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# COURSEWORK WIZARD: DEADLINES VISUALISER

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***A thesis submitted in fulfilment of the requirements for F21RP***

***in the***

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# Abstract

an abstract should tell the reader what to expect from the document, this is more like an introduction

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

## 1.1 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. Reports indicate that 3.8% of students with poor academic performance attempt suicide [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 prioritization, 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. Therefore, the author of this project will develop a website to help students manage their coursework deadlines by incorporating effective strategies suggested by experts in the IT and psychology departments. With a “deadlines visualiser”, coursework will be broken down into small manageable milestones, and students will receive regular reminders. Moreover, their progress will be visualized using gamification modules to motivate them and provide a reality check on their performance. The incremental approach to solving

coursework will reduce last-minute anxiety and give students an opportunity to review their work before final submission, allowing for enhancements to improve grades.

## 1.2 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
- Allow lecturers to manage deadlines
- Display student submission statistics to lecturers
- Conduct tests to evaluate usability and refine the website

## 1.3 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 proposed work.

## 2.1 Pedagogical Background

### 2.1.1 Historical Evolution of Coursework

Around 50 years ago, Michael Bassey introduced formal assignments, also known as coursework, to pedagogy after completing his teacher training programme. This programme used a combination of coursework and examinations for assessments, and 98% of students were satisfied with this twofold division approach. Bassey also favoured it after observing how it contributed to lower stress levels and enhanced performance [7].

In 1977, Derek Rowntree and John Heywood introduced effective alternatives to unseen examinations, such as open-book, pre-released, and essay examinations, to assess the student's strengths, weaknesses, and interests [8] [9]. They explained that when two people perform a similar action, the outcome might be the same, but their experience and motivation will differ [10]. By 1996, coursework became widespread across the UK. In 1985, it weighed 34% of the total marks and increased to 79% in 1994 [9]. Moreover, universities began to award degrees based on coursework instead of unseen examinations [11].

### 2.1.2 Definition and Significance of Coursework in Education

Coursework is defined as modes of assessments undertaken by students within a longer timeframe, either individually or collaboratively. These modes include, but are not limited to, assignments, dissertations, reports, software, and class assessments [9] [1]. Coursework boasts time management and teamwork skills, fostering a sense of collective responsibility for both positive and negative outcomes. Students learn to manage small projects and interact with industry experts to complete coursework [12].

Coursework has positively impacted academic performance. For instance, the percentage of graduates awarded first-class degrees in the UK increased from 39% to 68% from the 1950s to 2013. Similarly, by 1990, the upper second-class honour had become the most common degree conferred upon graduates [9]. These statistics indicated that the transition from unseen examinations to coursework led to higher marks across all fields when used alone or with examinations. They revealed that the amount of coursework in a course was directly proportional to the percentage achieved because students outperformed themselves through collaborative learning. In contrast, unseen examinations pressured them to cram information which is unlikely to reflect professional practice [11] [13].

Furthermore, the benefits achieved from coursework are long-lived as constant student engagement is maintained over an extended period. Through coursework, students can demonstrate their abilities on a broader scale and develop strategic thinking and problem-solving skills. A Norwegian study reported that 70% of the students applied their coursework knowledge in their professional lives after graduating [14].

However, since coursework is not invigilated, this opens doors to collusion and plagiarism. Anti-plagiarism systems can detect plagiarism but cannot detect contract cheating, in which material is purchased from expert academic writers. Additionally, online examinations also become a target of such malpractices [9] [13].

In summary, coursework plays an important role in enhancing students' performance and developing essential skills. As universities reward degrees based on coursework, effective coursework management is compulsory; otherwise, the student might fail despite excelling in exams. Since coursework is primarily self-paced, students require motivation to manage their workload and meet deadlines.

## 2.2 Current Trends and Challenges in Coursework Management

### 2.2.1 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 since 1966. In fact, in 1980, Seymour Papert stated that computers will be an

integral part of every child's life in the future. His claims were supported and echoed by multiple other researchers [15].

The demand for online courses increased as technology and the number of students with heterogeneous knowledge grew. Hence, universities also underwent a digital transformation by introducing blended and online teaching. Online courses provide students autonomy to manage their learning conveniently. Unfortunately, this degree of autonomy challenges students' capability to self-regulate learning, making online courses difficult [16].

With online and blended learning, students can submit coursework remotely at any time within the assigned dates. However, this leads many students to postpone submission until the very last moment and engage in plagiarism [2].

### 2.2.2 Analysis of Coursework Submission Patterns

In the 1860s, deadlines were used to contain prisoners in specific areas. Nowadays, academic deadlines mark the date or time by which tasks must be completed. 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.

The duration and frequency of deadlines can vary throughout the academic year. Short deadlines require continuous engagement whereas longer deadlines require students to work independently. As deadlines approach, study activities increase exponentially. 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] found that the submission patterns of second-and third-year students were clustered near the deadline and that experienced students were better at managing deadlines due to improved academic preparedness. Statically, 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. Moreover, 30% of submissions were made between 5 pm and midnight, while submissions between 6 am and 8 am were non-existent. [22] carried out similar research on different age groups and the same pattern was achieved.

[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]. Since students rely on deadlines for self-regulation, [23] formed two groups with fixed and self-imposed deadlines. They found that fixed deadlines boasted students' performance ($M \approx 89$) and self-imposed deadlines lacked effectiveness ($M \approx 86$).

To summarise, online study options provide students with the autonomy to submit coursework flexibly. However, this often leads to procrastination and last-minute submissions, resulting in poor grades and increased stress. It has been observed that students perform better when deadlines are fixed post-weekend or set before midnight, as students are more available to study during weekends and are more active. This accentuates the importance of proper deadline scheduling and emphasises the need for effective time management to help students avoid last-minute stress. The comparative analysis between fixed and self-imposed deadlines will guide the decision to implement weekly fixed deadlines for coursework.

### 2.2.3 Challenges in Coursework Management

While online learning benefits learners by providing the utmost flexibility, it also substantially increases work delays due to procrastination and inefficient time management. Digital ubiquity has increased student's addiction to social media, causing them to avoid work and engage in unproductive activities over the Internet. When research was carried out on 758 students in Mexico and Spain, the results revealed a problematic positive corelation between unnecessary Internet usage and procrastination [22].

Lack of self-control results in inefficient work prioritisation, reduced academic seriousness, increased anxiety, and poor performance. With insufficient time left to complete assignments, students tend to lose motivation due to the fear of failing which results in depression. They rationalise their poor performance by blaming their inadequate time management skills and lack of interest in the coursework [5].

