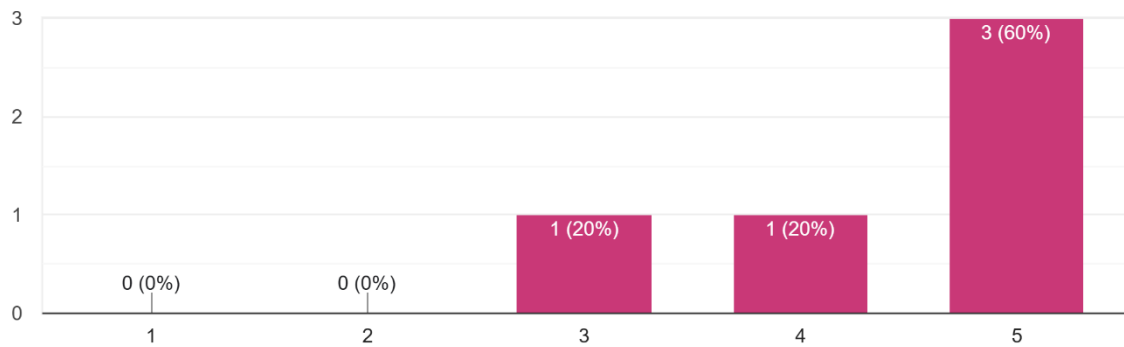


Figure 5. 17 Encouragement of Group-based Learning

5.4.1.1.8 LEARNER ENGAGEMENT AND INTERACTIVITY

Administrators unanimously recognized that the platform's interactive features such as videos, games, badges, and the leaderboard are highly effective in keeping students engaged and making learning more enjoyable.

The interactive features (videos, games, badges, leaderboard) engage students effectively

5 responses

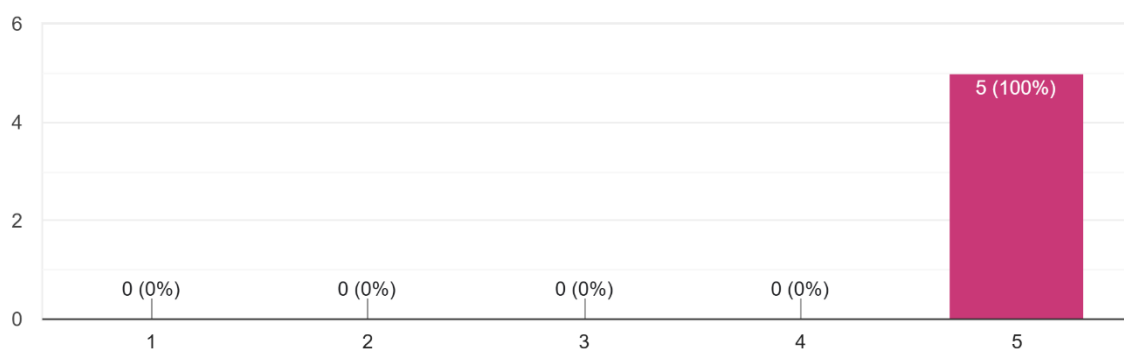


Figure 5. 18 Effectiveness of Interactive Features in Engaging Students

Feedback was consistently positive regarding the platform’s gamified elements, with administrators agreeing that these features successfully motivate a wider range of students to participate more actively in lessons.

The gamified elements encourage participation from more students than usual
5 responses

