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# Abstract

The effective management of coursework deadlines is critical for ensuring student performance and well-being. Since the incorporation of technology into education, time mismanagement and late submissions have significantly increased on Learning Management Systems (LMS). In this dissertation, we aim to address this issue by developing a website to manage and visualise coursework deadlines. We will integrate the website with self-regulation and time management strategies to help students initiate and complete coursework earlier, reducing the risk of missing deadlines. To attain this, we will use visualisation techniques such as gamification components and regular reminders to motivate students and instil deadline awareness in them. Lecturers will be able to manage deadlines and track submissions made by all students throughout the coursework duration. To ensure top-notch pedagogical usability, the website will be evaluated using Heuristic Evaluation (HE) and System Usability Scale (SUS). The website will serve as a proactive tool to manage coursework deadlines by distributing the workload evenly and promoting incremental completion of coursework.

**Keywords: Coursework, Deadlines, Visualisation, Gamification, Usability, Time Management.**

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# List of Abbreviations

|  |  |
| --- | --- |
| AI | Artificial Intelligence |
| API | Application Programming Interface |
| AR | Augmented Reality |
| BCM | British Computer Society |
| CPS | Cyber Physical System |
| FAQ | Frequently Asked Question |
| GPA | Grade Point Average |
| HE | Heuristic Evaluation |
| IoT | Internet of Things |
| IR | Industrial Revolution |
| ISO | International Organisation for Standardisation |
| LAD | Learning Analytics Dashboard |
| LMS | Learning Management System |
| MOOC | Massive Open Online Course |
| MVP | Minimum Viable Product |
| OOP | Object-Oriented Programming |
| OOUX | Object-Oriented UX |
| PJ | Project Journal |
| SMS | Short Message Service |
| STEM | Science, Technology, Engineering and Mathematics |
| SUS | System Usability Scale |
| TBD | To Be Decided |
| TMT | Temporal Motivation Theory |
| UI | User Interface |
| UX | User Experience |
| VR | Virtual Reality |
| WAF | Web Application Firewall |
| WBS | Work Breakdown Structure |
| XR | Mixed Reality |

# Chapter 1. Introduction

## Project Background

Coursework is a form of assessment that challenges students to apply knowledge in solving real-world problems through assignments, reports, dissertations, and more [1]. This practical approach has shown increased academic performance and satisfaction among students. With technology rapidly spreading globally, the education sector has introduced digital platforms such as learning management systems (LMS) to further assist students in their academic pursuits. LMS serves as e-classrooms where students can access study materials and submit assignments from home. Despite the many advantages of LMS, students often struggle to manage time and meet coursework deadlines. Statistics reveal that 50% of students delay starting coursework, and 75% submit their work within the last 48 hours, leading to heightened stress and late submissions [2] [3].

As coursework is a critical part of the degree, failure to meet deadlines can result in poor grades and subsequent depression. A Swedish study of 6,146 participants indicated that 20% of students aged 19-33 reported suicide thoughts and 3% attempted suicide. Upon further research, a positive relation was discovered between suicide attempts and school performance after considering factors like family background, social conditions, drug addiction, and health behaviours [4]. Researchers have addressed this issue by observing student behaviour through data analysis from LMS to uncover patterns. Upon evaluation, researchers found that delayed coursework is mainly due to a lack of self-control and time mismanagement [5]. Strategies to motivate students to start coursework early have been suggested, including setting proper deadlines, gamification, dashboards, task prioritisation, work breakdown structures, and time management. These strategies have shown positive results in experiments using various technologies alongside LMS. Research claims that integrating such self-regulation strategies into learning can help manage time [6].

While several LMSs exist in the market, they lack pedagogical usability and effective features for managing coursework deadlines, leading to increased stress and last-minute submissions. To address these challenges, this project proposes Coursework Wizard, a website designed to help students manage deadlines more effectively by incorporating proven strategies from experts in computer science and psychology. The website is inspired by Canvas, the LMS used at Heriot-Watt University, which has the highest usability score among all LMSs [6]. Coursework Wizard helps students break down their coursework into small, manageable milestones and summarises deadlines in an interactive, Gantt chart-like calendar. Students can track their progress visually through gamification modules that motivate them and provide real-time feedback on their performance. This incremental approach reduces last-minute anxiety and allows students to review their work before submission, improving both the quality of their work and their grades. The site also ensures academic integrity, as the step-by-step progress allows for clear evidence of the student’s own work. Ultimately, Coursework Wizard provides a comprehensive tool for managing deadlines, staying on track, and reducing stress, ensuring students can complete coursework on time with a higher degree of ownership and confidence.

## Aims and Objectives

The aim of this dissertation is to develop an engaging and usable website to help students and lecturers effectively manage and visualise up to four coursework deadlines. The system will integrate self-regulation and time management strategies in order to motivate students to start and finish coursework earlier. The primary objectives of the project are as follows:

* Visualise student progress to monitor performance and manage time
* Incorporate gamification modules to motivate students
* Provide regular reminders to maximise student engagement
* Display student submission statistics to lecturers
* Allow staff to track student performance and progress
* Conduct tests to evaluate usability and refine the website

## Report Outline

The organisation of the subsequent chapters in this document is as follows:

* Chapter 2: Constitutes the literature review to provide background on coursework submission and reasons for delays. Moreover, it also explores learning management systems and usability evaluation techniques.
* Chapter 3: Discusses the system requirements and prioritises them using MoSCoW. It also outlines the development and evaluation methodology selected for the website.
* Chapter 4: Presents the professional, legal, ethical, and social aspects of the project.
* Chapter 5: Concludes the document by presenting the project plan and risk assessment.

# Chapter 2. Literature Review

To encourage timely coursework submissions, it is crucial to understand the importance of coursework, the reasons behind late submissions, the role of learning management systems, and the significance of usability. This chapter will look into these aspects to grasp the aims and objectives of this dissertation. Every section concludes with a brief paragraph critically analysing the previous works and connecting it with the website developed.



## Pedagogical Background

### Historical Evolution of Coursework

Around 50 years ago, Michael Bassey introduced formal assignments, or coursework, to pedagogy after completing his teacher training programme. The programme used a combination of coursework and examinations for assessments, and 98% of students were satisfied with this twofold approach. Bassey favoured it for its positive impact on stress reduction and improved performance [7]. In 1977, Derek Rowntree and John Heywood introduced alternatives to unseen exams, such as open-book, pre-released, and essay exams, to better assess students' strengths, weaknesses, and interests [8] [9]. They noted that while two people may perform the same action, their experience and motivation can differ significantly [10]. In 1985, it weighed 34% of the total marks and increased to 79% in 1994. By 1996, coursework became widespread across the UK [9].

### Definition and Significance of Coursework in Education

Coursework refers to assessments completed over a longer period, either individually or collaboratively, such as assignments, dissertations, reports, and class assessments [9] [1]. It helps develop time management and teamwork skills, fostering collective responsibility and interaction with industry experts [12].

Coursework has positively impacted academic performance, with the percentage of first-class degrees in the UK rising from 39% to 68% between the 1950s and 2013 [9]. A 2024 study found that replacing exams with coursework worth 60% of the final grade contributed to grade inflation and increased the distribution of top-ranked degrees [12]. This suggests that coursework, whether used alone or with exams, leads to higher marks due to its collaborative nature, whereas exams, though resistant to AI manipulation, often encourage cramming that doesn’t reflect professional practice [11] [13]. Furthermore, coursework has long-term benefits, as students engage consistently over time, demonstrating broader abilities and developing strategic thinking. A Norwegian study found that 70% of students applied their coursework knowledge in their professional lives [14].

However, the lack of invigilation in coursework opens the door to plagiarism and contract cheating. While anti-plagiarism systems can detect some forms of cheating, they cannot identify AI-generated coursework. For instance, when [16] injected 100% AI-produced coursework into a UK-based university’s portal, 94% of the submissions went undetected, and 83.4% outperformed real student submissions. Unsurprisingly, unsupervised online exams have also become targets of similar malpractices [9] [13].

In summary, while coursework enhances student performance and skill development, effective management is crucial to prevent cheating and ensure academic success.

