6COSC023W – Final Project Report

# Project Title

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6COSC023W – Final Project Report – BSc CS & BEng SE 2

# Document Scope

# Declaration

This report has been prepared based on my work. Where other published and unpublished source materials have been used, these have been acknowledged in references.

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# Abstract

Students often struggle to track their academic work and meet their deadlines resulting in poor performance in school. Traditional note-taking methods are no longer effective, and some school systems, such as Blackboard and Modal, fail to provide a user-friendly system with a chat feature that enhances the sense of community within the school. In addition, the existing systems do not offer a planner that helps students to learn at their own pace. This project aims to develop a learning management system through an agile methodology that aims to provide a user-friendly platform to manage students' academic records, access learning materials, and communicate with their instructors and peers. The platform target is to address these challenges by offering a planner system that enables students to set their goals and deadlines, categorize them based on their priority, and access their learning materials and assignment from their instructors in various formats. In addition, the system features a chat function that facilitates direct communication between students and instructors, improving the overall learning experience.

# Acknowledgements

I would like to thank my Supervisor Alexander Bolotov, for his supportive feedback helping me adapt and improve my project.

Thank you

# Table of contents

[Project Title 1](#_Toc134534235)

[Document Scope 1](#_Toc134534236)

[Declaration 2](#_Toc134534237)

[Abstract 3](#_Toc134534238)

[Acknowledgements 4](#_Toc134534239)

[Table of Contents 5](#_Toc134534240)

[List of Figures 6](#_Toc134534241)

[1. Introduction 7](#_Toc134534242)

[1.1 Problem Statement 7](#_Toc134534243)

[1.2 Aims and Objectives 9](#_Toc134534244)

[2. Background 11](#_Toc134534245)

[2.1 Literature Survey 11](#_Toc134534246)

[2.2 Review of Projects/applications 24](#_Toc134534247)

[2.3 Review of Tools Frameworks and Techniques 29](#_Toc134534248)

[3. Legal, social and ethical issues 32](#_Toc134534249)

[4. Methodology 33](#_Toc134534250)

[4.1 Proposed Testing 4](#_Toc134534251)6

[5. Design 49](#_Toc134534252)

[5.1 Sequence Diagram 49](#_Toc134534253)

[5.2 Student Activity Diagram 51](#_Toc134534254)

[5.3 Teacher Activity Diagram 53](#_Toc134534255)

[5.4 Use Case Diagram 54](#_Toc134534256)

[5.5 User Interface 55](#_Toc134534257)

[6. Tools and implementation 67](#_Toc134534258)

[6.1 Tools 67](#_Toc134534259)

[6.2 Implementation 75](#_Toc134534260)

[7. Testing 93](#_Toc134534261)

[7.1 Test Coverage 93](#_Toc134534262)

[7.2 Test Methodology 100](#_Toc134534263)

[8. Conclusions and Reflections 103](#_Toc134534264)

[9. References 10](#_Toc134534265)7

[Appendix I 11](#_Toc134534266)4

# List of Figure

|  |  |  |
| --- | --- | --- |
| Figure 1 | Figure name | Page number |
| 1 | Moodle interface by ulmoodle.support.com | 25 |
| 2 | Blackboard by www.bu.edu | 26 |
| 3 | Canvas Interface by www.prnewswire.com | 27 |
| 4 | Brighter space by www.brightspace.com | 28 |
| 5 | Project milestone | 41 |
| 6 | Sequence diagram | 49 |
| 7 | Student activity diagram | 52 |
| 8 | Teacher activity diagram | 53 |
| 9 | Use case | 54 |
| 10 | Students sign up | 56 |
| 11 | Student’s sign in | 57 |
| 12 | Student’s homepage | 58 |
| 13 | Footer | 58 |
| 14 | Academic record | 59 |
| 15 | classwork | 60 |
| 16 | Objective | 61 |
| 17 | deadline | 61 |
| 18 | Report | 62 |
| 19 | Chat feature | 62 |
| 20 | chat | 63 |
| 21 | Instructor login | 64 |
| 22 | Use case diagram | 64 |
| 23 | Course notes | 65 |
| 24 | assignment | 66 |
| 25 | Student’s chat | 67 |
| 26 | Verify password | 69 |
| 27 | Chat interface | 70 |
| 28 | CSS files | 71 |
| 29 | XAMPP | 72 |
| 30 | MySQL | 73 |
| 31 | DB table | 74 |
| 32 | Sublime text interface | 75 |
| 33 | Novel code | 82 |

# Introduction

## Problem statement

In our current world, few individuals still maintain the habit of checking notices on notification noticeboards; this is also true with students who often skip detail about important issues and updates about their academic activities. Hence these students cannot track their progress regarding the various activities relating to their academic pursuits. The majority of the students do not have the knowledge of their progress within the various unit subjects and academic activities in which they are engaged; this often results in these students failing to meet deadlines regarding academic activities such as submission of assignments, submission of tutorials, and also examinations.

Traditional note-taking is a thing of the past; often, in most cases, instructors usually distribute notes in terms of soft copy through student emails as well as student chat groups. The notes assist the student in gaining further knowledge other than what is taught in class which is usually a small percentage of the content that the student is required to master. Students also look for extra resources from internet sources which they use to gain further understanding. However, some schools do not have systems that allow students to learn at their own pace and expect everyone to fall under prescribed expectations, not considering that each student is different from the other; this exerts much pressure on these students resulting in poor performance.

Some students are lucky to have Blackboard in their school which is a web-based platform that allows instructors or teachers to create and manage online courses. Students can have access to course materials, submit assignments, engage in online discussions and receive their grading through Blackboard. There are several challenges students may face while using platforms such as Blackboard. One of these difficulties is the inability to manage planning, which can cause one to feel constrained and forced to travel down a set course. For students who would like more control over their educational experience, this might be frustrating.

Confusing navigation is another issue that students may experience when using Blackboard. For some users, the platform's style and navigation may not be simple, which can cause confusion and make it challenging to locate the information they require. I'm devoted to developing a user-friendly design for my planner system that will make it simple for students to access their course materials and keep on top of their tasks. The user interface will use minimal details that are easy to understand.

Blackboard may present not only navigational difficulties but also communicational restrictions. Communication between students and their teachers and peers can be difficult, which can cause dissatisfaction and a lack of interest. I will include a chat feature in my planner system that lets students talk to their instructors directly to address this problem. According to Mpungose & Khoza (2022), integrating Short Message Service (SMS) with other educational technologies offers students a more thorough and coherent pedagogical encounter. As a result, the online learning environment will offer a more individualized experience and foster a stronger sense of community.

The student management system aims to develop a platform that tackles the issues that students have with current systems like Blackboard. I believe my planner system will give students a more natural and interesting learning experience by giving them more control over planning, streamlining navigation, and enhancing communication channels. Students can make their plans related to the course and set their deadlines with targets they wish to achieve. This will be critical to help students make their plans and achieve them.

## Aims and Objectives

**Aim**

Online Learning Management System aims to create a planner that helps students organize their academic work, set goals and deadlines, communicate with their peers and instructors, and receive notes and assignments from their instructors.

**Objectives**

1. To develop a web platform that allows students to store and retrieve their academic records and learning materials in various formats, including text, videos, PDFs, and images. This will help students securely store their files related to their course for future use. In addition, these files can be accessed anywhere at any time in case the student wants to refer.
2. Implement a functionality that enables students to set deadlines and goals for classwork and personal activities and categorize them as critical or non-critical. This will help students stay more organized by increasing their effort on critical work, especially when minimal time is left.
3. To enable instructors to upload notes and assignments to students with deadlines. This helps students to access course materials and plan their work in line with coursework.
4. Implement a system that helps students view their deadlines by showing the time left. The deadline section organizes all the deadlines set by students and classwork deadlines and categorizes them based on their priority.
5. To create a chat feature where students can talk directly to their teachers, instructors, and peers. The chat feature will be a game changer; it will help students interact directly with their peers and teachers within the platform, which is impossible with existing systems such as Blackboard. It will be a direct route where students can ask for clarification from their instructors and gain from their peers.
6. To develop a feature that generates reports for students so they may better understand their accomplishments and success rates. Students can see how much work they have completed on time or submitted late; this will help them reflect on their work and what they can do to improve.

# Background

## Literature survey

Several studies have been conducted, and a learning management system’s function can be broken down into the following modalities: -first individual self-paced offline learning is where the student can access educational material offline. Second individualized self-paced online learning allows students to access educational material online. Third, synchronous group-based self-paced learning is where the system can provide students with a way to collaborate in real-time through the school’s network or the Internet (Al-Samarraie & Saeed, 2018). Lastly, Asynchronous group-based online learning is where the system enables a group of students to collaborate on a task through the school’s network and internet. However, these interactions do not occur in real-time (Al-Samarraie & Saeed, 2018).

### **Impact of LMS**

According to (Al-Samarraie & Saeed, 2018) in “**A systematic review of cloud computing tools for self –paced collaborative Learning: Opportunities and Challenges to the blended-learning Environment**," web-based self-paced learning management systems enable sharing of learning materials between the students, the system also allows for viewing of important updates regarding activity deadlines, submission and return of assignments as well as communication among the students. Research shows several instances where students have successfully used a student management system to facilitate academic interactions and collaboration; however, there was very little knowledge concerning knowledge construction using this kind of technology (Al-Samarraie & Saeed, 2018).

**Dhupia, B., & Alameen, A. (2019). Adaptive eLearning system: Conceptual framework for personalized study environment**

The advent of personalized electronic learning systems has been regarded as a promising remedy for the difficulties encountered by students in conventional educational settings. As per the research conducted by Dhupia & Alameen (2019), the provision of individualized learning experiences for learners is facilitated by personalized e-learning systems, as expounded in their article “Adaptive eLearning System: Conceptual Framework for personalized study environment”. The findings provided in the study found that electronic learning (e-learning) systems ought to incorporate adaptability concerning students' individualized preferences, competencies, and cognitive styles. To attain this objective, customized e-learning systems ought to integrate components including individualized content dissemination, evaluation, and response mechanisms. According to the authors' proposition, the efficacy of e-learning systems can be augmented by the incorporation of social networking functionalities, which would enable students to engage in collaborative ventures and exchange knowledge. Although personalized E-learning management systems hold significant potential benefits, current literature still lacks comprehensive knowledge regarding the appropriate strategies to efficiently devise and introduce such systems. The study brought to attention a particular constraint.

The insufficiency of research concerning the identification and quantification of the efficacy of customized E-Learning Management systems is an issue prominent in this domain. The authors additionally underscore the potential for comprehensive research findings pertaining to the optimal balance between personalization and standardization in e-learning systems. Furthermore, limited literature exists regarding the optimal integration of individualized e-learning platforms with conventional classroom environments.

According to “**Using the technology adoption model to assess faculty comfort with Student Management System”** (Bove & Conklin, 2019), Learning management systems are widely used because of their functionalities that enable simplification of management and planning of various activities and content delivery regarding students’ academic journey. Even though they are widely used, they mostly concentrate on content delivery instead of the students. Current student management systems do not offer enough opportunities for students to control, manage and plan their learning pace as well as the various activities and tasks provided in the classrooms.

**Aldiab, A., Chowdhury, H., Kootsookos, A., Alam, F., & Allhibi, H. (2019).** **Utilization of Learning Management Systems (LMSs) in higher education system**

The employment of student management systems (SMS) has become indispensable in the realm of higher education, as pointed out by Aldiab et al. (2019) in their research titled " Utilization of Learning Management Systems (LMSs) in the higher education system." This study asserts the numerous advantages conferred by SMS, including the optimization of administrative procedures, enhancement of communication capacities, and the improvement of academic performance. It was discovered by the author that an SMS ought to possess inherently user-friendly features and be capable of facilitating accessibility by all stakeholders, with appropriate training measures being implemented to optimize the efficacy of user performance. The author found that SMS has the potential to significantly enhance student engagement, satisfaction, and retention. These benefits can be accomplished through the integration of personalized learning features that foster effective communication and collaboration among students.

In addition to the potential advantages of Short Message Service (SMS), the investigation also brings to the forefront certain limitations and obstacles associated with their adoption. Acquisition and maintenance expenses associated with Short Message Service (SMS) present a noteworthy obstacle for some institutions, particularly those situated in low-income territories, where such costs may pose a prohibitive impediment. Moreover, the research asserts that the efficacy of a Short Message Service (SMS) deployment affects the extent to which stakeholders exhibit a preparedness to comprehensively embrace the system. The non-acceptance of change and insufficient training could lead to reduced acceptance among end-users, thereby, negatively affecting the efficacy of the system. Hence, it is imperative to carefully contemplate relevant variables including but not limited to financial feasibility, user embracement, and adequate instruction before integrating a Short Message Service (SMS) in institutions of higher learning.