## I. Psychological Factors

Students struggle to dedicate undivided attention to 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. Researchers say that around 70% of university students engage in moderate procrastination, while 14% are chronic procrastinators. Several studies have identified the correlation of procrastination with time management, motivation, anxiety, and perfectionism. Procrastination, in return, causes poor academic outcomes, heightened stress, fear of failure, and mental distress [5].

In [24], procrastination is defined as the unnecessary and voluntary delay of intended actions, even when one is aware of the potential repercussions. Similarly, [25] define it as a habit of postponing tasks until they become difficult to complete within the allotted time span. [26], on the other hand, 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 one's lifestyle. In a Swedish study of 732 students, 344 engaged in mild procrastination experiencing anxiety and depression. The remaining reported severe procrastination with intense psychological symptoms [22]. This delay leads to feelings of incompleteness, guilt, and restlessness as the pending work keeps bothering them, disallowing them to relax. Moreover, when the deadline approaches, they regret delaying work and demonstrate an intransitive preference for earlier dates [26].

Procrastination can be caused by the following:

1. Temporal discounting: Temporal discounting means to discount delayed future rewards for short-term rewards that are immediately available such as joy from social media [24]. This leads students to procrastinate and delay studying for exams until the rewards, such as good marks, become immediate [27]. The delayed rewards are either linked to performance approach goals or performance-avoidance goals. In the former, students want to outperform others, so they start preparing earlier, but in the latter, the students want to avoid failure so they start preparing when the exams get closer [18].
2. Longer deadlines: Deadlines improve performance by mitigating procrastination and allowing students more time to prepare for exams if they complete assignments earlier [28]. However, long deadlines may coincide with other tasks and get overlooked, leading

to late submissions. Also, many deadlines begin at the start of the semester, before the required course content is taught, making it impossible for students to begin the coursework [2]. According to Parkinson's Law, a mismatch between the task length and the time frame can result in unnecessary tasks. Extended deadlines discourage students from completing coursework early, welcoming procrastination. If the deadline aligns with the task completion time, the job can be completed earlier [5].

3. Time mismanagement: Ineffective time management leads to poor self-control and academic performance. Students spend time engaging in leisure activities for temporary relaxation or prioritise other responsibilities [5]. As a result, they stressfully begin coursework closer to deadlines, causing them to panic and resort to ineffective strategies such as plagiarism and collusion [20].
4. Self-regulation failure: With computer technologies, students can easily waste time in unanticipated and undesirable ways. 47% of students procrastinate online due to their inability to self-regulate. They search for short-term rewards for instant mood repair and neglect important tasks. Self-regulation means understanding one's behaviour to achieve goals and emotional intelligence means controlling emotions to guide behaviour. When students fail to act upon their intentions, cognitive dissonance develops due to conflicting beliefs. This leads to procrastination and is linked to emotional intelligence, self-control, and self-regulation. Moreover, when students lack external help and guidance in coursework, they fail to self-regulate [24].
5. Lack of motivation: High motivation encourages students to set realistic timeframes for achieving their goals. However, when students experience low self-esteem, fear of failure, or self-distrust, they showcase poor organisational skills and feel unprepared. This lack of self-efficacy increases stress, causing students to question their ability to complete tasks and eventually, avoid attempting them. In an online setting, motivation may decrease further because students do not face peer pressure and are expected to initiate tasks themselves. Thus, they end up procrastinating [5].
6. Underestimation of time: Being overly optimistic is a common trait that can backfire when mismanaged. Students often overestimate themselves by assuming that coursework will take less time than it actually does. This happens because they fail to measure the task's complexity and estimate accurate timeframes. Consequently, they end up wasting time under the illusion of unrealistic expectations and poor planning [24].
7. Perfectionism: Perfectionism is a trait where individuals set high standards for their activities in order to achieve a flawless outcome. Such students constantly criticise their

work, feel dissatisfied, blame parents for setbacks, and worry about their grades dropping. This fear of failure causes them to focus only on perfecting tasks, leading to procrastination as they avoid other responsibilities [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].

II. External factors

Students may lag due to a lack of resources needed for completing and submitting online coursework. Unstable Internet connection and faulty devices are common challenges faced by learners, demotivating them and diminishing the quality of outcomes. As technology becomes pervasive, disrupted access to technology can adversely affect education. Moreover, external factors such as work or family responsibilities, poor health, financial constraints, and despair can prevent them from fulfilling their academic duties [5].

Some students experience the “over-doer” phenomenon, where they overcommit to duties with unrealistic timelines. Such students agree to take up several tasks without considering the possibility of getting overloaded. This leads to anxiety and exceeded deadlines. These delays differ from procrastination as they are caused by external factors rather than the psychological factors described earlier [5].

III. 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. According to students, the visuals of presentations evoke enthusiasm, allowing them to express themselves interactively and enjoyably. Writing tasks are often considered daunting making them highly susceptible to no submission, and long-term projects are delayed due to challenges in long-term commitment. The authors concluded that difficult, unpleasant, boring, and uninteresting

coursework tends to be started, completed, and submitted late. Students showcased higher tendencies of procrastination in both extremely easy and 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 |

Furthermore, when students perceive assignments as insignificant or lack the competence to understand them, they delay them until the deadline. Many students enrolled in online courses lack the necessary prerequisites, leading to a lack of motivation and contributing to delayed or missing submissions [5].

All factors can be summed up using the temporal motivation theory (TMT) which states that students prefer tasks that they enjoy, have benefits, and can be completed. The willingness to engage in a task (utility) is defined as $\text{Utility} = \frac{EV}{\Gamma D}$ where E is the probability of succeeding in the task, V is the value of the task, D is the delay between completing the task and receiving a reward, and Γ is the sensitivity of the student towards the delay [29].

In conclusion, students encounter challenges in meeting coursework deadlines due to various psychological, external, and academic factors. Passive procrastination and forgetfulness are common challenges experienced by students as students engage in short-term mood repair to avoid schoolwork. Moreover, they may forget submissions when deadlines are long and cannot be met unless the lecturer covers the required topic in class. To combat them, students require a system that reminds them of deadlines and makes it easy for them to begin work.

## 2.3 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].

### 2.3.1 Importance of Usability in Education

The term usability (previously known as user-friendliness and ease of use) 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]. There exist several definitions for usability, and all revolve around 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. Here, satisfaction refers to the subjective positive attitude to the system's use, effectiveness means completing goals accurately, and efficiency measures the resources utilised to achieve effectiveness [30].