## Current Trends and Challenges in Coursework Management

### Trends in Educational Technology

As mentioned by [9], academic bodies had started to shift to online examinations for essay-type questions, backed with overwhelming favour from older students. The usage of technology was not a surprise as many researchers predicted its permanent effect on education in 1966, stating that it will be an integral part of every child’s life in the future [15].

The demand for online courses increased as technology advanced and the number of students with heterogeneous knowledge grew. As a result, universities underwent a digital transformation, introducing blended and online teaching. With online and blended learning, students can self-regulate their learning and submit coursework remotely at any time within the assigned dates. However, this degree of autonomy often leads to procrastination, with many students postponing submission until the last moment or engaging in plagiarism, which makes online courses more challenging [16] [2]. Despite the availability of free Massive Open Online Courses (MOOCs), most students fail to complete these courses and often drop out. Engagement rates, content retention, and learning outcomes are typically lower in MOOCs compared to traditional learning methods. These issues can be addressed by using Learning Analytics (LA) [19].

### Analysis of Coursework Submission Patterns

Academic deadlines motivate students and combat procrastination, but they also lead to negative outcomes due to deadline rush [17] [18]. According to [19], 62% of students experience moderate stress over deadlines, with 19% experiencing severe stress. Short deadlines require continuous engagement whereas longer deadlines require students to work independently. As deadlines approach, students engage more in surface learning to gain temporary knowledge rather than deep learning [18]. This often results in a hyperbolic curve where submissions are clustered near deadlines and are more likely to be of poor quality [20].

To understand submission patterns, researchers analyse data from platforms like Learning Management Systems (LMS) and Massive Open Online Course (MOOC) dashboards [21]. For example, [3] found that 50% of students intentionally delay assignments until the last 24 hours, resulting in lower grades. A comparative study by [2] and [22] found second- and third-year students' submissions clustered near deadlines, with experienced students managing deadlines better. Statistically, 75% of third-year students made submissions within the last 48 hours, while 74% of second-year students submitted work in the last 24 hours.

[20] noted that deadlines scheduled before weekends increase procrastination more than those after weekends. Submissions made between 11 pm and 6 am were more likely to contain errors, indicating poor time management [2]. [23] found that fixed deadlines boosted student performance (mean ≈ 89), while self-imposed deadlines were less effective (mean ≈ 86).

To summarise, while online study offers flexibility, it often leads to procrastination and last-minute submissions, which result in poor grades and increased stress. Students need proper deadline scheduling and time management to avoid last-minute stress.

### Challenges in Coursework Management

Digital ubiquity has increased students' addiction to social media, leading them to avoid work and engage in unproductive activities. A study of 758 students in Mexico and Spain found a problematic positive correlation between excessive Internet use and procrastination [22]. Lack of self-control leads to poor prioritisation, reduced academic seriousness, higher anxiety, and diminished performance. With limited time to complete assignments, students lose motivation due to fear of failure, leading to depression. They often rationalize their poor performance by blaming time management issues and a lack of interest in the coursework [5].

1. Psychological Factors

Students struggle to focus on academics due to procrastination, which constitutes 80-95% of work issues such as unfinished assignments and missed deadlines. Since COVID-19, online learning has led to a swift surge in this trend with around 70% of university students engaging in moderate procrastination, and 14% being chronic procrastinators. Procrastination is linked to poor time management, motivation, anxiety, and perfectionism, and results in negative academic outcomes, stress, fear of failure, and mental distress [5].

In [24], procrastination is defined as the voluntary delay of intended actions despite knowing the potential consequences. Similarly, [25] define it as a habit of postponing tasks until they become too difficult to complete on time. [26] differentiates procrastination from postponement by stating that in procrastination, there is no guarantee when the task will be performed, and this could result in years of negligence. Procrastination negatively impacts lifestyle, as shown in a Swedish study where 344 students with mild procrastination experienced anxiety and depression, while others with severe procrastination showed intense psychological symptoms [22]. The delay leads to feelings of guilt and restlessness, and as deadlines approach, students regret the delay, preferring earlier deadlines [26].

Procrastination can be caused by the following:

1. Temporal discounting: Temporal discounting refers to prioritising short-term rewards, like the immediate joy from social media, over delayed future rewards such as good exam marks, leading students to procrastinate [24] [27] [18].
2. Longer deadlines: Longer deadlines can improve performance but may also cause students to overlook tasks, leading to late submissions, especially if deadlines are set before the required content is taught [28] [2]. According to Parkinson’s Law, a mismatch between task length and deadlines can lead to procrastination, as extended deadlines often discourage early completion [5].
3. Time mismanagement: Time mismanagement leads to poor self-control, as students prioritize leisure activities over coursework and panic as deadlines approach, often resorting to ineffective strategies like plagiarism, collusion, or using generative AI tools [5][20].
4. Self-regulation failure: Self-regulation involves understanding one’s behaviour to achieve goals, while emotional intelligence means controlling emotions to guide actions. When students fail to act on their intentions due to seeking short-term rewards, cognitive dissonance develops, leading to procrastination. About 47% of students procrastinate online due to their inability to self-regulate [24].
5. Lack of motivation: Low self-esteem, fear of failure, or self-distrust decreases self-efficacy, causing students to question their ability to complete tasks and eventually avoid attempting them. Motivation may decrease further in online settings due to the absence of peer pressure [5].
6. Underestimation of time: Being overly optimistic can backfire when students fail to accurately assess task complexity, leading to poor planning and wasted time [24].
7. Perfectionism: It causes students to focus on flawless outcomes, avoiding tasks out of fear of imperfection, which results in procrastination [5].

Students engage in either passive or active procrastination. All the attributes discussed earlier apply to passive procrastinators. Active procrastinators, on the other hand, intentionally delay submissions until they are pressured by deadlines for motivation. However, [24] and [26] argue that using procrastination as a coping strategy does not benefit students. Despite limited research, it has been observed that active procrastinators score higher than passive ones, but the risk of self-handicapping and failure exists [3].

1. External factors

Students may struggle to complete and submit online coursework due to a lack of resources. Common challenges include unstable internet connections and faulty devices, which can demotivate students and reduce the quality of their work. As technology becomes more pervasive, any disruption in access can negatively impact education. External factors such as work or family responsibilities, poor health, financial constraints, and emotional distress can also hinder academic progress [5]. Some students experience the "over-doer" phenomenon, where they overcommit to tasks with unrealistic timelines, leading to anxiety and missed deadlines. These delays differ from procrastination, as they are caused by external factors rather than psychological ones [5].

1. Academic Factors

[22] observed that assignment submission rates are influenced by academic factors, particularly the type of assignment, as shown in Table 2.1. They noted that students prefer working on presentations followed by projects and written assignments. Presentations are engaging and interactive, while writing tasks are often seen as daunting, leading to higher rates of non-submission, and long-term projects are delayed due to commitment challenges. The study found that difficult or unenjoyable coursework tends to be completed and submitted late. Students were more likely to procrastinate on both very easy and highly challenging tasks.

Table 2.1 Submission rates of coursework [22]

|  |  |  |  |
| --- | --- | --- | --- |
|  | On-time (%) | Delayed (%) | Not submitted (%) |
| Presentations | 24.5 | 7.4 | 1.5 |
| Written Assignments | 18.3 | 12.4 | 2.7 |
| Projects | 9.1 | 23.6 | 0.6 |

Additionally, students often delay assignments they perceive as insignificant or beyond their competence. Many online learners lack the necessary prerequisites, leading to demotivation and missed deadlines [5]. These factors can be explained by the Temporal Motivation Theory (TMT), which suggests students are more likely to engage in tasks they enjoy or find beneficial. The theory defines utility (the willingness to engage in a task) as , where E is the probability of success, V is the value of the task, D is the delay between completion and reward, and Γ is the student's sensitivity to the delay [29].

In conclusion, students face challenges in meeting coursework deadlines due to several factors. Passive procrastination and forgetfulness are common, as students seek short-term mood repair to avoid work. They may also forget submissions when deadlines are distant or when the necessary topics haven't been covered in class. To address these issues, students need a system that reminds them of deadlines and facilitates the start of their tasks.

