



Examining the Effectiveness of Gamification in Enhancing Web Usability Learning

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Abstract

This study explores gamification in online learning platforms to improve web usability education for computing students in Scotland. The study was motivated by the growing demand for IT skills and shifts in learning preferences caused by the COVID-19 pandemic. To achieve the study's objectives, a high-fidelity prototype of a gamified learning platform was developed based on feedback from focus group discussions with the targeted audience. The focus groups' insights provided valuable details about the users' specific needs and preferences. An independent experiment was then conducted with higher education students to assess the effectiveness of the gamified platform. The independent experiment's results showed an increase in learners' knowledge across both platforms. However, due to an insufficient sample size, conclusive findings regarding the impact of the gamified platform were not achieved. Nevertheless, these findings serve as a strong foundation for future research, indicating potential avenues to explore more effective ways to bridge the gap between educational content and workplace requirements in web usability.

1. Introduction

In recent years, Scotland has experienced a surge in students pursuing computing qualifications and a growing need for IT experts (BCS, 2022; Turner, 2023). This indicates a changing work landscape, presenting opportunities. At the same time, changes in study habits prompted by the COVID-19 pandemic have increased reliance on home-based learning and the necessity for effective online learning platforms (Jereb et al., 2023). Moreover, the changes during the pandemic are marked by an increased use of electronic materials and services (Maity & Sikdar, 2023). Additionally, research indicates that students can learn 60% faster when studying online (Li & Lalani, 2020). Furthermore, the adoption of online education is in line with students' preferences for flexibility, which is associated with increased agility, relevance, and customisation of learning programs (Wang, 2023).

Effective learning requires time, focus, and mental clarity, according to research in cognitive sciences (Pudelko, 2020). However, the presence of multiple distractions at home makes it challenging for students to concentrate (Oxford Royale Academy, 2024). The conflict between a preference for and benefits of online learning combined with the difficulties to concentrate emphasises the need for more engaging online learning systems.

This research aims to explore whether the use of gamification in online learning can lead to better or similar learning outcomes for computing students. The study will focus on web usability as the main learning objective. Usability is a component of User Experience (UX) design (Sogard, 2020), and its goal is to ensure that software effectively serves its intended purpose (Nielsen 2012). Therefore, usability knowledge is essential for students and professionals in computing.

1.1 Project Aims and Objectives

1.1.1 Aim

This project aims to contribute to the changing environment of computing education by investigating the development of an effective gamified learning platform.

1.1.2 Objectives

The primary objective of this project is to create a high-fidelity prototype for a targeted learning path that incorporates game elements while emphasising human-centred design principles. The prototype will be evaluated in comparison to a non-gamified learning experience. The final deliverables will include a high-fidelity prototype of the gamified learning page and a detailed Research Findings Analysis Report. To do this, the following actions will be carried out:

- Literature Review: Conduct a comprehensive literature review to gain insights into market trends, user needs, and best practices guiding product development.
- User Insights: Gather student feedback via focus group to understand usability challenges, learning needs and experiences within gamification.
- Design Documentation: Create a mood board, research similar websites for inspiration, and develop user personas to guide website design.
- Prototype Development: Develop two high-fidelity learning pages, one incorporating gamified elements and one without.
- Functional testing: Conduct comprehensive functional testing to meet quality criteria.
- Independent Measures Experiment: Assess the efficacy of the gamified learning page in comparison to the non-gamified version.
- Analysis: Analyse and document experimental research findings

1.2 Research Questions

1.2.1 Literature review

Considering the need for more engaging learning platforms and the growing interest in computing courses, along with increased industry demand, this literature review aims to answer the following questions:

- What are the latest trends and demands in digital learning and self-studding?
- How can integrating gamification into an educational platform effectively enhance the learning experience of students?
- What are the specific usability learning needs of students in higher education within the computing field in Scotland?

1.2.2 Focus Group

- Which e-learning systems do students prefer for online study?
- Which game elements are preferred by students in higher education?
- Which tools do students find unhelpful for learning?
- What specific usability learning needs do students have?

1.2.3 Independent measures experiment

- Can gamification improve learning outcomes?

1.3 Scope of the Document

The purpose of this dissertation is to investigate the integration of gamification in online learning environments, focusing specifically on web usability learning. It seeks to address the evolving educational landscape in Scotland, which is marked by a rise in the number of students pursuing computing qualifications and an increased demand for IT professionals (BCS, 2022; Turner, 2023). The document is structured to encompass a comprehensive review of current educational trends, the challenges and opportunities of online learning, and the potential of gamification to enhance learning outcomes.

1.3.1 Key Components of the Document

Literature Review

This section examines the modern trends in education, focusing on how gamification is being used in learning environments. It discusses the benefits and challenges of applying game elements in education and highlights the usability learning gaps for students in higher education.

Qualitative Research Methodology: Data Gathering and Analysis

This section outlines the use of focus groups to gather insights into participants' preferences for game elements and their needs in learning usability. The section also discusses the data analysis and findings to determine the most effective learning platform design strategy.

Design and Development

This section includes a detailed overview of the gamified learning platform's design and development process, emphasising user requirements, prototype creation, and functional testing to ensure quality and usability.

Quantitative Research Methodology: Data Gathering and Analysis

This section describes quantitative data collection during the independent measures experiment, including surveys and tests to assess participants' knowledge. The section also discusses the data analysis and findings.

Discussion

This section will evaluate the implications of findings from the literature review, focus groups, and independent measures experiments on computing education and the broader application of online learning platforms. It will examine how gamification integration aligns with educational needs, considering both theoretical insights and empirical data.

Limitations

This section acknowledges the limitations of the research study.

Conclusion

This section presents the main findings and discusses their impact on e-learning in computing education.

Self-Reflection

This section uses the STARL framework to reflect on the research journey of this honours project.

2. Literature Review

2.1 Modern Trends in Education

Today's vast availability of online information has made E-learning and independent study crucial for teaching and skill development (Li et al., 2022). Furthermore, technological advancements have provided the opportunity for novel learning methodologies and non-traditional teaching approaches. (Zamecnik et al., 2022). However, navigating and managing independent learning effectively requires strong self-discipline (Li et al., 2022).

Flipped learning (FL), or flipped classroom, has been increasingly gaining the interest of researchers over the last eleven years (Hwang et al., 2019). This new method is especially popular in practical disciplines like Computer Science and Social Sciences, offering students increased flexibility in their study routines (Hwang et al., 2019). FL involves students independently learning before class, enabling more interactive activities during class time (*Flipped Classrooms*, n.d.). However, this transition to increased independent learning can challenge students to understand pre-class content effectively (Huang et al., 2018). Within the context of FL, many students report feeling disconnected from extracurricular activities (Huang et al., 2018). These challenges underscore the growing demand for interactive educational materials.

Harvard University has stated that FL is often seen as synonymous with active learning (AL) (*Flipped Classrooms*, n.d.). FL and AL involve students in hands-on, interactive activities beyond passive listening or reading (*Flipped Classrooms*, n.d.). Although further research is needed, current data indicates a consistent rise in interest toward prioritising AL in Higher Education (González-Zamar & Abad-Segura, 2022). This may be because FL is associated with positive student outcomes (González-Zamar & Abad-Segura, 2022). For example, educators have observed that students in AL environments often demonstrate better academic performance, improved problem-solving skills, increased critical thinking abilities, and enhanced collaboration with their peers (González-Zamar & Abad-Segura, 2022).

The 21st-century digital society demands flexible, creative professionals with diverse skills and competencies (Zamorano et al., 2021). Universities and colleges must adapt to these changes and provide AL experiences that prepare students for the workplace (Zamorano et al., 2021). It has been found that gamification can effectively enhance skills development in AL without negatively impacting academic achievement or student satisfaction (Zamorano et al., 2021).

2.2 Gamification in Education

Gamification is defined as an "umbrella term for the use of video game elements in non-gaming systems to improve user experience (UX) and user engagement" (Deterding et al. 2011). In independent learning, gamification is a disruptive innovation, particularly in technology-based and lifelong learning (Largo et al., 2016). While game elements like scores have long been present in educational systems and proved motivating, the contemporary understanding of gamification goes beyond mere scoring. Today, gamification aims to enhance learning outcomes by seamlessly blending game elements like challenges, rewards, levels, avatars, leaderboards, points, narratives, badges, and social networks, among other components (Schober et al., 2020).

Schools in Scotland have shown a commitment to incorporating game elements into their teaching methods (The Scottish Government, 2015). Educational games, where employed, are generally tailored to complement the curriculum, aiming to enhance students' understanding of specific topics (The Scottish Government, 2015). Furthermore, gamified experiences tackle real-world problems, enhancing practical understanding (Scottishgames, 2021). However, there appears to be a need for more information regarding gamified learning experiences explicitly designed to enhance the skills of higher education students studying computing in Scotland.

2.2.1 Benefits of Educational Gamification

Abdulsalam and Kianoosh (2021) discovered that 26 out of 34 selected research investigations consistently demonstrated the advantages of gamified online learning. These benefits were observed in improved user experience, increased engagement, and notably higher course completion rates (Abdulsalam & Kianoosh, 2021). It has also been found that gamification teaching method boosts motivation and increases student learning satisfaction (Safapour et al., 2019).

Incorporating gamification elements into learning has been recognised as a catalyst for enhancing students' performance in computer science courses and empowers learners to effectively manage their learning pace (Safapour et al., 2019). In addition, a study conducted by Bouchrika et al. (2019) revealed that gamification positively influenced student participation. Moreover, some students who were introduced to a new gamified platform continued using it during holidays and after graduation (Bouchrika et al., 2019). Bouchrika et al. (2019) also revealed differences in platform usage based on gender and age, with female students being more involved and younger teaching

staff showing greater engagement. However, the study primarily emphasised student engagement and technology adoption without directly evaluating their effect on learning outcomes (Bouchrika et al., 2019).

Regarding in-classroom gamified learning, Putz et al. (2020) found that gamification could enhance knowledge retention, particularly in a short period. On the other hand, Poondej and Lerdpornkulrat (2019) investigated the impact of an online gamified environment. They researched the influence of gamification features within the Moodle platform. Their results affirmed higher student engagement in e-learning courses, consistent with previous studies, but no findings on learning outcomes (Bouchrika et al., 2019; Poondej & Lerdpornkulrat, 2019, Abdulsalam & Kianoosh, 2021). Moreover, education aims to enhance students' learning and understanding of the content (Awada et al., 2020). Therefore, it is crucial to note that although studies emphasise the advantages of gamification, more studies are needed to confirm its effectiveness in learning outcomes (Awada et al., 2020).

2.2.2 Challenges of Educational Gamification

Integrating gamification in education introduces many challenges that need careful consideration (Abadi et al., 2022). The primary negative impacts that can challenge the integration are described in Figure 1. It is worth highlighting concerns like an excessive reliance on traditional gaming elements in education, as it can reduce motivation and shift focus to external rewards (Abadi et al., 2022). Additionally, although gamification encourages continued usage, its effectiveness may be compromised by the rapid pace of content and technological changes, including "Diminished Value Over Time" and "Expensive to Develop" challenges (Abadi et al., 2022) (Figure 1). Moreover, creating engaging educational platforms that avoid resembling quizzes remains challenging. Striking the right balance between including game elements like points, badges, and competition while avoiding demotivation or learner confusion is a delicate task (Abadi et al., 2022). To address these concerns, it is vital to balance fun with educational value, ensuring that the gamified elements are directly tied to practical skills and real-world scenarios (Talalent, 2023).

Challenges	Description
Regulatory and Legal Issues	Concerns arise when students must share personal data for game access, necessitating stringent privacy measures and legal compliance.
Diminished Value Over Time	Games can quickly become outdated, potentially raising concerns about their relevance and the need for ongoing maintenance.
Games That Are Only Poorly Masked Quizzes	Creating engaging games without resembling disguised quizzes can be challenging, impacting their effectiveness in learning.
Pointsification	Over-reliance on game elements like points, badges, and leaderboards may lead to demotivation and confusion among learners.
Competition	Balancing competition with the cooperative nature required in education can be challenging, impacting collaboration among learners.
Assessment Challenges	Assessing learning outcomes within gamified experiences can be complex, making it difficult to gauge genuine comprehension.
Retaining Information	Learners might prioritise achieving in-game rewards over retaining information, potentially resulting in a superficial understanding.
Cheating	The gaming environment may inadvertently facilitate cheating, posing challenges in evaluating learners' true knowledge.
Frustration	Gamification techniques could reduce learners' patience and tolerance for non-instant gratification scenarios, leading to frustration.
Effect Assessment	Given its recent development, gamification lacks extensive long-term testing, requiring further research for comprehensive evaluation.
Expensive To Develop	Games can become outdated relatively quickly, and maintaining them can be costly.

Figure 1: Challenges of Educational Gamification (content adapted from Abadi et al., 2022)

Furthermore, although gamification can enhance engagement, it risks prioritising in-game rewards at the expense of deep content retention, potentially leading to a superficial understanding of subjects (Abadi et al., 2022). Therefore, gamification should allow failures to be teachable moments, maintain a balance in game design, incorporate social components, and continuously track its

effectiveness to ensure it meets learning objectives (Talalent, 2023). However, creating a practical learning experience that mitigates these challenges can be timely and costly. Therefore, these challenges and observed negative impacts should be further analysed and prioritised during the design phase.

2.3 Designing and Developing a Gamified Learning Platform

2.3.1 Theoretical Frameworks for Developing Gamified Learning

Two frameworks stand out when considering gamified learning experiences: structural gamification and content gamification, both aiming to motivate and engage users (Garone & Nesteriuk, 2019; Jacob, 2023). While sharing a common goal, these frameworks diverge in their methods and the experiences they offer. Structural gamification is recognised for its practicality, especially in cost-effectiveness and scalability. Jacob (2023) notes that this approach is particularly suited for repetitive or ongoing training programs. It incorporates game design elements like points and leaderboards into the learning environment. These features provide clear goals and rewards, fostering motivation through competition and achievement (Garone & Nesteriuk, 2019). However, it is essential to acknowledge that this approach may have limitations regarding depth of engagement, as pointed out by Garone & Nesteriuk (2019).

Conversely, content gamification offers a more immersive learning experience (Jacob, 2023). This method involves narratives and interactive scenarios seamlessly blending with the educational content (Garone & Nesteriuk, 2019). However, the richness of this approach demands a careful balance to ensure that the primary focus remains on meeting learning objectives, a challenge that needs to be considered (Garone & Nesteriuk, 2019).

In summary, while structural and content gamification have merits in educational settings, they present different challenges and benefits (Jacob, 2023). The choice between them should be guided by the specific needs of the learning environment and the objectives to be achieved (Jacob, 2023).

Moreover, both structural and content gamification approaches can significantly benefit from incorporating principles and insights rooted in the theoretical foundations of psychology, behavioural science, education, and management (Krath et al., 2021). These diverse theoretical bases offer a comprehensive yet complex landscape in game-based education (Krath et al., 2021). Based on

research by Krath et al. (2021), Figure 2 identifies the optimal use of multiple theoretical frameworks from psychology that support personalised gamification features.

Theory Group	Theoretical Framework	When to Use
Monitoring Performance	<ul style="list-style-type: none"> • Self-Determination Theory • Goal-Setting Theory • Flow Theory • ARCS Model 	<p>To boost intrinsic motivation and empower learners with autonomy</p> <p>When setting and communicating learning objectives.</p> <p>When deep engagement and concentration are desired.</p> <p>When designing engaging and motivating learning experiences.</p>
Behavioural Outcomes	Behaviourism	When shaping and reinforcing specific behaviours.
Cognitive Learning	<ul style="list-style-type: none"> • Constructivist Learning Theory • Sociocultural Theory 	<p>When promoting active learning and knowledge creation.</p> <p>When fostering social learning and cultural understanding.</p>
Individualisation	<ul style="list-style-type: none"> • Achievement Goal Theory • Experiential Learning Theory • Situated Learning Theory 	<p>When accommodating different learner goal orientations.</p> <p>When emphasising hands-on learning experiences.</p> <p>When promoting contextual and authentic learning.</p>
Social Interaction	<ul style="list-style-type: none"> • Social Cognitive Theory • Social Learning Theory • Social Comparison Theory 	<p>When leveraging social learning dynamics.</p> <p>When facilitating learning through social interactions.</p> <p>When facilitating learning through social interactions.</p>
Technology Integration	<ul style="list-style-type: none"> • Technology Acceptance Model • Multimedia Learning Theory 	<p>In technology-driven learning environments.</p> <p>When incorporating multimedia into gamification.</p>

Figure 2: Theoretical Frameworks for Enhanced Learning in Gamification (content adapted from Krath et al., 2021)

Notably, the Self-determination theory emerges as one of the most frequently employed frameworks (Khaldi et al., 2023). Self-Determination Theory is a psychological framework developed by Deci and Ryan in the 1980s (Krath et al., 2021). The theory is best used to provide valuable insights into understanding why people behave the way they do and how to create conditions that

foster more self-determined and fulfilment (Krath et al., 2021). This theory can be applied to gamification by incorporating elements that support autonomy, competence, and relatedness to enhance user engagement and motivation (Krath et al., 2021). For instance, allowing users to choose their game paths or offering prompt feedback on their progress can bolster autonomy and competence (Krath et al., 2021). The inclusion of social features like leaderboards and collaborative challenges can fulfil the need for relatedness (Krath et al., 2021).

Research has demonstrated that autonomy within the framework of Self-Determination Theory can also be achieved through personal images and emotional designs (Chiu, 2021). Currently, limited research is available on applying gamification in the context of emotional design within learning environments. In the field of UX/UI, *emotional design* is defined as the intentional use of emotional triggers to provide a more engaging and enjoyable user experience. It recognises that humans are not solely rational but also driven by emotions (Widen, 2020).

2.3.2 Customised Gamification Design

The emphasis on personalisation in gamification design emerges as a critical consideration, underlining the need for tailored approaches that accommodate individual learning styles and abilities (Metwally et al., 2021). A study published by Springer Nature suggests that understanding user type is essential when designing gamified systems (Santos et al., 2021). Santos et al. (2021) discuss the gamification design concerning Hexad's six distinct user types (Santos et al., 2021). Andrzej Marczewski's HEXAD Player Type framework extensively categorises users, offering insights into their motivations within gamified systems (Marczewski, 2015). Figure 3 displays a taxonomy of 21 gamification features organised into five dimensions (Santos et al., 2021). Each dimension corresponds to distinct user groups, revealing a relationship between user orientations and gamification design preferences (Santos et al., 2021).

User Type	Preferences	Gamification Dimensions
Achievers	Performance and Social	<ul style="list-style-type: none"> • Performance: Points, levels, progression, stats, and acknowledgement. • Social: Social pressure, competition, social status, and cooperation.
Players	Ecological and Social	<ul style="list-style-type: none"> • Ecological: Rarity and economy elements. • Social: Social pressure, competition, social status, and cooperation.
Socialisers	Fictional, Personal, and Social	<ul style="list-style-type: none"> • Fictional: Narrative and storytelling elements. • Personal: Clear objectives, puzzles, novelty, sensation, and renovation. • Social: Social pressure, competition, social status, and cooperation.
Disruptors	Social	Social: Social pressure, competition, social status, and cooperation.
Philanthropists	No significant associations	Negative association with fictional design
Free Spirits	Negative association with preference for the social design	Negative association with preference for the social design

Figure 3: User Preferences for Gamification Designs and Associated Dimensions (content adapted from Santos et al., 2021)

In Santos et al. (2021) study with 366 participants, philanthropists were the most common user group, while disruptors were less common. Philanthropists are motivated by purpose and meaning, seeking to give back to others (Marczewski, 2015). Interestingly, Santos et al.'s (2021) study noted a negative impact of fictional design on Philanthropists, suggesting that fictional elements may not be beneficial in educational settings. Moreover, the Performance gamification design was preferred, leading to a high sense of accomplishment (Santos et al., 2021). Additionally, the research emphasised the positive role of social elements in gamification. Santos et al. (2021) highlighted that this can be achieved through meaningful interactions with other users and effective engagement with the system, often facilitated by features like an "assistant".

To seamlessly incorporate a personalised experience, one practical approach is utilising an adaptive gamification framework, as illustrated in Figure 4 (Zourmpakis et al., 2023). This framework operates

as a dynamic and responsive system, tailoring gamified elements to individual users' distinct characteristics, preferences, and progress (Mbaba et al., 2019). However, users frequently exhibit traits from various user categories (Marczewski, 2015). As users become more acquainted with a system, their types may evolve (Marczewski, 2015). The shift from valuing points to seeking intrinsic satisfaction occurs when rewards diminish over time (Marczewski, 2015). Consequently, effective adaptive gamification will require customising gamification to individual user needs by integrating dynamic content with highly personalised features, which can be costly (Abadi et al., 2022). Therefore, designers could create effective gamified experiences with a smaller budget by recognising and accommodating diverse user motivations and preferences, even when the system does not allow personalisation.

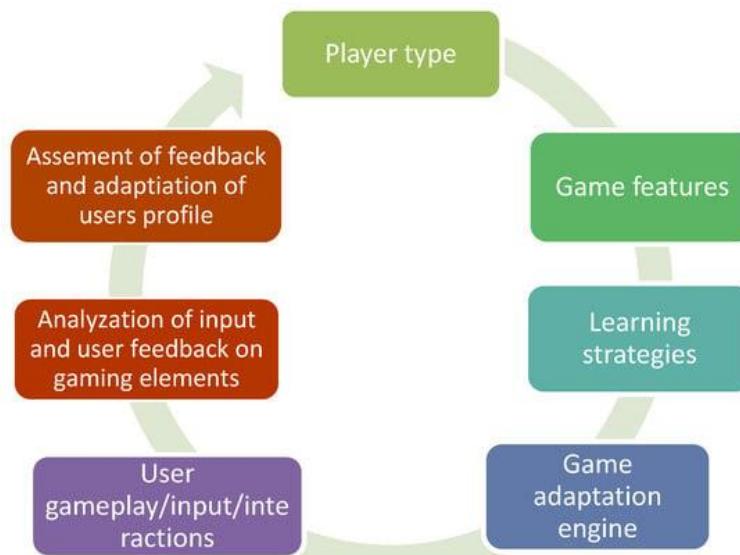


Figure 4: Adaptive gamification model (Zourmpakis et al., 2023)

2.3.3 Ethical Considerations

When designing gamified learning experiences, it is crucial to consider ethical principles (Marczewski, 2017). Ethical considerations ensure responsible and beneficial experiences, focusing on user privacy, fairness, inclusivity, and societal impact (Mavroeidi et al., 2019). Marczewski (2017) suggests that to identify ethical issues in gamification, one should consider asking the following questions:

"Does the system offer a choice?

What is the intention of the designer?

What are the potential positive and negative outcomes of being in the system?

Are the beneficial outcomes weighted toward the user's or designer's needs or desires?" (Marczewski, 2017).

The concern is that gamification, if used unethically, can obscure the line between persuasion and manipulation, potentially compromising the principles of honesty, integrity, and transparency crucial for fostering a fair and inclusive learning environment (Conick, 2019). The Open Gamification Code of Ethics presents five critical ethical principles for fostering a more inclusive and fair learning platform (Marczewski, 2017). These principles are not just guidelines; they embody the core values necessary for creating a respectful user environment (W3C, 2023). Firstly, honesty mandates that users are treated truthfully, particularly in avoiding unethical data collection methods (Marczewski, n.d.). This principle safeguards the integrity of the platform, ensuring trust and reliability (Marczewski, n.d.). Secondly, integrity goes beyond mere legal compliance involving respecting others, crediting contributions, and avoiding exploiting vulnerable groups (Marczewski, n.d.). This principle underpins the moral fabric of the platform (Marczewski, n.d.). Transparency, the third principle, is about clarity and openness in goals, data collection, and privacy policies (Conick, 2019). It targets free access to information consent for sharing personal data, reinforcing a culture of open communication and respect for user privacy (Marczewski, n.d.). As the fourth principle, quality emphasises the importance of delivering superior service and user experiences, reflecting a commitment to excellence (Marczewski, n.d.). Finally, respect encompasses avoiding promoting violence or discrimination, considering environmental impacts, and prioritising sustainability (Marczewski, n.d.). These principles emphasise creating a web that supports human rights, dignity, and personal agency, ensuring that technologies respect individuals' rights and empower them against potential harm (W3C, 2023).

2.3.4 Privacy

A study published in Future Internet suggests that designers should follow a Conceptual Model to guide developers in understanding how game elements might conflict with privacy requirements (Mavroeidi et al., 2019). A conceptual model is an abstract representation that demonstrates the system or problem, illustrating the relationships among its parts and often aiding in understanding or solving complex issues (Creswell, 1994). Using the conceptual model, Mavroeidi et al. (2019) have identified specific privacy concerns related to gamification elements and connected them to specific features displayed in Figure 5. In doing this, developers can make informed design choices to protect user privacy while still achieving the goals of gamification (Mavroeidi et al., 2019).

Privacy Considerations	Description	Game Element
Anonymity	Ability of a subject to remain unidentifiable to others.	Avatar, Challenge, Leaderboards, Location, Notifications, Profile, Quiz, Role, Collaboration
Pseudonymity	Use of pseudonyms or not real names to ensure anonymity.	Leaderboards, Location, Notifications, Profile, Quiz, Role, Collaboration
Unlinkability	Prevention of third parties from linking relationships between subjects, actions, and messages.	Challenge, Leaderboards, Location, Notifications, Profile, Quiz, Role, Collaboration
Undetectability	Ensuring the existence of a component cannot be detected by a third party.	Location, Profile
Unobservability	The ability to hide actions between subjects.	Profile

Figure 5: Privacy Requirements (content adapted from Mavroeidi et al., 2019)

2.4 Usability Learning Gaps in Higher Education

Usability is a crucial aspect of interface design, encompassing the evaluation of how user-friendly a design is and the methods employed to improve its functionality during the design process (Nielsen, 2012). Unfortunately, it has been found that in many higher education computing programs, students receive instruction primarily on software requirements (Oleson et al., 2020). However, it is essential to note that software developers make design decisions that can significantly impact the inclusiveness, accessibility, and usability of their software (Oleson et al., 2020). As a result, mastering user experience by understanding usability design principles ([Appendix 1](#)) is critical for developing highly usable software (J. Nielsen, 1994).