Another common definition for usability is provided by Nielsen who suggests parameters to evaluate the ease of use of an interface:

1. Learnability: The easiness to learning a system for the first time
2. Efficiency: The number of resources and time needed to complete tasks
3. Memorability: The easiness of remembering to use a system after a prolonged period of not using it
4. Error Rate: Reduced errors and the easiness to recover from them
5. Satisfaction: The comfort of using the system [33]

Despite all the efforts to define usability, these standards are not appropriate for educational technologies because the pedagogical and sociocultural elements are overlooked [30]. Pedagogical usability plays a key role in the acceptance of educational technology by learners and lecturers. It is often divided into content, multimedia, tasks, social interaction, and personalisation. If the LMS is difficult to use and understand, learners will spend more time learning to use the LMS than the content distributed over it, limiting the learning outcomes [34] [30]. Furthermore, [35] state that the intention of a learner to use a platform depends on the effort expectancy or the perceived ease of use. Their research suggests that complex learning systems can trigger anxiety in learners and increase the cognitive load making it hard for them to perform academically. They differentiate technical usability from pedagogical usability based on the effect of readability and ease of use on learning outcomes.

In pedagogical usability, it is recommended that the design of the system should mimic the user's learning behaviour by using similar schemas, avoiding unnecessary features that confuse students or increase anxiety, and minimising distractions, and interruptions. Over time, researchers have suggested principles of pedagogical usability that focus on technical usability and academic context [35]. Figure 2.1 illustrates how common the traits of technological, pedagogical, and socio-cultural usability are. According to the graph, 85% of the researchers focus on technological usability with only twenty out of 440 evaluations done for the pedagogical usability. Whereas only 1.4% of researchers have considered socio-cultural usability. This is problematic because technological usability only focuses on ergonomics and not on learning, making this data inappropriate for analysing and improving the usability of learning platforms [30].

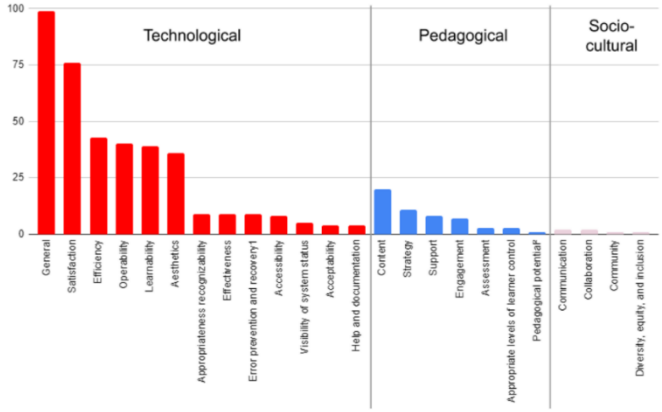


Figure 2.1 Breakdown of evaluations done for technological, pedagogical, and socio-cultural usability [30]

### 2.3.2 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 number of difficulties faced by users when using the system. Identifying and quantifying these problems can help determine the usability. The most common method of doing this is by conducting usability testing [31].

In usability testing, an observer observes typical users while they are interacting with the system to collect quantitative data like usage problems and effectiveness. The users can also be asked to Think Aloud to gather qualitative data like the learning process. Think Aloud is a technique where the user will verbalise his/her thoughts while using the system. This test is often followed by a survey to measure and record usability and user satisfaction ratings. These surveys can be developed by the user or can be standardised [31].

## I. Heuristic Evaluation (HE)

Usability evaluation can be performed using a variety of different methods, but the purpose remains the same: to identify problems and maximise the system's ease of use. This is crucial for educational platforms so that users can have a smooth learning curve that improves their academic performance. When [35] performed a usability evaluation on ElectronixTutor, an Intelligent Tutoring System for teaching electronics, students complained about how the poor design of the system disrupted their learning. The user interface (UI) and terminology did not match the students' mental model and the navigation components were not visible. The students suggested improvements to increase the font size, remove images from between the text, and include an option to enable closed captions. However, this option was available on the site but barely visible. They also suggested to:

- Change the button terminology. The learning site allowed students to ask questions to the tutor but the button to submit the question read "Submit Your Answer". This confused the students as they wanted to submit the question, not the answer.
- Move the progress bar's location. Students found it difficult to locate the progress bar that was located under a drop-down menu on the upper right corner of the screen. Students expected it to be on the left side of the screen along with the course content.
- Improve the graphics of the agent. The researchers noticed that the heat map generated by the eye-tracking software showed that students focused more on the tutor agent than on the content being explained. The students commented that the agent looked choppier, and the jerky quality was distracting them.

The suggestions mentioned above fall under usability heuristics. In Heuristic Evaluation (HE), individual evaluators interact with the interface, inspect the elements, and compare them with a list of usability principles called heuristics. The most famous 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 and novice evaluators can detect up to 51% of issues. However, in reality, novice evaluators can only identify 23% of issues. This is due to a lack of understanding of the usability heuristics because they are abstract. To bridge this gap and train novice evaluators, [37] presented a detailed version of Nielsen's heuristics as shown in Appendix A.

HE is commonly used because it takes around two hours, is easy to use, is cheap, and can be used for complete and incomplete systems. Moreover, the evaluation time can be further reduced to less than two hours if more evaluators are recruited [36].

II. System Usability Scale (SUS) Survey

A System Usability Scale (SUS) is a standardised survey for highly reliable and valid usability evaluation for varying sample sizes. This psychometric tool was developed by John Brooke in 1986 and around 43% of studies utilise it to gain subjective perceptions of the system's usability [31]. In their research, [38] divided students into five teams and asked them to evaluate software using a usability tool of their choice. Three teams opted for SUS because it is short, customisable, easy to calculate, good for comparing systems, and encourages participants to be honest. Furthermore, SUS allows small alterations to adapt to the test and is ideal for evaluating educational systems because it also focuses on learnability.

The SUS survey contains ten alternating positive and negative statements over a five-point Likert scale where one is "Strongly Disagree", five is "Strongly Agree" and three is neutral (Appendix B). To calculate the final score out of 100, the following steps are followed:

1. For the positive toned statements, take the scale position and subtract one (x-1)
2. For the negative toned statements, subtract five from the scale position (5-x)
3. Sum the ten values
4. Multiply the sum with 2.5 [31]

Every researcher interprets the SUS score differently. According to [31], a score above 51 is "Okay", 72 is "Good" and 85 is "Excellent".

SUS is compatible with all kinds of systems and is not limited to a single category. 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.