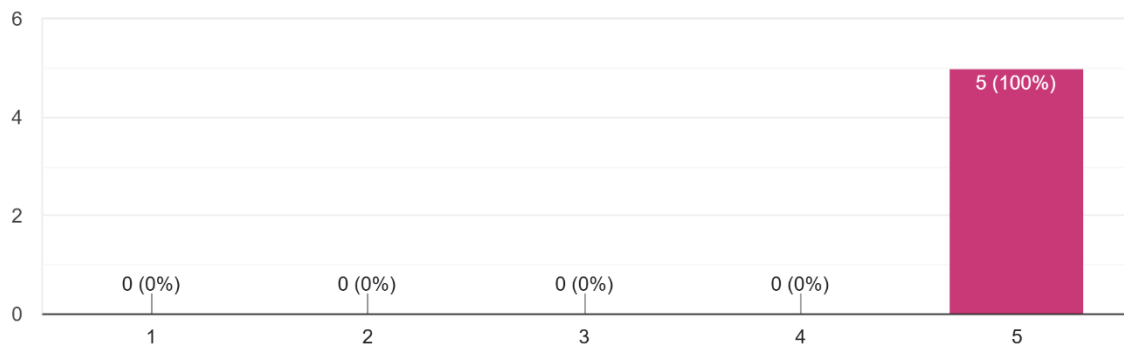


Figure 5. 19 Gamified Elements and Broader Participation

5.4.1.1.9 SYSTEM USABILITY AND PERFORMANCE

Most administrators observed that the platform performed reliably, with minimal lag or crashes during use. This indicates that the system’s technical stability generally meets expectations for classroom deployment.

Did the platform perform reliably (minimal lag or crashes)?
5 responses

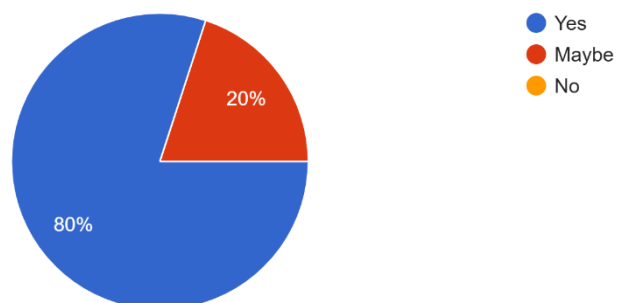


Figure 5. 20 Platform Reliability

Feedback showed that while some students were able to navigate and use the platform independently, others still required occasional guidance. This suggests the platform is intuitive but may benefit from further simplification or additional user prompts to better support younger learners working on their own.

Were students able to use the platform independently with minimal guidance?

5 responses

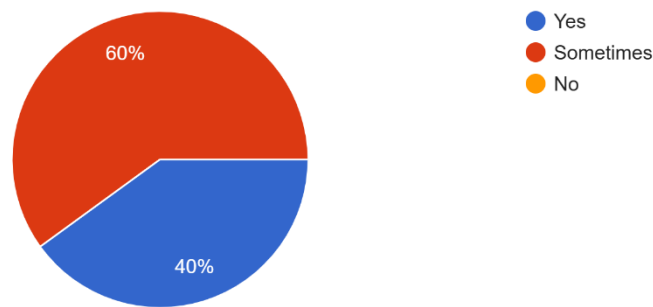


Figure 5. 21 Student Independence

The majority of administrators reported that students did not encounter significant issues when using quizzes, earning badges, or accessing lessons. A few noted minor or occasional difficulties, indicating these features are mostly robust but could be refined to ensure an even smoother experience.

Did students face any issues using quizzes, earning badges, or accessing lessons?

5 responses

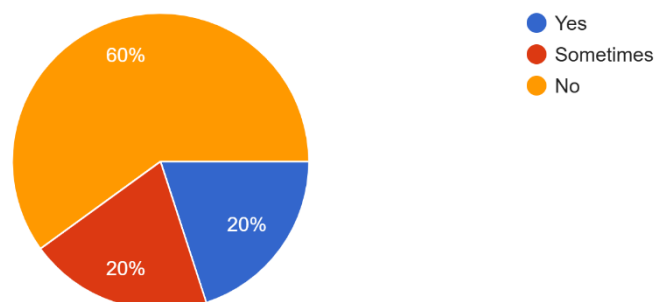


Figure 5. 22 Smooth Use of Quizzes and Gamified Features

5.4.1.1.10 PERCEIVED IMPACT ON LEARNING AND FUTURE USE

All administrators agreed that students appeared more interested in STEM subjects after engaging with the platform. This highlights the system's effectiveness in making STEM topics more appealing and relevant to young learners.