A report on "The Future of Skills: Employment in 2030" offers valuable insights into computer-related occupations, highlighting an evolving skill set that will become increasingly crucial. Bakhshi et al. (2017) identify that traditional computing skills will remain essential, but critical thinking and design abilities will become more vital (Bakhshi et al., 2017). This shift underscores the growing

importance of integrating computing expertise with design principles, illustrating the need for a harmonious blend of technical acumen and innovative creative thinking (Bakhshi et al., 2017).

Branch et al. (2021) analysis of higher education (HE) UX course modules reveals a notable lack of holistic teaching in contrast to the comprehensive nature of UX design (Branch et al., 2021). Despite the nature of UX, a mere 7% of these modules focus on crucial competencies, such as research and evaluation (Branch et al., 2021). On the other hand, employers prioritise practical competencies, such as "User-Centred Design, User Research; Psychology, Usability and Accessibility Testing, and Evaluation" (Branch et al., 2021). In contrast, HE institutions emphasise transferable, cognitive, and interpersonal competencies, focusing on "Interaction Design, Writing and Academic Skills, Research Design, Critical Thinking, and Visual Design" (Branch et al., 2021). This underscores the need for universities and colleges to better align their courses with industry demands. (Garousi et al., 2019).

Usability testing in UX design has become increasingly important, as highlighted by research from the State of UI/UX Testing (2022), which notes that about one-third of UX designers conduct usability testing for each deployment, emphasising its critical role in the industry. In this context, the Nielsen Norman Group has pinpointed key usability issues in web design, such as unexpected content locations, competing links and categories, islands of information, repetitive links, hidden fees and prices, stranding users on microsites, poor search results, flawed filters and facets, overwhelming users with information, and hidden links (Schade et al., 2016). However, educators have observed that computing students often prioritise implementation over understanding design principles. Hence, the Nielsen Norman Group's usability challenges assume substantial relevance when developing a usability-focused learning platform (Schade et al., 2016). These challenges provide invaluable insights that can effectively guide educational content creation. Moreover, an engaging approach to teaching usability can redirect students' focus and bridge the gap between industry requirements and educational practices.

2.5 Literature Review Conclusion

The literature review informs the development of a gamified learning platform for Scottish computing students, highlighting the increasing need for innovative educational approaches due to the growing demand for computing skills and the shift towards online learning.

As per the literature review, gamification is seen as promising for improving student engagement and learning in computing. However, there's no clear evidence that it is more effective than

traditional methods in terms of learning outcomes. Moreover, there is a gap in research on gamified learning for Scottish higher education computing students, offering an opportunity for this project to provide new insights and solutions.

Additionally, integrating gamification with education brings challenges, such as maintaining educational value while making learning engaging and user-friendly and addressing privacy and ethical issues. Therefore, these findings need careful attention during the platform's design and development stage.

The review also points out a mismatch between the skills taught in higher education and those required by the industry, especially in usability and user experience design. This mismatch highlights the importance of a learning platform that keeps students engaged and provides them with necessary practical skills. Therefore, the design of the learning platform will focus on real-world challenges to close the gap identified in the literature.

Additionally, the literature review indicates that general users prefer gamification elements that show progress and give recognition and dislike fictional elements. This preference should be explored further to tailor the gamification approach to the target audience's needs. Therefore, holding focus group discussions with Scottish HE students on gamification in learning and specific usability learning needs is essential. This approach will help gather essential information for developing an effective learning platform tailored for Scottish students.

Finally, it was found that incorporating Self-Determination Theory (SDT) principles into the platform's design is aligned with the project's goals. SDT's emphasis on autonomy, competence, and relatedness is critical to creating an engaging learning environment. By enabling student choice, designing challenging tasks, and adding social features, the platform could provide a highly engaging learning experience. Additionally, integrating gamification elements like challenges and rewards, informed by SDT, could make learning more immersive, aligning with contemporary educational trends and meeting the industry needs for platforms that engage students and equip them with practical skills.

In summary, the literature review establishes a strong foundation for this project, emphasising the need for a gamified learning platform that addresses educational gaps and is customised to the targeted user preferences. Future project stages will use these insights to develop a prototype for the learning platform.

3. Methodology - Focus Groups

A focus group involves gathering people to discuss a particular research topic based on their experiences (Sagoe, 2012). In the context of this study, the focus group will serve as a valuable method for gathering insights into users' needs concerning the learning of usability. It will also explore participants' opinions on gamified online learning and assess the potential effectiveness of learning usability through a platform that incorporates game elements.

Using a focus group is an appropriate choice for this short-term project because it provides valuable information inexpensively and quickly (Liamputtong, 2011). The research findings will guide the website's design, content, and pre-design graphical components (persona, user journey).

Moreover, the number of focus groups needed for research differs according to the project (Hennink, 2007). Generally, more than a single focus group is required to answer complex research questions (Hennink, 2007). Instead, it is recommended to conduct three to four groups (Hennink, 2007). However, the project constraints and target audience must be considered before making this decision. More than 80% of all themes in research can be identified in two to three focus groups and 90% in three to six groups (Guest et al., 2016). Notably, conducting three groups is often sufficient to uncover the most prevalent themes in a dataset (Guest et al., 2016). Therefore, this research analyses data from three focus groups covering HE students with different studying experiences.

3.1 Qualitative data analysis

After conducting focus groups, the next crucial step is to analyse the gathered qualitative data. There are many ways to work with qualitative data. For example, Discourse analysis examines how individuals express themselves and convey ideas through language (Woodilla, 1998). However, this method may not be the most fitting for addressing the research questions in this research. This is because the primary objective of the research is to obtain direct feedback to drive decisions on prototype content and interactions.

Applying the Constant Comparative Method for qualitative data analysis is another recognised approach with a central focus on coding (Flick, 2018). This method includes four main stages: comparing incidents relevant to each category, integrating categories and their properties, delimiting the theory, and writing it (Glaser, 1969, p. 220). The core of this method involves

continuously comparing coded incidents to ensure ongoing material integration in the comparative process (Flick, 2018).

However, it's important to note that while the Constant Comparative Method is a robust approach for coding qualitative data, this method often results in general conclusions drawn from various opinions rather than range of findings (Flick, 2018). Therefore, it's not appropriate method for this data analysis.

Thematic analysis is a valuable method for recognising patterns in language-based data (Lester et al., 2020). Its adaptable approach aligns seamlessly with critical phases like coding and transcribing while offering a systematic yet flexible approach (Braun & Clarke, 2021). This method analyses qualitative data by highlighting similarities and differences (King, 2004). Specifically, it involves identifying codes and organising them into themes (Figure 6) to draw specific conclusions (Rosala, 2022). Moreover, this approach requires little theoretical and technological knowledge, making it a good choice for less experienced researchers (Braun & Clarke, 2021).

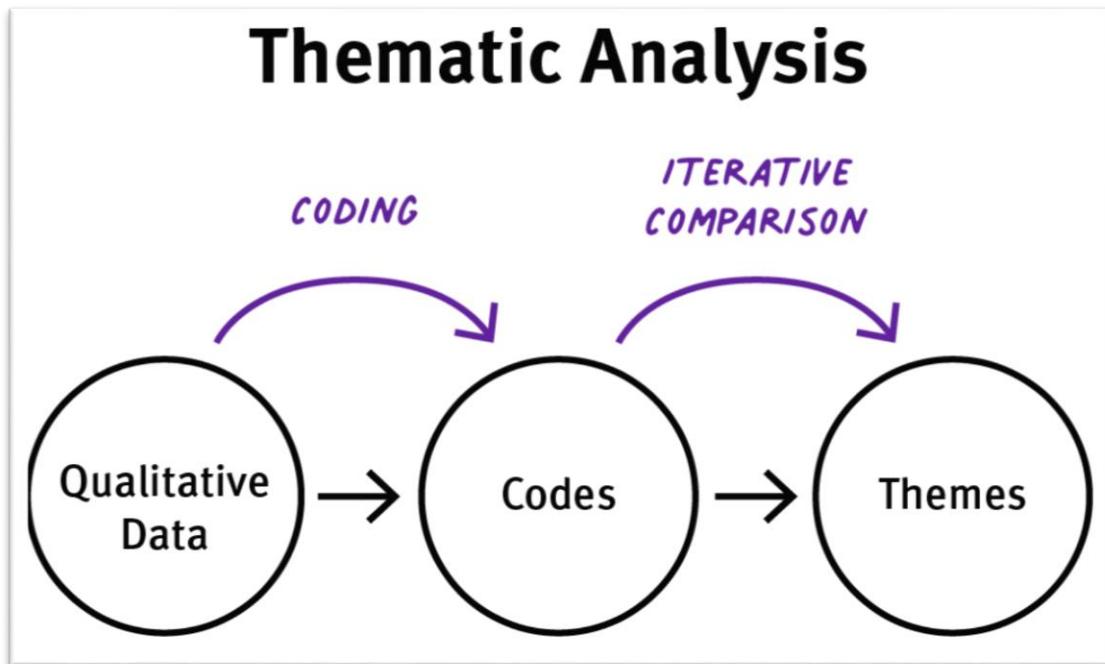


Figure 6: Thematic Analysis (Rosala, 2022)

Although thematic analysis is flexible, this flexibility may result in inconsistencies and a lack of structure when developing themes (Rosala, 2022). This challenge may be addressed by expressing fundamental beliefs about knowledge, known as epistemological position, forming the basis for

practical findings or empirical claims (Holloway & Todres, 2003). Furthermore, more comprehensive outcomes can be achieved by integrating other theories and methods into thematic analyses (Proudfoot, 2022).

Finally, Grounded theory (GT) is a research methodology that uses comparative analysis to discover or construct a theory from methodically gathered and analysed data (Tie et al., 2019). This approach efficiently interprets complex findings from quantitative research methods (Tie et al., 2019). Moreover, GT involves the creation of conceptual frameworks or theories through inductive data analysis (Tie et al., 2019). Inductive data coding is a systematic categorisation process that uncovers themes and patterns without predetermined expectations (Kyngäs, 2019). In the pre-analysis stage, GT can be applied by incorporating an iterative approach to requirements gathering (Tie et al., 2019). This involves adapting research questions based on previous findings to delve deeper into understanding user needs (Tie et al., 2019), as illustrated in Appendix 2., as illustrated in [Appendix 2](#). However, using Grounded Theory requires advanced research skills and it's not as flexible in adapting to changes in behaviour (Hussein et al., 2014).

Drawing upon these findings, the focus group research employs thematic analysis as its primary data analysis method, combined with the GT mindset, using inductive data coding. The process involves refining questions and approaches before each focus group and engaging with the data while focusing on the research questions but without preconceived ideas. Subsequently, codes are created, classified into themes, and themes are reviewed, leading to the reporting of findings (Nowell et al., 2017; Tie et al., 2019).

3.2 Focus Group Data Gathering and Analysis

Participants were required to meet specific criteria for inclusion, including having some knowledge of usability and gamification. Also, they had to be enrolled in higher education computing courses in Scotland and be between 18 and 70 years old. Recruitment involved various channels like Teams, Email, Discord, LinkedIn, and in-person to ensure diverse participation. Additional details on each focus group are provided in Figure 7.

Focus Group	Active Participants	Meeting duration
Focus Group 1	3 Participants HND Student (College- Web Design and Development)	40m 55s
Focus Group 2	6 Participants University students (Year 3 and Year 4 - Web design and development and UX courses)	1h 11s
Focus Group 3	4 Participants University students (Year 3 and Year 4 - Web design and development and UX courses)	1h 14m 27s

Figure 7: Focus Groups

3.2.1 Focus group data analysis

Following the principles of Grounded Theory, the three focus groups included participants with diverse backgrounds and explored usability and gamification from different angles. Each group built upon the insights from the previous one, ensuring a comprehensive understanding of participant perspectives. Building upon these discussions, the final group shifted from discussing usability learning needs to exploring ways to enhance learning through game elements, leading to a more focused discourse on usability learning rather than gamification.

The gathered data was anonymised for confidentiality per the consent form, and the key content was highlighted (Appendices 3, 4, 5). Then, the data was categorised into 18 codes for focus group 1 ([Appendix 6](#)), 33 codes for focus group 2 ([Appendix 7](#)), and 30 codes for focus group 3 ([Appendix 8](#)).

These codes were then grouped into four themes for Group 1 ([Appendix 9](#)), six themes for Group 2 ([Appendix 10](#)) and seven themes for Group 3 ([Appendix 11](#)). Although several themes were common across all three groups, some discussions were unique within certain focus groups, resulting in a total of 11 themes discussed across all sessions. These insights were organised into a table to combine repetitive themes (Figure 8).

Themes	Participant	Focus Group	Data
Learning Usability	3	1	So we learned a theory first from the lectures and browsing the Internet and just getting your own knowledge.
	1	1	It's a bit difficult to explain it, but my point is that. You cannot have the same elements doing different things.
	1	1	If the user needs to learn every page again and again, it's gonna be very difficult to use it. And if these users have any disability, uh, it makes it even harder.
	1	1	Let's just say you have a register form. All the validation that you need to do all the messages that you need to show. Sometimes it's very easy to miss something from there.
	3	1	So first of all the navigation, it has to be, you know user friendly and intuitive because if the user cannot navigate properly through your website then the website is pretty much redundant. Um than the layout has to be consistent.
	1	2	I think it should be something else about accessibility because that's usually it's forgotten. People forget at the beginning of making a website that needs to be accessible just sort of as a reminder that one needs to be done before you actually make the website live.
	2	2	I think that in terms of usability is quite important that while some people may know the theory behind it, most people don't usually have a field where they study that kind of theorems.
	4	3	For me would be the vastness of the information available. I don't ever feel like I was pointed towards 1 condensed concentrated resource with a clear pathway through the learning. All right, stuff that I'll generally miss to do with error handling like tooltips or a big one for me. I didn't use them very much and now I'm learning too because just like users need to orientate themselves with a NAV bar if there's nothing to inform them on what they're doing wrong with it, they're just not gonna know.
	3	3	And I suppose for me for the usability, there's always a baseline of, at least in theory, I should always consider disabilities and but other than that, yes.
	1	3	And if you apply it to like usability, then it could just be what the person is looking to create. Like if they're creating an app, it would be different to a website. Or, you know, if you're designing video and things like click those kind of things, you can see what you're doing in Taylor, what you're learning to the resource you're creating. Yeah, I definitely think that too, because there are so many different principles and theories and you don't know necessarily know which ones to apply Or which one do we prioritize and those kind of things? But when I'm designing for a different user group then I normally look back and see which usability principles will apply to them. And I think common mistakes and when I do projects would be probably when it comes to directly interacting with the user and things like error messaging and things like that and form filling.
Preferred Learning Platform	1	2	Yeah, like I think like for example of the codecademy like I can receive an actual certificate and I can actually post it on LinkedIn or something that I've done it. For me, I would prefer more, more, more serious. One that actually I can, you know, show someone else.
	3	2	Same with Rosetta stone. You have to do a whole lesson, You don't do like 3 minutes and you do like a listen in writing, talking even. Well, I don't know if they do that anymore, but they used to like you talk and the machine tells you how different your pronunciation is from the actual pronunciation. And then tell you pronounce it correctly. So it is a lot more immersive.
	4	2	Duolingo kind Usability Gaps of made of this their own identity. ... My favorite is Duolingo just because I think that overall it's really well designed and I personally use it a lot.

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	3	2	Gamification: I think it's pretty good for engagement and I think the companies mostly use it for engagement rather than for what the purpose supposedly is mostly for keeping people coming back connective.
	1	3	Yeah, I've only used W3 schools for the learning resource and I think it's good if you know what you're like for me when I've done it, I can like learn one or like I find out the information I need.
	3	3	I think things like scratch are quite popular because it's a very simple oversimplified in my opinion, but it's a very simple way of getting people to see an immediate effect of what they're doing and what they're learning, you know, so it's. So give an example I think is freecodecamp and and W3 schools. So yeah, they're quite good that they give you a kind of like sort of a curriculum almost. You can work your way through ... We might as well get this done with, you know, and and yeah, just work your way through and it's it's a good structure and build up and cause I've tried to jump from like base as I tried to skip the JavaScript and go into React like no, no.
Preferred Game Elements	3	1	I'm very competitive so. Getting that diploma just kind of validates my effort and I think that's really important for me to keep going. ... The certificates and feedback and yeah, so my favourite would probably be you Udemy cause that's where I I find that I learn quite easily. Especially like JavaScript and PHP courses that have done and I'm they're very affordable. You know you can get a course for on a sale for 11 pounds, which is absolutely fantastic. And then you get a certificate at the end of it.I like that that the lessons are obviously prerecorded and you can go back and reference and if there's anything that you missed or maybe you want to double check and then there is comments that you can write and then the lecture can reply and say that you know this is the mistake that you've done. Or so I think that the engagement and a lot of the times they have open forums or discords where you can go and sort of engage with other students and lectures you can help you.
	1	2	Like to see the progress and then getting like a badge like a [P5] mentioned. Uh, I like good progress bar.
	2	2	Do you have a good line of connection to your lecturers and making sure that if you have any questions you do, you know, send them to the appropriate people.
	4	2	Character which you get to impersonate with. So basically, if you kind of switch your identity to that character while you are completing the task, it feels more like a game, you know, it feels it could be something that feels like you are part of another story and you feel more pushed to go through the whole process either if it's a game or just a learning process.
	5	2	I like earning badges. It's just that little push to get you going to and and the extra thing I think you use properly, they'd be quite effective. I think maybe like you know, Duolingo is probably not the ideal way to use it, but if you wanna reinforce learning or something that refers reinforced learning and usability, then if you use a badge in the right way that I think that helps.
	4	2	But also like the one the character I think would be quite good as well. It's a character that cannot keep up or something.
	1	3	Progression definitely is my most important. I really need to see like how far away I am from the end, otherwise they're just feels endless. If Moodle had progression through your modules and like milestones along the way. Oh my goodness, you would see me more often, guys.
	4	3	.. what comes to mind is point systems competition, but I think the the more simple implementations that you get the bigger bang for your buck out really are the things that give direction that make you feel like you're achieving things and moving towards something and it's not something it's something you can see.
	3	3	Or maybe there's a limit but, but yeah, sort of like you know, you've got your main progression and like in a video game, you know, you've got your kind of in progression and you've got your side quests. It's kind of like, OK, you're really just learning the language, but there's a little badge because you've got every single verb question, right, you know? So maybe like little quizzes, it'd be good ..
User Dislikes	2	2	I will say that while I love a good competition, I'm not. I don't think it's particularly good for a learning environment that people should, you know, go against each other. They really should be helping each other.
	3	2	Duolingo in the past, although I don't use it anymore. I think it's effective in keeping you coming back. I think the business model of the linguists to have active users and sell advertisement, I don't think it's effective to make you learn anything at all.
	5	2	Yeah, because I use Duolingo for a while, but I just felt it was just drilling, words into my head rather than understanding why you say the word or why you put it in the sentence. ...It's just like because you do 3 minutes a day just to get rid of the notification thing and then you know it's not because you want to learn, it's because you want to keep on going.

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	4	2	I tried to explain myself if I have a platform that gives certifications and I have a platform which is like Duolingo, which is just for a secondary purpose, something that you do like a hobby in your free time.
	5	2	I like earning badges. It's just that little push to get you going to and and and the extra thing I think you use properly, they'd be quite effective. I think maybe like you know, Duolingo is probably not the ideal way to use it, but if you wanna reinforce learning or something that refers reinforced learning and usability, then if you use a badge in the right way that I think that helps.
	3	2	Duolingo in the past, although I don't use it anymore. I think it's effective in keeping you coming back. I think the business model of the linguists to have active users and sell advertisement, I don't think it's effective to make you learn anything at all.
	5	2	Yeah, because I use Duolingo for a while, but I just felt it was just drilling, words into my head rather than understanding why you say the word or why you put it in the sentence. ...It's just like because you do 3 minutes a day just to get rid of the notification thing and then you know it's not because you want to learn, it's because you want to keep on going.
	4	2	I tried to explain myself if I have a platform that gives certifications and I have a platform which is like Duolingo, which is just for a secondary purpose, something that you do like a hobby in your free time.
	4	3	I have never been able to do things on freecodecamp. I get so bored with like the interface and everything. It doesn't like engage me enough to do.
	4	3	I guess at the time to Udemy as well, structure is important, but if there's no progression I'm a I don't care. I gotta be able to see where I'm going.
	3	3	I have the other apps that don't have the same kind of gamification elements and and there might be other differences as well, but the the definitely didn't pull you back.
Design for Usability	4	3	- Important parts for me were learning actual solid concepts that I could apply. Let's call it would be all that useful if I didn't have the graph in my head. Same with the golden ratio. Same with the 6030 ten rule. You gotta have you got to communicate these with visual examples.
Testing and Analysis	3	1	So for me, I think it's the search functionality, so the search bar because I haven't do any search bar on my website so. I was thinking so new things, so with a challenge for me, if it's a design or developers and that why I'm thinking to put the search bar on my website because it could save the user's time, they can only just put the words and. Like a find the things they want. So that's the things I think is challenge for me, yeah.
	1	1	test your website.
	3	1	And then would do, um competitor analysis. You know, every colour has sort of predefined almost and meaning. So that's how we would choose the colours and and and then use the colour wheel to make sure that the the colours match well.
	1	1	According to the project that I want to do, the best thing for me if I don't know anything about it is to actually, yeah, go online and check competitors like a similar website. .. Check the layout. The colour that they use, how they do everything, so I will have an idea.
	3	1	So we do user analysis, we do user analysis and we figure out what the user needs... So obviously it's through user testing. So for me, I think it's the search functionality, so the search bar because I haven't do any search bar on my website so. I was thinking so new things, so with a challenge for me, if it's a design or developers and that why I'm thinking to put the search bar on my website because it could save the user's time, they can only just put the words and. Like a find the things they want. So that's the things I think is challenge for me, yeah.
	3	2	And they're like, how did you know that's the menu are like, Oh my God. OK, so now I'll write menu under the Burger menu with little letters.
	4	2	I think that usability is important for when it comes to also reviewing the product that has been published.

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	4	2	So I think that usability is important, but it's also important to track that the usability is going in the direction that you thought it for. But then maybe there is like a button that is fundamental and is missing and it's counterintuitive. I think that testing with people that are different from the developer is important.
	2	2	If we were a user for a different company with a different UI, we could analyse those and determine how effective those UI's are, and if they are not as effective, we could probably inform the company.
	3	2	And they're like, how did you know that's the menu are like, Oh my God. OK, so now I'll write menu under the Burger menu with little letters.
	3	3	... But there isn't a documented fallacy where you assume that other people have the same knowledge.....That's why I think that you always need to like peer review or the theory as well.... I don't like to generalize that much, so I think that the main thing for me would be more on the testing side of things. It's quite easy to kind of design something and get into the idea of like everyone will understand how this works and it's not always the case of course and like for example, a designed and uh, a NAV bar like a little user icon, the hover over to log in and and immediately people reported that they didn't have to log in, which is actually a reasonable stumbling block.
Usability learning needs	1	2	I think it should be something else about accessibility because that's usually it's forgotten. People forget at the beginning of making a website that needs to be accessible just sort of as a reminder that one needs to be done before you actually make the website live.
	2	2	I think that in terms of usability is quite important that while some people may know the theory behind it, most people don't usually have a field where they study that kind of theorems.
	4	3	For me would be the vastness of the information available. I don't ever feel like I was pointed towards 1 condensed concentrated resource with a clear pathway through the learning. All right, stuff that I'll generally miss to do with error handling like tooltips or a big one for me. I didn't use them very much and now I'm learning too because just like users need to orientate themselves with a NAV bar if there's nothing to inform them on what they're doing wrong with it, they're just not gonna know.
	3	3	And I suppose for me for the usability, there's always a baseline of, at least in theory, I should always consider disabilities and but other than that, yes.
	1	3	And if you apply it to like usability, then it could just be what the person is looking to create. Like if they're creating an app, it would be different to a website. Or, you know, if you're designing video and things like click those kind of things, you can see what you're doing in Taylor, what you're learning to the resource you're creating. Yeah, I definitely think that too, because there are so many different principles and theories and you don't know necessarily know which ones to apply Or which one do we prioritize and those kind of things? ...But when I'm designing for a different user group then I normally look back and see which usability principles will apply to them. ...And I think common mistakes and when I do projects would be probably when it comes to directly interacting with the user and things like error messaging and things like that and form filling.
	3	2	Usability theories: Sorry for interrupting, definitely important for the designers.
	1	2	Uh, for the Polish cinema websites I was like, Oh my gosh, that's anyone, you know, checking that stuff because the, you know, the phone was so small or the ad was everywhere, you know, like, like from 2000.
	3	2	I had to do a lot of paperwork and a lot of bureaucracy in Spain like last year, and I don't think any developer in Spain studies any usability because the websites are like horrible to use there. I can't imagine these people that only study PHP and MySQL doing like websites where you have to do things and it's so not intuitive and it's just like it doesn't work. I'm sure it only works in the way that the developer thought you know and they or any other way.
	1	2	Uh, for the Polish cinema websites I was like, Oh my gosh, that's anyone, you know, checking that stuff because the, you know, the phone was so small or the ad was everywhere, you know, like, like from 2000.
	4	3	Important parts for me were learning actual solid concepts that I could apply. Let's call it would be all that useful if I didn't have the graph in my head. Same with the golden ratio. Same with the 6030 ten rule. You gotta have you got to communicate these with visual examples.
Learning Platform	1	3	I think if you were like when you're actually teaching ..., you gave the user like a couple of examples of websites and then you were like to ask which one they think is more usable and and like has like his better usability.