### 2.3.3 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 (Figure 2.2) [42].

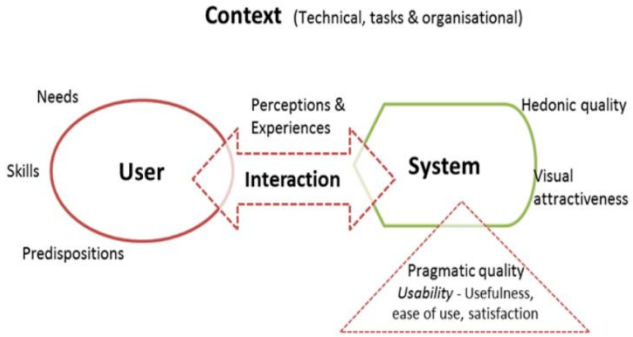


Figure 2.2 UX components [42]

[43] highlighted the following criteria for UX evaluation:

1. Pragmatic quality: The system should allow the fulfilment of the user's goals, making them feel satisfied. This is similar to usability but in an educational context.
2. Authentic learning: The content must relate to real-life problems to make learning relevant and provide learners with hands-on experience while making friends.
3. Autonomy and relatedness: Since the students are self-pacing their learning, autonomous interdependence must be offered by the LMS. Sufficient channels for acquiring support must be available, such as communities and contact details.
4. Motivation and engagement: Motivation is the energy and direction to perform a task, whereas energy is strength and direction is the purpose of the activity. Extrinsic motivation is achieved by external factors like rewards, and intrinsic motivation by the excitement of the task itself. When the website is poorly designed, the UX drops and reduces the user's motivation and engagement.

Lack of student motivation and engagement poses serious challenges to in-time coursework submissions. User engagement can be defined as giving control to users, making learning meaningful for the user, and allowing personalisation of the interface [44]. Locus of control and personalisation is achieved by allowing students to customise the interface and control their learning. Alternatively, engagement is achieved by strategies like gamification [43].

To successfully design for UX, the following tools are used by experts [45] [46]:

1. Personas: Fictional characters represent the target audience and are developed at the start of the design phase to help understand user needs and expectations. Personas can either be data-driven (based on research data) or ad-hoc (based on assumptions).
2. Scenarios: Stories about user activities and how they interact with the product. They clarify the product's purpose and features.
3. Product use cases: Derived from scenarios, these explain the step-by-step process to accomplish a task.
4. Object-Oriented UX (OOUX): Utilising the concept of object-oriented programming (OOP), OOUX considers everything as an object. First, the objects are identified and then actions are assigned to them. This approach replicates real-life situations where users associate actions with objects.

To increase the effectiveness of these tools, researchers recommend integrating personas and scenarios. According to Nielsen, scenarios transform passive personas into active ones by adding context, situation, and objectives [45].

In summary, while usability focuses on the effectiveness, efficiency, and satisfaction of the user interface, UX is about the overall value derived from using the system. Evaluation metrics and techniques are used to assess the achievement of UX and usability goals. Among the easiest evaluation methods for usability are HE and SUS, which can be modified to suit educational systems, do not require expertise, and given the time constraint for this project, can be performed quickly. Current observations indicate that educational platforms have acceptable usability scores, but there is scope for enhancements by allowing different font sizes and avoiding stressful components. These observations will inform the decision to allow UI customisation for changing font sizes.

## 2.4 Coursework Management Systems

### 2.4.1 Overview of Learning Management Systems (LMS)

Until the development of Learning Management Systems (LMS) in the late 1990s, lectures were delivered remotely via email. LMS was developed in response to online technology, and they facilitate learning by providing an all-inclusive online classroom with features such as course material, gradebook, professional training, communication with other users, and collaborative group work [47] [48]. The main purpose of LMS is to allow instructors and learners to distribute, share, store, and access learning material via the Internet without time and place constraints. This makes information easily available to users and reduces administrative costs since information management is no longer a hassle [49].

After the spread of Internet and multimedia, the LMS market surged rapidly by 2013 at an average growth rate of 7.9%, with 17% being the highest in a few countries [50]. Moreover, in 2018, 3500 institutions used LMS [48]. LMS usage further heightened during COVID-19 and since then, several institutions permanently adopted LMS, making it an integral part of their system [49].

LMS brings benefits to both, the professor and the student. The professor can use a wide range of media files, such as video, audio, images, and text, to support their student's learning, making it more interactive. They can easily use LMS to distribute pedagogical material by uploading it over to the system only once and tracking their student's performance. On the other hand, students can enrol in classes, read class announcements, access learning material, check grades, evaluate educational performance, participate in discussions, take tests, and gain support from classmates and professors [47].

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

When institutions actively use LMS, learners become more independent as the system provides them with constant feedback about their performance and it might even provide extra support material like guides and assessments. However, studies show that students usually struggle to meet deadlines regardless of how excellent or poor they are at their studies. To help meet deadlines, researchers suggested that professors should implement a

reward system that motivates students to stay on track [47]. This would increase their motivation to achieve goals, increase their efficiency, and help them retain focus [49].

### 2.4.2 Types and Examples of LMS in Education

I. Canvas

Canvas LMS, developed by Instructure, is used by 17.1% of American institutions and over 3000 universities worldwide. It proved to be a strong competition to Blackboard when an analysis revealed that the transition from Blackboard to Canvas was the second highest amongst institutions especially after Blackboard acquired the Angel LMS [50] [48].

Canvas can be accessed from computers and mobile devices, making it flexible for learners and instructors. With Canvas, users can participate in a variety of timed assessments within the available time frame and receive feedback instantly for quizzes [13]. Canvas can be integrated with open-source programs such as Google Docs, making the overall learning experience productive and collaborative. It contains features to create courses using drag and drop, view student progress using Canvas analytics, produce rubrics, and grade students using SpeedGrader. Canvas analytics helps identify students who are at risk of failure so that instructors can bring them back on track [48] [6].

Canvas has the highest satisfaction and usability scores as faculty members find it easy to build classes, upload files, make assignments, and grade quicker by using SpeedGrader [6] [50]. Furthermore, study participants noted that Canvas organises content using modules and allows users to engage in discussions using boards or groups. These functionalities helped users become more efficient and also improved academic performance. [50] mentioned that clear course goals, timely feedback, and active discussions with instructors increase user satisfaction and the cognitive presence of learners. Additionally, both teachers and students found the Canvas application accessible, and they valued the support provided by Instructure.