Based on your observation, did students show increased interest in STEM after using the platform?
5 responses

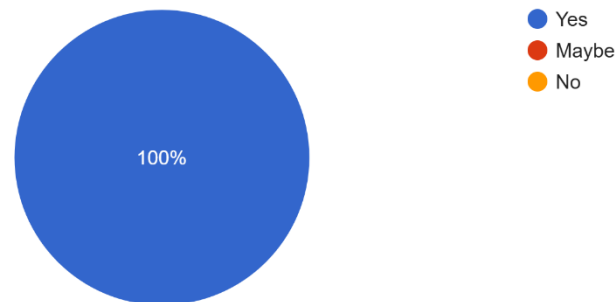


Figure 5. 23 Observed Increase in STEM Interest

All respondents indicated they would recommend using the platform as a supplementary tool in regular STEM lessons. This strong endorsement underscores its perceived educational value and practical fit within existing teaching practices.

Would you recommend integrating this platform into your regular STEM lessons as supplementary?
5 responses

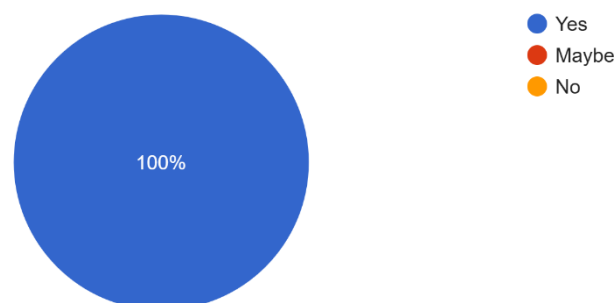


Figure 5. 24 Integration into Regular Lessons

5.4.1.1.10 FEEDBACK FOR IMPROVEMENT

In addition to the overall positive feedback, administrators also shared several constructive suggestions to further enhance the platform's functionality and educational value. These recommendations focused on improving learner engagement, increasing accessibility, and providing greater flexibility for teachers.

Administrators suggested adding a feature that would allow students to track their own progress across different learning modules. This enhancement could help learners become more aware of their achievements and areas that need improvement, further encouraging self-directed learning.

It was also recommended to expand the platform's language support to include Bahasa Malaysia, making it more accessible to a wider range of students. Additionally, administrators proposed providing more detailed average score reports. For instance, displaying separate graphs for different quizzes to give clearer insights into student performance by lessons.

Another key suggestion was to enable teachers to upload or add their own learning materials directly into the system. This would allow educators to tailor content more closely to their lesson plans and the specific needs of their students.

5.4.1.2 RESULT AND DISCUSSION

To conclude, the user acceptance testing results indicate that the STEM learning platform is both effective and well-received by its intended audience of young learners and administrators. Most students found the website easy to use, visually clear, and engaging, with interactive features and gamified elements strongly motivating continued learning. These findings align with the platform's objectives of enhancing STEM engagement and making complex topics easier to understand.

Administrators similarly reported that the platform performed reliably, was generally easy to manage, and provided useful features for tracking student progress and managing quizzes. Observations further revealed an increase in students' interest in STEM subjects, and all administrators expressed willingness to integrate the platform into regular lessons, highlighting its practical value in classroom settings.

The positive reception, combined with constructive suggestions for improvement such as adding progress tracking for students, broader language support, and customizable content

options which demonstrates the platform's strong foundation and its potential for further enhancement. Overall, the results support the platform's role in making STEM learning more accessible, interactive, and appealing for young learners, aligning closely with its educational goals.

5.5 SUMMARY

Testing is a vital phase in the development of the educational website, ensuring the system is both functional and reliable before deployment. This phase was carried out through two key testing type: functional and non-functional testing. The testing and evaluation process was essential in assessing the website's technical stability, ease of use, and the overall user experience. This phase provided critical feedback on the system's ability to engage its target users, which are students and teachers in a meaningful and educational way. Based on the results, necessary improvements were identified and applied to enhance the platform's functionality, usability, and effectiveness in achieving its educational goals.

CHAPTER 6: CONCLUSION AND FUTURE WORKS

6.1 INTRODUCTION

This final chapter marks the conclusion of STEMVerse's development process. It provides a reflection on the outcomes of the project and evaluates how well the platform has met its initial goals and objectives. By examining the effectiveness of the site in engaging learners and delivering educational content, we can assess the overall success of the system.

In addition, this chapter discusses the potential enhancements and future directions that can further enrich the user experience. Drawing insights from the testing and evaluation phase, several areas for improvement have been identified. These include both functional upgrades and additional learning features that could better support the platform's mission. Lastly, any limitations encountered throughout the development process will be outlined, serving as guidance for future improvements and expansion of the STEMVerse platform.