Examining the Effectiveness of Gamification in Enhancing Web Usability Learning

Content Ideas			<p>But you could do it like where one looks more attractive but isn't actually usable, and then one looks like not as good but is more usable and things like that just to and highlight like principles and study things that they weren't so far.</p> <p>And I think like simplifying things like simplify and all the information in a way that like can highlight where if you were learning about usability, maybe you could have like topics that show that you're like you've mastered these concepts, you're like developing these concepts and these are concepts that you've not explored yet and just to like see where you are on the learning, you're learning learning too.</p>
Preferred Learning Environment	3	1	<p>I'm very competitive so. Getting that diploma just kind of validates my effort and I think that's really important for me to keep going. The certificates and feedback and yeah, so my favourite would probably be you Udemy cause that's where I I find that I learn quite easily. Especially like JavaScript and PHP courses that have done and I'm they're very affordable. You know you can get a course for on a sale for 11 pounds, which is absolutely fantastic. And then you get a certificate at the end of it. --- I like that that the lessons are obviously prerecorded and you can go back and reference and if there's anything that you missed or maybe you want to double check and then there is comments that you can write and then the lecture can reply and say that you know this is the mistake that you've done. Or so I think that the engagement and a lot of the times they have open forums or discords where you can go and sort of engage with other students and lectures you can help you.</p>
	2	2	<p>My personal experience is that I don't have the best memory, I must admit, so I usually do revisit some of my older work and information from previous years. And so I need to go back to specific years where that was the target of that of a module and ensure that I am.</p>
	4	2	<p>Platform that gives you a proper certificate that could be like you, Udemy or something. It's that the simply invest your money so you feel more serious about it. So I think there is more commitment.</p>
	4	3	<p>For me, it's just having a practical anger. If I can anchor it to something practical, then I'll think about it. But if I can't, then it's not gonna come to mind, because it's not gonna be useful in producing any kind of deliverable.</p>
	3	3	<p>So give an example I think is freecodecamp and and W3 schools. So yeah, they're quite good that they give you a kind of like sort of a curriculum almost. You can work your way through ... We might as well get this done with, you know, and and yeah, just work your way through and it's it's a good structure and build up and cause I've tried to jump from like base as I tried to skip the JavaScript and go into React like no, no. ... It kind of makes you more intrigued to reconnect to that and work your way through the different materials and and a connecting that back to maybe you don't feel like you've learned that much but and but it's done quite well where like they'll be very basic words that you're gonna have covered in like say, part one wherever they call it and then in Part 2, they kind of assume you know that now and can work a little bit more. ... Now, you know, paying makes you more likely to go back and...</p>
	1	3	<p>Yeah, I need a little dark pattern in to get me through learning and it's like. And I think I don't think I've ever learned things on Duolingo that I would feel like I could then communicate in that language... It's kind of not like progressed far enough along, but I feel like that you learn more when you're actually speaking with somebody. ... It's just like it takes you slowly through it at your own pace. ... Uh, I used the Duolingo.... it takes you down in order which things to learn you don't like flip and like flip between lots of different things.</p>
Preferred Learning Platform	3	3	<p>But there isn't a documented fallacy where you assume that other people have the same knowledge. That's why I think that you always need to like peer review or the theory as well.</p>
Usability Testing		3	<p>But there isn't a documented fallacy where you assume that other people have the same knowledge. That's why I think that you always need to like peer review or the theory as well.</p> <p>I don't like to generalize that much, so I think that the main thing for me would be more on the testing side of things. It's quite easy to kind of design something and and get into the idea of like everyone will understand how this works and it's not always the case of course and like for example, a designed and uh, a NAV bar like a little user icon, the hover over to log in and and immediately people reported that they didn't have to log in, which is actually a reasonable stumbling block.</p>

Figure 8: Focus Group 1,2,3 Findings.

The thematic analysis from the three focus groups showed critical insights into learning usability, preferred learning platforms, game elements, user dislikes, design considerations, content ideas, learning environment preferences, and usability testing. Participants emphasised the significance of user-friendly navigation, consistency in layout, and accessibility features for enhancing usability. Platforms offering certificates, interactive lessons, and engagement with instructors were favoured, with gamification elements such as badges and progression tracking enhancing motivation. Dissatisfaction stemmed from platforms prioritising competition over collaboration and ineffective teaching methods.

Participants agreed that designing for usability required theoretical understanding and user testing. Suggestions for learning content included real-world examples and structured learning paths. Participants valued practical application, easy access to materials, and engaging content in their preferred learning environments. However, some participants expressed difficulties with error handling and validation messages, highlighting challenges in these usability areas. Also, some participants agreed that avoiding assumptions and identifying usability issues was crucial. These findings underscored the necessity of understanding targeted users' preferences when designing learning platforms, as some user preferences did not align with the overall game elements preferences discovered in the literature review.

4. Design documentation

4.1 User-Centric Design

4.1.1 Learning platforms

To create an intuitive user interface design, it's crucial to consider the preferences and experiences of the targeted audience. Based on insights gathered from the focus groups, it was found that users often use platforms such as Rosetta Stone, Codecademy, W3Schools, FreeCodeCamp, Udemy, Scratch, and Duolingo. Therefore, drawing inspiration from these platforms can effectively inform the design process.

Rosetta Stone employs bright colours to capture users' attention and create an engaging learning environment (Figure 9).

Examining the Effectiveness of Gamification in Enhancing Web Usability Learning



Figure 9: Screenshot Rosetta Stone

Codecademy features content-dense pages but ensures easy access through a well-structured menu and provides a wide range of courses. The use of accent colours effectively draws attention to essential elements (Figure 10).

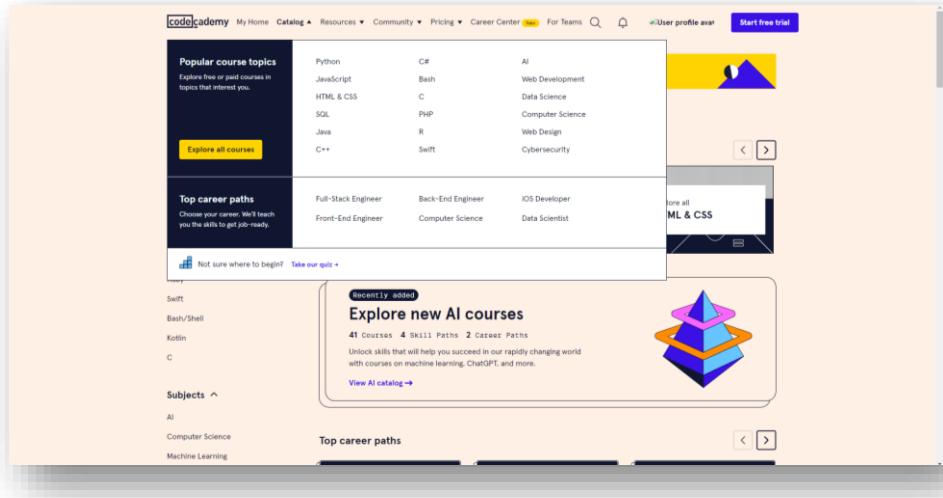


Figure 10: Screenshot Codecademy

W3Schools maintains a professional appearance with increased white space and a library-like content structure, facilitating easy access to various topics (Figure 11).

Examining the Effectiveness of Gamification in Enhancing Web Usability Learning

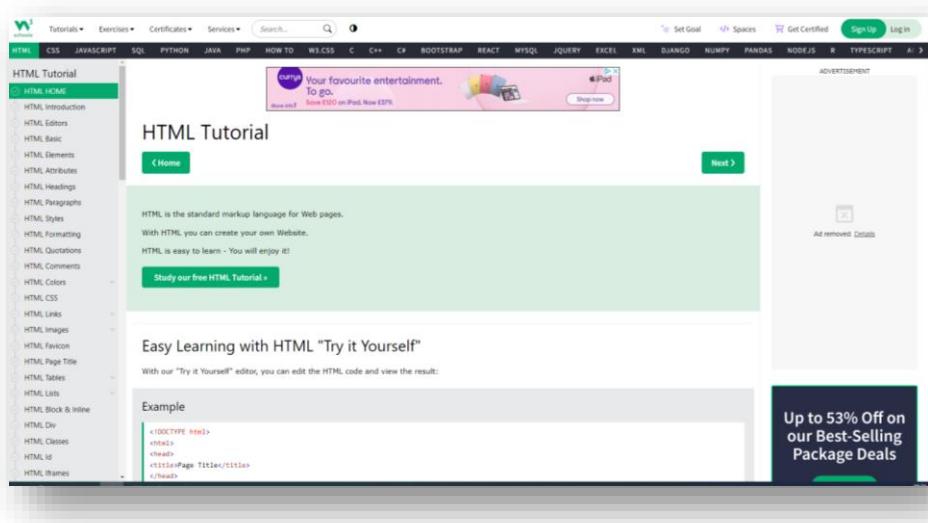


Figure 11: Screenshot W3Schools

FreeCodeCamp adopts a minimalist design approach while integrating interactive features into its training modules. This allows for hands-on learning experiences and highly accessible content (Figure 12).

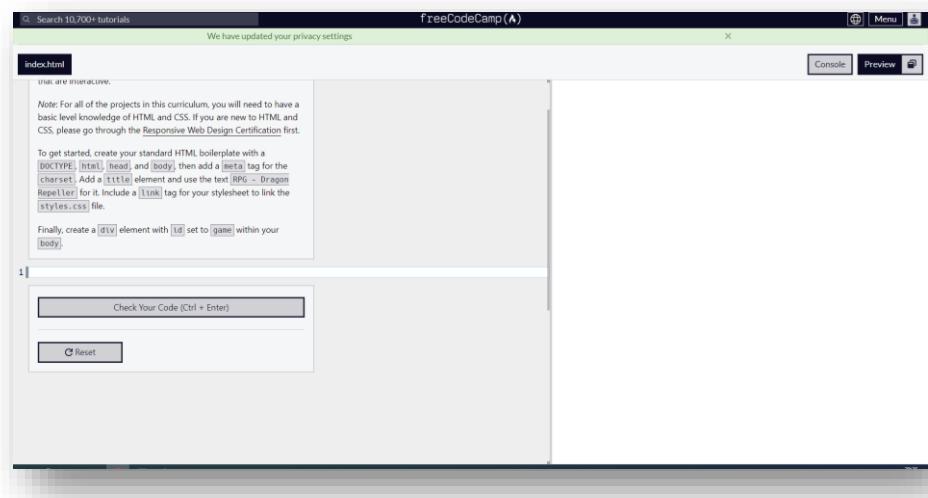


Figure 12: Screenshot FreeCodeCamp

Udemy offers paid video courses with a clear and professional design. It uses muted and accent colours, including a couple of shades of blue, to convey a sense of professionalism (Figure 13).

Examining the Effectiveness of Gamification in Enhancing Web Usability Learning

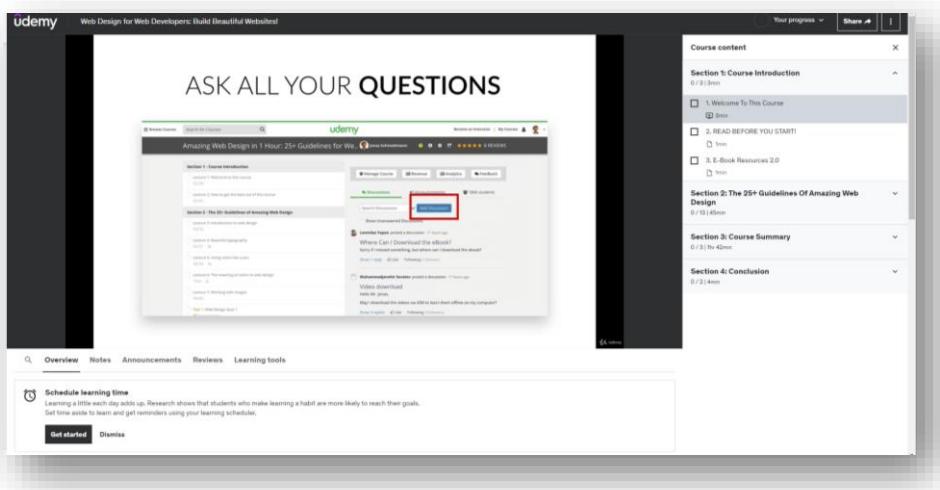
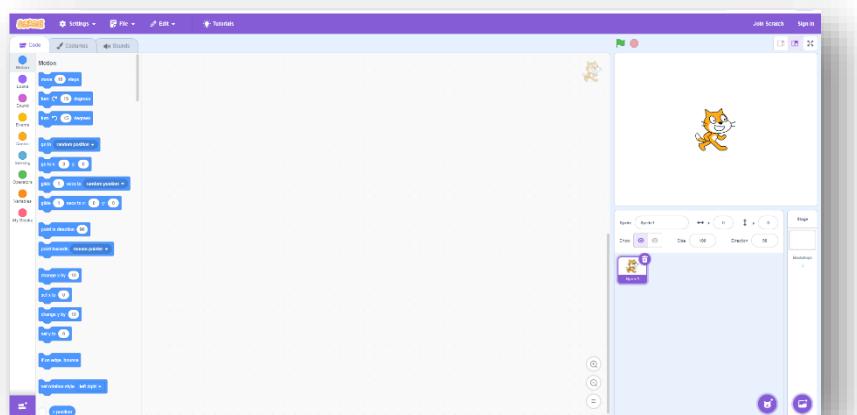


Figure 13: Screenshot Udemy

Scratch adopts a simple layout for easy navigation and incorporates a feedback system to enhance



usability. The platform uses accent colours, with blue as a background and accent colour, contributing to a playful yet professional design (Figure 14).

Figure 14: Screenshot Scratch

Duolingo features a straightforward, engaging design. It incorporates various learning methods and increased white space to avoid overwhelming users. Using green and blue as main accent colours contributes to the platform's professional and playful nature while maintaining usability (Figure 15).

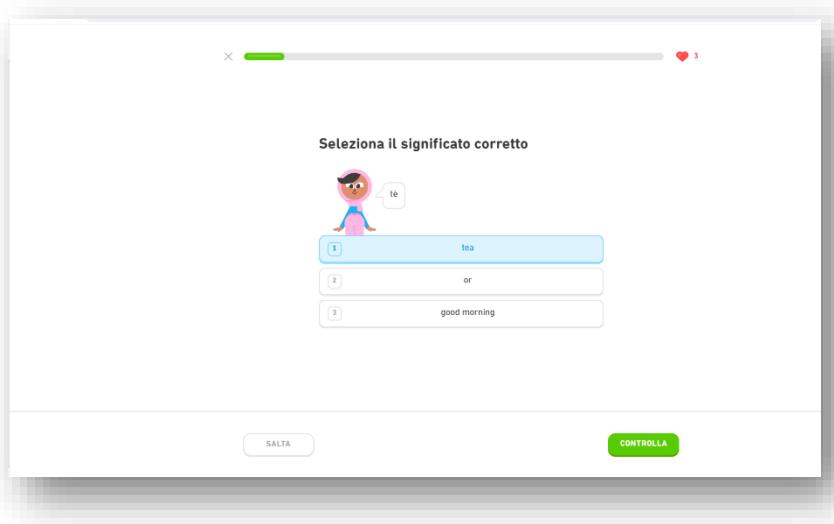


Figure 15: Screenshot Duolingo

In conclusion, to create a successful learning platform, it is essential to maintain a professional appearance while ensuring the content does not overwhelm users. Incorporating engaging elements such as quizzes can enhance user interaction and the learning experience (PurplePro Loyalty Program, 2023). Incorporating blue as a primary choice can convey professionalism and trustworthiness when selecting colours. Additionally, research has shown that blue is associated with increased subjective alertness and performance on attention-based tasks (Elliot, 2015). Moreover, effective use of white space can improve usability and prevent distractions from the content (Soegaard, 2024). Bright colours can be strategically used to draw attention, keeping users engaged (joshmeah, 2023). Additionally, allowing user input and interaction can enhance user engagement and foster a sense of ownership in the learning process. Following design principles and considering users' experience, the learning platform can effectively meet its audience's needs and create an effective learning environment.

4.1.2 Mood board

Mood boards are visual tools in UX design for gathering inspiration, communicating brand identity, and determining a product's visual direction (Yang, 2023). They typically comprise images, patterns, or text that evoke specific feelings and are utilised across various design disciplines, such as branding, fashion, and interior design (Yang, 2023). Mood boards facilitate the design process by

visually organising ideas and preferences and are particularly effective at the project's beginning (Yang, 2023).

In the context of this design project, which aims to build a new brand, the mood board centres on themes of learning, students, computing, usability, and errors, summarising the essence of computing ducation and usability (figure 16).



Figure 16: Mood board

The selection of colours further reinforces the meaning of the targeted words. Various shades of blue symbolise trust, reliability, and professionalism, crucial qualities for an educational platform (Showalter, 2018). Blue's association with technology and communication seamlessly aligns with the computing theme. Nude pink introduces a sense of warmth and support, fostering a nurturing environment conducive to learning (Showalter, 2018). Bright yellow injects energy and optimism, encouraging enthusiastic user engagement despite potential challenges (Showalter, 2018).

Overall, the mood board effectively identifies potential colour choices based on users' emotions and experiences with the website's topics. By incorporating these colours, the design aligns with the project's objectives and user expectations.

4.1.3 Style Guide colours

The colour choices for the website are informed by insights gathered from other learning platforms and the mood board (Figure 17).

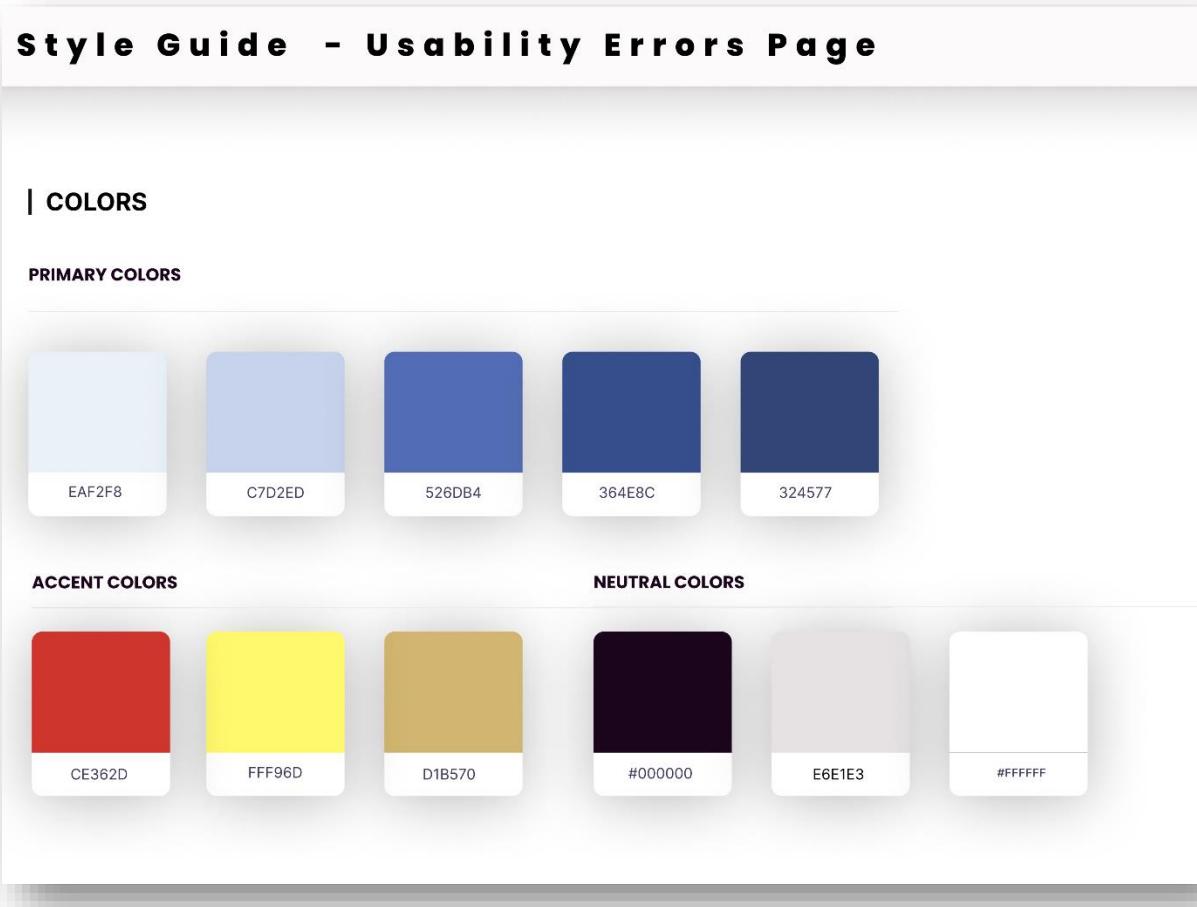


Figure 17: Colour style guide

4.1.4 Style Guide typography

The usability learning platform is designed with an emphasis on accessibility and usability. This is achieved through font selection, establishing a clear visual hierarchy and high contrast to achieve maximum readability.

Typography establishes visual hierarchy through font sizes, styles, and kerning (Prajeesh, 2023). Larger fonts attract user attention to primary content, while smaller fonts denote secondary

information. High contrast between text and background enhances readability across different screen sizes.

Poppins is the main font used on the website, offering various styles to suit different design needs, from body text to headlines. Its availability in Figma and Canva font libraries makes it accessible to designers. Being a sans-serif typeface, Poppins aligns well with modern design trends, making it suitable for digital interfaces (Poppins—Google Fonts, n.d.).

Open Sans is another font choice used specifically for buttons to enhance visibility. With its simple, friendly appearance and clear letterforms, Open Sans is ideal for print, web, and mobile platforms (Open Sans - Google Fonts, n.d.).

The website follows specific accessibility guidelines, ensuring a minimum font size of 18pt for small text on the homepage and 20pt on error pages (GOV.UK, 2021). The main text is set at 28pt, as designated on the errors page font style guide, illustrated in Figure 18.

Style Guide - Usability Errors Page

TYPOGRAPHY

MAIN FONT

ACCENT FONT

Poppins

Open Sans

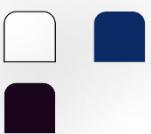
Font colours 	Logo Poppins 58pt Upper Case Weight - Bold	Heading 1 Poppins 44pt Weight - Bold	Heading 2 Poppins 32 pt Weight - Bold
Heading 3 Poppins 30pt Weight - Regular	Body text Poppins 28pt Weight - Regular	BUTTON 1 Open Sans 32 pt Weight - Bold	BUTTON 2 (quiz) Poppins Bold 20pt

Figure 18: Typography style guide

4.1.5 Navigation Map

Inspired by Einstein's philosophy of simplicity, the learning platform's navigation is designed to be straightforward, allowing users to move seamlessly between two main areas: the Library of Resources and Structured Training (Kalbach, 2007). Using icons, images, and text ensures an intuitive experience, making navigation feel natural and effortless.

The platform is organised into two main sections to cater to diverse learning needs:

Structured Training: Gamified Courses designed to build knowledge sequentially and provide a thorough learning path.

Library of Resources: This section gathers information from the training and offers text-based content for those looking to explore topics independently or supplement their learning.

Figure 19 displays a navigation map highlighting the active pathways in the prototype for a specific training module.

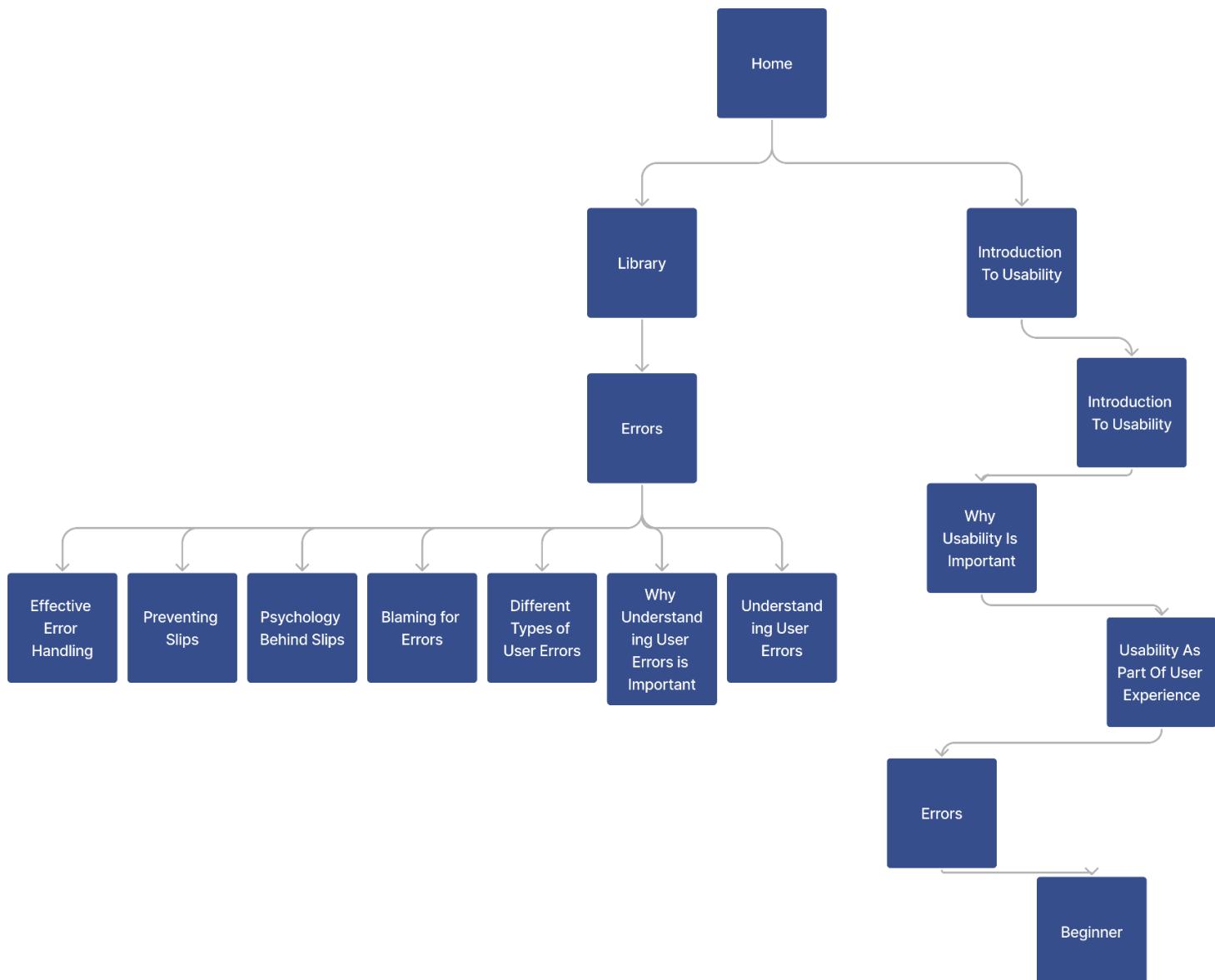


Figure 19: Navigation Map

The design of the learning platform structure was inspired by the focus group findings, where participants preferred structured, progressive learning. Additionally, the focus group preferred platforms that allow easy access and collect all relevant information in one place. To accommodate this, all topics are gathered in the library section, ensuring users can access information in a structured and accessible manner.