## Usability and User Experience in Educational Platforms

Educational technology has evolved drastically in the past years, becoming a crucial part of learning. This has caused designers and developers to create software for everyday users and not just for tech savvies, leading to the concepts of user experience and usability in education. Moreover, as suggested by software psychology, educational technology needs to be evaluated using usability evaluation techniques to ensure its effectiveness [30].

### Importance of Usability in Education

The term usability (formerly known as user-friendliness) was coined in the 1980s, but researchers failed to define it because it depends on varying factors and cannot be treated as a property of one entity [31]. Usability is generally defined by objective (performance) and subjective (satisfaction) outcome measures [32]. The International Organisation for Standardisation (ISO) defines usability as the extent to which a system can satisfy specific users in a specific context by helping them achieve goals effectively and efficiently, where satisfaction refers to the positive attitude toward the system, effectiveness means achieving goals accurately, and efficiency measures the resources used [30].

Nielsen provides a more specific definition, with parameters to evaluate the ease of use of an interface:

1. Learnability: Ease of learning a system for the first time
2. Efficiency: Resources and time needed to complete tasks
3. Memorability: Ease of remembering how to use a system after a break
4. Error Rate: Reduced errors and ease of recovery
5. Satisfaction: Comfort of using the system [33]

Despite efforts to define usability, existing standards often fail to fully apply to educational technologies because they overlook pedagogical and sociocultural factors [30]. Pedagogical usability, crucial for the acceptance of educational technology, includes content, multimedia, tasks, social interaction, and personalization. If an LMS is difficult to navigate, learners may spend more time figuring it out than engaging with content, limiting learning outcomes [34] [30]. According to [35], a learner's intention to use a platform depends on perceived ease of use, with complex systems increasing anxiety and cognitive load, thus hindering academic performance. They distinguish between technical usability and pedagogical usability, emphasising how readability and ease of use impact learning outcomes. In pedagogical usability, it is recommended that system design mimic user learning behaviour by using familiar schemas, avoiding unnecessary features, and minimising distractions and anxiety.

### Usability Testing and Evaluation

Evaluating usability is difficult but measuring difficulties incurred while using the system is easy. There is an inverse relationship between ease of use and the number of difficulties faced. Identifying and quantifying these problems can help determine the usability, and the most common method for this is usability testing [31].

In usability testing, an observer watches typical users interact with the system to collect quantitative data on usage problems and effectiveness. Users can also be asked to Think Aloud, where they verbalize their thoughts while using the system, providing qualitative data on the learning process. This is often followed by a survey to measure usability and user satisfaction, which can either be developed by the user or standardized [31].

1. Heuristic Evaluation (HE)

Usability evaluation methods aim to identify problems and maximize a system's ease of use, which is crucial for educational platforms to ensure a smooth learning experience and improve academic performance. When [35] evaluated ElectronixTutor, an Intelligent Tutoring System for electronics, students reported that poor design disrupted their learning. Issues included a mismatch between the user interface (UI) and students' mental models, and poorly visible navigation components. Students suggested the following improvements:

* Change the button terminology: The button to submit a question was labelled "Submit Your Answer," confusing students who wanted to ask a question, not submit an answer.
* Move progress bar: The progress bar was hard to find, located under a drop-down menu in the top-right corner. Students expected it on the left side with the course content.
* Improve agent graphics: Eye-tracking revealed students focused more on the tutor agent than the content. Students found the agent’s jerky graphics distracting.

These suggestions align with usability heuristics. In Heuristic Evaluation (HE), evaluators interact with the system and compare it to a list of usability principles, called heuristics. The most well-known heuristics were introduced by Nielsen and Molich in 1990, after evaluating 249 usability issues [36]. According to Nielsen, 3-5 expert evaluators can identify up to 87% of usability issues, while novice evaluators typically detect only 23%, due to a lack of understanding of the abstract heuristics. To help train novice evaluators, [37] developed a detailed version of Nielsen's heuristics (see Appendix A).

HE is commonly used because it takes around two hours, is easy to use, cost-effective, and applicable to both complete and incomplete systems. The evaluation time can be reduced further with more evaluators [36].

To ensure Coursework Wizard is highly usable and provides a smooth learning experience, avoiding the usability issues found in ElectronixTutor is essential. Coursework Wizard will undergo Heuristic Evaluation (HE) using Appendix A to identify potential usability issues. The results of this evaluation will be documented, providing insights into the system's interface and interaction flow. This will help confirm whether Coursework Wizard meets the usability standards necessary to enhance student engagement and academic performance.

1. System Usability Scale (SUS) Survey

A System Usability Scale (SUS) is a standardized psychometric tool developed by John Brooke in 1986, widely used for reliable usability evaluation across various sample sizes. Around 43% of studies use SUS to assess subjective perceptions of a system's usability [31]. In a study by [38], students were divided into five teams to evaluate software using their preferred usability tool. Three teams chose SUS because it is short, customizable, easy to calculate, and effective for comparing systems, and it encourages honest participant feedback. SUS is especially suited for evaluating educational systems, as it also focuses on learnability.

The SUS survey consists of ten statements with alternating positive and negative tones, rated on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree, and 3 = neutral) (Appendix B). To calculate the final score out of 100:

1. For positive statements, subtract 1 from the scale position (x-1).
2. For negative statements, subtract the scale position from 5 (5-x).
3. Sum the ten values.
4. Multiply the total by 2.5 [31]

Interpretation of the SUS score varies. According to [31], a score above 51 is “Okay”, 72 is “Good”, and 85 is “Excellent”.

SUS is versatile and applicable to all system types. When [34] analysed research papers on educational usability, they found the usage of SUS in all of them, attaining a mean SUS score of 63.30, similar to previous research with scores of 70.09 and 68. Educational multimedia was marked most usable with a mean score of 76.43, followed by mobile applications, affective tutoring systems, LMS, and lastly, university websites. They concluded that current educational usability is good but with some issues.

The SUS is a straightforward and effective tool for evaluating usability, and it will be used to assess Coursework Wizard. The goal is to achieve a score higher than 70.09, positioning Coursework Wizard as more usable than existing platforms.

### Importance of User Experience in Education

User Experience (UX) is the user’s feelings, emotions, and preferences associated with the system before, during, and after its use. It is concerned with the levels of satisfaction driven by the user’s needs and expectations [39] [40]. UX includes subjective factors that vary from one user to another, making usability a part of UX [41]. The UX of a system can be assessed on the content, usability, aesthetics, look and feel, functionality, as well as the sensual and emotional appeal [42]. Additionally, it is influenced by the user’s demographics, perceptions, cognition, experience, financial status, and usage context [41]. Therefore, UX can also be defined as the interaction between the user, system, and context of usage [42].

Lack of student motivation and engagement poses serious challenges to in-time coursework submissions. Engagement can be defined as empowering users, making learning meaningful, and enabling interface customization [44]. This can also be supported by gamification strategies [43].

To effectively design for UX, experts use the following tools [45] [46]:

1. Personas: Fictional characters representing the target audience, developed early in the design phase to understand user needs. Personas can be data-driven or ad-hoc.
2. Scenarios: Stories about user activities and interactions with the product, clarifying the product's purpose and features.
3. Use cases: Step-by-step processes derived from scenarios that outline task completion.
4. Object-Oriented UX (OOUX): An approach based on object-oriented programming, where objects are identified, and actions are assigned to them.

Combining personas and scenarios enhances these tools. According to [45], scenarios transform personas from passive to active by providing context, situation, and objectives.

In the context of Coursework Wizard, understanding UX principles is crucial for designing a platform that effectively supports students' time management. By developing ad-hoc personas, the design process can better align with the specific needs and expectations of students. These personas will guide the creation of a user-friendly interface that motivates students, enhances engagement, and ultimately improves academic performance.

## Coursework Management Systems

### Overview of Learning Management Systems (LMS)

The development of Learning Management Systems (LMS) responded to the growth of online technology, providing an all-inclusive online classroom with features like course materials, gradebooks, professional training, and communication tools [47] [48]. LMS allows instructors and learners to distribute, share, store, and access learning materials over the Internet without time and location constraints, making information more accessible and reducing administrative costs [49].