II. Moodle

Modular Object-Oriented Dynamic Learning Environment (Moodle) is an open-source LMS and is popular for its free-of-cost nature. It is used by 19.4% of institutions across 241 countries with over 291 million subscribers, making it the second most popular LMS after Blackboard [50] [51]. With Moodle, teachers can exchange files with students, have real-time

discussions, and explain on the digital whiteboard [6]. Moodle is similar to Blackboard and does not differ much except for being free and cost-effective [41].

Despite being updated in 2019, users find Moodle to be user-friendly but with several UX issues, such as speed, content organisation, the search function, and navigation [51] [41]. Users also report discomfort while using the mobile application and refuse to use it for courses such as philosophy due to its poor communication features [41]. Moodle also offers features to organise content, submit assignments, read updates, grade students, create checklists, and access course lessons. However, instructors struggle to use these features and often underutilise them [6].

III. 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. The number of users increased when Blackboard acquired a dynamic look by introducing communication tools and live tutorials [50]. Blackboard and Moodle share the same features; however, teachers found the announcement page of Blackboard more effective as they could reach more students [6]. To compare their features, researchers asked students to use both Blackboard and Moodle simultaneously for all their courses. The usability survey revealed that Blackboard was easier to learn and more satisfying to use. It was also found to be more usable than Moodle. However, a few students reported higher response times on Blackboard [50]

Overall, Blackboard is preferred for its assignments and gradebook, Moodle for assignments, and Canvas for quizzes, polls, syllabus, and tests. The satisfaction level for Canvas and Blackboard is rated as “C”, while for Moodle, it is a “D” [6].

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

Academic performance increases only when LMS are usable and provide a productive UX [50]. Despite having similar functionalities, LMS differ in terms of user-friendliness, customisation, cost, requirements, and the institution’s needs [52]. Researchers have studied these factors to come up with comprehensive lists to define the usability and UX of LMS. [50] presents seven factors that impact the user’s satisfaction on Blackboard: consistency, clear terminology, too many features, informed location, simple features, visible hyperlinks,

and help sections. They also mention that response time, reliability, and accessibility contribute to the intention of LMS usage equally as usability.

According to [43], 50% of users are unsatisfied with the LMS due to fewer features, outdated UX, poor customer support, difficult to use, lack of agility, and poor reporting features. They categorised these issues into design and managerial issues. Conversely, [42] argue that managerial issues like administration do not influence UX.

According to [39], students attending online lectures were unsatisfied with the system and received poor grades due to system interruptions and connectivity issues. To enhance the overall user experience of the learning platform, the following enhancements were suggested:

- Support service: Many software and hardware problems, such as slow transmission, delayed response, faulty microphone, and lost voice connection, are encountered during online learning. Moreover, teachers may lack expertise in operating online classes and diagnosing issues. Therefore, organisations must provide prompt customer support to solve user problems and simplify the configuration process.
- Interactive communication: During online classes, it becomes difficult for students to attend lectures and perform tasks simultaneously. For this purpose, LMS should allow students to split their screens so that they can engage in both activities.
- Ease of use: It should be secure, compatible, and user-friendly across all devices
- Learning resources: More learning resources and activities should be included to cover different disciplines and improve the student's enthusiasm.

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. Thus, it is important for LMS to be usable. When LMS were compared, Canvas emerged as the preferred choice, while Moodle and Blackboard faced issues. Analysis of such shortcomings provides valuable insight into how Coursework Wizard can be designed to enhance usability and UX.

## 2.5 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].

### 2.5.1 Coursework Management Strategies for LMS

I. 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.

## II. 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.

## III. 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.

IV. 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.

V. 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, prioritizing 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.

### 2.5.2 Coursework Visualisation Strategies for LMS

I. 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].

The progress bar will be used in Coursework Wizard to visualise student progress.

II. 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].

III. 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 visualise student data by visualising patterns, and Kanban visualises work after breaking projects into discrete tasks. Kanban is used in professional projects but implementing it in academics can help students get a clear idea about coursework and prevent them from missing deadlines.

### 2.5.3 Self-Management Strategies to Meet Deadlines

I. Assignment Logs

Assignment logs or work journals are used by students to record coursework data, enabling them to monitor their progress and behaviours. This technique increases their self-awareness by helping them identify and reflect on their counterproductive behaviours. Researchers urge instructors to encourage students to write journals and provide feedback to help them manage their coursework effectively. Through the use of journals, students are more likely to manage their time effectively, complete tasks on time, and achieve higher grades. According to a study, [53] concluded that students who engage in regular assignment journaling achieve higher grades than those who do not, with their submissions also being on time.

Furthermore, in 2024, Heriot-Watt University introduced project journals (PJs) and mandated them for all master's students enrolled in the courses F21RP and F21MP. PJs are defined as logs for documenting students' progress, challenges, and achievements throughout the project within time frames of 2-3 weeks. Professors Claudio and Hind stated that PJs enable students to manage their time, record tasks, measure progress, and identify setbacks. They also mentioned that PJs allow students to take ownership of their work in terms of plagiarism. The alignment of PJs with Agile development, where work is produced incrementally, prevents students from scrambling at the last minute to meet deadlines [69] [70].

II. Intentions and Planning

A study revealed that implementation plans enhance self-regulation and bridge the gap between intentions and actions, thereby reducing procrastination. However, this does not prevent students from making last-minute submissions because they often promise themselves to complete the assignment only in the final hours before the deadline [27].

According to [24], the most crucial step is simply getting started. In his book, he discusses that tasks are not as daunting as they may seem, and many people regret not starting earlier as it could have led to better performance. When students begin a task by breaking it into smaller subtasks, they find it less daunting, feel more optimistic and satisfied, and they engage in goal-directed behaviour the next day. As a result, their procrastination decreases. He also describes a psychological approach called "time travel", where students create mental images of the future to help motivate themselves to avoid regrets.

### III. The Eisenhower Matrix

In the Eisenhower matrix, all tasks are categorised and prioritised based on their importance and urgency. The most urgent and important tasks are completed first. Over time, tasks from one box of the matrix are moved to another based on approaching deadlines and completed tasks. The matrix comprises four boxes: Do (urgent and important tasks that need immediate attention), Schedule (less urgent but important tasks that can be scheduled later), Delegate (urgent but less important tasks that can be delegated to team members), and Delete (non-urgent and unimportant tasks that can be removed). Despite prioritising tasks, students may engage in non-urgent tasks when they lack energy. This approach can benefit them as they can complete tasks before they become urgent and have time to receive feedback from instructors. Some students prefer creating a to-do list instead, where tasks are broken down into smaller subtasks and prioritised according to their importance [57].