The prototype flow illustrates the sequence of user interactions on the platform. Users can access training sections sequentially, unlocking each after completing the previous one. However, they

have unrestricted access to all information in the library section at any time. This design decision aligns with the focus group findings, highlighting the importance of structured training and easy access to information.

The independent measurement experiment focused solely on the library section and the usability of the beginner learning landing page. This targeted approach allowed for an in-depth examination of user interaction and usability within specific platform sections.

4.1.6 Images and graphics

Images and graphics are essential in creating an immersive learning experience (Hai-Jew, 2010). The "Introduction to Errors" incorporates carefully selected images that align with the colour palette and effectively convey the intended message.

Relevant images and graphics increase visual appeal and engagement and help reduce information overload by providing users with visual cues (Hai-Jew, 2010). These images and graphics help users understand concepts faster and make the platform more straightforward because they relate directly to the written content (figure 20).

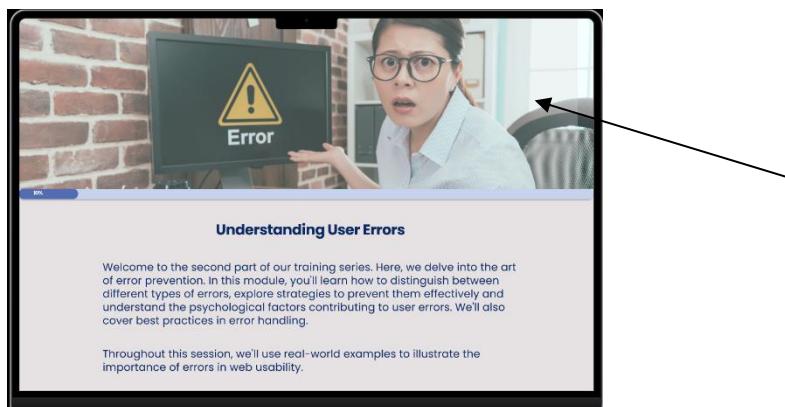


Figure 20: Images

In addition to images, interactive graphics are used to engage users and facilitate active learning. These dynamic elements empower users to explore concepts interactively, enhancing understanding and retention of the material (figure 21).

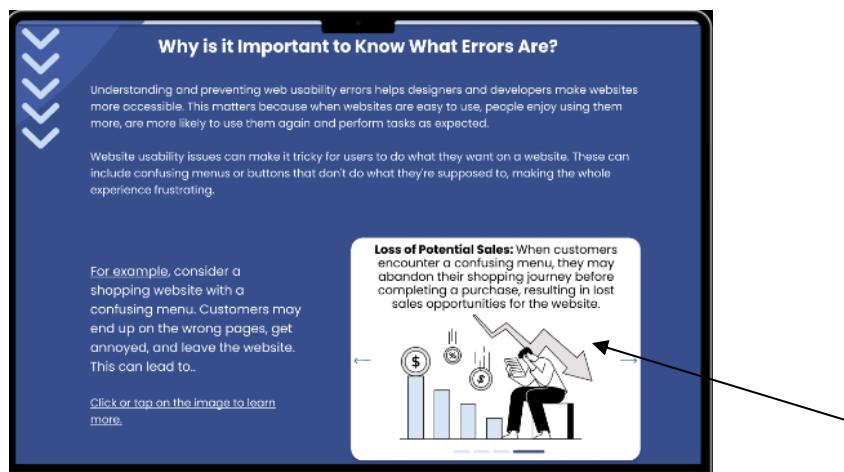


Figure 21: Graphics

Overall, the strategic integration of images and graphics enhances user engagement, comprehension, and usability on the learning platform. Thoughtful selection and application of visual elements are valuable tools in supporting the learning process and maximising the platform's impact (Hai-Jew, 2010).

4.1.7 High fidelity prototype

4.1.7.1 Design tools

When evaluating different design tools for developing learning platforms with interactive elements, several key factors should be considered: the ability to create interactive designs, ease of sharing with research participants, integration with other design tools and testing plugins, and ease of use. The most popular options today are Figma, Adobe XD, Photoshop, and Canva.

Figma stands out for its comprehensive prototyping features that effectively simulate user interactions, making it an excellent choice for creating interactive designs (Danielyan, 2021). Its web-based nature and collaborative environment facilitate easy sharing with research participants, allowing real-time feedback (Danielyan, 2021). Figma's extensive plugin ecosystem and seamless integration with other tools enhance its use for testing and iterative design processes (Danielyan, 2021). Although it may be more challenging to learn than Canva, Figma's user-friendly interface is accessible to designers with different levels of knowledge (Danielyan, 2021).

Adobe XD also offers strong capabilities in interactive design, with prototyping features that enable the creation of dynamic user interfaces (Adobe, 2023). Sharing prototypes is relatively straightforward through shareable links, although real-time collaboration is less robust than Figma's. Integration with Adobe's Creative Cloud provides a seamless workflow for users already familiar with

Adobe products, and its plugin library supports a range of testing and design needs (Adobe, 2023). However, most of them are not free.

Photoshop is primarily an image editing tool, is less tailored to interactive design and prototyping, making it less ideal for developing interactive learning platforms (Rodney, 2023). Sharing designs for feedback requires additional steps to export and share files (Rodney, 2023). While Photoshop integrates well with other Adobe products, its focus on image manipulation means it lacks direct integrations and plugins for prototyping and testing interactive designs (Rodney, 2023). Its complex interface may pose a significant learning curve for some users (Rodney, 2023).

Canva offers a user-friendly platform with a wealth of templates that can speed up the design process, particularly for non-designers (Vreeswijk, 2024). However, its capabilities for creating interactive designs are limited compared to Figma and Adobe XD, making it less suitable for developing complex interactive learning platforms (Vreeswijk, 2024). Sharing designs is simple, but Canva's integration with other design tools and availability of testing plugins are minimal. Despite this, Canva's ease of use makes it accessible to a broad audience, although it may be oversimplified for more complex design projects (Vreeswijk, 2024).

In conclusion, for projects focused on developing interactive learning platforms, Figma stands out as the most suitable option. It offers robust prototyping capabilities, ease of sharing, and a range of integrations and plugins to support the design and testing process. While Canva may only meet some of the specific needs of such projects its extensive library of graphics, images, and templates makes it an ideal complementary tool to be used alongside Figma. However, due to Figma limitations, certain gamified design elements, such as active progress bars and badges, could not be incorporated. Nonetheless, quizzes, static progress bars, storytelling elements, feedback, and interactive features were included.

4.2 User-Centred Learning Development

4.2.1 Targeted audience

The targeted audience for this learning platform is Scottish students in higher education. Based on the statistics of Scottish students for 2022, these typically include male and female students over 18 years old without strong religious views (Figure 22). They are typically white Scottish individuals (Erudera, 2023).

Category	2021/22
Sex	
Female	59%
Male	40%
Other	0%
Age group	
20 and under	32%
21-24 years	29%
25-29 years	14%
30 years and over	25%
Age unknown	
Disability status	
Known disability	15%
No known disability	85%
Religious belief	
No religion	59%
Buddhist	1%
Christian	27%
Hindu	3%
Jewish	0%
Muslim	6%
Sikh	1%
Spiritual	1%
Any other religion or belief	1%
Not known	
Ethnicity	
White	89%
Black	2%
Asian	5%
Mixed	3%
Other	1%
Not known	
Total UK domiciled students	100%
Total	100%

Figure 22: HE student enrolments by personal characteristics (HESA, 2023)

A persona was created to better understand the user and tailor the learning platform's design and features to their needs. This persona offers insights into the typical traits, objectives, tasks, motivations, frustrations, and usage patterns of the target audience. The user profile information

was gathered through focus groups and demographic data on Scottish students. These insights will inform decisions aimed at improving the user experience and effectively meeting their learning goals (figure 23).

LEARNING PROFILE

Goals:

- Improve web usability skills.
- Find an engaging, all-in-one learning platform.

Motivation:

- Meet university project deadlines.
- Simplify web usability study.

Frustrations:

- Difficulty focusing during self-study.
- Balancing class, study, and personal time.

Needs:

- Streamlined learning.
- Easy-to-understand content.
- More engaging study resources.



EMMA SCOTT

Student

I am a Full time student

BIO

Emma is studying web design and development and is interested in UX design. She often turns to online courses to improve her skills. Emma's university work keeps her busy and requires a lot of self-study, making digital resources her go-to option. This preference grew stronger with the shift to online learning during the pandemic. However, she sometimes struggles to stay interested in some e-learning sites.

WEBOGRAPHICS:

- Usage location: Primarily at university
- Usage platform: Desktop and Laptop
- Usage frequency: Regularly visits the website to remind her self some usability principals.
- Favourite websites: W3Schools, FreeCodeCamp, Udemy, Codecademy, Rosetta Stone, Scratch
- Social media sites: Active on LinkedIn

Figure 23: Persona

4.2.2 Customer journey

A user journey map is employed to understand user interactions within the learning platform. This involves recording user actions and examining emotional experiences, pain points, and touchpoints throughout the journey (Schicker, 2021). However, a Storyboard is integrated into the user journey map to better understand these interactions. This mixed approach is called an augmented Journey Map (Krause, 2018). An augmented Journey Map enriches the customer journey map by visualising the storyline, helping understand what drives the user's behaviour (Figure 24).

The Augmented Journey Map is a powerful tool for enhancing understanding of the customer journey and identifying opportunities. It describes Emma's progression through the learning platform, from initial discovery to successfully achieving her goal. Emma's journey encompasses seven stages, each evoking specific emotions, actions, touchpoints, and pain points. Emma's journey starts when she encounters a post on LinkedIn that leads her to the website. The user experiences different emotions throughout her journey, revealing the platform's flaws.

Emma's journey through the platform highlights both frustrations and opportunities. She faces frustration when attempting to access higher-level courses but is redirected, feeling constrained by the forced linear progression. These frustrations reveal opportunities for improvement. For example, enhancing the platform's user interface to provide clear, intuitive pathways to main content areas, offering a transparent approach to learning, and improving the library's search functionality with advanced filters can address these issues.

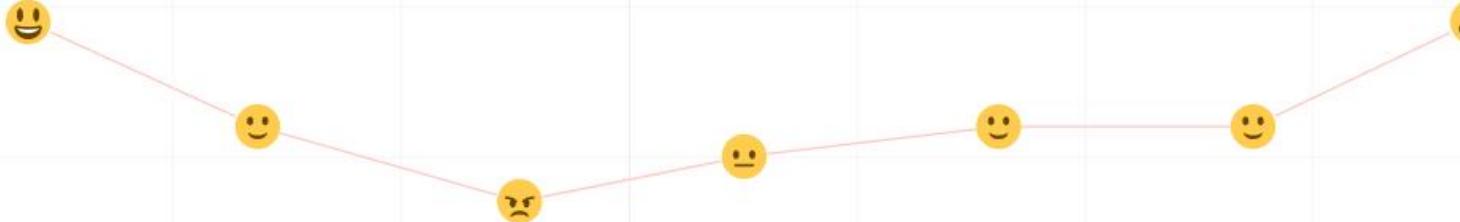
However, Emma's experience is considered satisfactory as she achieves her goal and returns to the platform.

The content and narrative of the Augmented Journey Map are based on insights from focus groups, which showed that users prefer platforms with shareable certifications on LinkedIn, structured learning content, and comprehensive information on web usability in one place.

Figure 24: Augmented Journey Map

Persona: Emma

User Story : Emma is tasked to create a user-friendly website incorporating validation messages for an upcoming class project.

User steps	Discovery	Exploration	Restriction	Library Access	Engagement	Achievement	Success
User actions	<ul style="list-style-type: none"> Key Actions: Clicks on the post to explore more. Emotions & Thoughts: Curiosity sparked by peer recommendation. Touchpoints: LinkedIn post. Pain Points: None at this initial stage. 	<ul style="list-style-type: none"> Key Actions: Navigating through courses, reading descriptions. Emotions & Thoughts: Excitement about possibilities, slight overwhelm due to choices. Touchpoints: Homepage, course listings. Pain Points: None at this initial stage. 	<ul style="list-style-type: none"> Key Actions: Attempts to access higher-level courses but is redirected. Emotions & Thoughts: Frustration over forced linear progression. Touchpoints: Course access gateway. Pain Points: Mandatory beginner-level completion. 	<ul style="list-style-type: none"> Key Actions: Utilizes the library for broad research. Emotions & Thoughts: Delighted by the wealth of information. Touchpoints: Library feature. Pain Points: None at this initial stage. 	<ul style="list-style-type: none"> Key Actions: Actively learning and interacting with course content. Emotions & Thoughts: Challenged yet absorbed by the material. Touchpoints: Introduction course module. Pain Points: None at this initial stage. 	<ul style="list-style-type: none"> Key Actions: Translates theory into practice for her project. Emotions & Thoughts: Determined to apply learning in a practical context. Touchpoints: Course content, class project. Pain Points: None at this initial stage. 	<ul style="list-style-type: none"> Key Actions: Seeks out particular information to aid project progress. Emotions & Thoughts: Reliance on the platform for ongoing support. Touchpoints: Library search function. Pain Points: None at this initial stage. 
Storyboard							
Opportunities			Enhance the platform's user interface to provide clear, intuitive pathways to main content areas and offer transparent explanations for the structure of training modules.	Improve the library's search functionality with advanced filters			

4.2.3 Accessibility testing

The learning platform's accessibility was assessed using the Figma plugin "Contrast." While the text was found to be generally accessible, some sections were highlighted as needing improvement for AAA standards, meaning that increased colour contrast for even better accessibility could be applied (figure 25).

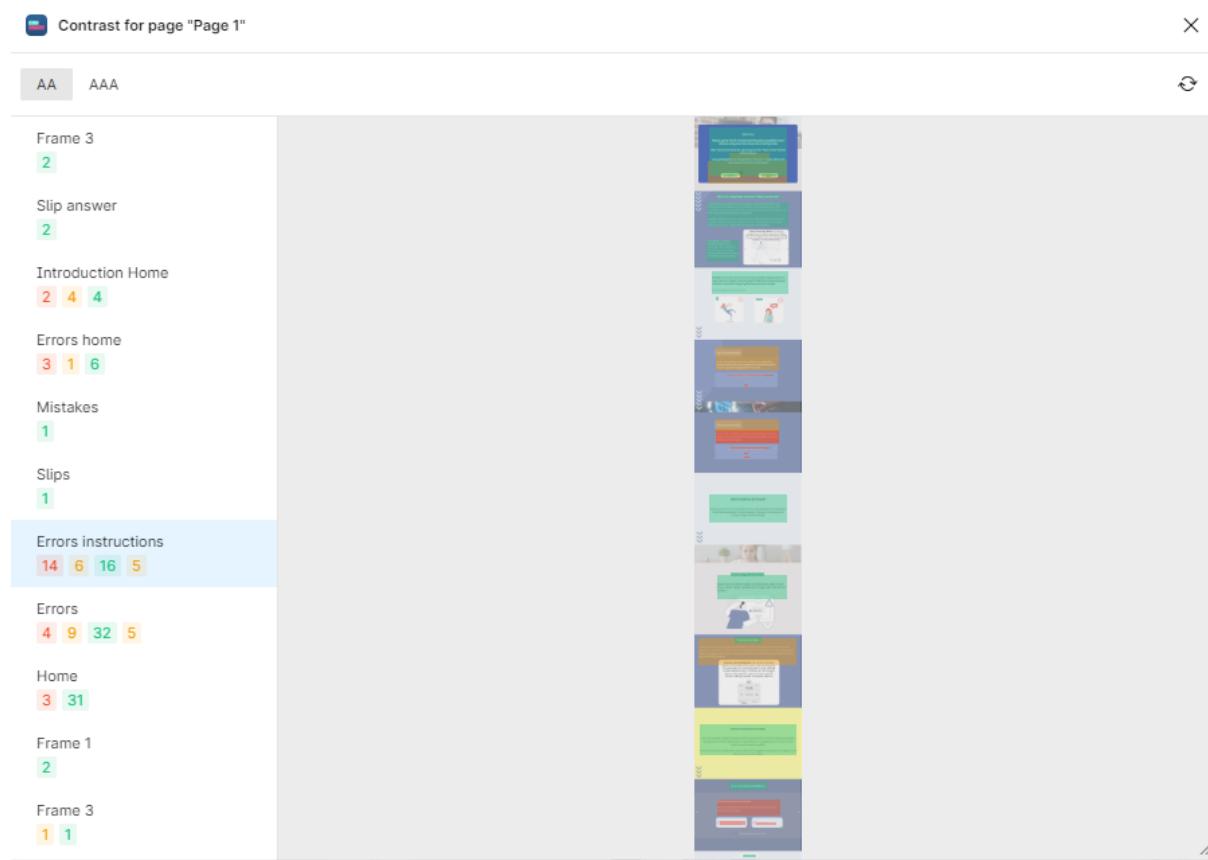


Figure 25: Accessibility testing

4.2.4 Designing with Ethical Considerations

The design was created to ensure an ethical platform with the users' needs in mind, guided by insights from the focus group. Clear instructions were provided to avoid dark patterns and ensure accessibility for all users. Additionally, the system offered choices, allowing users to follow a structured training path or engage in self-learning using the library. The potential positive and negative outcomes of using the system were carefully considered. Although the user journey revealed opportunities for more feedback and clarity, no further pages will be created as per this project objectives.

4.2.5 Functional Testing

Functional testing was carried out to ensure that all buttons, links, and slides worked as expected. This was recorded in a functional testing table, which features all intended-to-work interactions in the prototype (figure 26).

Test Case Description	Action	Expected Result	Pass/Fail
Test home page	Click on Library button	Library page is displayed	Pass
	Click on "Introduction to Usability"	Usability page is displayed	Pass
	Click on "Errors"	Errors page is displayed	Pass
Test Introduction page	Click on Logo	Returns to home page	Pass
Test Errors page	Click on Logo	Returns to home page	Pass
	Click on "Beginner course"	Redirects to gamified learning page	Pass
Test Errors learning page	Click on the first poster in the carousel	First poster slide changes	Pass
	Click on the slips window in the second section	Shows additional information window	Pass
	Click on the mistakes window in the second section	Shows additional information window	Pass
	Click to close the mistakes window in the second section	Window closes	Pass
	Click to close the slips window in the second section	Window closes	Pass
	Choose slips or mistakes option in the third section	Feedback window opens	Pass
	Click on the "Answers" window in the third section	Window closes	Pass
	Choose slips or mistakes option in the fourth section	Feedback window opens	Pass
	Click on the "Answers" window in the fourth section	Window closes	Pass
	Click on the carousel in the seventh section	Four images change	Pass
Test Library section	Click on the carousel in the ninth section	Seven sections change	Pass
	Click on "Take a test" button (independent measure experiment)	Leads to Google Form survey and test	Pass
	Click on "Errors" section side menu - "Understanding User Errors"	Goes to Understanding User Errors page	Pass
	Click on "Errors" section side menu - "Why Understanding User Errors is Important"	Goes to Why Understanding User Errors is Important page	Pass
	Click on "Errors" section side menu - "Different Types of User Errors"	Goes to Different Types of User Errors page	Pass
	Click on "Errors" section side menu - "Blaming for Errors"	Goes to Blaming for Errors page	Pass
	Click on "Errors" section side menu - "Psychology Behind Slips"	Goes to Psychology Behind Slips page	Pass
	Click on "Errors" section side menu - "Preventing Slips"	Goes to Preventing Slips page	Pass
	Click on "Errors" section side menu - "Effective Error Handling"	Goes to Effective Error Handling page	Pass
	Click on Logo	Returns to home page	Pass
Click on the "Next" button under each page for convenience in the experiment		Goes to next page	Pass

Figure 26: Functional testing table

4.2.6 Asset list

The asset list shows content sourcing and design choices, balancing originality with the practical use of royalty-free resources. Utilising Canva for images and graphics ensures a vast selection of visual

elements that can be tailored to fit the project's aesthetic, providing both variety and legal safety. The selection of fonts from Figma and Canva offers convenience by providing access to a broad spectrum of free fonts, simplifying the design process, and ensuring diverse typographical choices without compromising cost or accessibility. Integrating original content with external information increases the project with credible and in-depth content. Additionally, the mix of Canva's ready-made icons with Figma's custom illustrations allows for brand-specific imagery while maintaining efficiency.

Asset List:

Category	Source
Images and Graphics	Canva: Source for all images and graphic elements.
Fonts	Figma and Canva: Collection of fonts used for text.
Page Design	Figma: Designs, layouts, and wireframes for pages.
Text Content	Original content and information sourced from: Sunwall & Neusesser (2024), Laubheimer (2023), and Minhas (2018)
Icons and Illustrations	Canva: Library Figma: Custom illustrations tailored for the project.
Interactive Elements	Figma: Original content

4.2.7 Final deliverable

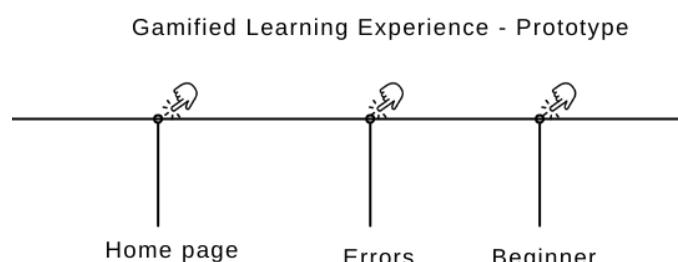
For a main deliverable in the design and development is considered the gamified learning platform prototype. The flow leading to the page is developed to address the user preferences as per the focus groups findings.

Explore the learning experience gamified prototype by following the touchpoint in the customer journey map (figure 27). 

Link to Prototype Flow

Link to Gamified Prototype

Figure 27: Customer Journey Map



The library section features the non-gamified content used in the independent measurement experiment, aligning with user preferences for convenient access. Its design is inspired by W3Schools, ensuring both learnability and accessibility (figure 28).

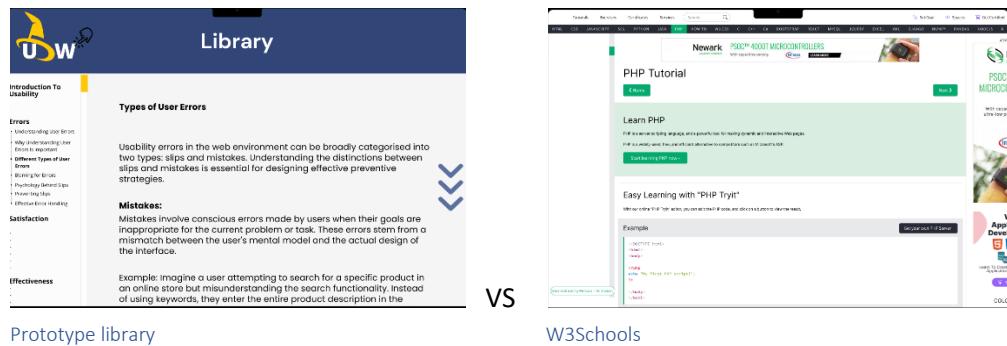


Figure 28: Library design

5. Learning development

The development of the gamified learning platform was guided by the Self-Determination Theory (Krath et al., 2021). The goal was to improve motivation and practical learning. The principles of autonomy, competence, and relatedness were embedded into the platform's design to achieve this goal (Krath et al., 2021).

Two learning paths were provided to enhance learner autonomy, including options between structural learning and free access to the library, allowing users to complete training at their own pace. Competence was fostered through structured levels and immediate feedback from quizzes, ensuring users continuously improved their skills. Despite challenges in incorporating relatedness due to limitations in Figma functionalities, measures were taken to simulate connectedness. For instance, participants engaged in live chat sessions with facilitators during training to replicate a sense of connection with others.

The content was based on insights from literature reviews and focus groups, addressing the demand for practical skills and usability learning challenges. Interactive elements, targeted tutorials, and real-world scenarios were integrated accordingly.

Engagement remained a central focus, carefully selecting game elements and interactive activities. Elements such as levels and progress bars were chosen to reflect users' progress and mastery, while

interactive components like storyboards and quizzes provided hands-on learning experiences, ensuring effective and immersive learning.

6. Methodology - Independent Measures Experiment

6.1 Quasi-experiment

Experiments are techniques to test new theories, understand behaviour, develop new technologies, or deepen knowledge of established processes (Wilson & MacLean, 2011). They facilitate controlled hypothesis testing and can uncover significant relationships between variables by isolating the investigated aspects (Wilson & MacLean, 2011). Experiments involve two types of variables: the independent variable, which researchers can manipulate, and the dependent variable, which is measured to observe changes in response to the independent variable (Wilson & MacLean, 2011). These variables are essential for designing experiments, identifying cause-and-effect relationships, and drawing conclusions from empirical evidence (Wilson & MacLean, 2011).

Experiments aim to test hypotheses derived from initial observations or existing knowledge (Wilson & MacLean, 2011). This study hypothesises is that students achieve different learning outcomes when using gamified online platforms compared to reading plain text online.

Participants are crucial for conducting experiments (Wilson & MacLean, 2011). Selection criteria must be established to ensure valid results (Wilson & MacLean, 2011). This independent measures experiment specifically targeted participants who matched the audience profile, ensuring that the gathered data would directly address the educational requirements of the intended users. Thus, the experiment required participants to be high-education students.