The LMS market grew rapidly after the spread of the Internet and multimedia, with an average annual growth rate of 7.9% by 2013, peaking at 17% in some countries [50]. By 2018, 3500 institutions had adopted LMS [48], and usage increased significantly during COVID-19, with many institutions permanently adopting LMS [49].

LMS benefits both professors and students. Professors can use a variety of media, such as video, audio, images, and text, to support learning, track student performance, and distribute materials with ease. Students can enrol in classes, access materials, check grades, participate in discussions, take tests, and seek support from peers and professors [47].

A well-designed LMS should have centralised control for accessibility, self-service for tasks like enrolment, quick content creation and distribution, a secure environment, personalisation options, and integration with educational content [48].

When actively used, LMS helps students become more independent by providing constant feedback and additional resources like guides and assessments. However, studies show students often struggle with meeting deadlines. Researchers suggest implementing reward systems to motivate students, helping them stay on track, and maintain focus [47] [49].

### Types and Examples of LMS in Education

1. Canvas

Canvas, developed by Instructure, is used by 17.1% of American institutions and over 3000 universities worldwide. It competes strongly with Blackboard, especially after Blackboard acquired Angel LMS [50] [48]. Canvas is accessible via computers and mobile devices, allowing flexible participation in timed assessments and instant feedback for quizzes [13]. It integrates with open-source tools like Google Docs for collaborative learning. Features include drag-and-drop course creation, student progress tracking through Canvas Analytics, rubric creation, and grading with SpeedGrader [48] [6].

Canvas consistently receives high satisfaction and usability scores, with faculty praising its ease of course creation, file uploads, assignments, and grading. Students appreciate the modular organization of content and the ability to engage in discussions via boards or groups. Study participants found that clear goals, timely feedback, and active discussions with instructors increased user satisfaction and cognitive presence [50].

1. Moodle

Moodle is an open-source, cost-free LMS used by 19.4% of institutions across 241 countries, with over 291 million users [50] [51]. It allows teachers to exchange files, conduct real-time discussions, and use a digital whiteboard. Though similar to Blackboard, Moodle’s key distinction is its free cost [41]. Despite updates, users report UX issues with speed, content organization, search functions, and navigation. The mobile app is especially criticized for its poor communication features, leading some users to avoid it for courses like philosophy [51] [41]. While Moodle offers tools for content organization, assignment submissions, and grading, instructors often underutilize these features [6].

1. Blackboard Learn

Founded in 1997, Blackboard ranks highest in the number of users. It has more than twelve million users and 33.5% of educational institutions use it. It gained popularity after acquiring communication tools and live tutorials. [50]. Blackboard and Moodle share many features, but teachers find Blackboard’s announcement page more effective for reaching students [6]. A usability survey comparing Blackboard and Moodle showed that Blackboard was easier to learn and more satisfying to use, although some students reported higher response times [50]

In terms of preference, Blackboard is favoured for assignments and gradebooks, Moodle for assignments, and Canvas for quizzes, polls, syllabi, and tests. Satisfaction ratings are “C” for Canvas and Blackboard, and “D” for Moodle [6].

### Perceived Usability and UX of Learning Management Systems (LMS)

Academic performance improves when LMS are usable and provide a productive UX [50]. While LMS share similar functionalities, they differ in user-friendliness, customization, cost, requirements, and institutional needs [52]. Researchers have identified factors influencing the usability and UX of LMS. For example, [50] lists seven factors impacting user satisfaction on Blackboard: consistency, clear terminology, feature overload, informed location, simplicity, visible hyperlinks, and help sections. Additionally, response time, reliability, and accessibility equally influence LMS usage intention alongside usability.

However, [43] found that 50% of users are dissatisfied with LMS due to limited features, outdated UX, poor customer support, complexity, lack of agility, and inadequate reporting. These issues were categorized as design and managerial issues, although [42] argue that managerial issues do not impact UX.

[39] found that students attending online lectures were dissatisfied with the system, receiving poor grades due to system interruptions and connectivity issues. To improve UX, the following enhancements were suggested:

* Support service: Addressing software and hardware issues (e.g., slow transmission, microphone problems) and providing prompt customer support.
* Interactive communication: Allowing students to split screens to engage in both tasks and lectures simultaneously.
* Ease of use: Ensuring security, compatibility, and user-friendliness across devices.
* Learning resources: Including more diverse resources and activities to enhance engagement.

LMS provides a digital learning environment for users to access learning materials and submit coursework. The system makes learning independent for students, making it difficult for them to manage assignments and meet deadlines. Therefore, LMS must be usable. In comparisons, Canvas was preferred over Moodle and Blackboard, which faced usability issues. Analysing these shortcomings provides insight into improving systems like Coursework Wizard to enhance usability and UX.

## Coursework Deadline Visualisation and Management

Throughout the academic year, students engage in several different activities outside school hours that suppress the skills of managing course load. Poor time management causes students to complete less than 80% of their assignments, which results in poor grades. Students who complete more assignments tend to receive higher grades [53]. To help students manage their time, experts have introduced management and visualisation tools and techniques which include processes, frameworks, concepts, trends, visuals, and exercises to meet project requirements [54] [55]. The concept of coursework management is inspired by project management where the project manager organises, schedules, controls, and monitors the project and team to achieve the goal efficiently. It is reported that project management improves the success rate of projects [56].

### Coursework Management Strategies for LMS

1. Deadlines

Imposing deadlines for coursework promotes time management but also increases stress and pressure [25]. Therefore, instructors must ensure that deadlines do not clash with other courses, allow sufficient time for completing the work, can be managed alongside other commitments, and promote student well-being [20]. By setting correct deadlines, students have a boundary against which they must work. The problem arises when deadlines are not set correctly, leading to counterproductive activities and last-minute submissions [26]. To avoid such issues, experts suggest that midnight deadlines scheduled at the end of the week encourage students to spread their work over the week to avoid last-minute stress. It is also advisable to avoid setting deadlines on Monday mornings as students often stay up late despite having work or school the next day [20].

Moreover, the frequency and duration of coursework also influence student performance. Having small but regular deadlines improves engagement, completion of work, and performance. However, if all courses adopt this approach, the likelihood of coinciding deadlines increases. Therefore, it is important to break down longer deadlines into smaller ones according to the module and start the deadline only after the required course material is taught. In the case of longer deadlines, instructors must monitor students to track progress and prevent collusion [2].

Lastly, according to [25], imposing significant penalties for late submission further decreases performance. They recommend a deadline policy based on their research, where instructors should impose minor penalties along with a strict midterm deadline or no penalties at all.

1. Rewards and Incentives

Providing students with incentives upon assignment submission can motivate them to work harder and meet milestones on time [28]. These rewards should complement coursework and be appealing to students [26]. In an experiment by [24], students engaged in two tasks: without rewards, and with rewards. Despite exhaustion after the first task, students performed better on the rewarded task. However, [28] noted that students are motivated by immediate rewards and that delayed rewards show no improvement in performance.

To promote timely coursework submission, students can receive rewards in various forms. Certificates for completing coursework are more rewarding than end-of-program certificates because they are received immediately, and not after 3-4 years. Furthermore, they are preferred over trophies as they hold recognition and value beyond university. When combined with deadlines, certificates improve grades and prevent blank submissions [28].

[28] observed that incentives did not impact low- and high-ability students. Low-ability students were unlikely to achieve high GPAs even with maximum effort and high-ability students were motivated only by monetary rewards. However, incentives are highly effective for average students who lack self-control. Deadlines and certificates can either help or hurt average students as most studies overlook them and focus on low- and high-ability students.

In summary, digital incentives like badges, trophies, certificates, and leaderboards can encourage students to increase engagement and submit work consistently. Competition on leaderboards may motivate them to start work early and avoid last-minute submissions.