6.2 OBJECTIVES AND ACHIEVEMENTS

To measure the success of the objectives obtained, the achievements will be compared to all the objectives in Chapter 1.

Table 6. 1 Objectives vs Achievements

Objective	Achievement
To investigate the requirements for developing the gamified STEM web-based platform.	The project began with a thorough investigation into the needs of the target users, primary school students and teachers. Requirements were gathered through online survey and reference to existing educational platforms as well as frameworks. The findings highlighted the importance of ease of use, curriculum alignment, gamification elements (badges, interactive quizzes, leaderboards), and content management capabilities for teachers.

To design and develop interactive, gamified web-based platform with educational content, ensuring relevance to classroom learning.	The STEMVerse platform was successfully developed using HTML, CSS, JavaScript, and PHP with XAMPP as the backend. It includes gamified elements (achievement badges, points, leaderboard), interactive learning content (quizzes, videos), a structured block-learning approach and admin functions for quiz creation and monitoring.
To evaluate the effectiveness of the developed system through user acceptance testing and analysis of feedback.	The user acceptance testing gathered detailed feedback from both students and administrators, which confirmed the system's effectiveness in engaging young learners, aligning content with classroom goals, and providing functional and user-friendly admin features. The overwhelmingly positive responses such as high levels of enjoyment, increased interest in STEM, successful use of interactive and gamified elements, and administrators' willingness to integrate the platform into lessons clearly demonstrate that the developed system meets its intended educational purpose and user needs.

6.3 PROJECT LIMITATIONS

While the STEMVerse platform has successfully achieved its core objectives, there were certain limitations and constraints encountered during its development.

Recognizing these limitations is essential to guide future improvements and to acknowledge the aspects of the platform that require further refinement before it can be deployed in real-world environment. Addressing these constraints in future development cycles will enhance

the overall usability, performance, and impact of the platform. The limitations identified in STEMVerse platform are shown below:

1. The platform does not include course progression tracking for students.
2. The platform only support English language.
3. The platform does not provide filters (by lessons) for average score reporting.
4. The real-time features like leaderboard may cause performance issues as the number of users grows.
5. The platform does not allow teachers to add their own learning materials in the system.

6.4 FUTURE WORKS

As the development of the STEMVerse platform continues, several areas have been identified for future enhancement to further enrich the overall learning experience. These improvements aim to provide young learners with a more engaging, personalized, and immersive educational journey. Based on the findings from the testing and evaluation phases, the following future works have been carefully considered to ensure the platform remains relevant, impactful, and enjoyable for its intended users.

Table 6. 2 Enhancements

Enhancement	Importance/Description
Scalability and Customization	Essential for long-term growth. Allows the platform to support more users, courses, and content while tailoring the experience to different schools or grade levels.
Language Support	Increases accessibility and inclusivity for learners from diverse linguistic backgrounds, making the platform usable for more schools and regions.
Expand Lesson Topics by Grade	Since STEMVerse only focuses on Grade 5 now, this enhancement suggestion supports differentiated instruction. Adding content for various grade levels

	ensures the platform can grow with the learner and support a wider audience.
Lesson Progress Tracking	Helps learners stay organized and motivated by clearly showing what they've completed and what's left. Also useful for teachers and parents to monitor progress.
Personalized Learning Paths	Maximizes individual learning potential by adapting content based on performance, helping learners focus on areas they need to improve.
Enhanced Score Report	Filter score reports by date, lesson, or grade. Include export to Excel/PDF options for documentation.
Characters Implementation (Cartoon)	Cartoon characters can dramatically increase engagement, emotional connection, and motivation for young learners. They can act as guides, mascots, or narrators, making lessons more relatable and enjoyable. This also helps in storytelling and builds continuity across lessons.
Social Features	Allow users to comment on lessons, reply in discussion threads, or form study groups to foster a learning community.