In this case, the study is identified as a quasi-experiment because of the lack of complete control over the independent variable (students in high education). This happens due to ethical concerns, practical limitations, or pre-existing groups (such as students already enrolled in specific courses or educational programs) (Wilson & MacLean, 2011). Quasi-experiments are invaluable for examining causal relationships using naturally occurring variations or pre-existing groups, especially when true experimental conditions, such as random assignment, are inappropriate (Wilson & MacLean, 2011).

Ideally, the independent variable should be influenced only by the dependent variable (Wilson & MacLean, 2011). However, uncontrolled environments involving human subjects are usually influenced by outside factors. Minimising these influences is essential (Wilson & MacLean, 2011).

Due to logistical constraints, this study was conducted via online meetings, introducing multiple challenges. For instance, some participants searched for answers on Google. Others used a keyboard instead of a mouse, moving the answers instead of the page. One participant viewed earlier test results, potentially biasing the following test outcomes. Consequently, data from these participants was deleted. To mitigate further issues, participants were required to share their screens during tasks to increase control over the experiment outcomes.

6.2 Test-retest method

This study employed a test-retest (pre-test post-test) design, a common experimental approach where the dependent variable is measured before and after certain events (Rogers & Revesz, 2019). The test-retest method is widely used in research to assess the effectiveness of interventions by comparing changes from baseline measurements to post-intervention measurements (Howitt & Cramer, 2020).

Moreover, test-retest reliability is essential for ensuring consistent and reliable results (Voyager Sopris Learning, 2023). Enhancing this reliability involves clearly defining the test's purpose, careful planning, pilot testing, and choosing appropriate intervals between tests to prevent recall and minimise external influences (Voyager Sopris Learning, 2023).

A test-retest design is suitable for this study as it could facilitate comparing participants' performance before and after learning to establish a learning curve. In this case, the method is used to compare learning effectiveness on gamified platforms to that of plain pages.

Initially, participants completed a knowledge test to determine their eligibility and assess their understanding of the subject. They then engaged in learning activities on either gamified platforms or plain pages. The same test was administered afterwards to measure any changes in their knowledge.

The study also included a pre-survey to collect demographic data for statistical analysis, helping identify factors like age and educational background that could influence learning outcomes. A post-

survey was conducted to understand participants' experiences, which will inform future usability testing of the eLearning systems.

6.3 Test-retest Data Gathering

Participants were recruited through both personal and professional networks. The project supervisor was requested to distribute a volunteer recruitment message through their professional channels. Simultaneously, word-of-mouth methods were used, such as contacting friends and acquaintances. Additionally, LinkedIn and a Facebook university group were utilised for broader exposure. Despite these efforts, responses from LinkedIn and Facebook were minimal, and word-of-mouth was unsuccessful. Ultimately, using personal connections proved to be the most effective method for gathering participants without offering rewards.

Moreover, participants completed the retest significantly faster than the pre-test. On the gamified platform, participants took an average of 7:18 minutes to complete the pre-test and 4:50 minutes for the retest. Similarly, on the non-gamified platform, it took 7:18 minutes for the pre-test and 3:33 minutes for the retest. This decrease in time is likely because the second survey was shorter, participants were already familiar with the software and its requirements, and they needed less time to contemplate the questions due to increased familiarity with the topic (figure 29).

Test gamified prototype		Test non-gamified prototype	
ID	Time for completion in minutes	ID	Time for completion in minutes
1	04:51	1	07:40
2	12:25	2	11:04
3	03:45	3	03:31
4	06:09	4	09:17
5	05:11	5	06:02
6	07:53	6	04:08
7	12:00	7	09:33
8	06:16	8	07:10
Average	07:18	Average	07:18

Retest gamified prototype		Retest non-gamified prototype	
ID	Time for completion in minutes	ID	Time for completion in minutes
1	02:58	1	02:21
2	06:41	2	04:52
3	01:35	3	02:11
4	04:45	4	06:09
5	06:54	5	03:52
6	06:30	6	02:16
7	06:07	7	00:15
8	03:10	8	06:28
Average	04:50	Average	03:33

Figure 29: Test-retest completion time

The tool used in the test-retest method was Microsoft Office Forms for administering the surveys. To ensure reliable data for this experiment, the test-retest process was carefully planned. Although a pilot test was conducted, it did not include participants from the target audience, leading to some confusion during the experiment. Technical issues, such as difficulties in navigating the test form and software, were resolved, but some data had to be discarded. To prevent participants from recalling answers, an interview was introduced between the two tests, and the answer positions were changed for the second test. Finally, statistical methods like the T-test were used to compare means between two groups and evaluate the significance of observed differences.

6.4 Quantitative data gathering and Sampling.

6.4.1 Survey Methodology Overview

Survey methodology involves asking individuals specific questions and systematically recording their responses (Sincero, 2012). As defined by Jackson (2011), this approach involves "questioning

individuals on a topic or topics and then describing their responses". Surveys efficiently collect, analyse, and interpret a target population's perspectives using various instruments and methods (Sincero, 2012).

6.4.2 Survey Instruments

Questionnaires are the primary tools used in survey methodologies, which can be in either paper-based or electronic formats (Trochim, n.d.). However, traditional paper and postal questionnaires have limited reach and speed, while electronic questionnaires can facilitate rapid data collection but may have accessibility issues (Trochim, n.d.).

Interviews, which can either be conducted in-person or via telephone, can also collect qualitative data (Trochim, n.d.). They can allow for structured and potentially richer data collection but require more resources and may introduce interviewer bias (Trochim, n.d.).

The most common administration methods include Email, social media, SMS, Digital Workspaces, In-App, QR Code, Website Pop-ups/Intercepts, Using a Panel, Over the Phone, and In Person (Qualtrics, n.d.). Choosing the right administration method depends on research objectives, population accessibility, and budget constraints.

6.4.3 Types of Questions and Questionnaire Design

There are two types of questions: closed or structured questions and open or unstructured questions. Closed questions offer predefined answers, simplifying the analysis process (Denscombe, 2010). An example of a closed question is "Are you currently studying in higher education?" with answer options "Yes" or "No". Open questions, on the other hand, produce detailed responses that are valuable for exploring complex issues (Denscombe, 2010). For instance, an open question could be, "What's your favourite university subject?"

6.4.4 Questionnaire Design

Understanding the different types of survey questions is crucial for effective data collection. Here are three common types:

Filter Questions:

Filter Questions: These are particularly useful when responses are expected to vary significantly based on key factors. For example, "Do you consent to take part in the research? " can lead to closing the rest of the survey.

Checklist Questions:

These allow respondents to select multiple options from a list, providing a comprehensive view of their preferences or behaviours. For instance, an example would be: "How would you describe the learning experience?" and offer a list of choices for respondents to select from.

Scaled Questions:

Scaled questions measure the intensity of attitudes or opinions using a Likert scale from "strongly agree" to "strongly disagree." This method captures nuanced responses about sentiments toward specific statements.

6.4.5 Types of Data in Questionnaires

Survey data collection involves three essential categories that are crucial for successful survey administration when collecting primary data.

- **Target data** includes facts, attitudes, opinions, preferences, and expectations.
- **Classification and analysis data** encompass information on age, gender, social class, employment, and the size of the company.
- **Administrative data** consists of respondent identification, date, and email address.

6.4.6 Sampling Strategy

Sampling is a research technique that allows survey results to be obtained accurately without needing responses from every individual in the population (Denscombe, 2010). This method is particularly cost-effective for survey researchers as it saves them time and money (Denscombe, 2010). For example, surveying 1,000 individuals from a group of 100,000 can significantly reduce the time and costs involved without compromising the accuracy of the survey's conclusions (Denscombe, 2010).

Selecting the right sampling technique is critical for efficient and effective research. It hinges on the study's objectives, the type of data required, the availability of a sampling frame, and research

resources (Denscombe, 2010). Each method has its own benefits and challenges that influence the decision-making process (Denscombe, 2010) (figure 30).

Probability Sampling Techniques	Description
Random Sampling	Every individual has an equal opportunity of being selected, which ensures a sample without any bias, and it truly represents the population.
Systematic Sampling	Every individual from a list is chosen, maintaining the selection process's randomness while introducing a systematic approach.
Cluster Sampling	Clusters or groups are randomly picked, and all individuals within those clusters are included in the sample.
Multi-stage Sampling	Samples are drawn in multiple stages, with each subsequent sample drawn from the previous one.
Stratified Sampling	The population is divided into subgroups, and samples are chosen from each subgroup to ensure that all segments are represented proportionately.
Non-Probability Sampling Techniques	Description
Quota Sampling	In this approach, categories are established, and samples are chosen in proportion to their presence in the population, not strictly by random selection.
Purposive Sampling	Specific individuals or events are deliberately chosen based on their relevance and knowledge about the research topic.
Theoretical Sampling	Selection is guided by an evolving theory, with samples chosen to confirm or refine the theoretical framework.
Snowball Sampling	Initial participants refer others to the study, and the sample grows like a snowball from these referrals.
Convenience Sampling	Samples are chosen based on ease and convenience for the researcher and not based on the principles of random selection.

Figure 30: Sampling- Content adapted from Denscombe (2010)

6.4.7 Selected Data Collection Strategies

In this study, both Targeted data and Classification and Analysis data were collected using MS Forms. All questions were closed-ended, designed specifically to address the research questions.

Types of Questions Used

- **Filter Questions:** Utilised for the consent form in the pre-survey (figure 31).

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1. Edinburgh Napier University requires that all persons who participate in research studies give their written consent to do so. Please read the following and sign it if you agree with what it says.
- I freely and voluntarily consent to be a participant in this research to be conducted by Violeta Lazarova, who is an undergraduate member in the Edinburgh Napier School of Computing.
 - I have been informed of the broad goal of this research study. I have been told what is expected of me and that the study should take no longer than 40 minutes to complete.
 - I have been told that my responses will be anonymised. My name will not be linked with the research materials, and I will not be identified or identifiable in any report subsequently produced by the researcher. I have been told that these data may be submitted for publication.
 - I also understand that if at any time during the session if I feel unable or unwilling to continue, I am free to leave. That is, my participation in this study is completely voluntary, and I may withdraw from it at any time without negative consequences.
 - In addition, should I not wish to answer any particular question or questions, I am free to decline.
 - I have been given the opportunity to ask questions regarding the study and my questions have been answered to my satisfaction.
 - **I have read and understand the above and consent to participate in this study. My consent is not a waiver of any legal rights. Press 'YES' if you want to continue.**

_____Violeta Lazarova_____

Signature

Yes

No

Figure 31: Filter Questions

- **Checklist Questions:** Employed for the test section and questions 3 to 10 in the pre-survey, and questions 2 and 4 in the post-survey (figure 32, 33).

3. What is your gender?	6. Are you currently studying in Scotland? ***	10. Are you currently enrolled in or have you completed studies in a computing-related program?
<input type="radio"/> Male	<input type="radio"/> Yes	<input type="radio"/> Yes
<input type="radio"/> Female	<input type="radio"/> No	<input type="radio"/> No
<input type="radio"/> Non-Binary		
<input type="radio"/> Trans-gender	7. Are you currently enrolled as a university or college student?	
<input type="radio"/> Prefer not to say	<input type="radio"/> University	
<input type="radio"/> Other...	<input type="radio"/> College	
	<input type="radio"/> Not Currently Enrolled	
4. What is your age group?	8. What academic year are you currently in at university?	9. Have you previously studied web usability?
<input type="radio"/> 18-24	<input type="radio"/> First year	<input type="radio"/> Yes
<input type="radio"/> 25-34	<input type="radio"/> Second year	
<input type="radio"/> 35-44	<input type="radio"/> Third year	
<input type="radio"/> 45-54	<input type="radio"/> Fourth year	
<input type="radio"/> 55-64	<input type="radio"/> Postgraduate	
<input type="radio"/> 65 or older	<input type="radio"/> Graduated	
5. Are you currently studying in higher education?		
<input type="radio"/> Yes		
<input type="radio"/> No		

Figure 32: Checklist Questions Pre-survey

The screenshot shows a survey interface with two questions. Question 2 asks if the user spent between 5 and 15 minutes learning content, with 'Yes' checked and a green checkmark. Question 4 asks how the learning experience was, with various options like 'Educational', 'Overwhelming', and 'Engaging' listed.

2. Did you spend between 5 and 15 minutes learning the content (understanding errors) on the learning platform?

Yes ✓
 No

4. How would you describe the learning experience?

Educational
 Overwhelming
 Interesting
 Engaging
 Average
 Confusing
 Inspiring
 Boring
 Intuitive
 Interactive

Figure 33: Checklist Questions Post-survey

- **Scaled Questions:** Applied to question 11 in the pre-survey and question 3 in the post-survey (figure 34).

The screenshot shows two scaled questions. Both ask for a rating on a scale of 1 to 10, where 10 is an expert in understanding errors. Each question has a horizontal row of numbered boxes from 1 to 10.

3. On a scale of 1 to 10, 10 being an expert in understanding of errors in usability contexts, how would you rate your knowledge?

1 2 3 4 5 6 7 8 9 10

11. On a scale of 1 to 10, 10 being an expert in understanding of errors in usability contexts, how would you rate your knowledge?

1 2 3 4 5 6 7 8 9 10

Figure 34: Scaled Questions

Sampling Method

The study utilized non-probability (convenience) and Convenience sampling to target a diverse group of higher education students studying in Scotland. This group varied widely in demographics, interests, age, and gender (The Scottish Government, 2023).

Sample Size

An online tool was utilised to determine the ideal sample size, taking into account the population size of 301,230 students enrolled in Scotland during the 2021-22 academic year (The Scottish Government, 2023) (Figure 35). The calculated ideal sample size was 384 individuals, whereas the experimental study was conducted with a sample of 16 participants ([Appendix 17](#)).

The screenshot shows a 'Sample size calculator' interface with a blue gradient background. It includes fields for Confidence Level (set to 95%), Population Size (301230), Margin of Error (5%), and Ideal Sample Size (384).

Setting	Value
Confidence Level	95%
Population Size	301230
Margin of Error	5%
Ideal Sample Size	384

Figure 35: ideal sampling size (Qualtrics, 2023)

Although the sample size was much smaller than the target size, the sample of 16 individuals is still relevant to the research for several reasons. Firstly, it provides a foundation for exploring the research question. Additionally, it gives valuable insights into the effectiveness of the research methods. Moreover, the findings from this smaller sample provide guidance for future research directions, identifying areas where further investigation can be focused to enhance understanding and address gaps in knowledge.

6.5 T-test and Data Analysis

6.5.1 Introduction to the T-Test

The t-test is a fundamental tool in inferential statistics. It evaluates whether the differences between two groups are statistically significant by calculating a t-statistic (Hayes, 2023). This statistic

measures the ratio of the difference between the group means to the variability within those groups (Hayes, 2023). This test proves particularly useful when the data sets are supposed to follow a normal distribution but have unknown variances (Hayes, 2023).

The t-test's applications are extensive and varied. In healthcare, it is commonly used to assess the efficacy of a new medication compared to a placebo (Hayes, 2023). In education, the t-test can compare the outcomes of different teaching methods.

These applications use the t-test to accurately identify real differences between groups, not just random variations, creating a solid basis for testing hypotheses (Hayes, 2023).

Three key elements must be considered for the effective implementation of the t-test: assumptions, types of t-tests, and interpretation of results (Hayes, 2023).

Assumptions: The data must be normally distributed, come from a random and representative sample, and have similar variances between the groups, especially for pooled t-tests (Hayes, 2023).

Types of t-tests: Based on the data and research needs, the type of t-test should be determined, such as one-sample, paired sample, and independent sample t-test (Hayes, 2023).

Interpretation: Results of a t-test are presented as t-values and p-values, which indicate the statistical significance of the observed differences (Hayes, 2023). These values are compared against the study's significance level, usually set at 0.05, to see if the differences are likely not due to random chance (Hayes, 2023).

6.5.2 Using a T-Test and Data analysis.

[Paired Sample T-Test](#)

The Paired Sample T-Test is used when the samples are related or consist of matched pairs (e.g., the same subjects tested before and after taking the training) (Hayes, 2023):

$$T = \frac{mean1 - mean2}{\frac{s(\text{diff})}{\sqrt{(n)}}}$$

where:

mean1 and *mean2* = The average values of each of the sample sets

s(diff) = The standard deviation of the differences of the pairs

n = The sample size (the number of paired differences)

n – 1 = The degrees of freedom

Figure 36: Paired Sample T-Test formula (Hayes, 2023)

Independent Samples T-Test

This t-test is used when the sample sizes and variances of the two groups are similar (Hayes, 2023).

$$\text{T-value} = \frac{mean1 - mean2}{\sqrt{\left(\frac{var1}{n1} + \frac{var2}{n2} \right)}}$$

where:

mean1 and *mean2* = Average values of each of the sample sets

var1 and *var2* = Variance of each of the sample sets

n1 and *n2* = Number of records in each sample set

and,

$$\text{Degrees of Freedom} = \frac{\left(\frac{var1^2}{n1} + \frac{var2^2}{n2} \right)^2}{\frac{\left(\frac{var1^2}{n1} \right)^2}{n1-1} + \frac{\left(\frac{var2^2}{n2} \right)^2}{n2-1}}$$

where:

var1 and *var2* = Variance of each of the sample sets

n1 and *n2* = Number of records in each sample set

Figure 37: Independent Samples T-Test formula (Hayes, 2023)

6.5.2.1 Data Analysis

In this study, data were collected using a pre-test and post-test methodology. Participants were first tested before using a learning platform and then tested again after completing their sessions. This was done for both a gamified and a non-gamified version of the platform, allowing for a comparative analysis of the educational impact of gamification.

The first phase of the analysis involves applying a paired sample t-test to each group. This statistical test is ideal for situations where the same participants are measured twice under different conditions. For this study, the paired sample t-test compare the pre-test results to the post-test

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results for both the gamified and non-gamified groups. The goal is to determine if there is a significant difference reflecting the direct impact of each learning platforms.

In order to complete the task, the data was first downloaded into a Microsoft Excel file (Figure 38).

After that, irrelevant information was removed from the data and the final scores for each participant were extracted (Figure 39). Microsoft Excel's statistical functions were then used to conduct the paired sample t-test and the independent measures t-test (Figure 40).

Test gamified prototype		ID	Time	Participant	Total	Conse	What	Are you	Are you	Are you	Are you	What	Have y	Are yo	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points	Whic	Points
1	04:51	G3	6	Yes	35:44	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points	Whic	Points
2	04:54	R1	4	Yes	Male	25-34	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points	Whic	Points
3	05:45	G3	8	Yes	Male	45-54	No	No	Graduate	Graduate	Yes	Yes	Yes	Yes	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points	Whic	Points
4	06:09	G5	0	Yes	Female	25-34	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points	Whic	Points
5	05:11	G6	6	Yes	Female	25-34	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points	Whic	Points
6	07:53	G7	7	Yes	Male	25-34	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points	Whic	Points
7	06:00	G8	4	Yes	Female	45-54	Yes	Yes	College	First year	No	Yes	Yes	Yes	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points	Whic	Points
8	06:16	G4	7	Yes	Female	25-34	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points	Whic	Points
Average	07:18		5.25															6.25		5	0		2	5	5	5	3	5	7			

Retest gamified prototype		ID	Time	Participant	Total	Conse	What	Are you	Are you	Are you	Are you	What	Have y	Are yo	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points
1	02:58	G3	8	Yes	9	Educator	Silips are unconsci	1	Providing	1	To foster	1	Failing to	0	It simplifi	0	Unconsci	1	Defaults	1	File uplo	1	By accm	1	Use humc	1	File uplo	1		
2	06:41	G1	7	Yes	8	Average	Silips are unconsci	1	Enforcing	1	To foster	1	Failing to	0	It fosters	1	Unconsci	1	Defaults	1	File uplo	1	I don't kn	0	Use humc	1	File uplo	1		
3	01:35	G2	8	Yes	8	Educator	Silips are unconsci	1	Providing	1	To foster	1	Enterin	1	It consci	1	Defaults	1	File uplo	1	By providi	1	Use humc	1	File uplo	1				
4	04:45	G5	6	Yes	4	Educator	Silips are unconsci	1	Providing	1	To enforc	1	Enterin	1	It consci	1	Defaults	1	File uplo	1	By providi	1	Use humc	1	File uplo	1				
5	06:09	G6	7	Yes	6	Educator	Silips are unconsci	1	Providing	1	To foster	1	Failing to	0	It fosters	1	Unconsci	1	Defaults	1	File uplo	1	By avoid	0	Use humc	1	File uplo	1		
6	06:30	G7	8	Yes	7	Educator	Silips are unconsci	1	Providing	1	To foster	1	Failing to	0	It fosters	1	Unconsci	1	Defaults	1	File uplo	1	By avoid	0	Use humc	1	File uplo	1		
7	06:07	G8	7	Yes	6	Educator	Silips are unconsci	1	Using brig	0	To foster	1	Failing to	0	It fosters	1	Unconsci	1	Defaults	1	File uplo	1	By providi	1	Use humc	1	File uplo	1		
8	03:10	G4	8	Yes	9	Educator	Silips are unconsci	1	Providing	1	To foster	1	Failing to	0	It fosters	1	Unconsci	1	Defaults	1	File uplo	1	By providi	1	Use humc	1	File uplo	1		
Average	04:50		7.38														8	6	7	2	6	8	6	8	2	6				

Test non-gamified prototype		ID	Time	Participant	Total	Conse	What	Are you	Are you	Are you	Are you	What	Have y	Are yo	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points
1	07:40	R1	6	Yes	25:44	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points
2	06:40	R3	3	Yes	9	Educator	Silips are unconsci	1	Providing	1	To foster	1	Failing to	0	It doesn't trut	0	Slips are unconsci	1	Defaults	1	File uplo	1	I don't kn	0	Use humc	1	File uplo	1		
3	03:31	R2	9	Yes	Male	25-34	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points
4	09:17	R4	6	Yes	Female	45-54	No	Yes	College	First year	No	Yes	Yes	Yes	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points
5	06:02	R5	3	Yes	Male	18-24	No	Yes	University	Fourth ye	Yes	Yes	Yes	Yes	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points
6	04:08	R6	6	Yes	Female	45-54	No	Yes	Graduate	Graduate	Yes	Yes	Yes	Yes	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points
Average	03:33		6.17														5.83	4	0		4	3	7	4	5	5	6	6		

Retest non-gamified prototype		ID	Time	Participant	Total	Conse	What	Are you	Are you	Are you	Are you	What	Have y	Are yo	On a sc	Why is	Feehi	Points	What i	Feehi	Points	How i	Feehi	Points	In th	Points	Why i	Points	Whic	Points
1	02:40	R3	8	Yes	7	Educator	Silips are unconsci	1	Providing	1	To foster	1	Enterin	1	It consci	1	Defaults	1	File uplo	1	By accm	1	Use humc	1	File uplo	1				
2	02:11	R2	10	Yes	8	Educator	Silips are unconsci	1	Providing	1	To foster	1	Enterin	1	It consci	1	Defaults	1	File uplo	1	By accm	1	Use humc	1	File uplo	1				
3	04:52	R3	8	Yes	7	Educator	Silips are unconsci	1	Using brig	0	To foster	1	Failing to	0	It fosters	1	Unconsci	1	Defaults	1	File uplo	1	By accm	1	Use humc	1	File uplo	1		
4	06:09	R4	6	Yes	5	Interestin	Silips are unconsci	1	Providing	1	To increas	1	Failing to	0	It fosters	1	Unconsci	1	Defaults	1	File uplo	1	By providi	0	Avoid tec	0	Use humc	1	File uplo	1
5	05:52	R5	9	Yes	9	Educator	Silips are unconsci	1	Providing	1	To foster	1	Accidents	1	It consci	1	Defaults	1	File uplo	1	By accm	1	Use humc	1	File uplo	1				
6	06:45	R6	9	Yes	8	Educator	Silips are unconsci	1	Providing	1	To increas	1	It consci	1	It consci	1	Defaults	1	File uplo	1	By accm	1	Use humc	1	File uplo	1				
7	05:15	R7	7	Yes	7	Educator	Silips are unconsci	1	Providing	1	To foster	1	Enterin	1	It consci	1	Defaults	1	File uplo	1	By clear	0	Use clear	0	Use humc	1	File uplo	1		
8	06:28	R8	5	Yes	7	Educator	Silips are unconsci	1	Using brig	0	To foster	1	Accidents	0	It helps n	0	Unconsci	1	Defaults	0	Error occ	0	By accm	1	Use humc	1	File uplo	1		
Average	03:33		5.64														7.29	8	6	7	3	7	7	7	6	6	6			

Figure 38: Survey data

In Figure 40, the paired two-sample t-test results for both the gamified and non-gamified prototypes are provided.

t-Test: Paired Two Sample for Means gamified prototype			t-Test: Paired Two Sample for Means non-gamified prototype		
	Retest	Test		Retest	Test
Mean	7.375	5.25	Mean	8	5.625
Variance	0.553571	6.5	Variance	3.428571	7.125
Observations	8	8	Observations	8	8
Pearson Correl	0.92256		Pearson Correl	0.606977	
Hypothesized	0		Hypothesized	0	
df	7		df	7	
t Stat	3.18839		t Stat	3.147984	
P(T<=t) one-ta	0.007655		P(T<=t) one-ta	0.008099	
t Critical one-ta	1.894579		t Critical one-ta	1.894579	
P(T<=t) two-ta	0.015311		P(T<=t) two-ta	0.016198	
t Critical two-ta	2.364624		t Critical two-ta	2.364624	

Figure 40: Paired Sample T-Test Results Score

Both prototypes were evaluated using a sample size 8, ensuring consistency in the sample populations under examination.

The mean test score for the gamified prototype is 5.25, increasing to 7.375 for the retest. The non-gamified prototype showed a mean test score of 5.625, increasing to 8 for the retest. This indicates a performance difference between the two prototypes.

Variance is a squared deviation from the mean. For the gamified prototype, the retest scores have a variance of 0.55, and the test scores have a variance of 6.5. The non-gamified prototype shows a retest variance of 3.43 and a test variance of 7.13. These values indicate how much the scores deviate from the average, with lower variances suggesting less spread and potentially more consistent performance. Therefore, the gamified prototype shows less variability in scores than the non-gamified prototype, implying potentially more consistent performance across assessments.