1. Reminders

Long deadlines allow students to work on coursework according to their preferences and availability. However, this often leads them to forget the coursework deadline [2]. [29] developed a tool for sending automatic periodic situational awareness emails to students. These emails compare students' current progress with the due date and their peers' progress. They began a week before the deadline and were customised based on the student's most recent submission. The tool assesses the submission and rates it on a four-point scale: 'good' for students ahead of schedule, 'neutral' for those on track, 'bad' for those behind, and 'undefined' for those with insufficient information. The email subject included the course code along with the status indicator. These emails resulted in a 23% decrease in late submissions and a 31% increase in early submissions.

LMSs can share weekly reports with students about their actual and expected progress to encourage them to complete the work early. Moreover, the status indicator used by the tool will help inform the decision of defining the status of the progress bar in Coursework Wizard.

1. Work Breakdown Structure (WBS)

Work Breakdown Structure (WBS) is a project management technique where the multi-level project is broken down into smaller manageable activities for managing complex projects. The tasks are arranged in levels where each parent level has several detailed child tasks that need to be completed to complete the parent task. The breakdown can be represented using spreadsheets, flowcharts, lists, or Gantt charts. These representations provide a roadmap for the project where team members can focus on their tasks with an understanding of where and how their tasks fit into the picture. It shows the milestones, dependencies, and deliverables of the project as well [56]. There are two kinds of WBS:

* Deliverable-based WBS: It focuses more on the deliverables produced throughout the project by breaking down the project into deliverables needed, and therefore, the main product is placed at the top of the hierarchy with sub-tasks as children.
* Phase-based WBS: It focuses more on the project phases by breaking down the project into phases of the project lifecycle, and therefore, the final phase of the project is placed at the top of the hierarchy with sub-phases as children.

WBS helps track the project, and if the project falls behind schedule, the team can identify the deliverables that will be impacted the most and plan ahead. Studies show that WBS simplifies project management and helps in predicting project delivery [56].

Despite being a project management tool, WBS can be implemented in academics. Instructors can divide the coursework specification into smaller tasks, linking it with the lecture content covered. In this way, students will get a well-structured specification that is easy to follow. This technique is used to inform the assumption of lecturers uploading coursework that is already divided into weekly milestones.

1. Time Mapping

Fiore suggests that when students have too much or too little time, they tend to procrastinate. To prevent this, he introduced time mapping. Here, deadlines are set for each calendar day by dividing it into 60-minute slots. First, unavailable time slots, such as school hours, are crossed out. Next, tasks are assigned to the available slots, compelling students to complete the task within the designated time period. Furthermore, each productive task is followed by a recreational activity as a reward [57].

Time mapping consists of three components: scheduling, unscheduling, and logging. In scheduling, the student reserves the available time slot for an important task, prioritising it over other activities. In unscheduling, the student adds a fun activity after the important task and highlights it using a bright colour of their choice. Bright colours boost people's moods and motivate them to work harder to achieve the reward, while colours like red signify danger, causing anxiety. Lastly, students log all their activities to analyse their time usage and identify peak times of high productivity for better planning [56].

Time mapping can also be implemented using digital schedule sheets, where students write tasks in plain text instead of using a digital calendar. However, this approach often leads to students overscheduling their time and creating unrealistic schedules [29].

The colour theory mentioned in this section will be used to inform the decision to avoid the colour red in Coursework Wizard as it represents danger and increases stress.

### Coursework Visualisation Strategies for LMS

1. Gamification

Gamification increases student motivation and engagement by integrating game design principles into non-game contexts. This concept was introduced by Nick Pelling in 2002 when he integrated gaming components like rewards into educational, fitness, and medical systems, leading to the emergence of serious games meant for serious purposes rather than entertainment. Gamification introduces fun elements into serious and boring tasks, motivating users to engage in behaviour and complete the activities [46]. In pedagogy, gamification captures the students’ attention and involves them in the learning process. What satisfies them the most is the excitement of using acquired knowledge to solve problems [58].

Gamification is a psychological strategy that involves three components [46]:

1. Motivation – “Why are we doing this?”
2. Mastery – “How are we doing this?”
3. Triggers – “When are we doing this?”

The most common and appreciated gamification element used across all systems for visualisation is the progress bar. In games, it represents the health bar, but in non-game systems, it encourages users to achieve their goals by visualising their progress. Upon completion, the brain releases endorphins, making the user feel happy and content. Failing to complete the activity may leave a sense of incompleteness, causing stress or restlessness [46]. This component is implemented in Moodle for teachers to record students’ progress and be alert to dropping engagement. However, students are not satisfied because the progress bar does not specify what it represents [58].

1. Learning Analytics Dashboard (LAD)

Visuals like shapes and patterns make it easier for humans to understand and analyse large volumes of data compared to textual information [59]. In 2015, Coursera had 15 million students of whom only 2.5 million completed courses. This was because students were unable to commit time, the course was poorly designed, or they had no prior knowledge. To help students manage their courses and understand their learning progress, Coursera suggested using data mining to produce visual analytics [60] [61].

LADs visualise students’ online data to represent their study habits, academic performance, and learning status. They assist students by visualising patterns and providing real-time feedback to motivate them [62]. Monitoring student data allows early detection of students with high tendencies toward procrastination and failure, with 97% accuracy [63]. These students can be easily identified, and instructors can assist them by providing extra homework, frequent feedback, and continuous monitoring [64]. Moreover, LADs track students' social networks and peer activities because upward social comparison with peers stimulates motivation and encourages students to work toward their goals [65]. In their study, [66] observed that LADs increase students' self-esteem, satisfaction, and enjoyment.

Course Signals is one of the many LADs developed for students and instructors. It collects data and presents it as a traffic light where red represents students at a higher risk of failing the course, yellow for medium risk, and green for low risk. This analysis is shared with the student through in-app notifications, emails, or SMS. Additionally, it uses bar graphs to display students' activities, line graphs for weekly trends, scatter charts for peer comparison, and sociograms for online networking [61].

1. Kanban

Kanban, meaning “sign” in Japanese, was developed by Toyota for lean management and later adapted into Agile software development by Microsoft. It is a visual technique for tracking projects by creating a board with three columns and moving cards between them:

* To do: Contains a long list of all the tasks that need to be completed
* Doing: 3-4 tasks from the “to do” are moved here when work starts on them
* Done: Completed tasks are moved to this column [67]

To ensure that time spent on tasks is efficiently utilised, the number of tasks in the “doing” column is limited. A Kanban board can be created using a physical whiteboard and sticky notes, or a specialised software [67]. Kanban improves communication within the team, problems are solved collaboratively, project completion time is reduced, and productivity is increased. Since each card is assigned to a specific member, it becomes relatively easy to follow up on tasks directly with the concerned person [68].

Kanban can be implemented in all kinds of projects and requires no training. It complements incremental development, allowing the integration of changes during the project. With Kanban, tasks are clearly defined to avoid wasting time on irrelevant tasks, thus reducing additional costs. However, Kanban supports project management but cannot be used independently [68].

Gamification components notify students about their progress, LADs visualize student data by identifying patterns, and Kanban visualizes work by breaking projects into discrete tasks. While Kanban is commonly used in professional projects, its implementation in academics helps students gain a clear understanding of their coursework and prevents missed deadlines. Therefore, Coursework Wizard incorporates a progress bar to visualize progress for each coursework, a rewards system for submitting subtasks, graphs to visualize statistics of students who have completed and not completed coursework, and a Kanban board to organize and prioritize subtasks.

### Self-Management Strategies to Meet Deadlines

Students can improve their academic performance and reduce procrastination through various techniques. One such method is the use of assignment logs or work journals, which help students track coursework data and monitor their progress. This practice increases self-awareness, enabling students to identify and reflect on counterproductive behaviours, leading to better time management and higher grades [53]. In 2024, Heriot-Watt University introduced project journals (PJs) for master’s students, requiring them to document their progress, challenges, and achievements in 2–3-week intervals. PJs align with Agile development practices, fostering incremental progress and helping students manage their work while preventing last-minute cramming and issues like plagiarism [69] [70].