6.5 SUMMARY

STEMVerse gamified learning platform demonstrates strong potential in meeting its core objectives of engaging young learners and raising awareness about the importance of integrating gamification into education. Through interactive learning activities, the platform has successfully captured interest while delivering valuable knowledge through the block learning technique. However, to enhance its impact and ensure long-term effectiveness, several areas can be improved in future development. These include expanding educational content, language support, scalability and customization, lesson progress tracking, personalized learning paths, enhanced score report and characters implementation. By focusing on these future enhancements, the platform can continue to grow into a more dynamic, inclusive, and impactful learning tool to make STEM learning more exciting and accessible for young minds.

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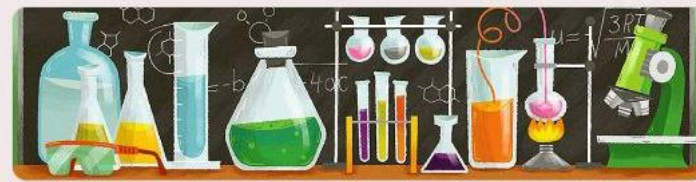
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APPENDICES

APPENDIX A: QUESTIONNAIRES FOR STUDENTS AND TEACHERS



Final Year Project Survey: Web-based Platform for Gamified STEM Learning

Welcome and Thank You for Participating!

Greetings, I am Nelly Shafina, a final-year Software Engineering student from Universiti Malaysia Sarawak (UNIMAS). This survey is part of my final year project, focused on developing a gamified STEM learning platform.

The goal is to create an engaging and interactive way to help primary school students learn Science, Technology, Engineering, and Mathematics (STEM) concepts more effectively.

Your feedback will provide valuable insights into:

- How gamification can improve learning experiences.
- Features that would make the platform enjoyable and educational.



The survey consists of 4 sections:

1. **Section A: Demographic** - Basic details about your background.
2. **Section B: Current Challenges & Experience** - Your experiences and current challenges in STEM education among students.
3. **Section C: Perspectives on Value and Key Features** - Your general perspectives and preferred features on STEM learning platform.
4. **Section D: Gamification Features and UI/UX** - Opinions on gamified learning tools and UI/UX preferences in STEM learning.



Time Required: 2–5 minutes



Confidentiality: All responses are anonymous and will be used solely for academic purposes.

For any inquiries, please contact me at: **017-4261585**

Thank you for your time and support. Your input is invaluable to the success of this project! 😊

* Indicates required question

Section A: Demographic

What is your age group? *

- ☐ Under 18
- ☐ 18-24
- ☐ 25-34
- ☐ 35-44
- ☐ 45+

What is your current occupation? *

- ☐ Educator
- ☐ Student
- ☐ Other: _____

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For Educators

What grade level(s) do you teach? *

- ☐ Kindergarten
- ☐ Primary school
- ☐ Secondary school
- ☐ Other: _____

Do you teach STEM subjects (Science, Technology, Engineering, Mathematics)? *

- ☐ Yes
- ☐ No

How many years of teaching experience do you have? *

- ☐ Less than 1 year
- ☐ 1–3 years
- ☐ 4–10 years



Does the school you're teaching at encourages the use of online resources to teach students? *

☐ Yes

☐ No

Would you like to use a gamified learning platform to teach your students? *

☐ Yes, I will actively use it during class time

☐ Yes, but as their extra activities (e.g., homework)

☐ Maybe

☐ No

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For Students

What level of education are you currently ^{*} pursuing?

- ☐ Primary school
- ☐ High school
- ☐ Undergraduate degree
- ☐ Postgraduate degree

What is your field of study? ^{*}

- ☐ STEM (Science, Technology, Engineering, Mathematics) related
- ☐ Education (e.g., teacher training, educational studies)
- ☐ Other: _____

Have you studied or worked with primary ^{*} school students as part of your coursework or experience?

- ☐ Yes
- ☐ No

Section B: Current Challenges & Experience

Have you used any educational platforms (e.g., Khan Academy, Duolingo, etc.) ? ★

☐ Yes

☐ No

If yes, please name the platform(s) you have used

Your answer _____

What resources do you currently use for STEM learning? ★

☐ Books

☐ Online Platforms

☐ Other:



What challenges do you think primary school students face in learning STEM subjects? (Check all that apply) *

- ☐ Lack of interest in STEM
- ☐ Difficulty understanding complex concepts
- ☐ Limited resources or materials
- ☐ Ineffective teaching methods
- ☐ Other:

How often do you feel that the STEM curriculum is too fast-paced for students to keep up? (Scale: Never (0), Rarely (1), Sometimes (2), Often (3), Always (4)) *

Never

0 ☐

1 ☐



4 ☐

Always

How often do you feel that STEM subjects fail to address real-world problems or practical applications? (Scale: Never (0), Rarely (1), Sometimes (2), Often (3), Always (4))

Never

0 ☐

1 ☐

2 ☐

3 ☐

4 ☐

Always

Section C: Perspectives on Value and Key Features

What do you find enjoyable about learning STEM subjects?