### IV. Pomodoro Technique

While in university, Francesco Cirillo tracked his coursework using a tomato-shaped timer, and in the 1900s, he developed the Pomodoro technique to help students focus on assignments [62]. Students first have to break tasks into smaller subtasks and then set a timer for 25 minutes to work, followed by a short break of 3-5 minutes. This cycle is repeated four times, after which students reward themselves with a longer break of 20 minutes [67].

[62] created an online tool that adopted the Pomodoro technique, suggested resources to support assignments, and prevented procrastination. As soon as the tool detected idleness, it would take immediate action. The Pomodoro technique has been proven to be effective in time management and reducing procrastination, benefiting students' grades.

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.

## 2.6 Future Trends and Innovations in Coursework Management

### 2.6.1 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 four main IRs ranging from 1IR to 4IR, starting from the eighteenth century until today. The ongoing 4IR is defined as a group of technologies that fuse the digital, biological, and physical spheres, impacting and challenging humans across all disciplines. It encompasses technologies like Artificial Intelligence (AI) and the Internet of Things (IoT), increasing human-machine interaction to boost performance and efficiency [71].

The current era focuses on developing Cyber Physical Systems (CPS) where machines communicate through sensors and wireless technologies, making decisions autonomously. The 4IR encourages humans to broaden their thinking prospects and re-examine common practices to tackle the challenges of the 21$^{st}$ century [72].

In the near future, 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].

### 2.6.2 Predictions for Future Coursework Management Systems

In the future, LMS will be a central hub with different teaching tools for varying purposes using the following 4IR concepts and technologies [76]:

- Artificial Intelligence (AI): E-learning platforms will be integrated with AI and machine learning to provide students with personalised learning experiences. Student data will be used by AI to provide recommendations, like translators to remove language barriers in learning content. Furthermore, AI agents will be able to answer questions and provide learning support to students, making the overall experience more engaging. For instructors, AI will help with e-assessment strategies by automating corrections and detecting whether students have completed the work themselves.
- Mixed Reality (XR): Mixed reality combines Virtual Reality (VR) and Augmented Reality (AR). Using XR makes the learning experience more immersive and engaging, as students can experience the topics taught via simulations and virtual tours. In the future, students will be able to immerse themselves in educational games and have higher connectivity with peers. This could make coursework easier and more interesting, potentially reducing procrastination.
- Big data: This will be crucial for producing analytics from LMS. Using big data, anomalies can be identified which could represent struggling students. It can also generate patterns showing similarities and characteristics that need improvement. With big data, student behaviour can be analysed, and students can be provided with personalised support.
- Blockchain: With blockchain, all data on learning platforms will be transparent and secure. Students can track their coursework submissions and also see how their grades are being calculated. All student activities will be timestamped, and fraud protection protocols will prevent cheating. Furthermore, blockchain can also help automate deadlines and reminders.
- Usability and inclusiveness: As discussed earlier, usability is a core design component that needs further improvement in LMSs. E-learning platforms will be made more accessible in the future for all kinds of users so that their disabilities do not hinder their learning. User-centred design principles will be applied to make LMSs adapt to students' learning needs. Several features can be implemented, like closed captioning, transcoding, audio scripts, and textual description generators.

# Chapter 3. Requirements Analysis and Methodology

## 3.1 System Specifications Using the MoSCoW Method

The system requirements can be prioritised using the MoSCoW method:

- **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

### 3.1.1 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 lecturers must be able to log into their respective accounts with suitable privileges. | M |
| R2 | Lecturers must be able to upload the coursework specifications and manage the deadlines. | M |
| R3 | Students must be able to submit the coursework for up to four courses. | M |
| R4 | Students must receive reminders from the system. | M |
| R5 | The website must display statistics of student submissions to the lecturer. | M |
| R6 | The website must have a progress bar with colour codes to monitor and track coursework completion for each student. | M |
| R7 | The Eisenhower matrix for work prioritisation should be integrated. | S |
| R8 | The website should allow users to personalise their UI. | S |
| R9 | Visuals for deadlines and progress should be displayed to the lecturer. | S |
| R10 | A calendar for time mapping should be present. | S |
| R11 | Automated feedback could be provided to each student via email. | 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 could mandate project journal submission at fixed intervals. | C |
| 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 |

### 3.1.2 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 and user guides 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 | Performance: The system shall be able to handle multiple concurrent users without affecting the response time. | TBD |
| N7 | Scalability: When the load increases, the website shall be able to scale up. Latency and throughput shall be at acceptable levels. | TBD |
| N8 | Availability & Reliability: The website shall be available at all times with minimal downtime and perform without failures. | TBD |

The high-priority system requirements are determined based on the limited time and expertise available for completing this project. For the MVP, once users log in, they will be able to view and submit coursework-related files. Students will be enrolled in four courses, and the website will visualize their progress for all coursework by generating a color-coded progress bar where blue would represent “early,” green for “on-time,” yellow for “slightly late,” and orange for “in danger.” Orange is used in place of red because red signifies danger and can make students anxious. The website will send reminders to the students every week, but as the deadline approaches, the frequency of reminders will increase to twice a week. Daily reminders can irritate students so having it on a weekly basis sounds reasonable. On the other hand, lecturers will be able to view all submissions and statistics such as who has not submitted and when submissions are made, etc. If the author has time, a LAD will be implemented to visualise these statistics.

All files will be backed up to prevent data loss, and users will have to provide credentials to log in. Users will also need to set strong passwords, and technical documentation will be created as a guide. The website will be developed following usability and UX guidelines.

However, if this project were to be developed in the industry, the website would get integrated into an LMS such as Moodle. 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. Other features that could be implemented include two-step authentication and CAPTCHA to ensure authorised access.

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.

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.

## 3.2 Software Development Methodology

Software can be developed using traditional and agile methodologies. Traditional methods involve sequential development without iterations. On the other hand, agile methods are flexible, user-centric, and speed up the process [79]. Nowadays, software development teams prefer agile for incremental product development, with Scrum being the most popular choice. Scrum, symbolising teamwork, has been adapted for solo developers since most teams only have one member [80] [81].

First, a product backlog is prepared containing a list of all the features that the final product must have. Next, a meeting is held to decide and move 1-3 features from the product backlog to the sprint backlog. A sprint is a timeframe with a varying length of one to six weeks for completing tasks in the sprint backlog. Sprints are created successively until the product backlog is empty. When a sprint ends, a sprint review is held to reflect on the completed sprint and plan ahead for the next one by making possible improvements. This makes each sprint faster than the previous one. The team also ensures that the product at the end of each sprint is workable and in a deliverable state [81] [82] [83].