Other techniques include the use of implementation plans, the Eisenhower Matrix, and the Pomodoro Technique. Implementation plans enhance self-regulation by bridging the gap between intentions and actions, although students often delay completing assignments until the final hours [27]. Breaking tasks into smaller, manageable subtasks is another effective approach to overcoming procrastination, as it makes tasks feel less daunting and helps students engage in goal-directed behaviour [24]. The Eisenhower Matrix prioritizes tasks based on urgency and importance, helping students manage their workload and avoid last-minute stress [57]. Finally, the Pomodoro Technique involves breaking tasks into smaller subtasks and working in short, focused intervals. Students set a timer for 25 minutes, followed by a short 3–5-minute break. This cycle is repeated four times, after which students reward themselves with a longer break of 20 minutes [62] [67].

To combat procrastination and manage time, experts suggest a few techniques. Developers can integrate these techniques into learning platforms to maximise academic performance. By producing journals, students can keep track of their tasks and also provide evidence of their own work. By intending to work on coursework, students can get themselves to at least start the coursework and protect themselves from regrets of delaying work. The Eisenhower matrix will help them sort out tasks by preventing them from wasting time on unimportant and non-urgent tasks. Finally, the Pomodoro technique will motivate them to work on the task without interruption. These strategies can be integrated into LMS to limit distractions and encourage students to start working on their coursework earlier.

## Education 4.0

The revolution caused by technology was defined using the term Industrial Revolution (IR) which means the societal transition from manual work to automated work. There are 4 main IRs ranging from 1IR to 4IR, starting from the eighteenth century until today. The ongoing 4IR encompasses technologies like Artificial Intelligence (AI) and the Internet of Things (IoT), increasing human-machine interaction to boost performance and efficiency [71].

Soon, it will not be uncommon for robots to deliver lectures and solve mathematical problems using AI [73]. The job pool will face several changes as the world adopts 4IR technologies, disrupting the job market. The skills considered crucial now will be deemed unnecessary then, causing people to have several different jobs over their lifespan. According to studies, machines will advance to extreme AI levels by 2040, challenging the need to hire humans. The World Economic Forum states that 47% (75 million) of the jobs done today will be automated by 2030 and 65% (133 million) of new jobs will exist [73] [71].

To cope with such challenges, people need to be retrained so that they are equipped with the required STEM skills [74]. Therefore, the educational sectors have implemented Education 4.0 in response to align with Industry 4.0. In Education 4.0, education providers teach about technology by utilising digital technology and interconnectivity such as teleconferencing. The content is personalised to the needs of students, positively impacting the learning curve [71]. Education 4.0 is linked with smart learning environments like LMS and MOOC [72]. Studies show that three common trends will take over the educational sector in the next fifteen years: online institutions, unlimited access to online education, and MOOCs [75].

# Chapter 3. Requirements Analysis and Methodology



## System Specifications Using the MoSCoW Method

The functional and non-functional requirements in this section reflect the final implemented features, categorized by MoSCoW prioritisation. Initial requirements were refined during development to meet project constraints and goals:

* **M**ust Have: Compulsory to achieve a minimum viable product (MVP)
* **S**hould Have: Important requirements that are not necessary
* **C**ould Have: Nice to have these requirements if there is extra time
* **W**ill Not Have: Not at all important because of reasons like complexity or budget

### Functional Requirements and MoSCoW Prioritisation

Functional requirements are system features that are linked to the system’s functionality [77]. The functional requirements using the MoSCoW method are outlined in Table 3.1.

Table 3.1 Functional requirements

|  |  |  |
| --- | --- | --- |
| ID | Details | Priority |
| R1 | Students and staff must be able to log into their respective accounts with suitable privileges. | M |
| R2 | Staff must be able to upload the coursework subtasks. | M |
| R3 | All users must be able to see the subtasks on their timeline. | M |
| R4 | Students must be able to view the coursework subtasks and visualisations. | M |
| R5 | Every coursework on the student portal must have a progress bar to track progress. | M |
| R6 | Staff must be able to track students with zero submissions. | M |
| R7 | Students should be able to organise and prioritise subtasks on Kanban Board. | S |
| R8 | Users should be able to edit their profiles. | S |
| R9 | Staff could be able to share submission statistics with students. | C |
| R10 | The website could allow users to personalise their UI. | C |
| R11 | Reminders could be provided to each student via email or website notifications. | C |
| R12 | Students who submit coursework early could be rewarded with digital incentives or be placed on a leaderboard. | C |
| R13 | Lecturers could provide one-on-one guidance to low-ability students. | C |
| R14 | The website will not support coursework grading | W |
| R15 | The system will not have a mobile version. | W |
| R16 | Advanced AI features, such as AI assistants, will not be integrated. | W |
| R17 | The website will not check for malpractices such as plagiarism. | W |

### Non-Functional Requirements

Non-functional requirements define the performance of the system [78]. They have also been prioritized using MoSCoW, as outlined in Table 3.2.

Table 3.2 Non-functional requirements

|  |  |  |
| --- | --- | --- |
| ID | Details | Priority |
| N1 | Security: The website must defend against intrusion by implementing access control, to protect student and lecturer information. | M |
| N2 | Usability: The user interface must be intuitive, satisfying, user-friendly, and meet the needs of the target audience. | M |
| N3 | Documentation: Comprehensive documentation, user guides or FAQs must be provided for all users, including developers. | M |
| N4 | Recoverability: The website should recover from system failures and resume normal processing. | S |
| N5 | Accessibility: The system could be accessible to users with disabilities. | C |
| N6 | Availability & Reliability: The website will not be available at all times with minimal downtime and perform without failures. | W |
| N7 | Scalability: When the load increases, the website will not be able to scale up. Latency and throughput shall be at acceptable levels. | W |
| N8 | Performance: The system will not be able to handle multiple concurrent users without affecting the response time. | W |

### MVP Goals and Additional Features

The MVP focuses on high-priority requirements aligned with limited time and expertise. In this version:

* Student Portal: Students enrolled in four courses can visualize their progress for each coursework through a color-coded progress bar (green for "on-time," orange for "late"), with a percentage showing completion. To help students prioritize, the portal also includes a Kanban board for organising unlocked subtasks, which are locked until their respective start dates.
* Lecturer Portal: Lecturers can upload coursework subtasks and view student submission statistics. Doughnut charts and a filterable student list allow tracking of students who haven't started coursework.
* Shared Features: A Gantt-chart calendar visualises upcoming subtasks, reducing memory load and improving deadline tracking. All users can edit their profiles, receive notifications, access the help section, submit a query, and change settings.

The website was hosted locally in development mode. However, security was enforced by implementing separate access for student and staff accounts through APIs. To prevent data loss and ensure recoverability, all files were continuously pushed to GitHub with additional local backups in case of any issues with GitHub. Help pages were included for all users, offering Frequently Asked Questions (FAQs) and a contact form for any unanswered questions. During development, evaluation, and testing, the website occasionally became unresponsive but was successfully restored by restarting the development server. Usability heuristics were consulted to enhance usability, and the supervisor was regularly engaged as a potential end user to provide feedback. Friends who are university students were also frequently consulted for usability feedback. Canvas was used as a model, as it is considered to have the highest usability among LMS platforms.

### Features Planned but Not Implemented

The website was initially planned to send weekly reminders to students, with increased frequency to twice a week as deadlines approached, avoiding daily reminders that could potentially irritate students. Additionally, personalisation options were considered, allowing students to adjust font sizes or change the overall appearance with a dark theme. A reward system was also planned to motivate students by recognising timely submissions, placing them on a leaderboard as an added incentive.