**Mpungose, C. B., & Khoza, S. B. (2022). Postgraduate students' experiences with the use of Moodle and Canvas learning management system**

Similarly, a research study by Mpungose & Khoza (2022), proposes the integration of Short Message Service (SMS) with other educational technologies, including Learning Management Systems (LMS), to offer a more thorough and coherent pedagogical encounter to students. The confluence of SMS and LMS facilitates the seamless exchange of information, thereby culminating in a more effective decision-making process and increased educational achievements. Notwithstanding, there exists a requirement for additional investigations pertaining to the efficacious attainment of SMS and LMS integration and its potential influences on the education process. The study emphasizes the significance of contemplating the difficulties and prospects connected with incorporating SMS in higher education organizations, alongside the necessity for proficient integration with other learning technologies.

**Çelik, K., & Ayaz, A. (2022). Validation of the Delone and McLean information systems success model**

The impact of student information systems (SIS) on enhancing the educational process has been investigated by several research endeavours, including a recent study conducted by Çelik & Ayaz (2022). Based on the research conducted, the utilization of a Student Information System (SIS) has exhibited noteworthy enhancements in the productivity and proficiency of the education system through the facilitation of precise and prompt knowledge dissemination to educators, pupils, and guardians. The aforementioned data encompasses attendance records, grade reports, and progress reports. The data facilitates the monitoring of students' academic advancement and enable stakeholders to detect areas in need of improvement. Furthermore, the Student Information System (SIS) facilitates educators in identifying pupils who require supplementary assistance and adapting their instructional techniques correspondingly.

To maximize the effectiveness of both systems, it is crucial to integrate SIS with other educational platforms like learning management systems (LMS). The study discovered that combining SIS and LMS can facilitate an uninterrupted exchange of information and cooperation among diverse educational participants. SIS is capable of furnishing LMS with significant insights including students' advancement in learning, data on achievements, and behavioural tendencies. Alternatively, the LMS has the capability to furnish the SIS with crucial data about students' involvement in various educational pursuits, that may prove to be valuable in assessing their academic growth. Integrating SIS and LMS can aid instructors in delivering customized learning encounters to learners and improve their scholastic achievements.

**Ramírez-Correa, P. E., Rondán-Cataluña, F. J., & Arenas-Gaitán, J. (2018). Student information system satisfaction in higher education: the role of visual aesthetics**

According to Ramírez-Correa et al. (2018), even though the SIS enhances the educational process, several restrictions and hurdles are present. One illustrative instance is that the successful deployment of an SIS necessitates substantial monetary resources, specialized knowledge, and robust physical facilities. Furthermore, there may be resistance to the implementation of Student Information Systems (SIS) from certain stakeholders, namely educators and guardians, primarily stemming from concerns surrounding the confidentiality and safeguarding of sensitive information. The constrained integration of the Student Information System (SIS) with other educational platforms may constrain its efficacy in facilitating customized learning opportunities. Thus, it is imperative to confront the aforementioned constraints and obstacles to guarantee the effective incorporation of SIS within the educational framework.

**Buraimoh, E., Ajoodha, R., & Padayachee, K. (2021). Prediction of student success using student engagement with the learning management system**

The study undertaken by Buraimoh et al. (2021) is significant due to its scholarly rigour and scientific validity. The particular research study aims to examine the impact of Learning Management Systems (LMS) on student engagement and academic achievements in the context of higher education. The research conducted revealed that the utilization of LMS exhibits a favourable effect on various aspects of student participation, drive, and contentment. As per the findings of the research, Learning Management Systems (LMS) can enhance active learning, promote collaboration and facilitate interaction among learners by offering a range of features such as discussion forums, chat rooms, as well as collaborative tools. This discovery underscores the significance of formulating Learning Management Systems (LMS) geared toward enhancing active learning and fostering collaborative practices. To optimize the efficacy of Learning Management Systems (LMS), it is critical to incorporate elements designed to facilitate interactivity and collaboration among students, including but not limited to group-based assignments and forums for discussion.

**Dlalisa, S. F., & Govender, D. W. (2020). Challenges of Acceptance and Usage of a learning management system amongst Academics**

Although the adoption of Learning Management Systems (LMS) has been proven to exhibit favourable effects on student engagement and academic performance, it is pertinent to acknowledge that certain drawbacks still exist in their implementation. The research conducted by Dlalisa & Govender (2020) highlighted that the Learning Management System (LMS) must be developed in a manner that is conducive to user-friendliness and easy navigation. Such an approach is critical to enabling learners to maximize the benefits afforded by the LMS functionalities. Promoting inclusivity and enhancing the learning experience is important in ensuring that all students, including those with disabilities, have access to the Learning Management System (LMS). Although LMS can support customized learning, flexibility is crucial to meet each pupil's needs for maximum effectiveness.

The research conducted emphasizes the importance of institutions offering satisfactory education and assistance to both educators and learners for the prosperous integration and execution of LMS. It is crucial for educators to receive adequate training in order to proficiently utilize the LMS, resulting in an enhanced teaching approach and customized educational opportunities for their pupils. Furthermore, students must receive appropriate instruction on utilizing the LMS to enhance its efficacy. The study concludes that for LMS to be effective, it must prioritize active learning and collaboration, while also being accessible and adaptable to meet the varying needs of students. Sufficient instruction and assistance for educators and pupils are imperative to guarantee the effective assimilation and execution of LMS.

**Sabharwal, R., Chugh, R., Hossain, M. R., & Wells, M. (2018, December).** **Learning management systems in the Workplace: A literature review**

The research conducted by Sabharwal et al. (2018) in " Learning management systems in the Workplace: A literature review", an exhaustive analysis of studies conducted on the utilization of learning management systems (LMS) in higher education is presented. The authors emphasize the capability of LMS to enhance education's general excellence through its various functions such as the distribution of educational materials, evaluation, and methods of communication. The research highlights the importance of creating an LMS that is flexible and adaptable to address the varying requirements of both students and educators. The authors propose that the functionality of LMS can be improved by the inclusion of additional technological features, such as social media utilities, game-like aspects, and AI integration, in order to create an enriched and tailored learning environment that is more captivating for users.

An inadequacy that has been underscored in the study pertains to the lack of inquiry into the efficacy of LMS about certain student groups, such as those who are non-native English speakers or those afflicted with learning disabilities. The aforementioned study highlights the necessity for further investigation into the utilization of Learning Management Systems (LMS) in various educational settings, including virtual and blended learning environments. An additional constraint that has been identified pertains to the restricted emphasis on the influence of LMS on pedagogy and educator contentment. The present investigation proposes that future research studies should focus on the correlation between the utilization of Learning Management Systems (LMS) and the satisfaction of instructors, as this factor may influence the standard of education provided.

**Kraleva, R., Sabani, M., & Kralev, V. (2019).** **An analysis of some learning management systems**

The investigation conducted by Kraleva et al. (2019) in their article “An analysis of some learning management systems”, the article offers significant contributions to the literature on the promise of learning management systems in the context of higher education. The utilization of Learning Management Systems (LMS) holds promise in enriching the overall educational landscape. Nevertheless, the study also brings into focus the necessity for LMS to be developed with flexibility and adaptability in mind, to align with the varied requirements of both students and instructors. Furthermore, the investigation highlights the necessity for further inquiry concerning the efficacy of Learning Management Systems (LMS) on distinct student demographics and varied educational settings. The study further examined how learning management systems affect both students' satisfaction and academic success and the findings indicate that the utilization of Learning Management Systems (LMS) has a constructive influence on student contentment and scholastic achievement. The authors propose in their study that the attainment of this objective can be realized through the creation of learning management systems that exhibit user-friendliness, interactivity, and engagement. Additionally, this study highlights the significance of offering adequate training and support to instructors and students alike, to guarantee successful implementation and integration of the system.

According to Palvia et al. (2018)**, "Online Education: Worldwide Status, challenges, trends, and Implications,"** the resource examines research works across several countries within the accepted five-year period. According to the study, online learning platforms are beneficial since they motivate and effectively engage learners by providing the students with an opportunity to learn using techniques that are most suited to their learning styles, this is a key aspect of students' performance. Currently, many young individuals are technologically literate regarding networking and mobile technology; however, most of these individuals still lack knowledge regarding using these devices for educational purposes.

**Walkington, C., & Bernacki, M. L. (2020). Appraising research on personalized learning**

Although personalized E-learning management systems hold significant potential benefits, current literature still lacks comprehensive knowledge regarding the appropriate strategies to efficiently devise and introduce such systems. Walkington & Bernacki (2020) brought to attention a particular constraint. The insufficiency of research concerning the identification and quantification of the efficacy of customized E-Learning Management systems is an issue prominent in this domain. The authors additionally underscore the potential for comprehensive research findings pertaining to the optimal balance between personalization and standardization in e-learning systems. Furthermore, limited literature exists regarding the optimal integration of individualized e-learning platforms with conventional classroom environments. In addition, personalized e-learning systems provide a tailored learning environment for students; however, concerns persist regarding the probable adverse impact of these systems on social interactions and collaborative efforts of students. They concluded that although personalized electronic learning platforms resulted in enhanced student engagement and motivation, there was a concurrent decrease in students' collaboration. This underscores the requisite for e-learning systems that are tailored to suit individual learners while also promoting social interdependence and collaborative engagement among students.

**Turnbull, D., Chugh, R., & Luck, J. (2021). Issues in learning management systems implementation: A comparison of research perspectives between Australia and China**

Despite the prospective advantages of LMS, the investigation also acknowledges certain constraints. The study by Turnbull et al. (2021), observed that the efficacy of learning management systems (LMS) is contingent on multiple elements, including the quality of educational content and learning techniques, alongside elements related to technical support and assistance. Furthermore, this study underscores the significance of instructors employing Learning Management Systems (LMS) in a way that is aligned with the set learning principles, with the ultimate goal of mitigating potential negative effects on students' academic performance. The authors recommend the undertaking of additional research to explore the optimal employment of Learning Management Systems (LMS) within the higher education setting. The study presents empirical evidence illustrating that the utilization of learning management systems positively influences both student contentment and academic achievement. Nevertheless, the research study underscores the imperative for educators to employ Learning Management Systems (LMS) in a pedagogically effective approach. Additionally, the study further examined the factors that impact student satisfaction with these systems. The research study ascertained that system quality, information quality, and service quality are critical determinants that influence student satisfaction. The research has revealed that the effectiveness of a learning management system in delivering precise, prompt, and pertinent information, combined with its user-friendliness and availability, is of considerable significance to the students. Furthermore, the level of customer service and technical support rendered by the system provider was determined to be pivotal in upholding the satisfaction of students.

## Review of projects/applications

Moodle, an open-source Learning Management System (LMS), has gained extensive global utilization within educational establishments. The e-learning platform, Moodle, provides a diverse variety of features to assist in the management of online courses, encompassing but not limited to, course materials provision, communication tools provision, assessment tools provision, and an array of other valuable features. However, certain scholarly studies have highlighted the limitations associated with Moodle. According to research conducted by Zaineldee et al. (2020), “Technology acceptance model concepts, contribution, limitation, and adoption in education”, Moodle's capacity to facilitate online collaborative learning activities was found to be limited. The study revealed that Moodle lacked effectiveness in providing adequate opportunities for students to engage in collaborative and communicative activities.

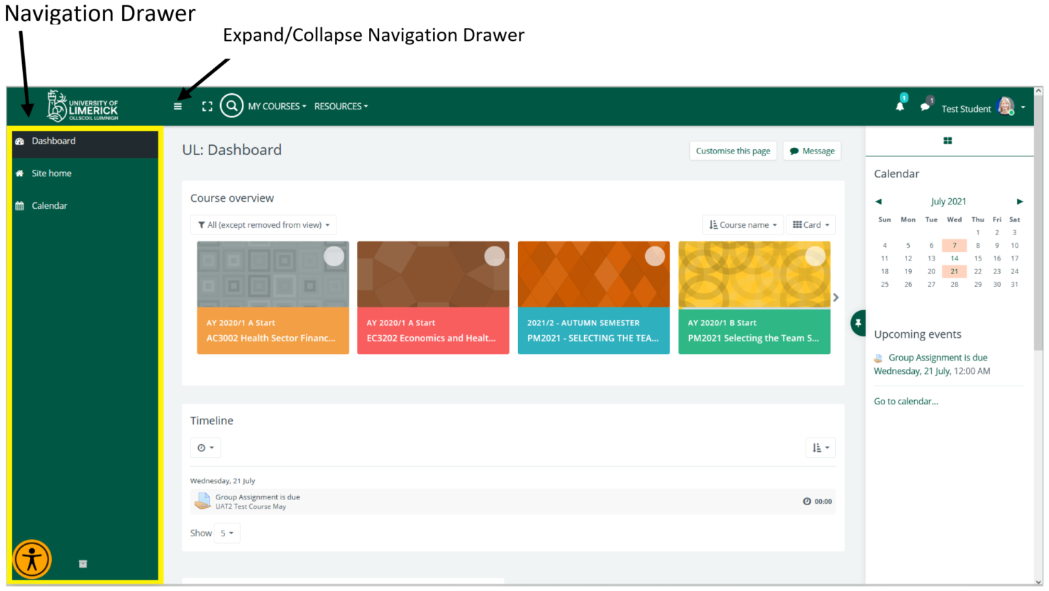


Figure 1: Moodle interface by ulmoodle.support.com

The Blackboard software platform also serves as a commercially available learning management system, offering a wide array of tools also designed to facilitate the management of courses. The utilization of Blackboard in higher education institutions has been widespread; however, the study by Alshammari et al, (2018), “LMS, CMS, and LCMS: The confusion among them “ has highlighted the limitations in its functionality and according to the research, the user interface of Blackboard is complicated and this presents a challenge for effective navigation. The research study has revealed that the complicated nature of the nature resulted in reduced levels of satisfaction among the students and a rise in the number of students who discontinued their studies.