- ☐ Experiments
 - ☐ Watching Videos
 - ☐ Interactive Quizzes or Games
 - ☐ Solving Problems
 - ☐ Other:
-

What features do you think are important for a STEM educational platform for primary school students?

- ☐ Interactive lessons with videos
- ☐ Hands-on experiments or activities
- ☐ Real-world problem-solving tasks
- ☐ Gamification elements (e.g., points, badges, leaderboards)
- ☐ Collaboration tools (e.g., peer discussion forums)



Do you prefer a STEM platform to provide theoretical lessons or practical exercises (or a mix of both)?

- ☐ Primarily theoretical lessons
- ☐ Primarily practical exercises
- ☐ A mix of both

Section D: Gamification Features and UI/UX

What gamification elements do you think are effective for engaging students?
(Check all that apply)

- ☐ Points and rewards
- ☐ Badges for achievements
- ☐ Leaderboards and competition
- ☐ Levels and progression
- ☐ Other: _____

How frequently should rewards or achievements be given to maintain students' motivation?

- ☐ After every task
- ☐ After completing a module
- ☐ Periodically (e.g., weekly or monthly milestones)
- ☐ Other: _____



How important is it for the platform to have a user-friendly interface and design?

Scale: Not important (1) - Very Important (5)

Not important

1 ☐

2 ☐

3 ☐

4 ☐

5 ☐

Very important

What design aspects do you think are most important for a STEM platform for children?

☐ Bright and colorful visuals

☐ Intuitive navigation

☐ Accessibility features (e.g., large fonts)

☐ Other:



What additional features or considerations would you recommend for a gamified STEM educational platform?

Your answer _____

APPENDIX B: USER ACCEPTANCE TESTING FORM FOR STUDENTS



Final Year Project UAT: STEMVerse Web-based Platform for Gamified STEM Learning

Greetings, I am Nelly Shafina, a final-year Software Engineering student from Universiti Malaysia Sarawak (UNIMAS).

Thank you for participating in the User Acceptance Testing (UAT) for **STEMVerse**, an interactive and gamified educational website designed to make STEM subjects more engaging and fun for young learners.

The goal of this testing is to gather your feedback on the platform's design, usability, and effectiveness. Your responses will help to improve the website and ensure it meets the learning needs of students while supporting teachers in the classroom.

This form includes a series of questions based on your experience with the platform. There are different sections for students and teachers. Please answer honestly because your input is very valuable!

 **Note:** There are no right or wrong answers. We simply want to know how well the platform works for you and what could be improved.

 **Time Required:** 2–5 minutes

 **Confidentiality:** All responses are anonymous and will be used solely for academic purposes.

For any inquiries, please contact me at: 017-4261585

Let's get started!

* Indicates required question

Are you a student or teacher? *

☐ Student

☐ Teacher

Final Year Project UAT: STEMVerse Web-based Platform for Gamified STEM Learning

* Indicates required question

I. Platform Use and Navigation

Did you find the website easy to use? *

- ☐ Yes
- ☐ A little hard
- ☐ No

Could you find your lessons and subtopics without getting confused? *

- ☐ Yes
- ☐ Maybe
- ☐ No

Was it fun to go through the different topics and activities? *

- ☐ Yes
- ☐ Maybe
- ☐ No

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II. Design and Appearance

Was the text big and clear enough for you to read? *

- ☐ Yes
- ☐ Maybe
- ☐ No

Did you like the design of the website? *

- ☐ Yes
- ☐ Maybe
- ☐ No

Did the buttons help you know where to go? *

- ☐ Yes
- ☐ Maybe
- ☐ No

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Clear form

III. Gamification Features

Did you enjoy playing the games inside the lessons? *

- ☐ Yes
- ☐ Maybe
- ☐ No

Did earning badges make you want to keep learning? *

- ☐ Yes
- ☐ Maybe
- ☐ No

Did you like seeing your name on the leaderboard? *

- ☐ Yes
- ☐ Maybe
- ☐ No

Was the final quiz fun or exciting to complete while competing with friends? *

- ☐ Yes
- ☐ Maybe
- ☐ No

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IV. Learning and Motivation

Please answer each question by choosing a number from 1 to 5, where 1 means "Strongly Disagree 😞" and 5 means "Strongly Agree 😄".