## Software Development Methodology

Solo Scrum was used to develop *Coursework Wizard*. Scrum is an agile, user-centric methodology that speeds up the development process. A product backlog is prepared containing a list of features required for the final product. The backlog is divided into sprints, which are timeframes, typically ranging from one to six weeks, for completing tasks in the sprint backlog. Sprints are created successively until the product backlog is empty. At the end of each sprint, a sprint review is held to reflect on what was accomplished and to plan for improvements in the next sprint. This iterative process ensures that each sprint becomes more efficient. Typically, teams hold daily scrum meetings to discuss daily goals and ensure the product is always workable and in a deliverable state [79] [81] [82] [83]. The entire process is summarised in Figure 3.1.

|  |
| --- |
| Figure 3.1 The Scrum Methodology [82] |

However, despite symbolising teamwork, Scrum can be adapted for solo developers, where one person performs the roles of all team members [80] [81] [82] [83]. The author adapted the Scrum framework as follows:

* Product Owner: The Product Owner defines and prioritizes the project’s scope. In this project, the author assumed this role by managing the product backlog in JIRA and designing the project's visual and functional scope through prototypes. This work was done primarily during Sprints 1-3.
* Scrum Master: The Scrum Master ensures the Scrum process runs smoothly, helps resolve impediments, and keeps the project on track. As a solo developer, the author took on this role by monitoring progress through the Kanban board, JIRA reports, and project journals. Impediments were identified and addressed by researching solutions or discussing issues with the supervisor when needed. This role was carried out throughout the entire project.
* Frontend Developer: The Frontend Developer is responsible for building the user interface and ensuring design consistency. In this project, the author focused on building the user interface for the student and staff portals, ensuring alignment with the Figma prototypes. This work occurred mainly in Sprints 4-5.
* Database Designer and Backend Developer: The Database Designer and Backend Developer are responsible for the database setup and backend logic. The author combined these roles to design and set up the database, integrate it with the frontend, and implement the backend functionality for both the student and staff portals. This was primarily completed in Sprints 6-8.
* Tester and Documenter: The Tester and Documenter ensures usability testing is conducted, and the project is properly documented. The author took on this role in Sprint 9, conducting staff testing, gathering feedback, and documenting the final results for the report.

The project was developed incrementally, prioritising the MVP features first. Due to time constraints, non-essential features were moved to later sprints to focus on core functionalities, highlighting the agile flexibility of Solo Scrum. The development was completed in 9 sprints, with multiple features being implemented in each sprint. The development process could have been smoother if the sprints were more concise, rather than being vague or abstract, especially at the start of the project. Table 3.3 provides step-by-step details of each sprint's objectives, role adaptations, and results.

|  |  |  |  |
| --- | --- | --- | --- |
| Sprint | Focused Features | Adapted Role(s) | Outcome |
| 1 | Website theme, logo design, and prototype of the landing pages | Product Owner and Designer | Selected the website’s colour theme, designed the logo, and created landing page prototypes in Figma. |
| 2 | Prototype for the login pages and student portal | Product Owner and Designer | Developed Figma prototypes for the login pages and partially completed the student portal prototype. |
| 3 | Prototype for the student and staff portals | Product Owner and Designer | Finalized the full website prototype on Figma, covering both student and staff portals. |
| 4 | Set up the Next.js application and build initial frontend | Frontend Developer | Set up the Next.js environment and implemented the GUI for pre-login pages and the majority of the student portal frontend. |
| 5 | Complete frontend for student and staff portals | Frontend Developer | Finished all frontend coding for both the student and staff portals. |
| 6 | Design, create, populate, and connect database | Database Designer and Developer | Created the MySQL database, designed the schema, populated it, and connected it to the frontend. |
| 7 | Complete backend coding for the student portal | Backend Developer and Tester | Implemented backend logic for the student portal and conducted initial usability testing. |
| 8 | Complete backend coding for the staff portal | Backend Developer | Completed backend coding for staff functionalities. |
| 9 | Conduct staff testing and finalize the report | Tester and Documenter | Conducted staff interviews for testing, gathered feedback, and completed the final report. |

The process followed the core principles of Solo Scrum, with adjustments made to fit the needs of a single developer. While daily scrums were skipped, tools like JIRA and the Kanban board helped maintain progress and ensure continuous delivery. The development was iterative, with each sprint becoming more focused and efficient, although clearer sprint goals at the beginning would have streamlined the process further (Figure 3.2).

|  |
| --- |
|  |
| Figure 3.2 Sprint Flowchart |

# Chapter 4. Design and Implementation

## Development Tools and Technologies

The development of the Coursework Wizard website was carried out using a combination of technologies chosen for their suitability in solo development and their efficiency in meeting the project objectives. These tools were selected to streamline the process, ensure consistency, and optimize time management. The following technologies were used:

* Next.js: Next.js was chosen for its full-stack capabilities, as it is built on top of React and includes both front-end and back-end functionality. This allowed the author to avoid the need to learn separate technologies for the front-end and back-end, saving valuable time and effort. The entire website was developed using Next.js, maintaining a consistent development environment throughout the project.
* JavaScript: JavaScript is the foundation of the project, as it is required for both React and Next.js development. Initially, React was considered for front-end development; however, by transitioning to Next.js, which is also JavaScript-based, the development process became more efficient and cohesive. Familiarity with JavaScript also allowed the author to focus on building features without learning a new programming language.
* MySQL: MySQL was selected as the database system for the project due to the author’s prior experience with relational databases. Given the time constraints, there was insufficient time to learn a non-relational database like MongoDB. MySQL’s familiar structure and commands provided a reliable and efficient solution for managing the project’s data.
* Postman: Postman was used to test and validate APIs during development, particularly for operations that involved interacting with the database (e.g., adding rows). This tool was essential for ensuring the backend APIs were functioning correctly and that data was being processed as expected.
* GitHub: GitHub was used for version control throughout the development process. This was critical for safeguarding against data loss, as well as for tracking changes made to the project over time. Using GitHub allowed the author to maintain a record of all development milestones and provided the ability to revert to earlier code versions if necessary, particularly during the integration of different components.
* JIRA: JIRA was an essential tool for tracking progress throughout the project. It was used to manage tasks, set deadlines, and monitor the overall dissertation process. JIRA helped the author stay organized and ensured that each phase of development was completed within the designated timeframe.
* Figma: Figma was used to create a high-fidelity prototype of the entire website UI, which significantly streamlined the front-end development process. By providing interactive prototyping, Figma depicted the actual interactions of the website, serving as a comprehensive guide for development. This allowed the author to focus on coding the front-end without spending excessive time on design decisions or trial and error. The prototype also helped identify and address potential usability and UX issues early on, ensuring a smoother development process.

These tools were carefully chosen to support the efficient execution of the project and to address the challenges faced during solo development. Their integration allowed for a smoother development process, with minimal need for learning new technologies, which was crucial given the time constraints of the project.

## Personas and User Requirements

## System Design

Entity-Relationship Diagram (ERD) and any system diagrams that help explain the structure.

## Prototyping and UI Design

Explain the process of developing prototypes using Figma.

Discuss feedback integration and design adjustments based on initial evaluations.

## Implementation

Detail how you implemented the features, linking back to Chapter 3 requirements.

Explain any technical challenges and solutions.

## Assumptions and Limitations

The author has assumed that lecturers will upload coursework that is already broken down into weekly milestones, similar to the WBS described in 2.5.1. These weekly milestones will be linked to deliverables and contribute to incremental coursework completion.

# Chapter 5. Testing and Evaluation

testing development

evaluation with users

The aim of testing is to verify that your software does what it is designed to do. The aim of evaluation is to validate that your software fulfils the project's requirements.

Challenges and limitations

## Evaluation (add in separate chapter)

A usability study will be conducted post-development of the prototype and the website. Three lecturers and three students from the Computer Science department of Heriot-Watt University will be invited for the evaluation. To begin with, the author will first develop a prototype of the website with varying font sizes and component locations. The selected participants will be contacted for feedback on usability and UX. The feedback will be incorporated into the final front end. After the website is completed, a usability test will be carried out. The test will take a maximum of one hour, during which every participant will interact with the UI and perform fixed tasks. The author will observe the participants and make notes during the usability test, which will be used for the Heuristic Evaluation described in 2.3.2. Moreover, the author may also ask participants to ‘Think Aloud’ while performing tasks to gain insight into their cognitive processes, helping to understand the website’s ease of use.

After the test, the author will request suggestions to enhance their experience and achieve the goal of minimising coursework submissions right before the deadline. Participants will also receive a website link to the online SUS survey, which they can complete at any time after the usability test. The SUS score for each participant will be calculated, and the average score of all six surveys will be used to rate the website’s usability using the procedure and metrics explained in 2.3.2. The reason behind the selected evaluation approach is also defined in 2.3.

The results obtained from this evaluation will be recorded and suggestions for improvements will be discussed.