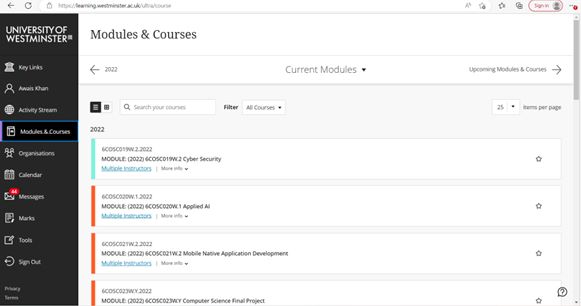


Figure 2: Blackboard by www. learning.Westminster.ac.uk

Once again Canvas is also a cloud-hosted Learning Management System (LMS) that provides several functionalities to manage courses. Canvas has significantly become famous in modern times and this is because of its ease of use and modern design. However, some studies reveal limitations in the functionality of Canvas. According to a study conducted by SOUZA et al. (2019) “Limitations of Automated Accessibility Evaluation in a MOOC Platform”, Canvas was deemed inadequate in terms of its Collaborative and communicative tools for students. The authors acknowledged that this constraint may result in reduced learner involvement and reduced academic achievements.

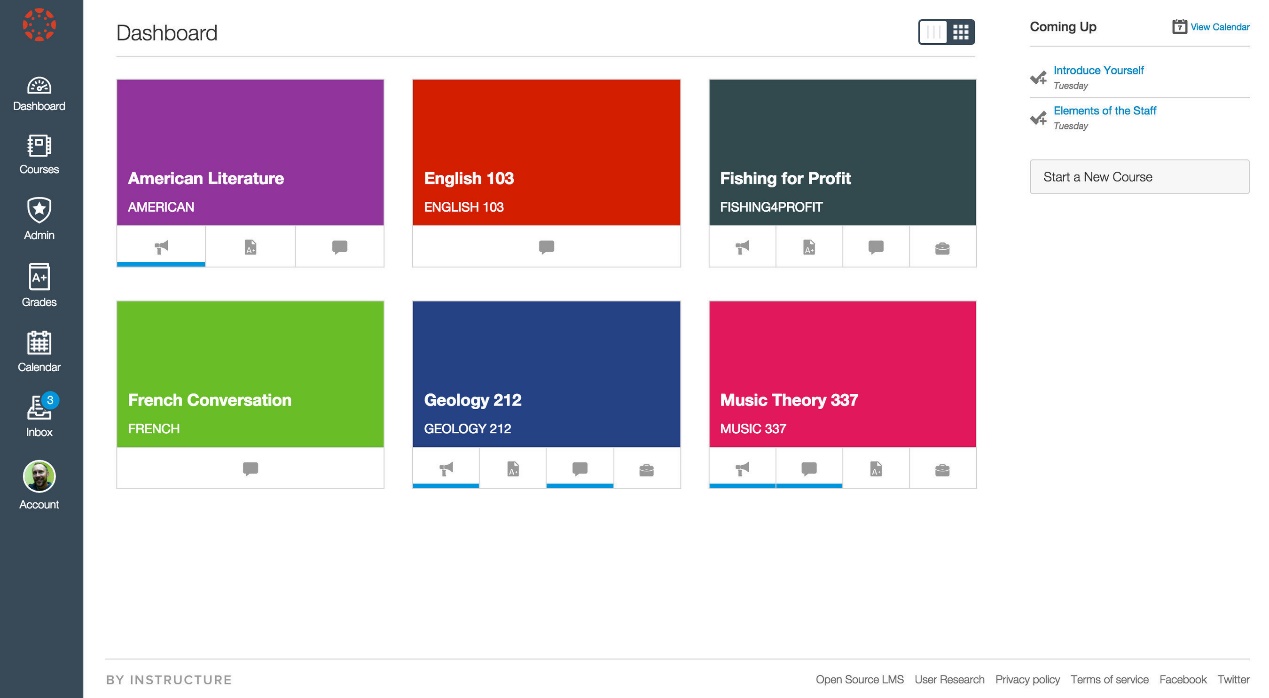


Figure 3: Canvas Interface by www.prnewswire.com

Brightspace is another LMS tool, and it is a Cloud-based Learning Management System (LMS) that has been widely adopted across various educational establishments worldwide. However, there exist certain constraints to the effectiveness of the educational tool. According to the findings of Setiawan et al. (2021) “Trend of learning management system (LMS) platforms for science education before-after COVID-19 pandemic”, research, Brightspace was found to have insufficient tools to facilitate customized learning experiences. The study acknowledges that this constraint can result in decreased student involvement and a general reduction in student performance.

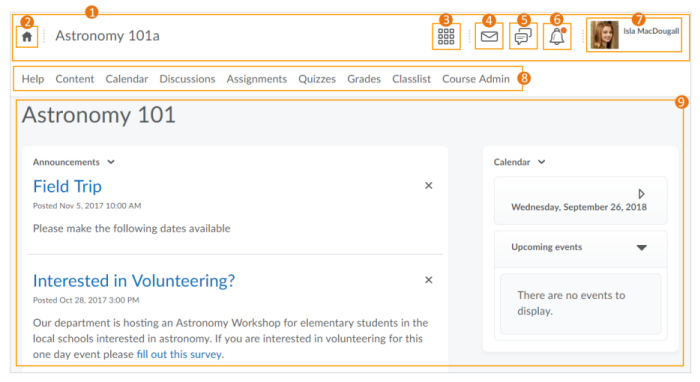


Figure 4: Brighterspace by www.brightspace.com

Lastly, Google Classroom is a free learning management system that provides a user-friendly interface for both educators and learners, thereby streamlining the creation and administration of educational content. Google Classroom has significantly become famous among educators globally, mainly because of its ease of use and seamless integration with other Google applications. However according to a study by Wilcha (2020) “Effectiveness of virtual medical teaching during the COVID-19 crisis: a systematic review”, the Google Classroom platform lacked features that are effective in providing prompt feedback to students. according to the authors, these limitations may have implications for reduced student involvement and reduced student performance.

## Review of tools frameworks and techniques

HTML, CSS, and Bootstrap are prevalent front-end technologies employed in contemporary web development. HTML is responsible for providing a fundamental structure and content for a webpage, whereas CSS is utilized to facilitate attractive styles and formatting (Smyth, 2018). Bootstrap is a CSS framework that facilitates the creation of responsive web designs. The utilization of the mentioned technologies offers several benefits such as ease of use, adaptability, and broad compliance with major web browsers. They enjoy extensive support and a sizeable community that offers assistance and a wealth of resources. Despite their advantages, HTML, CSS, and Bootstrap possess certain drawbacks. The drawback of these tools is their restricted capacities in terms of functionality and interactivity (Smyth, 2018).

JavaScript is commonly utilized to incorporate interactive features and dynamic actions into web pages. JavaScript is a widely adopted programming language utilized in web development which grants developers the ability to generate dynamic and interactive web-based applications (Tómasdóttir et al., 2018). The utilization of JavaScript presents numerous benefits, encompassing its flexibility, speed, and compatibility with the majority of web browsers. Additionally, the software is straightforward to comprehend and features a substantial community that offers extensive assistance and a vast number of available resources. Nevertheless, the programming language of JavaScript exhibits certain drawbacks. A primary concern pertains to the potential utilization of this element to generate security vulnerabilities. Inadequately constructed JavaScript code may facilitate the injection of malicious code and unauthorized access to user data by malicious actors (Osmani, 2023). To avoid such occurrences, the JavaScript code must be composed carefully and subjected to rigorous validation.

PHP is a scripting language that operates on the server-side platform and is widely employed in the development of web applications with dynamic features. This framework exhibits a particular utility in facilitating data management and HTML generation (Lutfiani et al., 2022). One of the benefits associated with adopting PHP is its notable user-friendliness, adaptability, and ability to operate seamlessly with countless web servers. Furthermore, the platform boasts a large and diverse community that offers substantial aid and a plethora of valuable assets. Nevertheless, PHP exhibits certain shortcomings in its functionality. A prominent issue pertains to the potential for inadequate PHP code to generate security susceptibilities. Furthermore, it is inadequate for conducting intricate computations and analyzing voluminous datasets (Lutfiani et al., 2022).

The Sublime Text is a widely accepted text editor in the domain of web development. The utilization of Sublime Text confers several benefits including its fast performance, user-friendly interface, lightweight nature and robust integration with diverse plugins and packages. Moreover, the platform boasts an extensive community, which offers extensive assistance and a vast number of resources. Nevertheless, Sublime Text possesses certain limitations and negative aspects. This text editor lacks certain sophisticated functionalities commonly present in alternative text editors, such as the integration of debugging and version control (Aryani et al., 2021).

The MySQL software is a prevalent option as a relational database management system, as it boasts widespread application in the field of web development. The software exhibits remarkable attributes of scalability, processing speed, and reliability (Deari et al., 2018). The utilization of MySQL offers several benefits, including its ease of use, capability to accommodate expansive systems, and ability to comprehend an extensive range of programming languages. Furthermore, the subject under consideration boasts of a vast community that offers substantial support and valuable resources. Notwithstanding its utility, MySQL presents certain shortcomings. One of the principal concerns is that inadequately designed databases may result in issues relating to both performance and security. The task of sustaining and expanding in intricate and expansive applications may pose considerable difficulty (Deari et al., 2018).

XAMPP is a multi-platform web server solution comprising Apache, MySQL, PHP, as well as Perl. Frequently, it finds applications in local web development and evaluation. XAMPP is very helpful because it is easy to use, portable, and works with most computer systems. Moreover, there is a vast community that can offer assistance and a vast number of resources. Nevertheless, XAMPP presents certain drawbacks. One crucial issue to be considered is that it lacks the ability to accommodate production applications, moreover, the task of configuration and security can pose significant challenges (Salim Khan et al., 2021).

# Legal, social and ethical issues

The development of the system entails several concerns that are legal, ethical, social, professional, and security-related in nature. It is essential to address such issues to guarantee system compliance and fulfilment of requisite standards. One of the ethical considerations pertinent to education is the confidentiality of students' information. The system must ensure the safeguarding of students' data and limit its access solely to authorized personnel. Moreover, it is crucial to establish a transparent protocol pertaining to the acquisition, retention, and utilization of student information. Regarding security, the system is required to possess appropriate measures for preventing unauthorized access and hacking attempts. This encompasses the implementation of robust data encryption measures, stringent login authentication protocols, as well as periodic system updates aimed at mitigating any potential security threats and vulnerabilities.

Numerous social and professional considerations warrant attention, including the provision of universal accessibility to the system for students with disabilities and the design of a user-friendly interface that enables easy navigation. It is imperative to deliberate upon legal concerns such as copyright violation and intellectual property protections. The system must ensure that all utilized materials possess appropriate licensing and that students display a comprehensive understanding of the system's acceptable usage policies.

# Methodology

The project will adhere to the Agile methodology regarding both its design and subsequent implementation. The Agile approach focuses on the incremental and iterative development of projects, along with the provision of continuous feedback, and encourages collective collaboration amongst project stakeholders. This approach is particularly suitable for projects that involve dynamic requirements and fluctuating customer preferences, given that it enables a degree of flexibility and adaptability in response to the various modifications.

By the Agile development methodology, the project's fundamental phases and milestones include the following:

**Planning Phase**

In the initial planning phase, I will establish the specific goals, scope, and outputs attributable to the project (Chapram & Solutions, 2018). This project aims to develop a web-based platform that facilitates the storage and retrieval of academic records and learning materials in multiple formats, as well as the establishment of deadlines and goals by students. In addition, the platform seeks to provide instructors with the means to upload notes, assignments, and announcements to students, while allowing students to monitor their deadlines and progress. The endeavour will additionally provide a forum for students to engage in discourse with their educators, as well as a functionality that produces progress reports for students to enhance the comprehension of their achievements.