The Pearson correlation coefficient, which highlights the strength and direction of the linear relationship between test and retest scores, shows a higher correlation (0.92) for the gamified prototype compared to the non-gamified prototype (0.61), suggesting a more consistent performance pattern across assessments for the gamified prototype.

The t-statistic is a measure of the difference between the means of paired observations in relation to the variation within the pairs. This measure helps to differentiate between the two prototypes. The gamified prototype produced a t-statistic of 3.188, while the non-gamified prototype recorded a slightly lower value of 3.148.

P-values, indicating the probability of observing the given t-statistics under the null hypothesis of no difference, suggest a statistically significant difference between the test and retest scores for both prototypes, with values. However, the gamified prototype has a lower p-value of 0.0153 compared to the non-gamified prototype's p-value of 0.0162. Since the significance level is typically set at 0.05, any p-value below this point indicates a statistically significant difference. Therefore, the performance difference in the gamified prototype is slightly more significant than in the non-gamified prototype.

The t Critical values, also known as critical t-values, serve as benchmarks for determining the significance of the t-statistic in hypothesis testing. They are calculated based on the chosen significance level (typically 0.05) and the degrees of freedom (df). In the data, the degrees of freedom (df) are 7 for both prototypes, calculated as the number of observations minus 1. For the gamified prototype, the t-statistic of 3.188 exceeds the critical t-value of 2.365, leading to rejecting the null hypothesis. Similarly, the non-gamified prototype shows a t-statistic of 3.148, surpassing the critical t-value of 2.365, also resulting in rejecting the null hypothesis. Therefore, both prototypes demonstrate statistically significant differences in performance between test and retest evaluations.

Figure 41 compares the retest scores of the gamified and non-gamified prototypes using the T.TEST function in Microsoft Excel. The first dataset or sample is Array1 (C3:C10), and the second dataset or sample is Array2 (C17:C24). A two-tailed test is conducted to determine if there is a significant difference between the two groups in either direction, and the type argument 3 suggests that the two samples are independent. The resulting p-value of 0.40 indicates no significant difference between the retest scores of the two prototypes. However, due to the small sample size used, it cannot be concluded that both prototypes have a similar effect on the targeted audience.

Examining the Effectiveness of Gamification in Enhancing Web Usability Learning

F3	A	B	C	D	E	F
1	Test gamified prototype					
	Participant ID	Test	Retest		T-test	
3	G3	6	8			0.40
4	G1	4	7			
5	G2	8	8			
6	G5	0	6			
7	G6	6	7			
8	G7	7	8			
9	G8	4	7			
10	G4	7	8			
11						
12	Mean	5.25	7.38			
13						
14						
15	Test non-gamified prototype - Total points					
16	Participant ID	Test	Retest			
17	R1	8	10			
18	R3	3	8			
19	R2	9	10			
20	R4	6	6			
21	R5	3	9			
22	R6	8	9			
23	R7	6	7			
24	R8	2	5			
25						
26	Mean	5.63	8			

Figure 41: T-Test Results Score

Figure 42 presents the paired two-sample t-test results for both the gamified and non-gamified prototypes for participants' self-reported knowledge levels before and after taking a learning session on understanding errors in usability contexts.

Question: On a scale of 1 to 10, 10 being an expert in understanding of errors in usability contexts, how would you rate your knowledge?						
t-Test: Paired Two Sample for Means gamified prototype			t-Test: Paired Two Sample for Means non-gamified prototype			
	Restes	Test		Retest	Test	
Mean	7.375	6.25	Mean	7.375	5.75	
Variance	2.839286	5.357143	Variance	1.410714	6.5	
Observati	8	8	Observati	8	8	
Pearson C	0.924894		Pearson C	0.648677		
Hypothesi	0		Hypothesi	0		
df	7		df	7		
t Stat	3.210777		t Stat	2.303244		
P(T<=t) or	0.007421		P(T<=t) or	0.027364		
t Critical o	1.894579		t Critical o	1.894579		
P(T<=t) tw	0.014842		P(T<=t) tw	0.054729		
t Critical t	2.364624		t Critical t	2.364624		

Figure 42: Paired Sample T-Test Results knowledge levels

Before the learning session, participants rated their knowledge levels on a scale of 1 to 10, with 10 indicating expert-level understanding. Subsequently, they underwent the learning session, after which their knowledge levels were reassessed using the same scale.

For the gamified prototype, participants reported mean knowledge ratings of 6.25 before and 7.375 after the learning session. The non-gamified prototype's mean knowledge ratings were 5.75 before and 7.375 after the learning session.

Data analysis revealed significant differences in mean knowledge ratings after compared to before the learning session for both prototypes, as indicated by the calculated t-statistics and corresponding p-values.

Regarding variability, the test scores show more significant variation than the retest scores for both the gamified and non-gamified prototypes. This suggests more inconsistency among the test scores than the retest scores in both cases. The observed differences in variability could be due to outliers in the dataset.

Furthermore, the Pearson correlation coefficients suggest a strong positive linear relationship between participants' knowledge ratings before and after the learning session, with higher correlations observed for the gamified prototype (0.92) than the non-gamified prototype (0.65). This implies a more consistent pattern in knowledge improvement for participants exposed to the gamified prototype.

Overall, the findings suggest that both prototypes effectively improved participants' knowledge levels in usability errors, with the gamified prototype demonstrating slightly more significant improvements and a stronger correlation between pre- and post-learning knowledge ratings.

A T-test was again conducted to compare the retest scores of the gamified prototype and non-gamified prototype. The test resulted in a p-value of 1, indicating no statistically significant difference between the retest scores (figure 43).

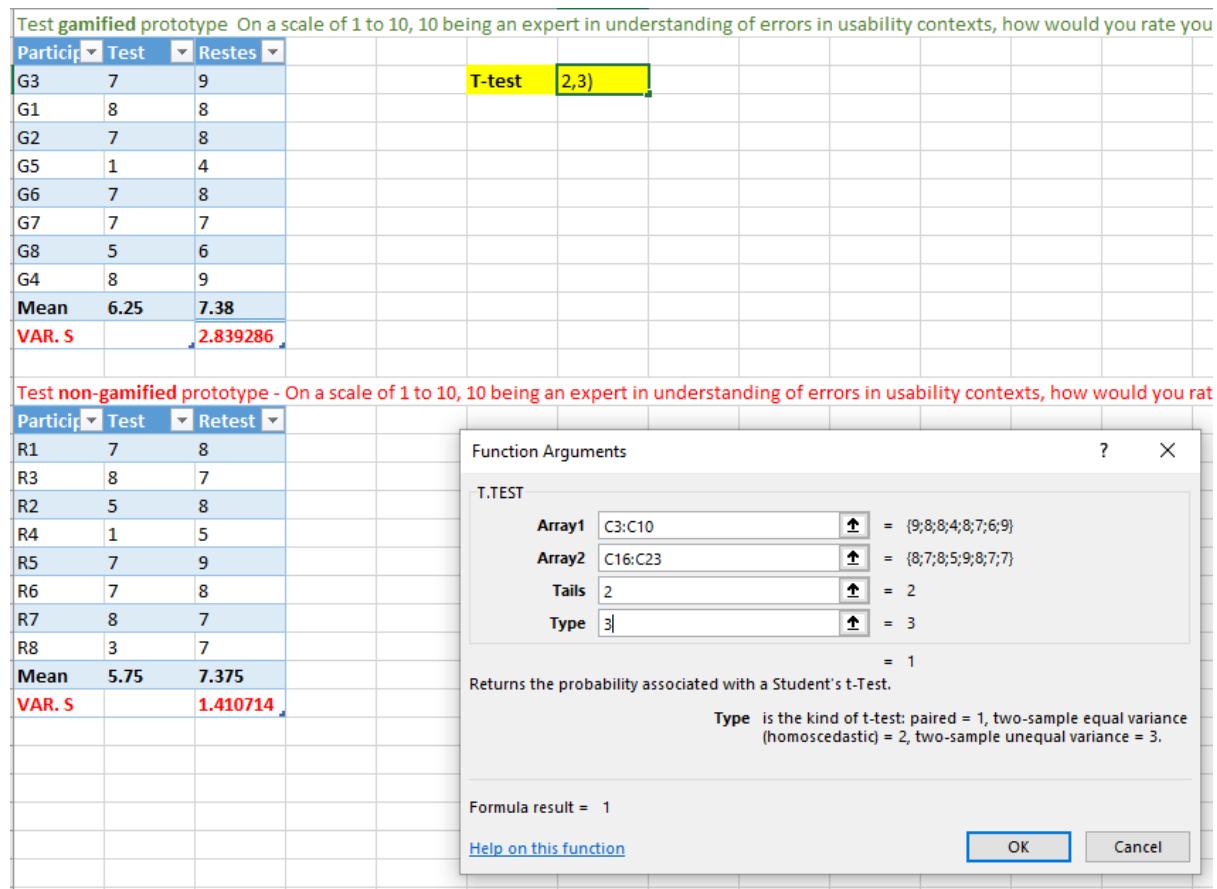


Figure 43: T-Test knowledge levels

7. Findings

7.1 Focus Group Findings

This study's main objective was to understand the digital learning requirements of students in Scotland and build a prototype for a usability learning platform using this knowledge. In order to accomplish this, the primary goal of the focus group data collection was to investigate four research inquiries:

Which e-learning systems do students prefer for online study?

Which game elements are preferred by students in higher education?

Which tools do students find unhelpful for learning?

What specific usability learning needs do students have?

Due to the lack of information on the needs of Scottish computing higher education students in digital learning, a grounded theory approach was employed to gain in-depth insights and remain open to new findings.

Which e-learning systems do students prefer for online study?

Participants expressed preferences for various learning platforms. Codecademy was favoured for its certification, which users could share on LinkedIn, showing a preference for recognition. Rosetta Stone was preferred for its immersive experience and various exercises. Duolingo was liked for its user-friendly interface and gamification interaction, which was considered very engaging, driving people back to the system for years. W3Schools was appreciated for structured information—scratch for simplicity and immediate feedback and FreeCodeCamp for structured learning and progression. Udemy was found to be a go-to platform for those looking for affordability and an interactive experience.

In conclusion, the identified platforms for design inspiration, including Udemy, Codecademy, Rosetta Stone, W3 Schools, Scratch, LinkedIn, FreeCodeCamp and Duolingo, showcase diverse preferences. Learners were drawn to a professional feel, high-quality content, easy access, and simplicity of use. Examining these platforms provided valuable insights into designing the prototype, ensuring the user's preferences are met.

Additional Concepts - Preferred Learning Environment

During the focus groups, participants discussed their preferred learning environment. They expressed a preference for a versatile and supportive environment that includes several key features.

Access to prerecorded lessons was seen as a priority due to its convenience and flexibility. Additionally, user-friendly navigation and a structured learning pathway were emphasised, highlighting the importance of intuitive design and content prioritisation. The participants also expressed a desire for practical examples that could be used to contextualise theoretical concepts and make them more engaging. Furthermore, the discussion revealed a strong preference for progression learning, where learners are guided through a step-by-step journey of gaining knowledge and skills. One participant suggested using dark patterns as a tool to make people study

more, but this approach was deemed unethical and potentially harmful to individuals. Most users preferred usable and clear design as it fosters trust and credibility.

Moreover, the preference for self-paced learning was evident throughout the discussions, indicating the value of flexible learning identified in the literature review.

Overall, the insights gathered regarding preferred learning environments provide valuable guidance for designing and developing educational platforms.

Which game elements are preferred by students in higher education?

The preferred game elements identified in the focus group's data analyses were feedback mechanisms, certificates, progress bars, badges, avatars, and quizzes. Participants expressed a strong motivation derived from tangible recognition of their achievements as badges and certification, aligning with gamification principles.

Which tools do students find unhelpful for learning?

According to the research, participants disliked certain aspects of some learning platforms. For instance, competitive environments were found to be distracting for some participants. However, one participant found the competition to be very motivating.

Duolingo was criticised for prioritising gamification over learning outcomes, making it more fictional and less effective. Similarly, the literature review highlighted that over-gamification could harm the learning process. Participants also disliked platforms that lacked clear progression pathways, which could make them feel overwhelmed or unmotivated. Finally, poorly designed, and confusing interfaces were identified as detrimental to the learning process because they can prevent users from effectively utilising the tool.

Overall, participants' dislikes, such as unengaging environments, over-gamification, competitive learning, lack of structured lessons, and absence of visual progress indication, show that there is a fine line between a successful learning tool and an unusable online platform. Understanding these findings is crucial for creating a positive and user-friendly learning environment.

What specific usability learning needs do students have?

The insights gained from the focus groups and literature offer a rich understanding of learning preferences in usability learning. Participants in the focus groups emphasised the need for practical, visually oriented content aligned with contemporary e-learning trends and industry demands, which was in line with the findings of the literature review. The study identified a gap in understanding usability theories among college computing students, particularly at the HND level.

The findings showed significant challenges in error handling and validation messages, which most participants pinpointed as their primary difficulties. These difficulties were discussed in the context of understanding user perspectives, preventing errors, and implementing validation error messages.

Accessibility principles emerged as a significant consideration, underscoring the importance of inclusivity in web development. Incorporating accessibility principles was a consideration in two of the decisions, aligning with the growing recognition of inclusivity in web development and pointing towards its part in usability learning. The need to tailor usability for diverse user groups and recognise the practical challenge in real-world projects was discussed in one of the focus groups and highlighted in the literature review. This again brought up the need for practical examples to close knowledge gaps. The usability learning gap section of the literature review identified this as an unmet need in Scottish higher education. To address this gap, the curriculum should integrate practical, real-world examples. Moreover, all the focus groups stressed the importance of visual examples and interactive learning, indicating a preference for hands-on learning.

One participant acknowledged the concept of cognitive bias when highlighting the importance of testing in understanding usability. Moreover, it highlighted the need to separate usability learning for desktop and mobile design. The emphasis on tailoring usability teaching even more towards specific products aligns with the inclusive app approach, recognising the varied needs of potential learners and how future designers and developers can meet them. Creating such tailored learning could give students even more practical and applicable knowledge.

7.2 Independent Measures Experiment Findings

The primary goal of the independent measures experiment was to assess whether gamification improves learning outcomes. However, the statistical results revealed no significant differences in learning outcomes between participants using the gamified prototype and those using the non-gamified one. Nevertheless, the findings indicated an increase in knowledge in both cases.

Furthermore, the pre-and post-surveys revealed other participant differences concerning demographics, knowledge, and preferences. This data was collected to show whether other factors were influencing the outcomes.

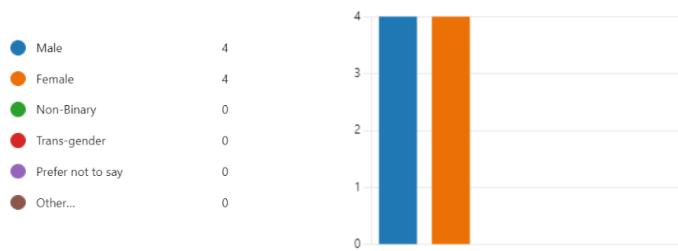
The first question in the pre-survey aimed to confirm participants' consent for their data to be used in this research. The second question collected participants' pre-generated ID numbers. In Figure 44, the third question (what is your gender?) indicated that there were four male and four female participants in both cases. This suggests equal gender distribution but no high level of diversity.

Pre-survey

Gamified learning platforms

3. What is your gender? (0 point)

[More Details](#)



Non-gamified learning platforms

3. What is your gender? (0 point)

[More Details](#)

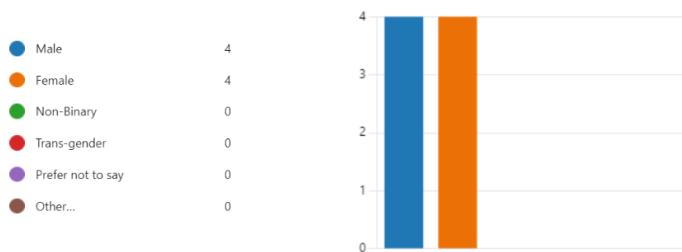


Figure 44: Question 3 – Gender

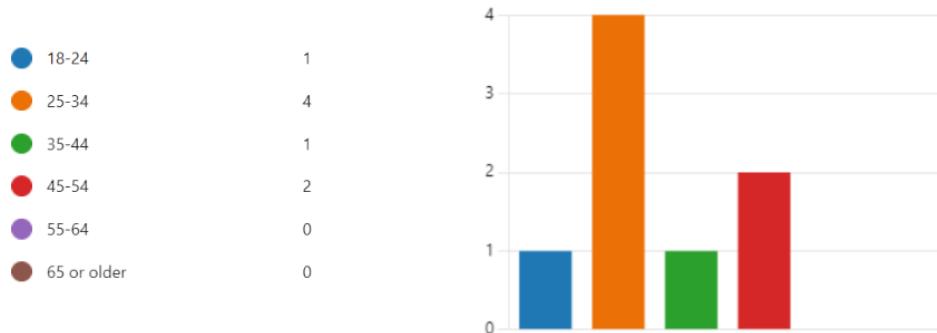
Figure 45 displays the age distribution across two groups. Although a range of ages is included, the distribution within each group is uneven. The younger demographic (25-34 years) is overrepresented in gamified learning platforms, whereas older participants (45-54 years) are more prevalent in non-gamified platforms. This difference suggests potential sampling bias, which may affect the reliability of the study's findings. Although the effect of this bias could be more significant in a larger sample, it could also reveal learning preferences across different age groups.

Pre-survey

Gamified learning platforms

4. What is your age group? (0 point)

[More Details](#)



Non-gamified learning platforms

4. What is your age group? (0 point)

[More Details](#)

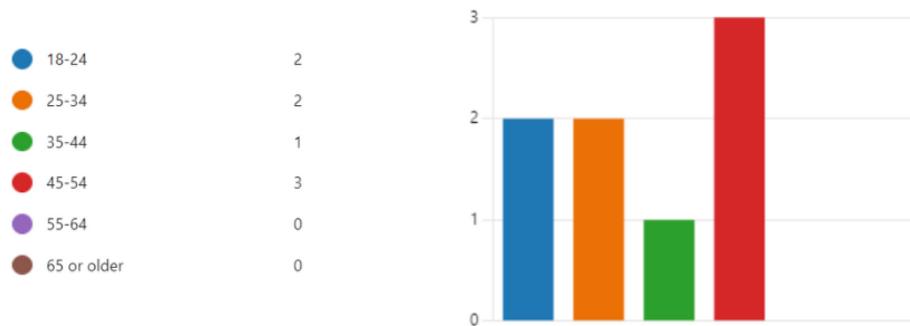


Figure 45: Question – Age Group

Similar to question 4, Figure 45 can provide insights into potential learning differences among students in higher education or recent graduates.

Pre-survey

Gamified learning platforms

5. Are you currently studying in higher education? (0 point)

[More Details](#)

- Yes
- No

7

1



Non-gamified learning platforms

5. Are you currently studying in higher education? (0 point)

[More Details](#)

- Yes
- No

5

3



Figure 46: Question – High education

The next question (Figure 46) assesses whether the participants are currently studying in Scotland, which is one of the study's participation requirements. However, the question wasn't adjusted for graduate students who were invited to participate due to a shortage of participants. As a result, data from one participant who was not currently studying in Scotland was included. Further down, it is revealed that this participant is a graduate student.

In the future, this question should have been modified to inquire whether the participant currently studies or has previously studied in Scotland to ensure that all participants meet the participation

requirements.

Pre-survey

Gamified learning platforms

6. Are you currently studying in Scotland? (0 point)

[More Details](#)

- Yes
- No

7
1



Non-gamified learning platforms

6. Are you currently studying in Scotland? (0 point)

[More Details](#)

- Yes
- No

7
1



Figure 47: Question – Studying in Scotland

Question 7 (Figure 48), like previous questions, was not tailored to accommodate graduate students. The purpose was to gather data to find differences in responses between university and college students. However, the data from the graduate students cannot be utilised as it does not specify whether they graduated from a university or a college.

Pre-survey

Gamified learning platforms

7. Are you currently enrolled as a university or college student? (0 point)

[More Details](#)

- | | | |
|---------------------------------------|------------------------|---|
| ● | University | 5 |
| ● | College | 2 |
| ● | Not Currently Enrolled | 1 |



Non-gamified learning platforms

7. Are you currently enrolled as a university or college student? (0 point)

[More Details](#)

- | | | |
|---------------------------------------|------------------------|---|
| ● | University | 5 |
| ● | College | 2 |
| ● | Not Currently Enrolled | 1 |



Figure 48: Question – College or university student

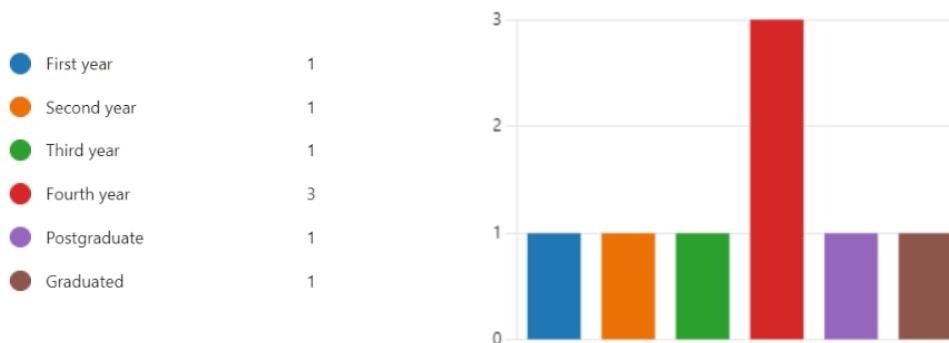
Figure 49 displays the distribution of participants across different academic years in both the gamified and non-gamified prototypes. With a larger sample size, this question could also reveal varying patterns of studying needs within the participants' different academic levels.

Pre-survey

Gamified learning platforms

8. What academic year are you currently in at university? (0 point)

[More Details](#)



Non-gamified learning platforms

8. What academic year are you currently in at university? (0 point)

[More Details](#)

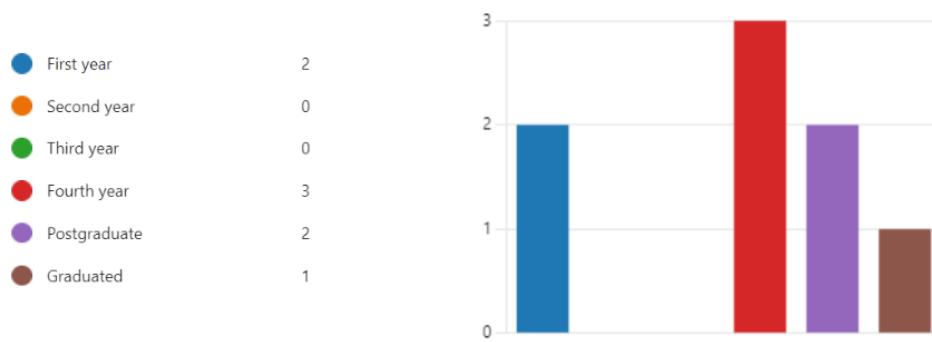


Figure 49: Question – Academic year

The following question (Figure 50) indicates an even distribution of participants between those studying web usability and those who did not within the two groups. This question aims to identify patterns within learning preferences among students with an academic interest in the subject and those without.

Pre-survey

Gamified learning platforms

9. Have you previously studied web usability? (0 point)

[More Details](#)

●	Yes	6
●	No	2



Non-gamified learning platforms

9. Have you previously studied web usability? (0 point)

[More Details](#)

●	Yes	6
●	No	2



Figure 50: Question – web usability

The following question serves the same purpose as the previous one. However, the distribution between the two cases of students studying in computing-related programs is uneven (Figure 51).

Pre-survey

Gamified learning platforms

10. Are you currently enrolled in or have you completed studies in a computing-related program?

[More Details](#)

●	Yes
●	No

7

1



Non-gamified learning platforms

10. Are you currently enrolled in or have you completed studies in a computing-related program?

[More Details](#)

●	Yes
●	No

4

4



Figure 51: Question – computing-related programs

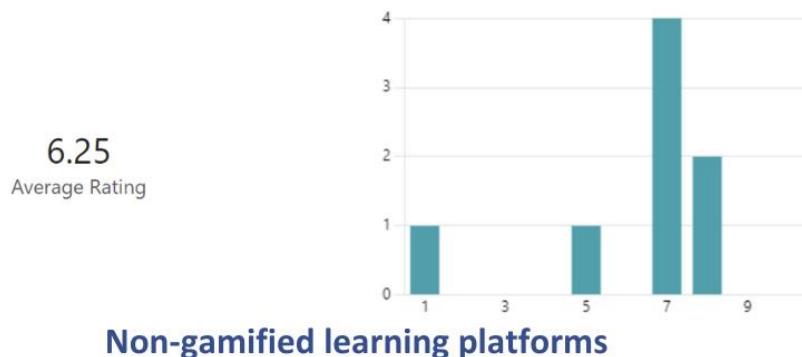
The last question in the pre-survey questionnaire before the test revealed that participants in the gamified experiment showed higher confidence in their overall knowledge of the subject than the students in the non-gamified group. However, both groups claimed to have above-average levels of knowledge in the area (see Figure 52).