I learn something new about science, math, or other STEM subjects. *

	1	2	3	4	5	
Strongly Disagree 😞	☐	☐	☐	☐	☐	Strongly Agree 😄

I find it to be easier to understand complex topics using the website.

	1	2	3	4	5	
Strongly Disagree 😞	☐	☐	☐	☐	☐	Strongly Agree 😄

The website makes you become more interested in learning STEM in the future. *

	1	2	3	4	5	
Strongly Disagree 😞	☐	☐	☐	☐	☐	Strongly Agree 😄

V. Overall Experience

Would you tell your friends to use this website to learn? *

- ☐ Yes
- ☐ Maybe
- ☐ No

What was your favorite part of the website?

Your answer

Was there anything you didn't like or found difficult?

Your answer

APPENDIX C: USER ACCEPTANCE TESTING FORM FOR TEACHERS

I. Features Evaluation

Was it easy to log in as an admin? *

☐ Yes

☐ Maybe

☐ No

Could you easily navigate the admin dashboard? *

☐ Yes

☐ Maybe

☐ No

Was it easy to create, edit, or delete quiz questions? *

☐ Yes

☐ Maybe

☐ No

Were you able to assign quizzes to the correct lesson or subtopic without difficulty? *

☐ Yes

☐ Maybe

☐ No

Could you view and manage student accounts easily (e.g., edit, delete)? *

- ☐ Yes
- ☐ Maybe
- ☐ No

Was the user information (e.g., names, scores, badges) clearly displayed in user management as well as student progress tracking features? *

- ☐ Yes
- ☐ Maybe
- ☐ No

Could you easily track the progress of individual students? *

- ☐ Yes
- ☐ Maybe
- ☐ No

Was the average score report displayed clearly in graph form? *

- ☐ Yes
- ☐ Maybe
- ☐ No

II. Content Relevance and Curriculum Fit

The educational content aligned with classroom learning goals. *

	1	2	3	4	5	
Strongly Disagree	☐	☐	☐	☐	☒	Strongly Agree

The website encouraged group based learning through the implementation of experiments/group activities section. *

	1	2	3	4	5	
Strongly Disagree	☐	☐	☐	☒	☐	Strongly Agree

The lessons help reinforce what is taught in class. *

	1	2	3	4	5	
Strongly Disagree	☐	☐	☐	☐	☒	Strongly Agree

III. Engagement and Interactivity

The interactive features (videos, games, badges, leaderboard) engage students effectively

	1	2	3	4	5	
Strongly Disagree	☐	☐	☐	☐	☒	Strongly Agree
Clear selection						

The gamified elements encourage participation from more students than usual *

	1	2	3	4	5	
Strongly Disagree	☐	☐	☐	☐	☒	Strongly Agree

IV. Usability and Functionality

Did the platform perform reliably (minimal lag or crashes)? *

- ☒ Yes
- ☐ Maybe
- ☐ No

Were students able to use the platform independently with minimal guidance?

- ☐ Yes
- ☒ Sometimes
- ☐ No

Clear selection

Did students face any issues using quizzes, earning badges, or accessing lessons? *

- ☐ Yes
- ☐ Sometimes
- ☒ No

V. Perceived Impact on Learning and Future Use

Based on your observation, did students show increased interest in STEM after using the platform? *

- ☐ Yes
- ☐ Maybe
- ☐ No

Would you recommend integrating this platform into your regular STEM lessons as supplementary? *

- ☐ Yes
- ☐ Maybe
- ☐ No

VI. Feedback for Improvement

What improvements or features would you like to see in future versions?

Your answer _____

Were there any technical issues or limitations that affected usage?

Your answer _____