**Project stakeholders:**

* Project Manager (Supervisor)
* Web developer
* Graphic designer
* Quality Assurance tester
* Students
* Instructors/Teachers

**Resources required:**

* Project management software
* Web development tools
* Graphic design tools
* Hosting and server resources
* Testing tools and resources
* Communication tools (e.g. email, chat, video conferencing)
* Project budget

Furthermore, alongside the determination of project objectives and stakeholders, I will craft a comprehensive project plan that entails outlining the distinct tasks, respective timelines, as well as resource allocation necessary for each phase of the project. The aforementioned plan will undergo periodic review and revision to ascertain that the project remains on schedule and remains fiscally responsible. After the development of the project plan, I will establish communication and reporting protocols. This step aims to provide updates to all stakeholders regarding the progress of the project, as well as any modifications to the scope, timeline, or budget. The implementation of stakeholder involvement in the project will serve to facilitate an unambiguous comprehension of expected deliverables by all parties involved.

**Analysis Phase**

During the analytical stage, I will be expected to meticulously discern the essential prerequisites and system specifications that will be indispensable in designing and developing the platform (Chapram & Solutions, 2018). The present stage will encompass the task of compiling relevant data from stakeholders while ascertaining the viability and extent of the intended project. In the initial stage of the Analysis phase, it is imperative to undertake a comprehensive needs assessment to ascertain the precise requisites and specifications of the web platform. The proposed undertaking entails the acquisition and examination of data from prominent parties, encompassing students, educators, officials, and professionals endowed with technical expertise. The requirements shall be documented in a comprehensive requirements specification document, which will meticulously enumerate the specific features and functionalities that are deemed necessary for the efficient and optimal operation of the platform.

The subsequent step entails undertaking a feasibility analysis to assess the feasibility and extent of the project. This investigation will undertake an assessment of the resources at hand, the projected timeline, and the allocated budget for accomplishing the project with satisfactory outcomes. Subsequently, the next step will entail the process of formulating a coherent project plan that illustrates the constituent tasks, timelines, and resource exigencies imperative for culminating the project. To obtain the requisite system specifications, I will engage in different activities, including brainstorming sessions, exhaustive interviews, and surveys. These endeavours serve to ascertain the user's requirements, anticipations, and obstacles that may be encountered in the present system. I intend to leverage the compiled data to construct functional application scenarios, schematics, and sample models which accurately embody the target feature set and user interface for the website.

After the identification of system requirements and specifications, I will conduct a gap analysis to detect any inadequacies or discrepancies in the requirements. Implementing this strategy will contribute to the provision of a comprehensive and salient end product, by warranting that all essential attributes and operations are incorporated. Before proceeding to the subsequent phase, stakeholders will meticulously scrutinize and authenticate the requirements and specifications.

**Design Phase**

The design phase constitutes a paramount stage within the development process of any given project, entailing the creation of the system's architecture and user interface, the blueprint for which is derived from the set of requirements and specifications gathered during the preceding phase (Chapram & Solutions, 2018). During the present stage, I as an aspiring software developer will endeavor to produce a visual presentation of the system's design. This will entail outlining how the data will be archived and operated, as well as expounding on how the end users will engage with the system. To commence the design stage, I intend to generate an intricate architectural schematic, which would succinctly depict the integration and interlinking of all the system elements. The included graphic representation serves as a valuable tool in enabling developers to comprehend the operational mechanics of the system and pinpoint any potential hindrances or inadequacies. I plan on creating a user-friendly interface that is intuitive and accessible to both instructors and students, with a focus on enhancing the overall user experience that will serve as the basis for the development of the web platform's front end.

After settling on the system architecture and user interface design, I (acting as the development squad) will commence crafting wireframes or prototypes of the system. I will be able to evaluate the functionality and user-friendliness of the system through the wireframes, which present a graphical depiction of the platform's various screens and pages. The data storage and retrieval process of the system will be defined through the construction of a data model. During the design process, I will collaborate with the project stakeholders to ensure that the system design satisfies their needs and anticipations. The system design will undergo adjustments or modifications as per the feedback received from stakeholders. The design stage will be concluded upon the production of a finished design that satisfies all project prerequisites and is prepared for execution.

**Development Phase**

In the development stage, the software is created following the specified design parameters that were previously established. During this phase, the software development process entails the actual coding, followed by rigorous testing and debugging to guarantee it aligns with both functional and non-functional specifications (Chapram & Solutions, 2018). The first phase of the developmental process entails the execution of code. Following the design phase, I will employ the programming languages and tools that have been identified to produce the software application. The process of coding encompasses the conversion of design specifications into executable code. I will engage in close collaboration with all the project stakeholders, to achieve strict adherence to the design specifications when producing code.

After the completion of the code, the subsequent stage involves testing. The process of testing plays a pivotal role in the sphere of software development, as it serves to verify that the software functions in accordance with the anticipated outcomes. The testing phase comprises distinct stages such as unit testing, integration testing, and system testing. Unit testing encompasses the process of examining individual code components to confirm their adherence to expected behaviour. Integration testing is a software testing approach that focuses on verifying the proper interaction and functioning of individual code components within a system. This is done to ascertain that the different components are effectively integrated and functioning in accordance with the expected outcome. The process of system testing involves a comprehensive evaluation of the software's functionality and adherence to both functional and non-functional requirements.

Debugging refers to the activity of detecting and resolving flaws or malfunctions within computer programs. The process includes conducting thorough assessments of the software to detect any glitches and subsequently eliminate them. I will collaborate closely with all the stakeholders involved in the project to thoroughly detect and resolve any issues before advancing to the next stage. I will collaborate with the stakeholders to verify that the software satisfies the designated design requirements. Moreover, the Supervisor will collaborate with me to guarantee their requirements are fulfilled and the project is accomplished within the designated time frame and financial limits.

**Deployment Phase**

The deployment phase signifies the ultimate stage in the software development life cycle. The current phase entails the deployment of the system to end-users, thereby allowing for its practical utilization. (Chapram & Solutions, 2018) The present study outlines the primary tasks that are scheduled to be executed during the deployment phase. Initially, the implementation strategy formulated during the preceding phase will be implemented. This proposal will encompass a comprehensive outline of the methodology involved in the installation, configuration, and testing of the system. I will undertake the installation of the system in the production environment, to ensure that all essential hardware and software prerequisites are duly satisfied. Subsequently, a range of assessments will be conducted on the system to ascertain its conformity with the anticipated performance standards. This will encompass assessments of functionality, performance, and security.

Upon the successful completion of all required testing procedures, the system will be deemed ready for deployment to end users. This endeavour will entail imparting skill-building sessions to end-users concerning the usage of the system, along with provisioning them with requisite access credentials. A help desk will be established to attend to any concerns or inquiries that may arise in the course of utilizing the system. Following deployment, I will partake in a post-implementation review. This critique shall evaluate the efficacy of the undertaking and endeavour to pinpoint any potential prospects for refinement. This evaluation will assess whether the system is fulfilling the predetermined objectives and expectations established during the project's inception. The deployment phase is an essential and pivotal component within the software development life cycle. The process of system deployment entails the delivery of the said system to the intended final recipients and ensuring that comprehensive testing and appropriate training have been undertaken before its actual implementation. During system deployment, I will be required to ensure that the system is functioning according to specifications and that users are provided with appropriate assistance to utilize the system effectively.



Figure 5: Project milestone

The project's implementation will heavily rely on effective UX and UI design considerations. The objective is to ensure that the system possesses an aesthetically pleasing appearance that is coupled with user-friendly navigability for its intended users. This will be accomplished by implementing clear and concise guidelines and providing helpful feedback. The project will prioritize UX and UI during its creation and execution to guarantee that the system is both easy to use and visually attractive. To initiate the design procedures, data will be compiled from surveys and observations to understand the needs, hopes, and preferences of users. This information will identify the struggles and obstacles faced by students dealing with academic records and course materials. During the system design, I will make sure to generate wireframes and prototypes to visualize the interface and features. Then seek feedback from users based on this visualization. The adjustments in design will consider the input of users to optimize their experience and guarantee a user-friendly and instinctive system. I made sure that the system's design remained uniform and logical throughout its various segments.

During the UI design, I will demonstrate careful deliberation towards fundamental principles of UI design, including the coordination of colours, the selection of typography, and the visual arrangement of elements, to craft an interface that is visually striking and aesthetically pleasing (Vlasenko et al., 2022). The system will be designed with usability and compatibility considerations in mind, aiming to render it navigable and functional across a spectrum of devices and varying screen dimensions. To guarantee a user-friendly system, I plan to execute usability testing to pinpoint any aspects in need of enhancement. Additionally, they will furnish users with instructional and assistance resources to facilitate their utilization of the platform. Furthermore, they will make certain that the system offers straightforward and succinct guidance and responses to users, amplifying their satisfaction.

The utilization of the Agile methodology was found to be greatly beneficial within the confines of this specific project, mainly due to several significant factors. The initial implementation resulted in a flexible and adaptable approach to meet the changing demands. As the project progressed, the client demonstrated a proclivity to incorporate modifications or adjust specific functionalities at distinct intervals. The implementation of the Agile methodology expedited the swift assimilation of the aforementioned modifications. As a result of these measures, I was able to adapt efficiently to the exigencies of project requirements, with minimal effect on the expected timeline and budgetary limitations (Kaim et al., 2019). The Agile methodology enabled periodic evaluation of prerequisites, which enabled me to swiftly enhance the developmental process and synchronize it with the client's requisites, ensuring the ultimate product meets their expectations.

Secondly, its emphasis on iterative development, the Agile methodology prioritizes collaboration and communication among team members, leading to the successful attainment of project goals (López-Alcarria et al., 2019). Through the employment of monthly stand-up meetings, I substantially enhanced my capability to partake in regular dialogues concerning the current performance and recognize and tackle significant problems or uncertainties that may have hampered the development of the project. The continuous establishment of rapport with the stakeholders resulted in successful collaborations toward addressing problems and executing the project plan with prompt modifications as required. Periodic assessments were carried out to ascertain the project’s achievement of objectives and ensure congruence of efforts towards identical targets. Throughout the process of these evaluations, I demonstrated the ability to provide insightful feedback regarding the progress while also acknowledging areas that required improvement. This measure was implemented to ensure strict adherence to the predetermined milestones of the project and to facilitate the expeditious resolution of any issues that might arise(López-Alcarria et al., 2019).

Thirdly, it can be pointed out that the Agile methodology has made a significant and noteworthy contribution to the successful implementation of high-quality software for student learning management. The iterative approach, within the Agile methodology for development, is appreciated for its considerable benefit in light of its focus on the consistent process of testing and receiving feedback (Kaim et al., 2019). My efficiency in promptly identifying and correcting potential issues during the developmental phase was considerably enhanced with the introduction of regular testing. As a result, the likelihood of encountering bugs or errors during the final release phase was significantly reduced. By utilizing the technique of breaking down the project into smaller sprints, I was able to allocate my attention toward specific features and functionalities while conducting in-depth testing measures and ameliorating any encountered difficulties before advancing to subsequent sprints. The aforementioned enabled the affirmation of comprehensive functionality, adherence to required quality standards, and exceptional readiness for the implementation of each subsequent stage of the system.

Moreover, the Agile methodology champions the cultivation of collaborative efforts and efficient correspondence between members of a team, ultimately promoting collective comprehension and dedication to achieving mutually established goals. This facilitated a consistent evaluation of the system's progress and examination protocols, ensuring timely and efficient resolution of any possible issues that might arise (López-Alcarria et al., 2019). The Agile methodology has demonstrated considerable efficacy in expediting software development to produce top-notch results within a reasonable period and with maximum efficiency. This can be mainly attributed to the prioritization of continuous testing and feedback, proactive collaboration and communication during project implementation, and an iterative approach to development allowing for frequent modifications and improvements to the system (Kaim et al., 2019).

Finally, the implementation of Agile methodology, with a specific focus on the utilization of short iterations to develop functional software, played a critical role in facilitating the timely and efficient delivery of the project. By dividing the developmental process into iterative sprints, I was able to concentrate on discrete elements of the project, leading to improved monitoring of advancement and prompt resolution of concerns. This approach may have contributed to my ability to effectively manage the project and achieve desirable outcomes, this methodology ensured the accelerated development of crucial features (López-Alcarria et al., 2019). The successful adoption of the aforementioned methodology served to mitigate the likelihood of project delays by prioritizing crucial components during earlier stages of development, thus preventing their relegation to subsequent phases. This approach ultimately averted the possibility of project completion being delayed.