Pre-survey

Gamified learning platforms

11. On a scale of 1 to 10, 10 being an expert in understanding of errors in usability contexts, how would you rate your knowledge? (0)

[More Details](#)



Non-gamified learning platforms

11. On a scale of 1 to 10, 10 being an expert in understanding of errors in usability contexts, how would you rate your knowledge? (0)

[More Details](#)

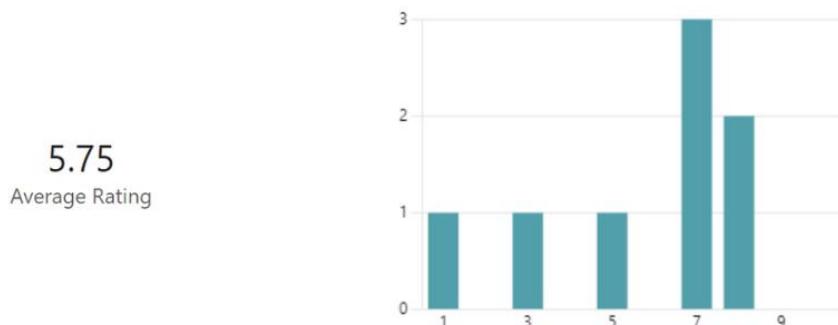


Figure 52: Question – usability error knowledge Pre-survey

The post-survey consisted of four general questions. Firstly, participants were requested to provide their ID number to establish a connection between the pre-test and post-test. Next, they were asked to confirm if they had spent at least 5 minutes on the task. After evaluating test (deleted) data, this time frame was determined, ensuring that 5 minutes is the minimum time needed to read through the page. In comparison, 15 minutes was the maximum to prevent participants from spending too long, which could lead to varied learning outcomes (Figure 53).

Post-survey

Gamified learning

2. Did you spend between 5 and 15 minutes learning the content (understanding errors) on the learning platform? (0 point)
- 100% of respondents (8 of 8) answered this question correctly.

[More Details](#)

- Yes
- No

8 ✓
0



Non-gamified learning

2. Did you spend between 5 and 15 minutes learning the content (understanding errors) on the learning platform?
- 100% of respondents (8 of 8) answered this question correctly.

[More Details](#)

- Yes
- No

8 ✓
0

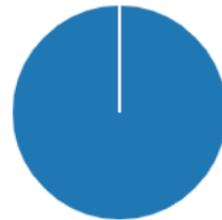


Figure 53: Question – Time spend to learn

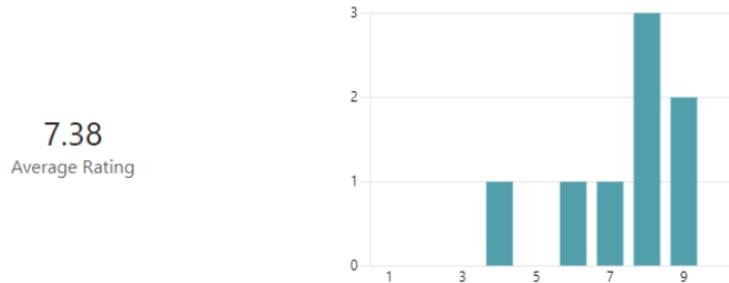
Question 3 measured the confidence levels in knowledge on the subject after the training, revealing identical results for both the gamified and non-gamified groups (figure 54).

Post-survey

Gamified learning

3. On a scale of 1 to 10, 10 being an expert in understanding of errors in usability contexts, how would you rate your knowledge?

[More Details](#)



Non-gamified learning

3. On a scale of 1 to 10, 10 being an expert in understanding of errors in usability contexts, how would you rate your knowledge?

[More Details](#)

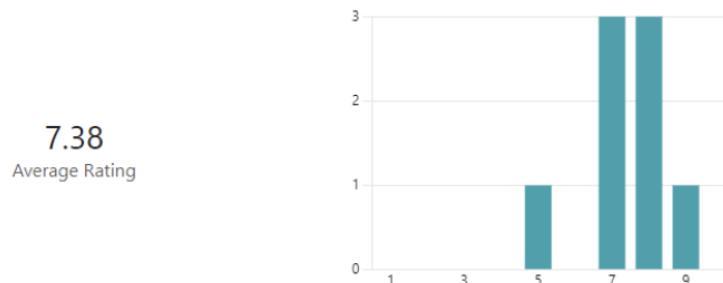


Figure 54: Question – usability error knowledge post-survey

Question 4 aimed to gain a better understanding of participants' experiences with each platform to inform future usability testing.

Participants using the gamified learning platform mostly found the page educational, interesting, engaging, and interactive. Average, confusing, and inspiring characteristics received only one point. Notably, no participant found the gamified platform overwhelming or boring.

Participants using the non-gamified platform primarily found it educational and interesting. Fewer participants found it engaging, intuitive, and interactive. Finally, no participant perceived the non-gamified learning platform as overwhelming, average, confusing, uninspiring, or boring.

In summary, both platforms were perceived as educational, with participants generally finding the gamified platform more interesting, engaging, intuitive, and interactive. While the non-gamified platform scored lower on these aspects, it was still considered educational and interesting. Neither platform was perceived as overwhelming or boring.

This suggests that the customised content, informed by the focus group findings, successfully addressed participants' expectations and requirements in both scenarios.

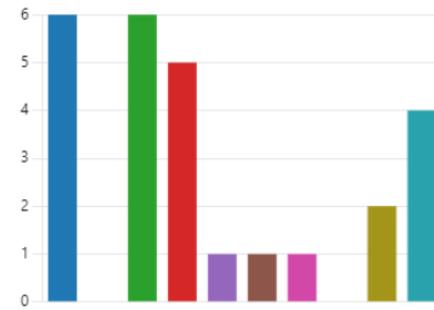
Post-survey

Gamified learning

4. How would you describe the learning experience? (0 point)

[More Details](#)

● Educational	6
● Overwhelming	0
● Interesting	6
● Engaging	5
● Average	1
● Confusing	1
● Inspiring	1
● Boring	0
● Intuitive	2
● Interactive	4



Non-gamified learning

4. How would you describe the learning experience? (0 point)

[More Details](#)

● Educational	6
● Overwhelming	0
● Interesting	3
● Engaging	1
● Average	0
● Confusing	0
● Inspiring	0
● Boring	0
● Intuitive	1
● Interactive	1

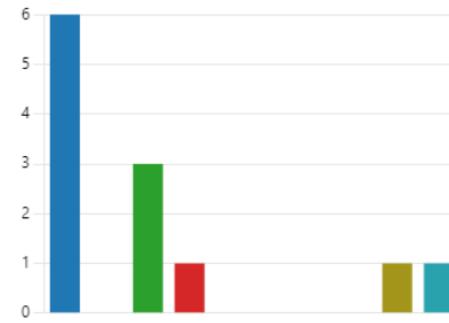


Figure 55: Question – Learning experience

8. Discussion

The focus group findings revealed that computing students need more practical skills and basic knowledge regarding usability, particularly in usability errors. This lack of knowledge aligns with findings from the literature review suggesting that computing students often neglect usability learning. This also confirms that Scottish higher education institutions do not entirely meet industry knowledge standards. This is apparent because, despite the learning platform's emphasis on fundamental usability errors principles, a significant increase in knowledge was observed between pre and post-tests.

In the context of gamification, the literature review findings suggest that the intended audience prefers assessment challenges such as scenarios and exercises. Additionally, practical interfaces are preferred over fictional ones, with a preference for performance-oriented gamification designs incorporating assessments. These preferences were confirmed in the focus group findings, where participants favoured serious websites like Codecademy over casual learning like Duolingo. Moreover, feedback gathered from focus group participants reveals a general dislike for competitive elements. Nevertheless, one participant demonstrated strong motivation precisely because of the competitive aspect. However, the literature review underscores the potential disadvantages of incorporating competitive game elements like points and leaderboards. These elements may impose limitations on users' depth of engagement.

Insights from the focus groups underscored the value of self-paced and hands-on learning, informing the platform design to align with modern educational trends and industry requirements outlined in the literature review. The prototype focused on addressing usability errors, recognised as the most common knowledge gap, ensuring a learning curve during the independent measurement experiment. While features such as badges, certification, social media, and community chats were preferable according to the focus group and literature review, they were not feasible within the project's timeframe; however, direct feedback during task completion was incorporated.

The literature review highlighted the primary ethical considerations for constructing gamified learning systems. The following questions were proposed to address these concerns:

- Does the system provide users with a choice?

- What is the designer's intention?
- What are the potential positive and negative outcomes of engaging with the system?

Consequently, the system was developed to offer users choices between structured learning and accessing library content. The design aimed to effectively teach usability by incorporating insights from the focus group findings, with no adverse outcomes detected during system use. However, usability testing must be conducted to comprehensively assess the learning platform's positives and negatives.

Additionally, privacy considerations outlined in the literature review were considered during data collection rather than for the system itself. Since the system is currently in the prototype stage and does not require personal data collection, privacy concerns were managed during the data-gathering phase.

By examining the most favoured platforms, inspirational design ideas were outlined, which helped integrate industry trends and meet user expectations and requirements.

The literature review highlighted that successful usability learning can be achieved by developing content that includes unique information, uses reputable sources, and uses real-life examples. These findings align with the focus group's need to gain practical skills relevant to workplace requirements.

Finally, to achieve effective usability learning, the learning content was developed using the latest data, established sources, and real-world examples, aligning with the literature review's findings on the importance of creating learning materials that provide practical skills and are relevant to industry needs.

In conclusion, while the study could not definitively establish the effectiveness of gamification in learning environments due to limitations in the independent measurement experiment, it highlighted the importance of tailoring content to specific target audience needs. Survey results indicated that the developed learning content was educational and engaging, leading to increased knowledge among participants who previously thought they had a good understanding of the area. These insights offer valuable considerations for targeted learning development for future research in educational technology.

9. Limitations

The academic project faced time and resource constraints in collecting and analysing the data, which affected the quality of insights. The intended data from the focus groups was collected successfully; however, due to design software and project schedule limitations, only some findings could be incorporated into the design. This could have affected how well the platform met user requirements and, therefore, final outcomes. Moreover, the independent measure experiment did not gather enough participants due to time and resource limitations. This means that the insights from the sample size may not fully represent the broader student population or capture the full range of learning capabilities. Therefore, further research with a larger and more diverse in terms of age, year of study, usability knowledge and studying degree they attend is needed to validate and expand upon the initial findings.

10. Conclusion

This document explored the usability learning needs of computing students through a literature review, focus groups, and an independent measures experiment. The primary deliverable was the gamified learning prototype, carefully designed based on the focus group's findings and established design principles. All methodologies employed in this study were thoughtfully selected to maximise the effectiveness of each research phase.

The study confirmed the importance of aligning educational tools with user needs and preferences, highlighting the need for platforms that offer flexibility, user engagement, and practical, relevant content. Although gamification did not show a distinct advantage over traditional methods in this limited study, it was well-received by users, suggesting that further investigation could produce significant results and innovative findings for the educational sector.

In conclusion, the primary limitation of this study was its small sample size, which likely did not capture the full impact of gamification across diverse educational contexts. Consequently, the results may not be generalisable to a broader population. Future research should aim to include a larger and more diverse group of participants to validate these initial findings.

11. Self-reflection

11.1 Methodology

Reflective writing can significantly benefit personal and professional development (Pulapaka, 2023). It enables teams and individuals to assess their experiences and determine what went well, what did not, and how they can improve. Many models, such as CARL, STARL, and Gibbs' Reflective Cycle offer structured approaches to reflection. However, different reflective models are formulated with specific objectives and contexts in mind, making them more or less suitable for various types of reflection.

The CARL model is adapted from a job interview technique (The University of Edinburgh, 2018). It is a customised approach that promotes reflection by emphasising the situational context through a customised approach (The University of Edinburgh, 2018). The process includes analysing the Action taken, the Results achieved, and the learning gained (The University of Edinburgh, 2018). However, this model works best when reflecting on business meetings, feedback scenarios, and competency-based or behavioural interview queries. Therefore, it is possible that the outcomes for this project reflection may not be appropriate.

The STARL framework provides a systematic approach and an easy-to-follow reflection structure. It includes the Situation, task, action, result and learning section, where, in some cases, the result is replaced by reflect and learning by planning. This flexibility in the section's content makes it more adaptable to different types of reflection needs than many other models (Queensland University of Technology, 2011).

The Gibbs' Reflective Cycle is a comprehensive framework which encourages in-depth reflection (Pulapaka, 2023). It consists of six sections, which include Description, Feelings, Evaluation, Analysis, Conclusion, and Action Plan (Pulapaka, 2023). The inclusion of feelings provides a different point of view than other reflective models. However, recalling feelings might be difficult when reflecting on a completed project. Moreover, it should be noted that not all projects necessitate further action plans, hence restricting the applicability of Gibbs' Reflective Cycle. In addition, the framework's comprehensive nature may result in a more time-consuming process that may be inappropriate for some situations. Therefore, this strategy may be more suited for weekly reflection cycles that need in-depth understanding.

The choice between models for reflecting on complex projects depends on the specific needs and constraints. As per the discussed reflective models, Gibbs' Reflective Cycle is unsuitable for this project due to its complexity and lack of flexibility. The CARL model is adaptable; however, it doesn't

have much depth compared to others. On the other hand, the STAR framework is both adaptable and straightforward to follow, making it the most appropriate option for reflecting on this project.

11.2 Reflective Analysis Using the STARL Approach

11.2.1 Report Writing

Situation

The dissertation aimed to improve UX design and research skills, with a specific focus on e-learning development. The project included tasks such as reviewing existing literature and aligning it with project goals. Additionally, it involved analysing methodologies and writing research content.

Task

The task was to write the dissertation report.

Action

Initially, the project objectives and the scope of the document were identified. Then, a literature review was conducted to enhance the understanding of the topic and identify strategies. After that, a project plan was developed ([Appendix 13](#)) to ensure the project's completion. Following the project plan, the focus group methodology and data analyses were discussed, followed by the independent measure experiment methodology. In addition, discussion and conclusion sections in the document were written.

Result

As a result of these actions, the dissertation report was successfully completed.

Learning

The project enhanced knowledge about effective planning and research methods. It provided new perspectives on analysing data and presenting findings. A supervisor's guidance and adherence to the plan were crucial in achieving success. As a result, the acquired skills and knowledge have expanded potential employment opportunities.

11.2.2 Focus Group

Situation

Three focus groups were conducted to gather information from the targeted audience and address specific research questions.

Task

The task involved finding participants and organising three focus groups to address specific research questions.

Action

Participants were recruited via email, Microsoft Teams, personal contacts on Discord, and word of mouth. The first focus group included college students invited by a lecturer at Edinburgh College. University students were invited through Microsoft Teams and Discord to participate in the second and third groups. All sessions were held online to accommodate participant preferences. Microsoft Team meetings were set up for each focus group. Unstructured questions were prepared based on research objectives.

Result

As a result of these efforts, enough participants were recruited for the three focus groups. However, the first group initially had six participants, but only two remained actively engaged by the end. The college students faced challenges in participation due to a lack of understanding of the topics. In contrast, university students showed better understanding, resulting in higher participation rates and more data collected.

Learning

The focus groups provided valuable insights into facilitating focus groups. The challenges encountered underscored the importance of clearly defining participation requirements to achieve desired outcomes. This experience will guide the planning and execution of future focus groups.

11.2.3 Design Section

Situation

The design phase started after conducting focus groups and gathering insights into the intended audience's learning requirements and preferences.

Task

The task was to develop an interactive learning platform that integrates game elements and effectively teaches web usability while considering the focus group findings.

Action

The relevant research findings were listed, and the design was planned accordingly. Figma was chosen as the design tool for the project, and learning resources such as the Figma community page and YouTube tutorials were utilised to understand how to create interactive features in Figma.

Result

Due to limitations in Figma, some interactive components could not be incorporated, resulting in not achieving all design requirements. For example, features such as the active progress bar, certification, and badges were found helpful for users but could not be integrated.

Learning

The project's time constraints and requirements prevented further exploration of alternative approaches to addressing the design challenges. However, this project underscored the significance of understanding the software before using it to mitigate unexpected situations. Despite the challenges, the project helped develop skills in using Figma. Moreover, the outcome was satisfactory, and the prototype successfully fulfilled its intended purpose.

11.2.4 Independent Measure Experiment

Scenario

After completing the design process, an experiment was conducted to evaluate the effectiveness of the prototypes. The gamified prototype was compared to a traditional online learning page. The study aimed to collect participant data through a survey to measure learning outcomes among higher education students.

Task

The task was to recruit a sufficient sample size to obtain reliable quantitative data. This involved developing survey questions, a test, and a retest with a post-survey. The data collection was intended to take place at the university to access more in-person participants.

Action

The survey was developed after researching survey development methods. Afterwards, the experiment's questionnaire was created using Microsoft Forms. However, the timing of the experiment overlapped with the university's Easter break, resulting in limited access to students. Consequently, online meetings were organised. Participants were invited via word of mouth, social

media, and personal contacts. A calendar was set up for participants to book a 30-minute slot at their preferred time.

Result

During the Easter holidays, many students were occupied with dissertation writing and holidays and did not have time for a meeting. Consequently, the first few participants were allowed to go through the process independently. This led to misunderstandings of some requirements, and the data collected from them was found unreliable and, therefore, deleted. The rest of the data was collected during online meetings in Teams, resulting in the collection of reliable data from only 16 participants.

Learning

Gaining skills in conducting research experiments and understanding the importance of flexibility in unexpected situations has proven beneficial. In the future, incorporating pilot testing to confirm the effectiveness of the chosen approach will help avoid potential pitfalls. This knowledge will be valuable for future projects, where a deeper understanding of research methods and procedures can enhance productivity.

11.2.5 Project Management

Scenario

A project management plan was developed before the project began to ensure that the project goals were achieved within the set time limitations ([Appendix 13](#)).

Task

The task involved adhering to the project plan ([Appendix 13](#)) and utilising a Kanban board (Appendix 16) and weekly diary ([Appendices 14](#) and 15). This method helped break down the project into manageable tasks and gain a clearer understanding of its requirements.

Action

The Kanban board was set up, and the project timeline proceeded as planned until the Easter holiday disrupted the schedule. This holiday restricted in-person access to the students required to conduct the independent measurements experiment. As a result, the risk management strategy, detailed in the risk register ([Appendix 13](#), Figure 4), was implemented.

Result

Following the risk management strategy, multiple communication channels were utilised to recruit participants, including Teams, social media, emails, and personal contacts (refer to Appendix 13, Figure 4). However, despite these efforts, an insufficient number of participants were recruited. Moreover, due to time constraints, the risk management strategy required compromising the research's conclusiveness in order to complete the project within the given time frame.

Learning

This experience highlighted the importance of project planning to ensure successful completion within the set timelines while prioritising tasks.

In conclusion, the project management process has highlighted the importance of proactive planning and adaptability in navigating unforeseen challenges and effectively meeting project objectives.

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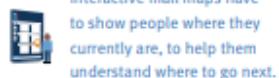
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Appendices

Appendix 1 – Usability Heuristics (J. Nielsen, 1994)

1 Visibility of System Status

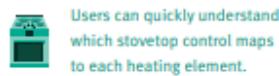
Designs should *keep users informed about what is going on, through appropriate, timely feedback.*



Interactive mall maps have to show people where they currently are, to help them understand where to go next.

2 Match between System and the Real World

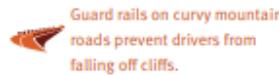
The design should *speak the users' language. Use words, phrases, and concepts familiar to the user, rather than internal jargon.*



Users can quickly understand which stovetop control maps to each heating element.

5 Error Prevention

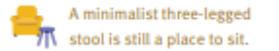
Good error messages are important, but the best designs *carefully prevent problems from occurring in the first place.*



Guard rails on curvy mountain roads prevent drivers from falling off cliffs.

8 Aesthetic and Minimalist Design

Interfaces should not contain information which is irrelevant. Every extra unit of information in an interface competes with the relevant units of information.



A minimalist three-legged stool is still a place to sit.

Nielsen Norman Group

Jakob's Ten Usability Heuristics

3 User Control and Freedom

Users often perform actions by mistake. They need a clearly marked "emergency exit" to leave the unwanted action.



Just like physical spaces, digital spaces need quick "emergency" exits too.

6 Recognition Rather Than Recall

Minimize the user's memory load by making elements, actions, and options visible. Avoid making users remember information.



People are likely to correctly answer "Is Lisbon the capital of Portugal?".

9 Recognize, Diagnose, and Recover from Errors

Error messages should be expressed in plain language (no error codes), precisely indicate the problem, and constructively suggest a solution.



Wrong-way signs on the road remind drivers that they are heading in the wrong direction.

4 Consistency and Standards

Users should not have to wonder whether different words, situations, or actions mean the same thing. *Follow platform conventions.*



Check-in counters are usually located at the front of hotels, which meets expectations.

7 Flexibility and Efficiency of Use

Shortcuts — hidden from novice users — may speed up the interaction for the expert user.



Regular routes are listed on maps, but locals with more knowledge of the area can take shortcuts.

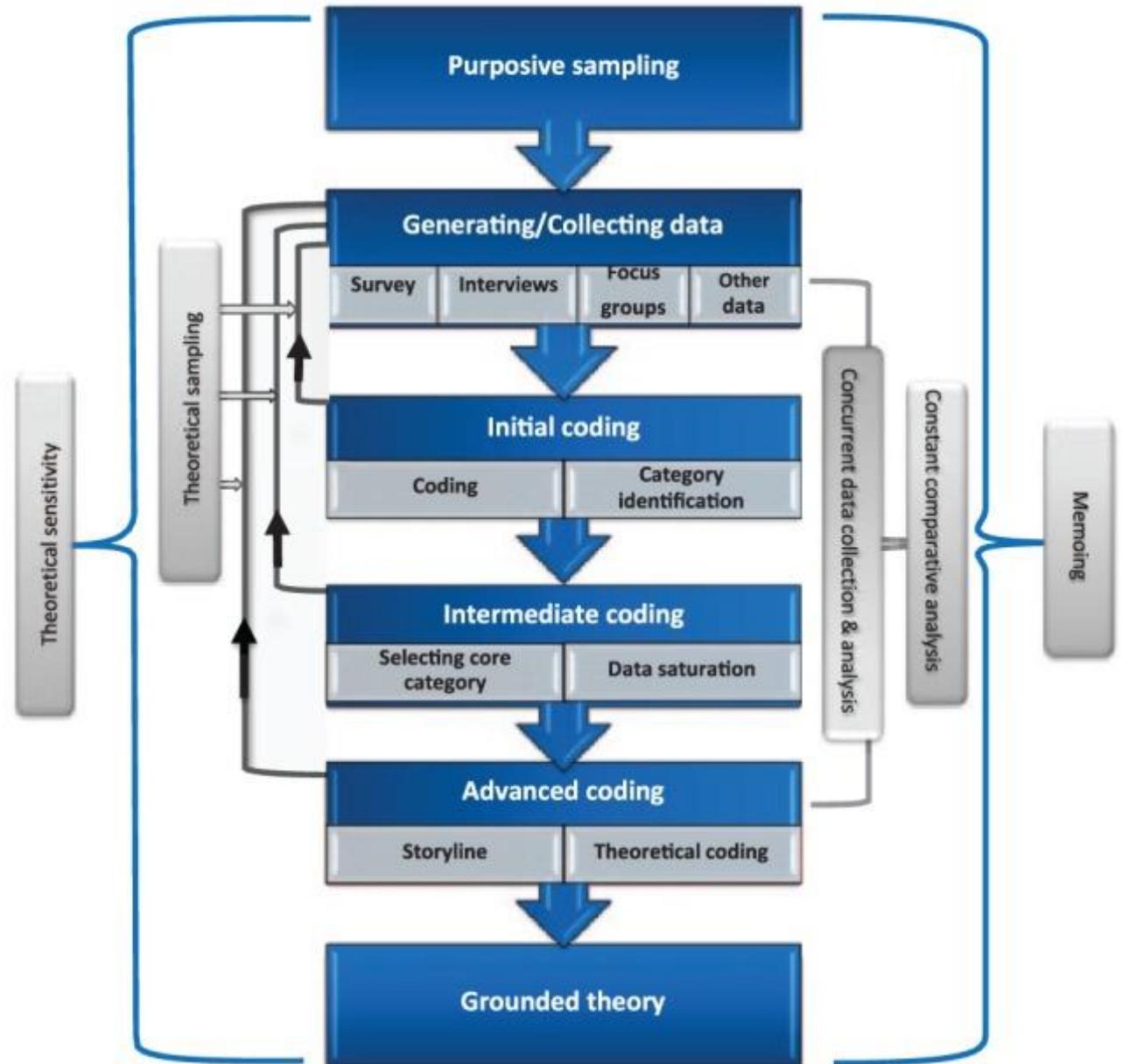
10 Help and Documentation

It's best if the design doesn't need any additional explanation. However, it may be necessary to provide documentation to help users complete their tasks.



Information kiosks at airports are easily recognizable and solve customers' problems in context and immediately.

Appendix 2- Grounded theory (Tie et al., 2019)



Appendix 3 – Focus Group 1 Transcript

Transcript Example Page

22 January 2024, 11:04am

M Which gamified learning platforms do you use, and what makes them helpful for your studies?

P3 My favourite would probably be you Udemy cause that's where I find that I learn quite easily. Especially like JavaScript and PHP courses that have done and I'm they're very affordable. You know you can get a course for on a sale for 11 pounds, which is absolutely fantastic. And then you get a certificate at the end of it. So yeah, that would be my favourite.

M Are there any additional game elements you find useful?

P3 I like that that the lessons are obviously prerecorded and you can go back and reference and if there's anything that you missed or maybe you want to double check and then there is comments that you can write and then the lecture can reply and say that you know this is the mistake that you've done. Or so I think that the engagement and a lot of the times they have open forums or discords where you can go and sort of engage with other students and lectures you can help you. So I think that's quite that would be, yeah.

M Thank you.
Anyone else?
Any ideas?

P1 Well, I haven't used any of those so.

P3 I think a lot of us are using and YouTube and Stack Overflow for sort of coding and stuff.

P1 Yeah, definitely.
Uh plus, I've managed to find a few discord channels that the uh, the PHP developers, HTML developers.
It's not an actually an app like those that you said, but there's just some people that they are happy to help each other and discuss a few.
But albums that we might face and you know, they are just helping each other to learn and code better, I guess.