To make Scrum efficient, daily Scrum meetings are held where team members meet every day for 15 minutes to discuss yesterday's work, today's work, and identify obstacles. These meetings are sometimes called stand-up meetings when conducted while standing to keep them short and quick [82]. The entire process is summarised in Figure 3.1.

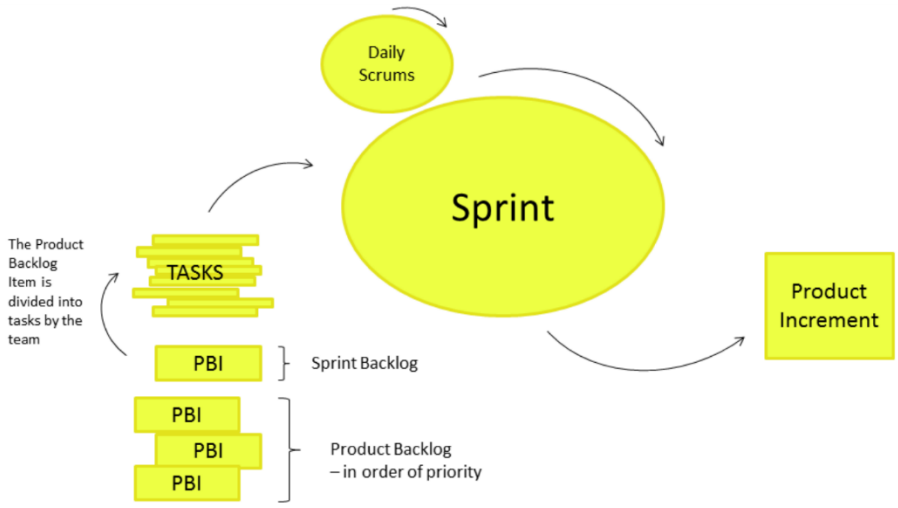


Figure 3.1 The Scrum Methodology [82]

Scrum has three roles but for this project, the following key adaptations from Solo Scrum will applied:

- Product Owner: Product owners know the product well and create the product backlog. They communicate with the team and answer questions. In this project, the author will use JIRA to create the product backlog from the functional requirements mentioned in this document. The author will focus on the end goal and the deadline to differentiate between important and unimportant goals [83].
- Scrum Master: The Scrum master is like a project manager who supervises the process and resolves issues [82]. In this project, the author will ensure productivity by monitoring

progress using the Scrum board on JIRA and project journals. Also, when there is a problem, the author will brainstorm and resolve it [83].

- Development Team: It usually consists of 5-9 developers who work on the sprint backlog to produce deliverables. In this project, the author will work alone to develop the website and remain self-motivated by using techniques discussed in section 2.5 [83]. Due to other commitments, the developer will only engage in sprint review and planning instead of daily scrum meetings.

Overall, the proposed methodology, Scrum, is adapted for solo development. The software development lifecycle stages (planning, designing, implementing, and testing) will be treated as sprint tasks.

## 3.3 Development Tools

The website will be developed using React, Node.js, MongoDB, and Figma, they are chosen for their suitability in solo development and for meeting project objectives efficiently:

- React: It is a JavaScript framework for front-end development used by developers of varying skill levels. React is useful for creating UIs with changing data sets to make the web page dynamic and interactive. It will be used for this project because it has reusable code packages for all UI components, making website development faster. For authentication, the author might use Firebase or passport.js [84]
- Node.js: It is a runtime environment that allows developers to run the JavaScript code outside the browser. It is used for front- and back-end server-side development. In this project, Node.js will be used for the backend to handle the functionality and will be helpful for real-time events like pushing reminders [85]
- MongoDB: It is a flexible and scalable NoSQL database for storing documents and has drivers that make it easy to use MongoDB with Node.js scripts. Moreover, MongoDB has a JSON-like format that aligns with Node.js. Thus, in this project, learning MongoDB will not be very difficult once the author is familiar with Node.js [86]
- Figma: To make the front-end development easy, the author will use Figma to create a high-fidelity prototype of the UI. Figma allows interactive prototyping, depicting the actual interactions of the website. Additionally, having a prototype as a guide will make front-end development faster and reduce trial and error. Having a prototype will also help tackle usability and UX issues from the very beginning [87]

## 3.4 Evaluation

A usability study will be conducted post-development of the prototype and the website. Three lecturers and three students from the IT 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.

# Chapter 4. Professional, Legal, Ethical and Social Issues

## 4.1 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.

## 4.2 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.

## 4.3 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.

## 4.4 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.

# Chapter 5. Project Plan

## 5.1 Gantt Chart

The Gantt chart for the project plan is presented in Figure 5.1. The timeline provided is an estimate and changes may be required at a later stage.