The implementation of an approach that entails regular delivery and iteration enabled my project to garner feedback from stakeholders and end-users at an early stage, which consequently facilitated prompt alterations and enhancements before the finalization of the project (Kaim et al., 2019). The implementation of this methodology proficiently alleviated all noteworthy concerns or inaccuracies that may have resulted in project postponements and ensuing auxiliary costs. I successfully upheld exceptional levels of efficacy while sustaining focus on the project's goals and priorities through the implementation of iterative delivery of functional software. The adoption of the said approach had a significant impact on the expeditious execution of the project, thereby providing crucial support in achieving its set goals and fulfilling the requirements of multiple stakeholders.

## Proposed Testing

The project will incorporate multiple forms of testing to assess the effectiveness of the student learning management system. The above-mentioned evaluation approach encompasses functional testing, integration testing, performance testing, and user acceptance testing. The key objective of the examination is to ascertain that the system functions by the defined specifications, sufficiently meets the system requirements, exhibits user-friendliness, and presents a simple interface.

Functional testing is a testing approach that prioritizes validating the accuracy and proper functioning of all components within the system. The process entails evaluating distinct parts or units of the system to verify if they are executing the desired operations (Graham et al., 2021). An illustration of this is when the student learning management system undergoes functional testing to ensure that accessing course materials, logging into the system, and submitting assignments tasks can be accomplished effectively.

The process of integration testing entails assessing the functionality of the interconnected components contained within the system to verify their cooperation and coherence. For instance, the process of integration testing for the student learning management system will encompass a comprehensive evaluation of the system's functionality regarding the instructor's ability to upload course materials and the student's capability to easily retrieve the materials (Graham et al., 2021).

Performance testing refers to a testing approach that entails evaluating the system's performance capabilities under diverse circumstances to determine whether it can cope with a high anticipated workload. For instance, the process of conducting performance testing on the student learning management system will entail an evaluation of the system's ability to cope with an extensive influx of users all accessing the system concurrently, the process will be carried out with the help of the Selenium WebDriver tool.

User Acceptance Testing (UAT) assesses the effectiveness, functionalities, and operation of a system while taking into account the perspective of the user, this form of evaluation is critical as it ensures the system achieves the system specifications and expectations of the end-users. The primary goal of UAT is to ascertain whether the system not only satisfies the users' needs but is also user-friendly (Graham et al., 2021). For instance, the User Acceptance Testing (UAT) process of the student learning management system, will involve a comprehensive evaluation carried out to verify the system's usability by ensuring that students can easily navigate its interface, locate the required course materials, and successfully submit assignments.

Apart from the above-mentioned forms of testing, the testing phase will also incorporate both manual and automated evaluation. To ensure proper functioning, every feature of the system is checked manually. An example of this would be assessing how well the student learning management system functions across various web browsers by manually assessing the functionality of the system', its layout, and visual appeal across various web browsers, including Google Chrome, Mozilla Firefox, Microsoft Edge, and Safari.

The process of automated testing entails utilizing automated instruments to evaluate the functionality and performance of the system. For instance, the student learning management system will undergo automated testing employing Selenium WebDriver to ensure its capability to effectively accommodate a considerable number of concurrent users (Graham et al., 2021). The software tool can simulate how users interact with the web application, like selecting buttons, entering information into forms, and navigating around pages, and can offer a comprehensive analysis of the behaviour of the system.

The Agile methodology selected for the project is suitable because it permits modifications and adaptability to cater to fluctuating demands and client preferences. The methodology significantly focuses on collaboration, nurturing effective communication and resolving issues right from the start of the project, in turn establishing unity in accomplishing project goals and targets. In addition, the Agile methodology promotes a culture of transparency and accountability among project stakeholders, ensuring that the project is delivered promptly and satisfies the customer's expectations (Salza et al., 2019).

# Design

## Sequence Diagram

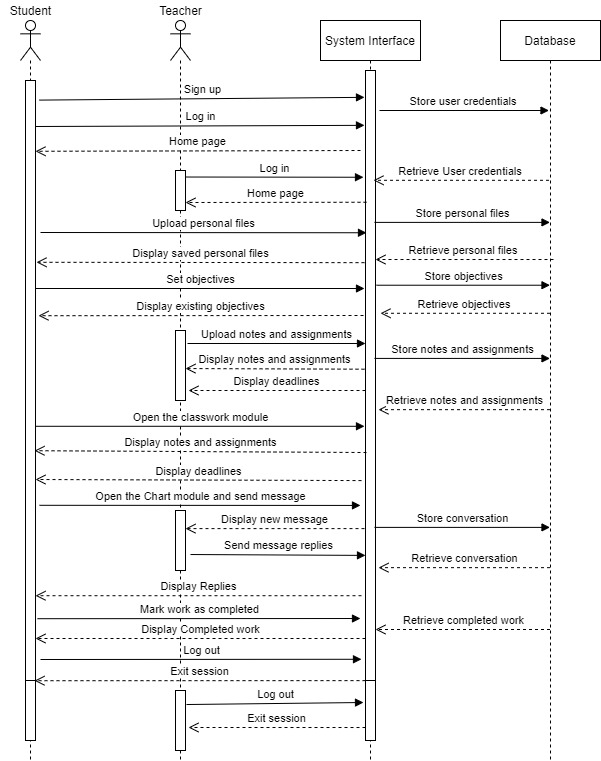


Figure 6: Sequence diagram

The above diagram visualizes the sequence diagram of the learning management system project. It consists of two actors: a student and a teacher, who interact with the system’s interface accordingly. The sequence starts with a new student signing up and then logging in using the provided credentials; the teacher also needs to log in to perform tasks on the system. After the login is successful, the home page is displayed. From the home page, both actors can perform different actions as they desire. The student can upload personal files and will be able to view the uploaded files. They can as well access classwork materials such as notes and assignments. Set and view objects, and send and receive messages from the teacher. Finally, students can mark work as completed.

The teacher also interacts with the system similarly but has different actions. The teacher uploads class work materials and interacts with students through a message interface where they can send and receive messages. All the data is stored and retrieved from the database accordingly.

## Student Activity Diagram

The activity diagram below depicts the student’s activity diagram. The activity starts when the students launch the application. If the student is new, they will need to sign up and then proceed to log in. If they already have an account, they can just sign in. On the home page, they can perform tasks such as uploading personal files, viewing notes and assignments, chatting, and setting objectives. The objectives have a critical deadline, if the deadline is over the student can mark the work as completed. They can also view their objectives at any time. The activity ends with the student logging out of the application.

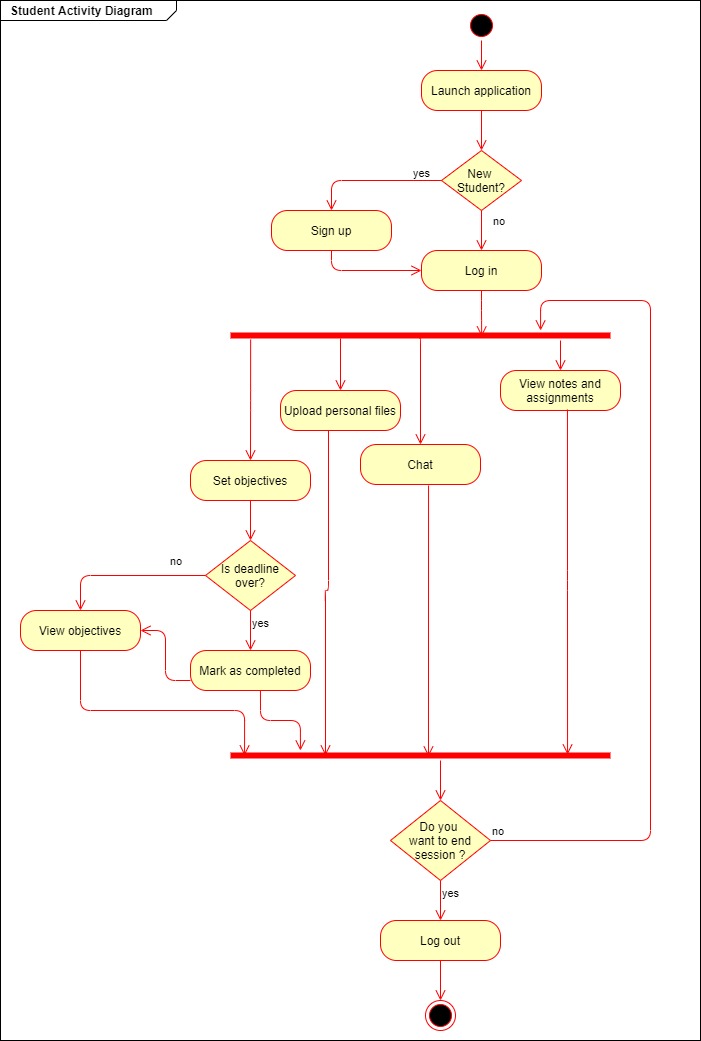


Figure 7: Student activity diagram

## Teacher Activity Diagram

The activity starts with the teacher launching the application, the teacher then logs in and can upload notes and assignments under the class work module. The teacher can also chat with a student. The activity ends with the teacher logging out of the system.

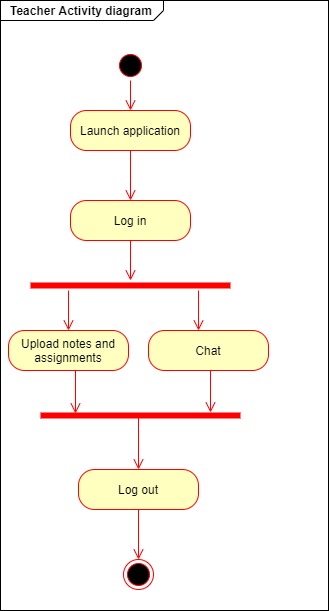


Figure 8: Teacher activity diagram

## Use Case Diagram

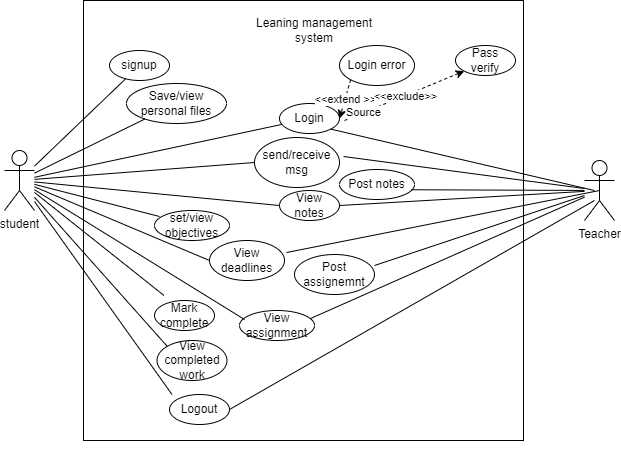


Figure 9: Use case

The learning management system consists of two actors -the student and the teacher. A student can create an account and then login into the system. They can save or upload their files and send and receive messages from their peers and instructor. Students can also view classwork (assignments and notes), set objectives, and view deadlines and reports. The teacher, on the other side, can log in, upload classwork, view deadlines and chat with students.

## User interface

### **5.5.1 Student Interface**

**Sign Up**

Student signup consists of the following fields: full name (text box), email address (text box), student ID (text box), major (drop down) password (text box) and confirms password (text box). A student can register into the Learning Management System using the signup form, where they have to fill all the fields with the correct format data format; for instance, the email must be valid, the password must be strong, consisting of at least one upper case letter, at least one symbol at least one number and minimum of 8 characters. An error message is displayed if any of the fields are missing or in an incorrect format. After successfully creating an account, a success message is returned, and the student can log into the system.

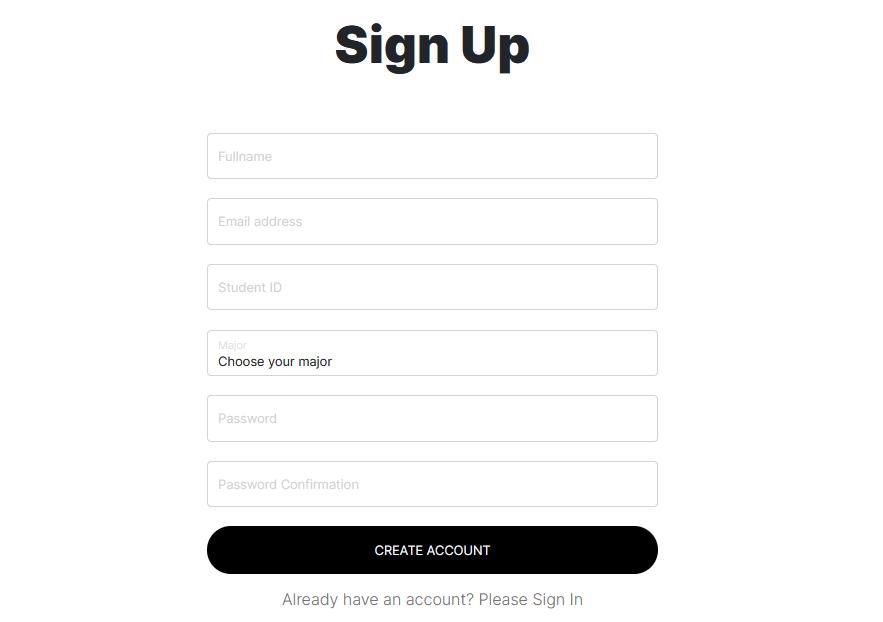


Figure 10: Students sign up

**Sign In**

The sign-in form requires the user to input a correct email address and password; the user must fill in all the fields and use the correct detail that matches the ones stored in the database. If the user uses any incorrect information, an error message is displayed; otherwise, the user can log in.