 **5.1 Testing**

* 5.1.1 Unit Testing
* 5.1.2 Integration Testing
* 5.1.3 Heuristic Evaluation

 **5.2 Evaluation**

* 5.2.1 Usability Testing (task sheets, think-aloud, SUS and questionnaire results)
* 5.2.2 Staff Feedback (from interviews, including suggestions and feedback)

 **5.1 Testing Strategy**

* Describe the testing approaches used, including usability testing, heuristic evaluation, and any automated testing.

 **5.2 Test Cases and Results**

* List specific test cases and outcomes.

 **5.3 Usability Testing and Feedback**

* Explain the process of user testing, observations, and improvements.

 **5.4 Evaluation Metrics**

* Show results of evaluations, such as SUS scores or heuristic feedback.

 **5.5 Summary of Findings**

* Summarize the test results, noting areas of success and recommendations for future improvements.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ID | Scenario | Test Case | Pre-Condition | Test Steps | Test Data | Expected Results | Post Condition | Actual Result | Status |
| LOGIN\_  VALID\_  USER | Verify user login | Verify user login with valid username and password. | Need a valid user account. | 1. Go to login  2. Enter username  3. Enter password  4. Click button | Valid user credentials | Login successful | User dashboard open. | User dashboard open | Passed |
| LOGIN\_INVALID\_  USER | Verify user login | Verify user login with invalid username and password. | Need a valid user account. | 1. Go to login  2. Enter username  3. Enter password  4. Click button | Invalid user credentials | Login failed.  Show error message – invalid credentials | Error message | Error message | Passed |
| LOGIN\_  STUDENT\_AS\_STAFF | Verify student login | Verify student login with staff username and password. | Need a valid staff account. | 1. Go to login  2. Enter username  3. Enter password  4. Click button | Valid staff credentials | Login failed.  Show error message – invalid credentials | Error message | Error message | Passed |
| LOGIN\_  STAFF\_AS\_STUDENT | Verify staff login | Verify staff login with student username and password. | Need a valid student account. | 1. Go to login  2. Go to staff portal  3. Enter username  4. Click next  5. Enter password  6. Click button | Valid student credentials | Login failed.  Show error message – invalid credentials | Error message | Student dashboard open | Failed |
| ATTEMPT\_2 | Passed |
|  |  |  |  |  |  |  |  |  |  |

# Chapter 6. Conclusion and Future Work

## Potential for Industry Implementation

If this project was to be developed in the industry, the website would get integrated into an LMS such as Canvas. The website would adapt to different screen sizes and also have an application for mobile users. Inclusive UX design would allow all kinds of users to utilise Coursework Wizard by supporting people with varying disabilities like colour-blindness and hearing impairment.

Moreover, to support the non-functional requirements, the website could be connected to Cloudflare’s nameserver, which would provide a dashboard to visualise website traffic, security events, and performance metrics in real time. By using these tools, the development team could identify bottlenecks and take actions to optimise the website. With Cloudflare’s reverse proxy, website traffic would first go through Cloudflare’s servers and then reach the website, increasing security, performance, and reliability:

* Performance: Website contents will be stored on the nearest Cloudflare server, reducing response time because data will be loaded from the nearest server.
* Security: Cloudflare’s Web Application Firewall (WAF) will protect the website from attacks by filtering malicious or suspicious requests.
* Scalability and Reliability: When website traffic increases near deadlines, the load balancer will distribute load and scale up by using more servers to ensure high availability, reduced downtime, and fault tolerance.

 **6.1 Summary of Key Findings**

main achievements of *Coursework Wizard*.

 **6.2 Limitations and Future Work**

limitations encountered and ideas for extending the project

 **6.3 Final Reflections on the Project**

Personal insights and learnings from undertaking the project as a solo developer.



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# Appendix A: Heuristic Evaluation

Below is a list of Nielsen’s heuristics created by [37]:

1. Visibility of system status
   1. State: The current state of the system and available actions
   2. Location: Where the user is currently
   3. Progress: How much more is left to complete a task
   4. Closure: Notification upon task completion
2. Match between system and the real
   1. Understandability: Use content that the target audience can understand easily
   2. Natural and logical order: Present information in steps that are followed normally in the real-world. For example, e-shopping
   3. Appropriateness: The content should be appropriate for the target audience
3. User control and freedom
   1. Reversibility: All actions should be reversible - recover deleted files
   2. Emergency exit: Exit undesirable situations without extensive procedures
   3. Informing users: Inform the user about the critical action he/she is taking
4. Consistency and standards
   1. Consistency: Element usage should be the same throughout the system
   2. Standards: Use knowledge of previous similar systems and apply it
5. Error prevention
   1. Instructions: Clear instructions and requirements for performing tasks
   2. Constraints: Do not allow certain input from the user like numbers for name
   3. Confirmation: To avoid unintentional actions, the system should ask before executing serious and irreversible actions
   4. Notification: Notify users about critical changes and updates
   5. Autosaving: If the system fails, all user data will be lost. To prevent this, the system should autosave time-consuming data
   6. Flexible inputs: Allow alternate ways of entering input to enhance flexibility
   7. Defaults: Add default states that are preferred by people and inform them
6. Recognition rather than recall
   1. Availability: Make information visible at all times so that users do not need to memorise it. For example, directions on streets
   2. Suggestions: Provide accurate suggestions to users because they might be unfamiliar with the system and want they want
7. Flexibility and efficiency of use
   1. Flexibility: The system is usable for all kinds of users
   2. Efficiency: Do not add unnecessary steps to compete a task
8. Aesthetic and minimalist design
   1. Aesthetic: If the system is aesthetically pleasing, users will perceive it as usable and ignore minor usability issues
   2. Organisation: Organise sections in a sensible order by categorising similar elements together and separating different sections
   3. Simplicity: Simple and uncluttered interface with only necessary content
9. Help users recognise, diagnose, and recover from errors
   1. Recognising errors: When an error occurs, the system should clearly display the error message and the user should be able to understand that an error has occurred
   2. Understanding errors: Location and reason of the error
   3. Recovering from errors: Display instructions and steps for resolving the error
10. Help and documentation
    1. Help: There should be a contact point for providing help to users
    2. Documentation: Easy to follow user guides, FAQs, and tutorials

# Appendix B: SUS Survey

Figure 1 shows the questions of an SUS survey [88].

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| A white box with black text  Description automatically generatedAppendix B – Figure 1 The standard SUS Survey [88] |

# Appendix E: Professional, Legal, Ethical and Social Issues

**Professional Issues**

The work done during this project will be compliant with the British Computer Society (BCM) Code of Conduct. The development of the website and its testing will follow software engineering practices, ensuring a professional development process. Moreover, all code will be properly organised, commented, and documented for increased readability, and the website will adhere to usability standards. Any outside work referred to will be clearly referenced. Software and tools will only be utilised if their licenses permit it.

**Legal Issues**

All relevant laws and regulations will be followed for this project. The data collected from the usability test will be obtained by participants’ consent and will be completely anonymised to protect their privacy. Throughout the project, all software and other copyrighted materials will be used with permission from their respective licenses. After the development of the website, the developer will ensure that only authorised individuals have access to the website.

**Ethical Issues**

Since data will be obtained from human subjects during testing, all participants will be provided with information sheets describing the project and the testing procedure. Additionally, they will be provided with consent forms explaining how their anonymised data will be used. The participants will be given the freedom to withdraw from the test at any point. The research will be transparent and will adhere to General Data Protection Regulation Compliance. Finally, the website will also ensure user privacy with the help of authorisation.

**Social Issues**

This project aims to reduce the negative social impact of deadline mismanagement practiced by students. The website will monitor and visualise students’ progress to motivate them, help them combat procrastination, and prevent heightened stress levels caused by delaying assignments out of a lack of self-regulation. Additionally, the website will aim to promote positive user experiences by following usability guidelines and helping students manage their coursework efficiently.

# Appendix E: Prototype

# Appendix E: Final Website

# Appendix E: Questionnaires and Testing Documents

# Appendix E: Evaluation Results

# Appendix E: JIRA Sprints