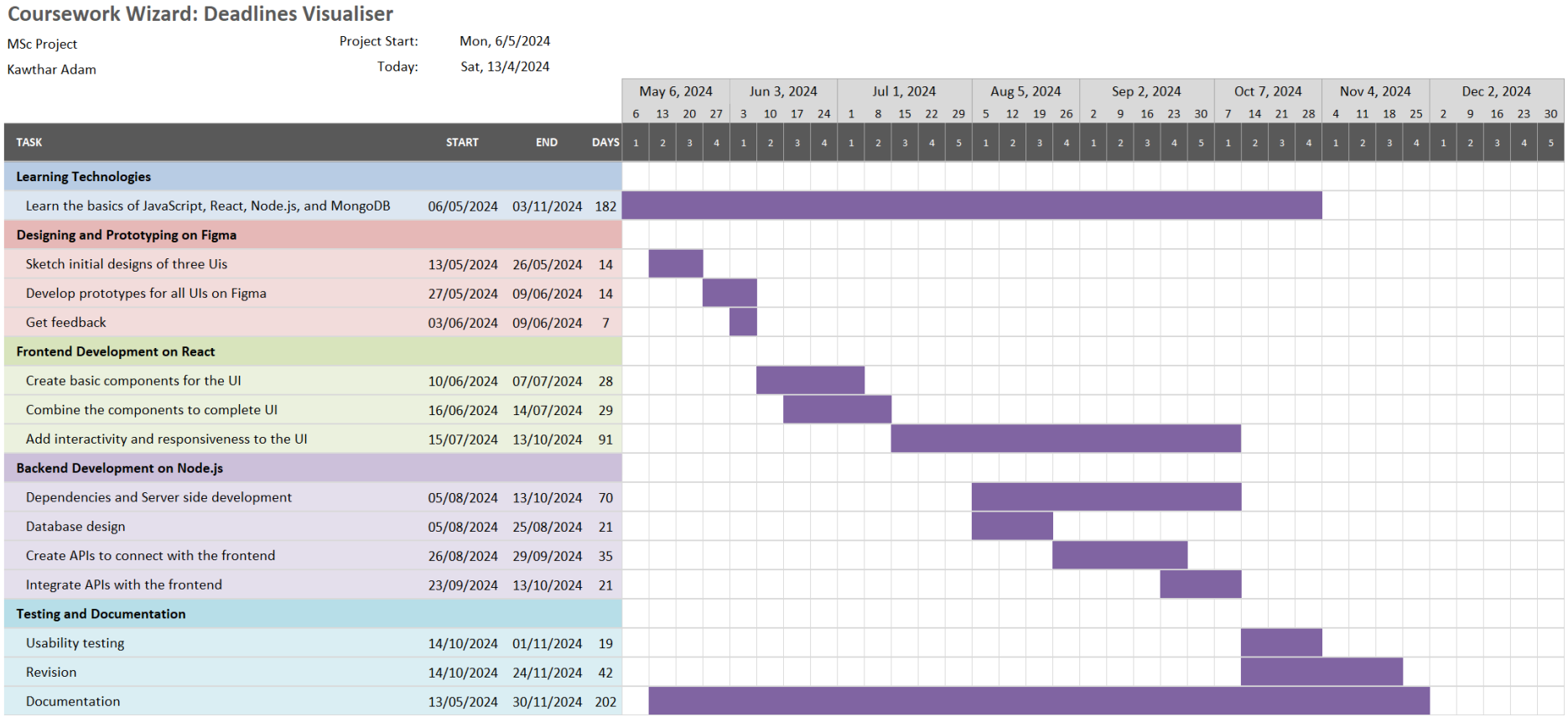


Figure 5.1 Project Gantt Chart

## 5.2 Risk Management

A proactive approach to risk assessment involves identifying and evaluating uncertainties that have a negative impact on the project objective. Table 5.1 outlines the associated risks, their likelihood level (high, medium, and low), and mitigation strategies. The developer will continuously monitor and review these factors throughout the project [77].

Table 5.1 Project risk analysis and mitigation plan

| Risk | Probability | Impact | Mitigating Action(s) |
|---|---|---|---|
| Lack of technical proficiency | High | High - Website will get delayed and have poor quality | • Keep learning the tools and start small<br>• Take support from available tutorials and guides |
| Unavailable or outdated packages or APIs | Medium | High – The project plan and requirements will change | • Research about them before beginning the task<br>• Leave it if the task is of low priority |
| Computer failure and loss of data | Low | High - Work will have to begin from scratch | • Keep a backup of all files on HWU OneDrive<br>• Use version control programs |
| The project falls behind schedule | High | Medium - Less time to work | • Plan tasks realistically with buffer time |
| Change in requirements | Medium | High - Project plan will change | • Develop the website in iterations and prioritise requirements |
| High workload at work | High | High - Less time to work on project | • Shift to remote work or take a short leave |
| Author illness | Medium | Medium – The project will halt temporarily | • If the case is severe, discuss it with the university |
| Supervisor illness or emergency leave | Medium | Medium - Difficult to communicate and get feedback | • Use Teams or email for communication<br>• If the case is severe, discuss it with the university |

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# Appendix A: Heuristic Evaluation

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

H1. Visibility of system status
   a. State: The current state of the system and available actions
   b. Location: Where the user is currently
   c. Progress: How much more is left to complete a task
   d. Closure: Notification upon task completion

H2. Match between system and the real
   a. Understandability: Use content that the target audience can understand easily
   b. Natural and logical order: Present information in steps that are followed normally in the real-world. For example, e-shopping
   c. Appropriateness: The content should be appropriate for the target audience

H3. User control and freedom
   a. Reversibility: All actions should be reversible - recover deleted files
   b. Emergency exit: Exit undesirable situations without extensive procedures
   c. Informing users: Inform the user about the critical action he/she is taking

H4. Consistency and standards
   a. Consistency: Element usage should be the same throughout the system
   b. Standards: Use knowledge of previous similar systems and apply it

H5. Error prevention
   a. Instructions: Clear instructions and requirements for performing tasks
   b. Constraints: Do not allow certain input from the user like numbers for name
   c. Confirmation: To avoid unintentional actions, the system should ask before executing serious and irreversible actions
   d. Notification: Notify users about critical changes and updates
   e. Autosaving: If the system fails, all user data will be lost. To prevent this, the system should autosave time-consuming data
   f. Flexible inputs: Allow alternate ways of entering input to enhance flexibility
   g. Defaults: Add default states that are preferred by people and inform them

H6. Recognition rather than recall
   a. Availability: Make information visible at all times so that users do not need to memorise it. For example, directions on streets
   b. Suggestions: Provide accurate suggestions to users because they might be unfamiliar with the system and want they want

H7. Flexibility and efficiency of use
   a. Flexibility: The system is usable for all kinds of users
   b. Efficiency: Do not add unnecessary steps to compete a task

H8. Aesthetic and minimalist design
   a. Aesthetic: If the system is aesthetically pleasing, users will perceive it as usable and ignore minor usability issues
   b. Organisation: Organise sections in a sensible order by categorising similar elements together and separating different sections
   c. Simplicity: Simple and uncluttered interface with only necessary content

H9. Help users recognise, diagnose, and recover from errors
   a. 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
   b. Understanding errors: Location and reason of the error
   c. Recovering from errors: Display instructions and steps for resolving the error

H10. Help and documentation
   a. Help: There should be a contact point for providing help to users
   b. Documentation: Easy to follow user guides, FAQs, and tutorials

# Appendix B: SUS Survey

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

| | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1 | I think that I would like to use this system frequently. | O | O | O | O | O |
| 2 | I found the system unnecessarily complex. | O | O | O | O | O |
| 3 | I thought the system was easy to use. | O | O | O | O | O |
| 4 | I think that I would need the support of a technical person to be able to use this system. | O | O | O | O | O |
| 5 | I found the various functions in the system were well integrated. | O | O | O | O | O |
| 6 | I thought there was too much inconsistency in this system. | O | O | O | O | O |
| 7 | I would imagine that most people would learn to use this system very quickly. | O | O | O | O | O |
| 8 | I found the system very awkward to use. | O | O | O | O | O |
| 9 | I felt very confident using the system. | O | O | O | O | O |
| 10 | I needed to learn a lot of things before I could get going with this system. | O | O | O | O | O |

Appendix B – Figure 1 The standard SUS Survey [88]