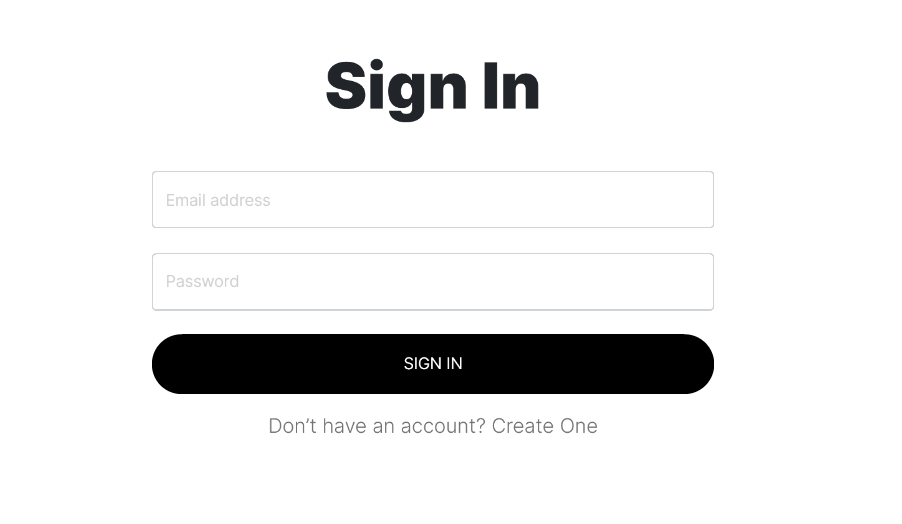


Figure 11: Student’s sign in

**Home page**

The home page has a simple graphical user interface with a navigation bar, a central panel with academic records, classwork, objectives, deadlines, completed and chat. It also has an upcoming deadline section that overviews the task due. There is also a footer which gives the necessary credits.

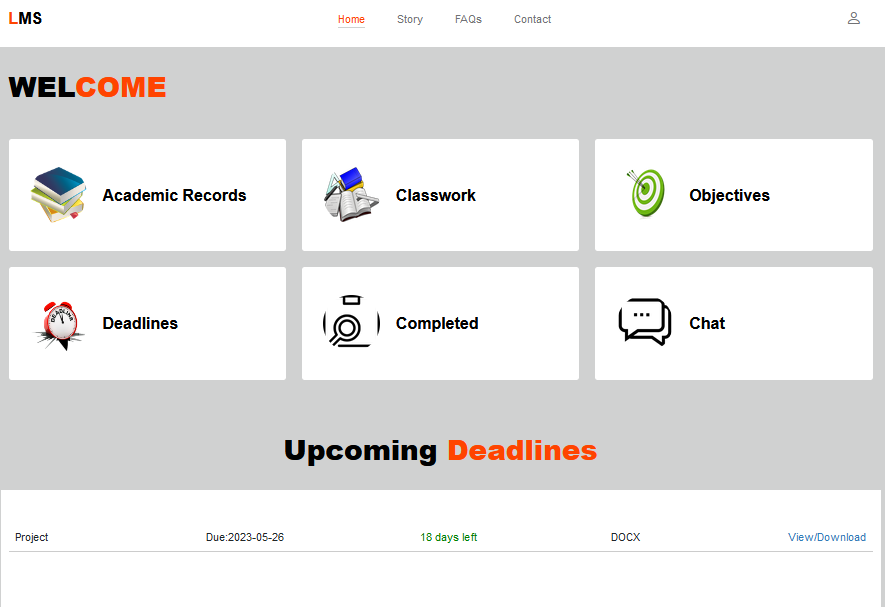


Figure 12: Student’s homepage

**Footer**

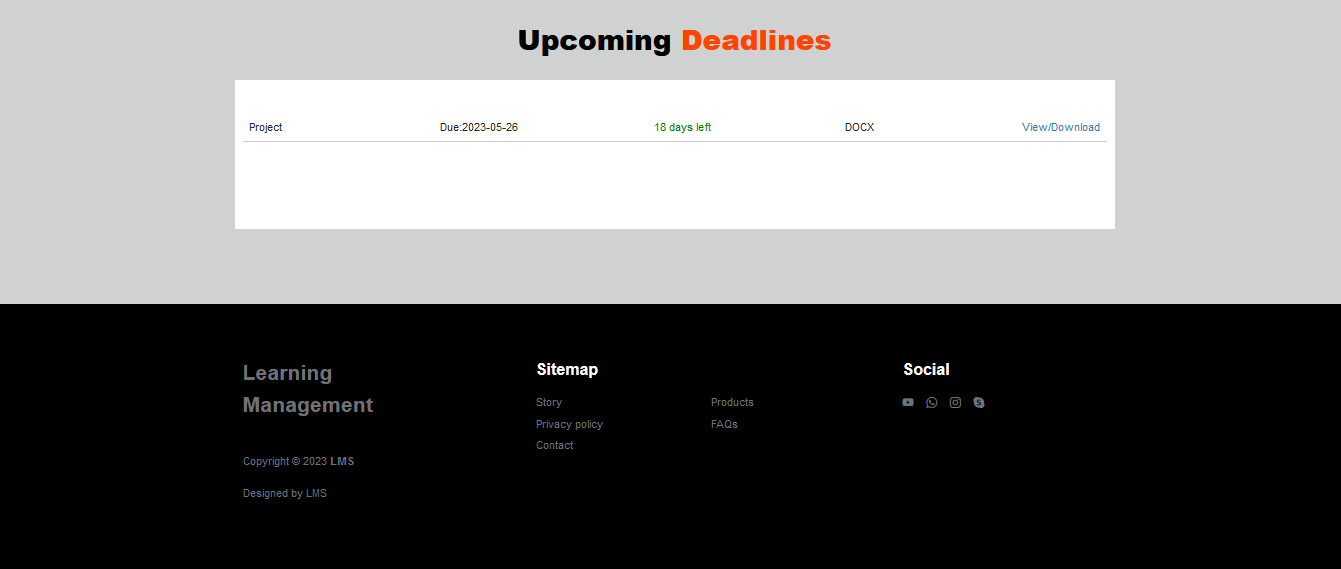


Figure 13: Footer

**Academic Records**

Academic records consist of a form which allows the student to save their files related to the course. A success message is displayed if the file is successfully saved and an error message is displayed if the file failed to save. Students can view their saved files below the input form.

Graphical user interface, application

Description automatically generated

Figure 14: Academic record

**Classwork**

The classwork sections display all the work related to official classwork uploaded by the teacher. These include class notes and assignments with captions as instructions. It shows when the files were uploaded and the number of days left on the assignment. Students can click view/download to view the class notes or assignments files.

**Graphical user interface, text, application, email, website

Description automatically generated**

Figure 15: Classwork

**Objectives**

The objectives page consists of a simple and concise form that allows students to set their objectives related to the course. The notes’ text area is used to input relevant information related to the objective, and drop-down labelled deadlines are used to choose whether the task deadline will be critical or non-critical. The due date input field is used to select dates, and the file input field is used to choose files that relate to the objectives from the local machine or computer hard drive. The upcoming deadline section is used to display objectives set by the student.

Text

Description automatically generated with low confidence

Figure 16: Objective

**Deadlines**

The deadline page displays critical and non-critical deadlines related to the student’s work. Students can see the number of days left or how many days they are overdue on a given task. In addition, they can mark a given task as complete using the ‘complete’ button.

Graphical user interface, text, application

Description automatically generated

Figure 17: Deadline

**Report**

Using a simple interface, users can see the number of completed tasks. When they are completed, the task can be viewed and checked whether the delivery was on time or late

**Graphical user interface, text, application, chat or text message

Description automatically generated**

Figure 18: Report

**Chat**

Students can chat with their peers or instructors in the chat area. They can search the search text box for the user they want to text, within the platform. Chats with messages are displayed below with a green indicator that shows a user is online.

**Graphical user interface, application

Description automatically generated**

Figure 19: Chat feature

The chat interface has the recipient's name, last seen or whether they are online. Recipient messages are positioned on the left and the sender on the right. The text area is used to type the message, and the blue icon is used to send the message.

**Graphical user interface, text, application, chat or text message

Description automatically generated**

Figure 20: Chat

### **5.5.2 Instructor Interface**

**Login**

**Graphical user interface, application

Description automatically generated**

Figure 21: Instructor Login

**Instructor’s Homepage**

The instructor’s homepage consists of a header, class notes section, assignment section and student’s chat section.

Graphical user interface, application, Teams

Description automatically generated

Figure 22: Use case diagram

**Course notes**

**Graphical user interface, application

Description automatically generated**

Figure 23: Course notes

**Assignment**

**Graphical user interface, text

Description automatically generated with medium confidence**

Figure 24: Assignment

**Student’s Chat**

**Graphical user interface, application

Description automatically generated**

Figure 25: Student’s chat

# Tools and implementation

## Tools

Creating the Learning Management System (LMS) is a complex and challenging task that needs the use of several tools and resources to complete, such as programming languages, frameworks and libraries. This section discusses tools and frameworks used during the implementation of the system including, PHP, Bootstrap, HTML, JavaScript, MySQL, XAMPP and server. The effectiveness of these tools and frameworks was obtained from feedback collected from previous developers. Through understanding their strengths and weaknesses, a learning management system that can help students organize their work, never to miss their deadlines and chat with their teachers and peers was created.

At the beginning of system implementation, I was conversant with HTML and CSS, unfortunately when it came to PHP and JavaScript, I only had basic knowledge. To improve my skills in JavaScript and HTML, I had to use online tutorials, sites such as 3wschool and stack overflow to enhance my skills. I sometimes used this website as a reference whenever I got stuck.

### **6.1.1 Programming Languages, framework, and Libraries**

**PHP**

PHP is a backend language that runs on the server’s side and is commonly used to create web applications. Its widespread use, simplicity, and compatibility with the majority of operating systems and web servers made me use the language. In addition, since it is open source, a sizable developer community participates in its creation and upkeep. Its vulnerability to security risks if improperly set is one of its drawbacks.

PHP was applied in Learning Management System to create a backend script that would communicate with the XAMPP server to retrieve and store data in the MYSQL database. In addition, the language was used to perform input field verifications such as passwords. The figure below shows a PHP script used to verify passwords in the Learning Management System.

Text

Description automatically generated

Figure 26: Verify password PHP

**JavaScript**

A client-side scripting language referred to as JavaScript was necessary for making Leaning Management System interactive; this is one of its main advantages. In addition, it was used to include dynamic content, such as pop-up windows and animations, on web pages. Additionally, open-source, JavaScript has a sizable plugin and framework library that allowed the use of functional expansion for instance jQuery. The figure below shows a JavaScript code that is used to create the scroll-down functionality of the chat interface in the Learning Management System.

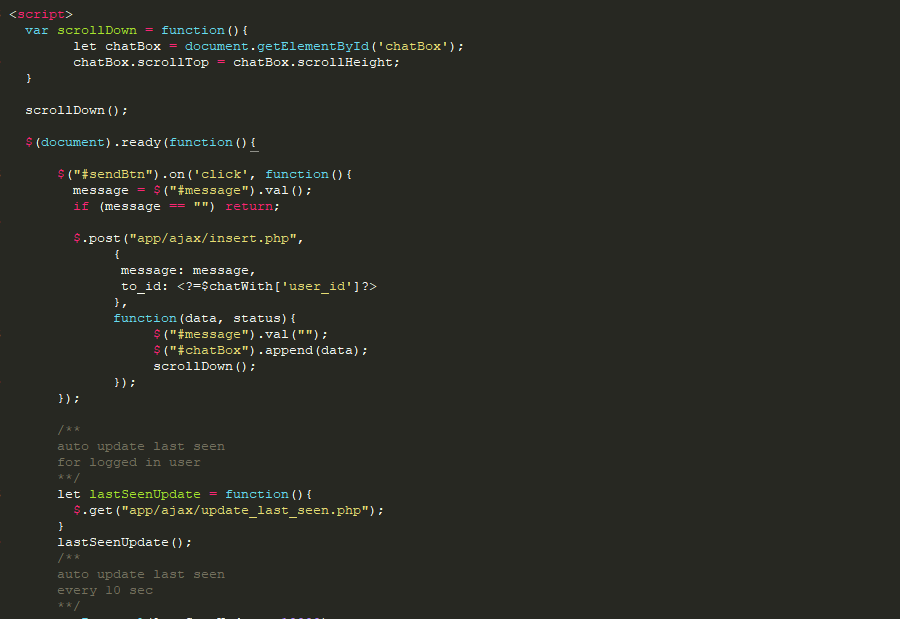


Figure 27: Chat interface

The main concern of using JavaScript is its security flaws since the language executes on the client side. The language is vulnerable to various attacks such as cross-site request forgery (CSRF) and cross-site scripting (XSS). In addition, JavaScript proved to be extremely hard to debug, when an error would occur, it would take a lot of time to debug

**CSS and Bootstrap**

CSS (Cascading Style Sheets) is a language that is used to determine the arrangement and presentation of HTML elements. Bootstrap is a framework that incorporates both JavaScript and CSS to create responsive web applications. Learning Management System employed both CSS and Bootstrap to achieve a perfect interface that is responsive. Bootstrap provided a consistent and customizable component that was easily integrated into the system. Its limitation is when it limited creativity as a result CSS was used in such instances. The figure below shows the bootstrap and CSS files used in the system.

Graphical user interface, text, application

Description automatically generated

Figure 28: CSS files

**Database and server**

**XAMPP server**

XAMPP is an open-source cross-platform webserver that consists of MYSQL, Apache, Perl and MYSQL. The main reason this webserver was used is that it's free, and it also offers an easy-to-use environment that simulates the actual production server. It was used to create a database and install PHP for the development of the Learning Management System.

Graphical user interface, application

Description automatically generated

Figure 29: XAMPP

**MYSQL**

MYSQL is a widely used relational database management system. It is reliable fast, and scalable as a result it was used for data storage. In addition, MYSQL is highly compatible with PHP which made it easy to integrate during development. Using MYSQL, it was possible to create a robust and scalable database system to store students’ data, notes, assignments, deadlines, chats, and teacher data. Furthermore, it is supported by a wide range of hosting providers making it easy to deploy the system. The drawback of using MySQL is its security vulnerability when improperly configured.

Graphical user interface, application

Description automatically generated

Figure 30: MySQL

Graphical user interface, text, application, email, website

Description automatically generated

Figure 31: DB table

### **6.1.2 Integrated Development Environment**

**Sublime**

During the development of the Learning Management System, sublime text was used to write and edit web pages and files. This is because the application is fast, has minimal lags and starts up quickly and is easy to use due to its clean interface. One of the main challenges that was experienced with sublime text is its lack of an inbuilt debugging tool making debug process hard and time-consuming.

Text

Description automatically generated

Figure 32: Sublime text interface

## Implementation

### **6.2.1 Introduction**

A learning management system is a web application developed using PHP, JavaScript, CSS and Bootstrap, HTML and MYSQL database. This section provides an overview of the implementation approach employed to develop LMS.

### **6.2.2 Main code**

A Learning management system consist of two actors/users, a student and a teacher (Figure 9: Use case page p.55). A student must sign up to use the system whereas a teacher's credentials are provided by the school or created on behalf.

A teacher can log in to the system and access three key features, the ability to post and view notes, the ability to post assignments and set deadlines; they can view the assignment’s files and the number of days left to the deadline. In addition, they can view messages sent by students and reply.

Upon login, a student can save personal files related to the course and retrieve them later. This includes pdf files, images or docs files. They can see the posted notes with a caption on them as instructions. Moreover, they can view posted assignments with their due dates and set their own personal objectives and overall deadlines for all activities in the system. The deadlines are divided into critical and non-critical, with their due dates and a label indicating whether they are late. In case of any queries, they can chat directly with their teachers or their peer students. If they need to see how much they have completed or the deadlines missed, they can do so in the report section.

**Signup**

The signup form is created using HTML CSS and Bootstrap. The form has an action attribute that points to a PHP file where the form data will be processed and stored. The method attribute is set to "post, " meaning the form data will be sent to the server as an HTTP POST request. The input fields from the user (signup form) are stored in a super global array $\_POST. The inputs are then validated using PHP, where empty fields are checked, and ensure the email format is valid using FILTER\_VALIDATE\_EMAIL. In addition, passwords are checked to see whether they match or not.

The error messages are crucial to guide users through the signup process by making them understand what is going on or what went wrong if there is any issue with the signup process.

The error message is triggered through an if-else statement that examines whether the ‘submit’ button was clicked or not in the signup form. If the ‘submit’ button was clicked, the PHP script proceed to analyze the user inputs for error through the use of conditional statements.

The code uses the password\_hash() function to hash the password before inserting it into the database; this ensures the password is securely stored. SQL query stores data in the database. A success or message is then passed back to the user.



Figure 33: sign up code

**Sign-in**

Users must sign in using the correct password and email to access the system’s resources. The sign-in form data is passed to a PHP file that authenticates user input by comparing the data stored in the database with the user input provided. If the input matches, the user can log in; otherwise, an error message is displayed.

When the user fills in the sign-in form with the relevant details, the PHP authenticator file accesses email and password using the $\_POST global variable. Fields are checked to determine whether they were properly filled or not. If any field is empty or the email is invalid, an error message is displayed using JavaScript.

SQL query is executed to retrieve the user’s data from the database using the email entered by the user. If the query fails to execute, an error message is displayed. If the query successfully executes and at least one row is returned -meaning the user exists- the mysqli\_fetch\_assoc() function retrieves the user’s data.

The script confirms that the password entered by the user matches the hashed password using the password\_verify() function. If a match occurs, a session is started using the session\_start() function and redirects the user to the homepage.



Figure 34: sign in code

**Add academic records/Classwork/Objectives**

Code has been reused in instances where uploading of files and other data into the database has taken place in the system, especially when it comes to academic records, classwork and objective uploads. All these sections consist of the data input field and a file input field. The input data is submitted to a PHP file through a post method using a button method.

Files are uploaded into the system on the above three areas as follows: The file information is retrieved using the $\_FILES array from the input field. This includes file name, type, size and temporary location. Next, the script confirms whether file type is allowed. After verification, the script creates a unique file name through the uniqid() function. This ensures that the file names never conflict with the existing files. The code then saves the file to the ‘AcademicRecord’ folder using the move\_uploaded\_file() function. The new filename and the rest of the data filed by the user are inserted into the database using SQL query.



Figure 35: Insert files code

**Display of deadlines/classwork/academic record/completed task**

SQL SELECT statement is used to display data to users from the database. The SELECT statement is executed through the mysqli\_query() function, which takes two parameters-DB connection object ($conn) and SQL ($query). Rows from the database are retrieved using SQL query.

The while loop is used to retrieve all the instances of data retrieved from the database then an echo is used to display data using variables $row to the user. Echo Is used to display data between HTML lines such as dates, file types, actual files etc.



Figure 36: Display files

**Main chat Display**

Main chat display lists chats between the logged-in user and other users. The first thing it does is see if any existing conversations can be displayed. If there are, it goes through each conversation in turn and displays the users' names and the most recent messages sent between them. Additionally, based on the user's most recent sighting, it displays the user's status online or offline. If no discussions are available, a notice asking the user to start a new chat is displayed.



Figure 37: Chat display

Additionally, the code contains two search features that let users look for a particular chat by putting a term into the search box or by hitting the search button. The code refreshes the discussion list with the search results when a user types a search phrase or clicks the search button, sending an AJAX request to the server to receive the results.



Figure 38: Chat search

Furthermore, two functions in the code are also used to automatically update the user's last seen time. The second code updates the last seen time every 10 seconds, while the first function updates the last seen time when the page initially loads.

### **6.2.3 Novel code**

The following code below shows a PHP query that displays files and dates to the user interface. The whole code is not novel; however, the code section that creates a new Date Time object for the current date and then creates another Date Time object for a future date is novel. The novel code calculates the difference between the current and future dates (inserted by the user as the deadline dates) to determine how many days are left to the deadline or how many days have passed after the deadline. The novel code also helps to determine when a task is late or when the task still has time left. This code is very important since it helps inform the user how many days are left on the task and helps their planning.



Figure 39: Display code





Figure 40: Novel Code

### **6.2.4 Adapted code**

The signup and sign-in interface were adapted from w3school (n.d.). However major Modifications were made whereby CSS was modified and Bootstrap was added to make both the sign-in and sign-up responsive and better looking. In addition, a few ideas were also borrowed from Bootrap's (n.d.) official website (getbootstrap.com). The idea used in the signup and sign-in authenticator files was borrowed from PHP Tutorial. (n.d.). Although a lot of was borrowed intensive modifications were made to make the code fit LMS web application needs. The use of error messages was quite challenging at first, I wanted to use a prompt that consist of JavaScript code and PHP this idea was obtained from stack overflow (n.d.). In addition, stack overflow played a critical role in solving my syntax errors whenever I got stuck through their question-and-answer forum.

The slider, the navigation bar and the footer were adapted from Bootstrap. (n.d.). In this case, only a few modifications were made like changing the colour of the labels, adding labels and my web application logo (LMS).

The chat feature is critical to my project; this was the first time implementing this. As a result, I adapted several codes from YouTube tutorials (Codecourse,2015) (Chat with Elias,2021). While adapting the code, I made several areas that helped the code fit into my project’s requirements, such as modifying the displays and queries. I made several changes to the font, labels, and colours. On the queries, I adjusted the SQL to display only the data I needed on my interface.

### **6.2.5 Gained skills**

I found developing a sign-in and signup form with HTML and CSS to be more challenging than I anticipated. I had to learn how to create a form action that points out the PHP file that needs to receive user data for processing and retrieval/storage of data in the database. I also learned how to use the $\_POST super global array to store input fields from the user. Additionally, I learned how to validate the input fields using PHP, where empty fields were checked, and the email format was validated using FILTER\_VALIDATE\_EMAIL. Passwords were also checked to ensure they matched. This was the first skill I gained.

In addition, the second skill gained was learning how to generate error messages using php and JavaScript. Error messages were triggered using an if-else statement examining whether certain conditions were met.

Reusing the code was always going to be very crucial in speeding up the coding process. I had to learn how to reuse my code throughout the system. In instances where file uploads were necessary for the system, particularly in adding academic records, classwork, and objectives. I created input data and file input fields, which were submitted to a PHP file through a post method using a button method. Files were uploaded into the system, and the file information was retrieved using the $\_FILES array from the input field. The code then saved the file to the appropriate folder using the move\_uploaded\_file() function.

Another skill I gained was using the SQL SELECT statement to display data to users from the database. The SELECT statement was executed through the mysqli\_query() function, which took two parameters-DB connection object ($conn) and SQL ($query). Rows from the database were retrieved using the SQL query.

JavaScript, PHP, MYSQL, AND CSS were all used to create a chat interface, during which I gained various skills applicable to my future projects. To begin with, I managed to learn how to design a chat user interface through CSS and Bootstrap. In addition, I implemented interactive chat features such as sending messages, showing online status, and last seen with date and time.

I learned how to handle user inputs and the storage process in the database. I created a form allowing users to search and send messages and submit them to a PHP file through the POST method. I used the $\_POST superglobal array to retrieve the message and the user's ID from the form. Then, I stored the message in the database using an SQL INSERT statement.

I also learned how to retrieve and display messages from the database to the relevant users. SQL SELECT statements were used to obtain data from the database and display it to the user chronologically.

Lastly, I learned how to optimize chat through AJAX, which helped me retrieve messages from the database without refreshing. This increased chat efficiency and reduced load time.

# Testing

## Test coverage

Testing plays an integral role in the process of software development as it serves to verify the attainment of necessary specifications and the proper functioning of applications. In the domain of software development, a range of testing techniques includes unit testing, integration testing, performance testing, and user acceptance testing. Furthermore, two predominant methodologies for software validation against stipulated requirements are black-box testing and white-box testing.

### **Unit testing**

The practice of unit testing entails subjecting discrete code units, namely functions, and procedures, to testing procedures to determine their operational efficacy and accuracy (Graham et al., 2021). The objective of applying unit testing is to detect and rectify defects in code during the initial stages of software development to mitigate the expenditure associated with addressing such issues during subsequent phases of development. The present study involved the execution of unit testing on the PHP code utilizing the PHPUnit testing framework.

Test Case: test\_create\_new\_account\_with\_unique\_username\_and\_password

The present test case serves to verify the capability of the system to comply with the learning system requirement, which entails enabling users to generate a novel account utilizing a distinctive username and password. The test protocol comprises sequential processes involving the generation of a novel user profile, validation of its successful completion, and an experimental endeavour to generate an additional user with identical login credentials. The anticipated outcomes are intended to ensure that the system functions by the established expectations. Specifically, upon successful creation of a user account, a confirmation message is displayed, whereas, if the username and password combination has already been taken, an error message is prompted.

### **Integration testing**

The integration testing methodology serves as a testing technique utilized to evaluate the collective functionality of individual units of code operating as a cohesive group (Graham et al., 2021). The primary objective of integration testing is to detect and rectify any flaws that result from the interplay among diverse modules of software code, thereby ensuring that the eventual product is devoid of such defects upon its deployment. The present study involved the execution of integration testing as a mechanism to evaluate the inter-module functionality within the system. As an illustration, the Login module underwent testing to ascertain its seamless integration with the User module as well as other system modules.

**Integration Test Case:**

Preconditions: A user has completed several assignments.

Actions: The user signs in to their account and goes to the page that shows the completed tasks and assignments.

Expected Result: This page shows how well the user is doing over time regarding the assignments. It includes how many assignments they finished and how much time they spent on each activity.

Postconditions: The student can see how they are doing in terms of task completion and use that to find out where they need to work harder.

### **Performance testing**

Performance testing is a method employed to evaluate an application's functionality within given conditions, such as high user traffic, heavy usage, or pressure. Performance testing serves the purpose of pinpointing performance obstacles and improving the overall performance of the application before its launch (Graham et al., 2021). This project involved conducting performance tests to guarantee the system's ability to handle heavy traffic without experiencing any crashes. The system underwent testing by simulating heavy traffic to ensure that it could maintain speed and stability without any delays or failures. To illustrate, assessing the performance of the student learning management system involves examining how effectively it can handle a large volume of users accessing the system simultaneously. This process will be facilitated by the utilization of the Selenium WebDriver software.

### **User acceptance (UAT)**

UAT is a method of evaluating an application's functionality and user-friendliness from the viewpoint of its intended user group (Graham et al., 2021). The purpose of UAT is to verify whether the application is in line with the needs and desires of the final user. In this undertaking, the User Acceptance Testing phase was carried out by engaging the system's end-users to assess its functionality and furnish constructive criticism. As an illustration, the system's functionality, usability, and navigation were evaluated by the end users.

Test Case:

* User logs in to the learning system.
* The user navigates to the learning plans section of the system.
* The user clicks on the "Create New Learning Plan" button.
* The user enters the required information for the learning plan, including a title and description.
* The user saves the learning plan.
* The user verifies that the learning plan has been added to their list of learning plans.
* The user navigates to the learning plan details page and verifies that all information entered is displayed correctly.
* The user edits the learning plan by adding new goals and objectives.
* The user saves the changes and verifies that they have been successfully saved.
* The user deletes the learning plan and verifies that it has been removed from their list of learning plans.

Expected Result: The user be allowed to generate and manage their learning objectives without encountering any form of hindrances or challenges. The system ought to precisely show all the data entered by the user and accommodate effortless modification and deletion of the learning objectives.

### **Black-box testing**

Black-box testing is a methodology employed to evaluate an application's efficacy without any comprehension of its internal operations. The primary objective of black-box testing is to detect system defects that may affect its performance and verify that the system operates according to its intended function (Irawan et al., 2018). During this undertaking, the black-box testing procedure was employed to verify the system's compliance with predetermined criteria and specifications. To illustrate, the functionality of the system was verified by conducting tests to confirm its ability to incorporate new users, modify user data, and eliminate users as needed.

Test Case: Create an objective

System requirement: Users should be able to create a new study objective and specify the level of urgency.

Precondition: The user is logged in to the learning system.

Test Steps:

1. Navigate to the objectives page.
2. Click on the "Create New Objective" button.
3. Enter a name and description for the new objective and add a level of urgency.
4. Click the "Save" button.
5. Verify that the new objective appears in the list of objectives.
6. Click on the newly created objective and add the level of urgency.
7. Click on the "Save" button.
8. Verify that the level of urgency is successfully added to the created objective.

Expected Result:

The new objective should be created and the level of urgency should be added to it.

### **White-box testing**

White-box testing is an analytical testing methodology employed to evaluate the internal functioning of an application. The primary objective of white-box testing is to detect flaws in the code of the system and guarantee the optimization of code functionality (Irawan et al., 2018). Through this project, an evaluation of the PHP code was executed through the implementation of the white-box testing approach utilizing the PHPUnit testing framework and thoroughly guaranteeing the code's optimal execution in terms of performance.

To guarantee a thorough examination of the system, precise testing scenarios were formulated and categorized by corresponding prerequisites. As an illustration, in the Login module, testing scenarios were formulated to examine whether the system authenticated the user's credentials, authorized entry to the system upon correct login data input, and restricted entry in the event of erroneous login data entry by the user.

Test Case Title: User Authentication and access control

Test Objective: To verify that the system correctly verifies the user's credentials and grants/denies access based on the input

Preconditions:

* The system is running
* The user is registered in the system
* The user has a valid username and password

Test Steps:

* Enter a valid username and password
* Click on the "Login" button
* Verify that the system successfully authenticates the user's credentials
* Verify that the system grants access to the user if the correct login details are entered
* Verify that the system denies access to the user if the incorrect login details are entered

Expected Result:

* The system should verify the user's credentials and grant/deny access accordingly.
* If the user enters the correct login details, the system should grant access and allow the user to proceed to the system dashboard.
* The system should deny access and display an error message if the user enters incorrect login details.

Test Data:

* Username: "john\_doe"
* Password: "password123"

Test Outcome:

* If the system verifies the user's credentials and grants/denies access accordingly, the test passes.

If the system fails to verify the user's credentials or does not grant/deny access as expected, the test fails.

## Test methodology

The learning system's output underwent comprehensive testing to verify its adherence to stipulated criteria and its capacity to generate projected outcomes. A combined approach of manual and automated testing was implemented to substantiate the proper functioning of the application and to detect any flaws during the initial phases of development. The process of verifying whether the application satisfies the specifications, encompassing both functional and non-functional requisites, was performed through manual testing. During quality assurance, I conducted manual testing following a predetermined testing checklist to verify that all features and functionalities were thoroughly examined in compliance with the specified requirements. The manual testing procedure incorporated regression testing, which entailed examining previously implemented features to confirm their continued correct functioning. Utilizing manual testing techniques enabled us to detect any potential anomalies and faults within the application, which would have otherwise remained unnoticed.

Automated testing was utilized to conduct assessments of the application. The implementation of automated testing facilitated the efficient reproduction of test cases, yielding significant utility in the identification of anomalies within the application (Graham et al., 2018). Automated testing tools, namely Selenium, were employed to mechanize the testing procedure and facilitate the evaluation of diverse scenarios. This approach has enabled the early detection of any inaccuracies during the developmental phase, thereby mitigating the time and expenditure involved in the developmental processes. To obtain feedback, a combination of expert and non-expert users was solicited. Expert users were characterized as individuals possessing significant experience in the realms of software development and testing and were capable of offering noteworthy assessments regarding the quality of the software. An expert evaluation was acquired through the implementation of code reviews and walkthroughs. Code reviews facilitated the detection of any glitches, faults, or discrepancies in the code, whereas walkthroughs provided an opportunity to scrutinize the application's functionality while leveraging the insights of a proficient evaluator (Graham et al., 2018).

Individuals who lacked technical expertise, herein referred to as non-expert users, were capable of offering feedback on the usability and user experience of the application. Obtaining non-expert feedback was achieved through the conduction of user testing sessions. Through the implementation of these sessions, users were observed engaging with the application to discern any potential usability concerns and complications regarding their experience. The feedback provided aided in comprehending the user's viewpoint, thereby being pivotal in effecting enhancements to the application. Incorporating the feedback garnered from both proficient and unskilled users, we implemented enhancements to enhance the application. The utilization of the iterative method facilitated the ongoing enhancement of the application, thereby guaranteeing that it satisfied the requisite quality standards (Ruiz et al., 2020). After incorporating feedback and implementing necessary enhancements, we successfully developed an application that exhibited ease of use, fulfilled all prerequisites, and generated the anticipated results.

In conclusion, the practice of testing is a crucial undertaking that is aimed at verifying if an application conforms to the prescribed specifications and delivers the anticipated outcomes. The utilization of a mixture of manual and automated testing methodologies facilitated the early detection of potential defects during the developmental phase, resulting in cost and time efficiencies. Acquiring feedback from both expert and non-expert users facilitated our comprehension of the user's outlook and enabled us to implement essential enhancements to the application, which ultimately culminated in a product that satisfies requisite quality standards.

# Conclusions and reflections

The project was aimed at developing a learning management system to enhance student learning experience in higher education institutions. The project lifecycle involved various stages such as planning, design, development, testing, and implementation. In this section, we will critically reflect on each aspect of the project lifecycle and evaluate how effectively the results met the stated objectives.

Planning phase: In the planning phase, the project's objectives were established, accompanied by the identification of requirements and the definition of its scope. In addition, market research was carried out to ascertain extant learning management systems and their corresponding functionalities. Nevertheless, during the planning phase, certain hurdles were encountered, which included inadequate communication channels and poorly defined requisites. The challenges mentioned posed a hindrance to the timely initiation of the project and subsequently mandated a revision of the project plan.

Design phase: During the design phase, I was able to craft a user interface design and formulated a database schema to store the pertinent data of the system. The success of the design phase was attributed to the active involvement of all stakeholders in the design process, thereby ensuring that the design met their specified requirements and expectations. Nevertheless, the project encountered certain impediments that included a lack of proficiency in terms of database design, ultimately leading to reduced efficiency in the design.

Development phase: During the development phase, the system's features were conceptualized and subsequently incorporated within the system. The successful outcome of the development phase was attributed to the adoption of the Agile methodology, which proved to be efficacious in promoting stakeholder collaboration and improved communication. The iterative approach employed by Agile methodology facilitated the timely testing and feedback, thereby enabling timely detection and rectification of any anomalies in the developmental process. During the developmental phase, several challenges were encountered, including integration issues, which ultimately led to project delivery being delayed.

Testing phase: During the development phase, the system's features were conceptualized and subsequently incorporated within the system. The successful outcome of the development phase was attributed to the adoption of the Agile methodology, which proved to be efficacious in promoting collaboration and improved communication. The iterative approach employed by Agile methodology facilitated the timely testing and feedback, thereby enabling timely detection and rectification of any anomalies in the developmental process. During the developmental phase, several challenges were encountered, including integration issues, which ultimately led to project delivery being delayed.

Implementation phase: During the implementation phase, the application was deployed on the web server and rendered accessible to the end users. The successful implementation of the project was evident as the deployed application exhibited no significant issues. Notwithstanding, there were certain impediments, notably concerning the acceptance and utilization by users, that led to a suboptimal acquisition of the system.

**Conclusions on the system, research, and findings**

The learning management system that has been created through this project presents a promising opportunity to augment the educational experience of individuals in higher education establishments. The system is equipped with a multitude of functionalities, including but not limited to course management, assessment management, and communication tools. Such features empower both instructors and students with the ability to effectively regulate their respective educational pursuits. The previously mentioned system exhibits a high degree of user-friendliness and navigational ease, thereby resulting in improved usability and increased adoption. In the sphere of research, this project has provided an augmentative contribution to the extant collection of information about learning management systems. This study has disclosed the fundamental features of a learning management system and its potential to improve the educational experience in institutions of higher learning.

The investigation's results demonstrate that the Agile methodology is a proficient strategy when it comes to the development of software. The employment of an iterative approach in Agile facilitated the frequent testing and feedback cycles, thereby facilitating early identification and resolution of any potential issues during the development phase. The employed methodology effectively enabled collaboration and communication, culminating in the successful delivery of the project.

Strengths and weaknesses of the implementation

One deficiency worthy of consideration pertains to the project timeline, as it was significantly constricted, thereby limiting the margin of error or allowance for unforeseeable interruptions. Consequently, I was compelled to operate under substantial stress to meet the set timelines, which possibly compromised the quality of their output.

Shortcomings aside, the task exhibited notable strengths. Firstly, the stakeholders demonstrated effective collaboration and knowledge sharing, resulting in a seamless progression of the project. Moreover, the adoption of Agile methodologies facilitated the maintenance of project concentration and advancement towards the predetermined goals. The union of both manual and automated testing techniques facilitated an exhaustive evaluation of the system, ensuring that it satisfied the requisite standards of quality.

In summary, the endeavour yielded desirable outcomes by fully attaining the designated targets. Moreover, the resultant system has been effectively operationalized and satisfactorily caters to the requirements of the end users. Despite its current capabilities, there are still opportunities to improve the system and make it more functional and user-friendly in future developments. Subsequently, potential future endeavours may centre on augmenting the system's reporting functionalities, refining its user interface, and integrating supplementary functionalities by user feedback and requisites. Additionally, future investigations could be conducted to elucidate how the mentioned system can be leveraged in alternative environments or to facilitate diverse forms of educational encounters

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# Appendix I

Use one Appendix to provide a link to an online video demo of the project.

<https://drive.google.com/drive/folders/15DXQUAVVUmOinGy-39d25r1LI5bx3EWD?usp=share_link>