Appendix 4 – Focus Group 2 Transcript

Transcript Example Page

26 January 2024, 11:00am

- P1 0:34:46.330 --> 0:34:47.330 I like him earning badges.
- P1 0:35:29.510 --> 0:35:36.750 It's just that little push to get you going to and and the extra thing I think you use, they'd be quite effective.
- P1 0:35:36.810 --> 0:35:52.160 I think maybe like you know, Duolingo is probably not the ideal way to use it, but if you wanna reinforce learning or something that reinforced learning and usability, then if you use a badge in the right way that I think that helps.
- P1 0:35:52.170 --> 0:35:55.390 I mean, there's a few technical websites I look at.
- P1 0:35:56.870 --> 0:36:4.310 If I'm learning some program or something, some websites kind of gamify the actual learning on the web page.
- P1 0:36:4.730 --> 0:36:7.880 Uh, so you can use badges that way and things like that.
- P1 0:36:7.890 --> 0:36:10.610 And it makes you want to push a little bit more, so yeah.
- P4 0:36:13.620 --> 0:36:37.570 And I personally think also that uh characters or something that could, uh, increase the communication element because not just like in Duolingo, where there are characters that kind of push you to do stuff that could be even bothering for somebody, but more like real video game where you have a character which you get to impersonate with.
- P4 0:36:37.580 --> 0:37:0.140 So basically, if you kind of switch your identity to that character while you are completing task, it feels more like a game, you know, it feels it could be something that feels like you are part of a of another story and you feel more pushed to go through the whole process either if it's a game or just a learning process.
- P3 0:37:4.500 --> 0:37:9.720 I think gamification is good for engagement.
- P3 0:37:10.690 --> 0:37:18.560 And returning but I'm not sure it's that good for actual learning, but just maybe my opinion.
- P3 0:37:19.470 --> 0:37:32.170 I think it's pretty good for engagement and I think the companies mostly use it for engagement rather than for what the purpose supposedly is mostly for keeping people coming back connective.
- P1 0:37:37.510 --> 0:37:39.720 Uh, I like good progress bar.
- P1 0:37:40.430 --> 0:37:49.660 Like to see the progress and then getting like a badge like a [P5] mentioned.
- P1 0:37:49.990 --> 0:37:54.810 But also like the one the character I think would be quite good as well.
- P1 0:37:54.820 --> 0:37:57.320 That's sort of, you don't have to think that it's you.
- P1 0:37:57.390 --> 0:38:0.770 It's a character that cannot keep up or something.

Appendix 5 – Focus Group 3 Transcript

Transcript Example Page

26 January 2024, 13:00pm

- M 0:4:54.220 --> 0:5:1.30
Do you notice any common usability issues in your projects?
- P4 0:5:5.190 --> 0:5:5.790
Common mistakes.
- P3 0:5:8.380 --> 0:5:9.370
I think there's a coder.
- P3 0:5:9.380 --> 0:5:35.110
It's quite easy to kind of design something and and get into the idea of like everyone will understand how this works and it's not always the case of course and like for example, a designed and uh, a Nav bar like a little user icon, the hover over to log in and and immediately people reported that they didn't have to log in, which is actually a reasonable stumbling block.
- P3 0:5:35.120 --> 0:5:45.120
So it's very easy to kind of as a designer to kind of know how the site works and then assume I think I can't remember the name of the fallacy.
- P3 0:5:45.130 --> 0:5:49.280
But there isn't a documented fallacy where you assume that other people have the same knowledge.
- P3 0:5:49.950 --> 0:5:55.40
And so yeah, it's it's very, very easy to do that as a joining.
- P3 0:5:55.50 --> 0:6:0.780
That's why I think that you always need to like peer review or the theory as well.
- P3 0:6:1.470 --> 0:6:4.470
My personal bias against theory is just laziness, to be honest.
- P3 0:6:4.480 --> 0:6:13.110
But it's, but yeah, it's definitely go from the established work and the established with norms and design as well.
- P3 0:6:13.160 --> 0:6:18.790
And it's nice to step out of the kind of the expected, but for usability sake.
- P3 0:6:18.840 --> 0:6:19.320
Yeah.
- P3 0:6:19.330 --> 0:6:24.640
And this you better just to kind of follow the emerging trends where where he can?
- P1 0:6:25.420 --> 0:6:27.430
Yeah, I agree with that.
- P1 0:6:27.440 --> 0:6:41.170
And I think common mistakes when I do projects would be probably when it comes to directly interacting with the user and things like error messaging and things like that and form filling.
- P1 0:6:41.580 --> 0:6:54.290
Sometimes I won't do it the most efficient way, or it'll be like I could be a bit more efficient or it's not like appropriate for the target audience or something.
- P4 0:6:57.0 --> 0:7:3.770
Or like, stuff that I'll generally miss to do with error handling Tooltips is a big one for me.
- P4 0:7:3.880 --> 0:7:14.930
I didn't use them very much and now I'm learning too because just like users need to orientate themselves with a NAV bar if there's nothing to inform them on what they're doing wrong with it, they're just not gonna know.
- P4 0:7:15.260 --> 0:7:19.830
So I'd say words is is useful as emoticons are.
- P4 0:7:20.320 --> 0:7:22.70
Consider using words where possible.

Appendix 6 – Focus Group 1 Codes

Participant 1	Codes	Data
Relevant to research	Learnability	If user needs to learn every page again and again it's gonna be very difficult to use it. And if these users has any disability, uh, it makes it even harder.
Relevant to research	Error Prevention in Complex Websites	Let's just say you have a register form. All the validation that you need to do all the messages that you need to show. Sometimes it's very easy to miss something from there.
Relevant to research	Learnability Factors	It's a bit difficult to explain it, but my point is that. You cannot have the same elements doing different things.
Relevant to research	Connecting with Developers for Feedback	Uh plus, I've managed to find a few discord channels that the uh, the PHP developers, HTML developers.
Relevant to research	Testing Strategies	test your website.
Relevant to research	Competitors Analysis	According to the project that I want to do, the best thing for me if I don't know anything about it is to actually, yeah, go online and check competitors like a similar website.
Relevant to research	Colour Theory Considerations	Check the layout. The colour that they use, how they do everything, so I will have an idea.
Not relevant	Gamification Awareness	What do you mean with game element? Even if you gave me, like a few. More examples, I don't know it maybe it's me but I didn't really get what it is.
Participant 2	N/A	N/A
Participant 3	Codes	Data
	Intuitive Navigation Principles	So first of all the navigation, it has to be, you know user friendly and intuitive because if the user cannot navigate properly through your website then the website is pretty much redundant. Um than the layout has to be consistent.
Relevant to research	Certificates and Feedback	The certificates and feedback and yeah, so my favourite would probably be you Udemy cause that's where I I find that I learn quite easily. Especially like JavaScript and PHP courses that have done and I'm they're very affordable. You know you can get a course for on a sale for 11 pounds, which is absolutely fantastic. And then you get a certificate at the end of it.
Relevant to research	Feedback Mechanisms	I like that that the lessons are obviously prerecorded and you can go back and reference and if there's anything that you missed or maybe you want to double check and then there is comments that you can write and then the lecture can reply and say that you know this is the mistake that you've done.

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		Or so I think that the engagement and a lot of the times they have open forums or discords where you can go and sort of engage with other students and lectures you can help you.
Relevant to research	Testing Best Practices	So obviously it's through user testing. You can enhance the gamification.
Relevant to research	User Testing Approaches	So we do user analysis, we do user analysis and we figure out what the user needs.
Relevant to research	Accessibility for Enhanced Usability	You know, every color has sort of predefined almost and meaning. So that's how we would choose the colours and and and then use the colour wheel to make sure that the the colours match well.
Relevant to research	Theoretical Learning	So we learned a theory first from the lectures and browsing the Internet and just getting your own knowledge.
Relevant to research	Competitor Analysis	And then would do, um competitor analysis.
Relevant to research	Certification	I'm very competitive so. Getting that diploma just kind of validates my effort and I think that's really important for me to keep going.
Participant 3	Codes	Data
Relevant to research	Error Prevention on Complex Websites	So for me, I think it's the search functionality, so the search bar because I haven't do any search bar on my website so. I was thinking so new things, so with a challenge for me, if it's a design or developers and that why I'm thinking to put the search bar on my website because it could save the user's time, they can only just put the words and. Like a find the things they want. So that's the things I think is challenge for me, yeah.

Appendix 7 – Focus Group 2 Codes

Participant 1	Codes	Data
Relevant to research	Certification	Yeah, like I think like for example of the codcademy like I can receive actual certificate and I can actually I don't post it on LinkedIn or something that I've done it. For me, I would prefer more, more, more serious. One that actually I can, you know, show someone else.
Relevant to research	Accessibility as part of Usability	I think it should be something else about accessibility because that's usually it's forgotten.people forgetting at the beginning of making website that's needs to be accessible just sort of as a like a reminder that one needs to be done before you actually make website live.
Relevant to research	Lack of Usability Awareness in Professional Developers	Uh, for the Polish cinema websites I was like, Oh my gosh, that's anyone, you know, checking that stuff because the, you know, the phone was so small or the ad was everywhere, you know, like, like from 2000.
Relevant to research	Preference for Progress Bar	Uh, I like good progress bar.
Relevant to research	Preference for Badge	like to see the progress and then getting like a badge like a [P5] mentioned.
Relevant to research	Positive Environment through Avatars	But also like the one the character I think would be quite good as well. It's a character that cannot keep up or something.
Participant 2	Codes	Data
Relevant to research	Usability Gap in Computing Professionals	I think that in terms of usability is quite important that while while some people may know the theory behind it, most people don't usually have a field where they study that kind of theorems.
Relevant to research	Recognising Usability as a Skill	If if we were a user for a different company with a different UI, we could analyze those and determine how effective those UI's are, and if they are not as effective, we could probably inform the company.
Relevant to research	Easy-to-find content is necessary for learning	My personal experience is that I don't have the best memory, I must admit, so I usually do revisit some of my older work and information from previous years. And so I need to go back to specific years where that was the uh target of that of a module and ensure that I am.
Relevant to research	Importance of Support	Do you have a good line of connection to your lecturers and making sure that if you have any questions you do, you know, send them to the appropriate people?
Relevant to research	Negative Impact of Competitive Environments	I will say that while I love a good competition, I'm not. I don't think it's particularly good for a learning environment that people should, you know, go against each other. They really should be helping each other.

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Relevant to research	Peer Learning as a positive environment	So, you know, talking amongst themselves to create a more, uh, you know, helpful environment, sharing tips and tricks. Essentially, you know.
Participant 3	Codes	Data
Relevant to research	Duolingo Ineffectiveness	Duolingo in the past, although I don't use it anymore. I think it's effective in keeping you coming back. I think the business model of the linguists to have active users and sell advertisement, I don't think it's effective to make you learn anything at all.
Relevant to research	Preference for Immersive Learning Apps - Codecademy	I think I think, uh, this applications help more because they are more immersive like in code Academy. You actually get into the thing and think about it now.
Relevant to research	Preference for Rosetta stone	Same with Rosetta stone. You have to do a whole lesson, You don't do like 3 minutes and you do like a listen in writing, talking even. Well, I don't know if they do that anymore, but they used to like you talk and the machine tells you how different your pronunciation is from the actual pronunciation. And then tell you pronounce it correctly. So it is a lot more immersive.
Relevant to research	Importance of Usability Theories for Designers	<u>Usability theories:</u> Sorry for interrupting, definitely important for the designers.
Relevant to research	Positive View on Gamification	Gamification : I think it's pretty good for engagement and I think the companies mostly use it for engagement rather than for what the purpose supposedly is mostly for keeping people coming back connective.
Relevant to research	Backend Developers' Usability Gap	I had to do a lot of paperwork and a lot of bureaucracy in Spain like last year, and I don't think any developer in Spain studies any usability because the websites are like horrible to use there. I can't imagine these people that only study PHP and my SQL doing like websites where you have to do things and it's so not intuitive and it's just like it doesn't work. I'm sure it only works in the way that the developer thought you know and they or any other way. I'm sure it only works in the way that the developer thought you know and they or any other way.
Relevant to research	User Testing	and they're like, how did you know that's the menu are like, Oh my God. OK, so now I'll write menu under the Burger menu with little letters.
Participant 4	Codes	Data
Relevant to research	Increased Commitment with Paid Learning	Platform that gives you a proper certificate that could be like you, Udemy or something. It's that the simply invest your money so you feel more serious about it. So I think there is more commitment.
Relevant to research	Positive Experience with Duolingo	My favorite is Duolingo just because I think that overall it's really well designed and I personally use it a lot.
Relevant to research	Platform Identity opportunities	Duolingo kind of made of this their own identity.

Examining the Effectiveness of Gamification in Enhancing Web Usability Learning

Relevant to research	Duolingo for Leisure	I tried to explain myself if I have a platform that gives certifications and I have a platform which is like Duolingo, which is just for a secondary purpose, something that you do like a hobby in your free time.
Relevant to research	Ongoing Usability Testing	I think that usability is important for when it comes to also reviewing the product that has been published
Relevant to research	Importance of Usability Testing	So I think that usability is important, but it's also important to track that the usability is going in the direction that you thought it for. ... But then maybe there is like a button that is fundamental and is missing and it's counterintuitive. I think that testing with people that are different from the developer is important.
Relevant to research	Engagement through Characters (avatars)	character which you get to impersonate with. So basically, if you kind of switch your identity to that character while you are completing task, it feels more like a game, you know, it feels it could be something that feels like you are part of a of another story and you feel more pushed to go through the whole process either if it's a game or just a learning process.
Participant 5	Codes	Data
Relevant to research	Critique of Duolingo's Learning Approach	Yeah, because I use Duolingo for a while, but I just felt it was just drilling, words into my head rather than understanding why you say the word or why you put it in the sentence. ...It's just like because you do 3 minutes a day just to get rid of the notification thing and then you know it's not because you want to learn, it's because you want to keep on going.
Relevant to research	Preference for Rosetta Stone's	So I ended up getting a Rosetta Stone that has less gamification in it, but I find that the content is higher quality in it and it makes you actually, yeah. Rosetta Stone is much better than Duolingo the past and I actually learn some German when interlingual like a visit four years or not like I can't even remember a word.
Relevant to research	Finding Inspiration in Other Websites	I like to look at other websites for inspiration.
Relevant to research	Significance of Usability	now when you create something with a visual aspect and then you have to think about usability as well.
Relevant to research	Significance of Usability Theories	We used to create a lot of internal software all through web interfaces and everything was an absolute mess. ... know the the fundamentals and you know it properly then yes we can start maybe banging rules
Relevant to research	Effectiveness Through Accessibility	Accessibility : You can't exclude it, but yeah, [P1] is right, you know, should always you'll be designing something. but if it's if you're excluding a big part of a user base then it's not very effective.
Relevant to research	Impact of Badges	I like earning badges. It's just that little push to get you going to and and the extra thing I think you use properly, they'd be quite effective. I think maybe like you know, Duolingo is probably not the ideal way to use it, but if you wanna reinforce learning or something that refers reinforced learning and usability, then if you use a badge in the right way that I think that helps.

Appendix 8 – Focus Group 3 Codes

Participant 1	Codes	Data
Relevant to research	Design for Specific User Group	But when I'm designing for a different user group then I normally look back and see which usability principles will apply to them.
Relevant to research	Error Messaging	And I think common mistakes and when I do projects would be probably when it comes to directly interacting with the user and things like error messaging and things like that and form filling.
Relevant to research	Usability Theories	Yeah, I definitely think that too, because there are so many different principles and theories and you don't know necessarily know which ones to apply Or which one do we prioritize and those kind of things?
Relevant to research	Ordered Lessons Effectiveness	Uh, I used the Duolingo.... it takes you down in order which things to learn you don't like flip and like flip between lots of different things.
Relevant to research	Its good to study with your own paced	It's just like it takes you slowly through it at your own pace.
Relevant to research	Self-Paced Learning	And I think I don't think I've ever learned things on Duolingo that I would feel like I could then communicate in that language... It's kind of not like progressed far enough along, but I feel like that you learn more when you're actually speaking with somebody.
Relevant to research	Dark Patterns for Motivation	Yeah, I need a little dark pattern in to get me through learning and it's like.
Relevant to research	Freecodecamp not engaging	I have never been able to do things on freecodecamp. I get so bored with like the interface and everything. It doesn't like engage me enough to do.
Relevant to research	W3 Schools Learning Resource	Yeah, I've only used W3 schools for the learning resource and I think it's good if you know what you're like for me when I've done it, I can like learn one or like I find out the information I need.
Relevant to research	Importance of Progression Indicators	Progression definitely is my most important. I really need to see like how far away I am from the end, otherwise they're just feels endless. If Moodle had progression through your modules and like milestones along the way. Oh my goodness, you would see me more often, guys.
Relevant to research	Simple Layout for Learning Progress	And I think like simplifying things like simplify and all the information in a way that like can highlight where if you were learning about usability, maybe you could have like topics that show that you're like you've mastered these concepts, you're like developing these concepts and these are concepts that you've not explored yet and just to like see where you are on the learning, you're learning learning too.
Relevant to research	Quizzes Enhance Learning	So maybe like little quizzes, it'd be good ..
Relevant to research	Real Website Examples for Usability	I think if you were like when you're actually teaching it as well, like if you did, you gave the user to like a couple of examples of websites and then you were like to ask which one they think is more usable and and like has like his better usability.

		But you could do it like where one looks more attractive but isn't actually usable, and then one looks like not as good but is more usable and things like that just to and highlight like principles and study things that they weren't so far.
Relevant to research	Resources Tailored to Web Product Usability	And if you apply it to like usability, then it could just be what the person is looking to create. Like if they're creating an app, it would be different to a website. Or, you know, if you're designing video and things like click those kind of things, you can see what you're doing in Taylor, what you're learning to the resource you're creating.
Participant 3	Codes	Data
Relevant to research	Consideration of Accessibility	And I suppose for me for the usability, there's always a baseline of, at least in theory, I should always consider disabilities and but other than that, yes.
Relevant to research	Emphasis on Testing	I don't like to generalize that much, so I think that the main thing for me would be more on the testing side of things. It's quite easy to kind of design something and get into the idea of like everyone will understand how this works and it's not always the case of course and like for example, a designed and uh, a NAV bar like a little user icon, the hover over to log in and immediately people reported that they didn't have to log in, which is actually a reasonable stumbling block.
Relevant to research	curse of knowledge (cognitive bias)	But there isn't a documented fallacy where you assume that other people have the same knowledge. That's why I think that you always need to like peer review or the theory as well. That's why I think that you always need to like peer review or the theory as well.
Relevant to research	Motivation through Payment	Now, you know, paying makes you more likely to go back and...
Relevant to research	Learning in Chunks	It kind of makes you more intrigued to reconnect to that and work your way through the different materials and and a connecting that back to maybe you don't feel like you've learned that much but and but it's done quite well where like they'll be very basic words that you're gonna have covered in like say, part one wherever they call it and then in Part 2, they kind of assume you know that now and can work a little bit more.
Relevant to research	Engagement through Gamification	I have the other apps that don't have the same kind of gamification elements and and there might be other differences as well, but the the definitely didn't pull you back.
Relevant to research	Freecodecamp/ W3Schools - good structured lessens	So give an example I think is freecodecamp and and W3 schools. So yeah, they're quite good that they give you a kind of like sort of a curriculum almost. You can work your way through ... We might as well get this done with, you know, and and yeah, just work your way through and it's it's a good structure and build up and cause I've tried to jump from like base as I tried to skip the JavaScript and go into React like no, no.

Relevant to research	Importance of Progression and Badges	Or maybe there's a limit but, but yeah, sort of like you know, you've got your main progression and like in a video game, you know, you've got your kind of in progression and you've got your side quests. It's kind of like, OK, you're really just learning the language, but there's a little badge because you've got every single verb question, right, you know?
Relevant to research	Scratch for Interactive Learning	I think things like scratch are quite popular because it's a very simple oversimplified in my opinion, but it's a very simple way of getting people to see an immediate effect of what they're doing and what they're learning, you know, so it's.
Participant 4	Codes	Data
Relevant to research	Application of Golden Ratio	Important parts for me were learning actual solid concepts that I could apply. Let's call it would be all that useful if I didn't have the graph in my head. Same with the golden ratio. Same with the 6030 ten rule. You gotta have you got to communicate these with visual examples.
Relevant to research	Preference for Practical Examples	For me, it's just having a practical anger. If I can anchor it to something practical, then I'll think about it. But if I can't, then it's not gonna come to mind, because it's not gonna be useful in producing any kind of deliverable.
Relevant to research	Error Handling Knowing	All right, stuff that I'll generally miss to do with error handling like tooltips or a big one for me. I didn't use them very much and now I'm learning too because just like users need to orientate themselves with a NAV bar if there's nothing to inform them on what they're doing wrong with it, they're just not gonna know.
Relevant to research	Validation System and Competition	I guess a validator would be good, some kind of validation system. You could set that up with the gamification element would be like points. You could compete against classmates and fellow peers. Could be a way to do it.
Relevant to research	All-in-One Usability Resource	For me would be the vastness of the information available. I don't ever feel like I was pointed towards 1 condensed concentrated resource with a clear pathway through the learning.
Relevant to research	Progression as the Key Element	I guess at the time to Udemy as well, structure is important, but if there's no progression I'm a I don't care. I gotta be able to see where I'm going.
Relevant to research	Point Systems and Competition	.. what comes to mind is point systems competition, but I think the the more simple implementations that you get the bigger bang for your buck out really are the things that give direction that make you feel like you're achieving things and moving towards something and it's not something it's something you can see.

Appendix 9 – Focus Group 1 Themes

Themes	Data
Learning Usability	<p>Participant 3 So we learned a theory first from the lectures and browsing the Internet and just getting your own knowledge.</p>
	<p>Participant 1 It's a bit difficult to explain it, but my point is that. You cannot have the same elements doing different things.</p>
	<p>Participant 1 If user needs to learn every page again and again it's gonna be very difficult to use it. And if these users has any disability, uh, it makes it even harder.</p>
	<p>Participant 1 Let's just say you have a register form. All the validation that you need to do all the messages that you need to show. Sometimes it's very easy to miss something from there.</p>
	<p>Participant 3 So first of all the navigation, it has to be, you know user friendly and intuitive because if the user cannot navigate properly through your website then the website is pretty much redundant. Um than the layout has to be consistent.</p>
Testing and Analysis	<p>Participant 3 So for me, I think it's the search functionality, so the search bar because I haven't do any search bar on my website so. I was thinking so new things, so with a challenge for me, if it's a design or developers and that why I'm thinking to put the search bar on my website because it could save the user's time, they can only just put the words and. Like a find the things they want. So that's the things I think is challenge for me, yeah.</p>
	<p>Participant 1 test your website.</p>
	<p>Participant 3 And then would do, um competitor analysis.</p>
	<p>Participant 3 You know, every colour has sort of predefined almost and meaning. So that's how we would choose the colours and and and then use the colour wheel to make sure that the the colours match well.</p>
	<p>Participant 1 According to the project that I want to do, the best thing for me if I don't know anything about it is to actually, yeah, go online and check competitors like a similar website.</p>

	Participant 1 Check the layout. The colour that they use, how they do everything, so I will have an idea.
	Participant 3 So we do user analysis, we do user analysis and we figure out what the user needs.
	Participant 3 So obviously it's through user testing.
Preferred Game Elements	Participant 3 I'm very competitive so. Getting that diploma just kind of validates my effort and I think that's really important for me to keep going.
	Participant 3 The certificates and feedback and yeah, so my favourite would probably be you Udemy cause that's where I find that I learn quite easily. Especially like JavaScript and PHP courses that have done and I'm they're very affordable. You know you can get a course for on a sale for 11 pounds, which is absolutely fantastic. And then you get a certificate at the end of it.
	Participant 3 I like that that the lessons are obviously prerecorded and you can go back and reference and if there's anything that you missed or maybe you want to double check and then there is comments that you can write and then the lecture can reply and say that you know this is the mistake that you've done. Or so I think that the engagement and a lot of the times they have open forums or discords where you can go and sort of engage with other students and lectures you can help you.
Preferred learning environment	Participant 3 ...my favourite would probably be you Udemy cause that's where I find that I learn quite easily. Especially like JavaScript and PHP courses that have done and I'm they're very affordable. You know you can get a course for on a sale for 11 pounds, which is fantastic. And then you get a certificate at the end of it.
	Participant 1 Uh plus, I've managed to find a few discord channels that the uh, the PHP developers, HTML developers.
	Participant 3 I like that that the lessons are obviously prerecorded and you can go back and reference and if there's anything that you missed or maybe you want to double check and then there is comments that you can write and then the lecture can reply and say that you know this is the mistake that you've done. Or so I think that the engagement and a lot of the times they have open forums or discords where you can go and sort of engage with other students and lectures you can help you.

Appendix 10 – Focus Group 2 Themes

Themes	Data
Preferred Learning Platform	<p>Participant 1 Yeah, like I think like for example of the codecademy like I can receive an actual certificate and I can actually post it on LinkedIn or something that I've done it. For me, I would prefer more, more, more serious. One that actually I can, you know, show someone else.</p>
	<p>Participant 3 Same with Rosetta stone. You have to do a whole lesson, You don't do like 3 minutes and you do like a listen in writing, talking even. Well, I don't know if they do that anymore, but they used to like you talk and the machine tells you how different your pronunciation is from the actual pronunciation. And then tell you pronounce it correctly. So it is a lot more immersive.</p>
	<p>Participant 4 Duolingo kind of made of this their own identity.</p>
	<p>Participant 4 My favorite is Duolingo just because I think that overall it's really well designed and I personally use it a lot.</p>
	<p>Participant 3 Gamification: I think it's pretty good for engagement and I think the companies mostly use it for engagement rather than for what the purpose supposedly is mostly for keeping people coming back connective.</p>
Preferred Game Elements	<p>Participant 1 Like to see the progress and then getting like a badge like a [P5] mentioned.</p>
	<p>Participant 1 Uh, I like good progress bar.</p>
	<p>Participant 2 Do you have a good line of connection to your lecturers and making sure that if you have any questions you do, you know, send them to the appropriate people.</p>
	<p>Participant 4 Character which you get to impersonate with. So basically, if you kind of switch your identity to that character while you are completing the task, it feels more like a game, you know, it feels it could be something that feels like you are part of another story and you feel more pushed to go through the whole process either if it's a game or just a learning process."</p>
	<p>Participant 5 I like earning badges. It's just that little push to get you going to and and the extra thing I think you use properly, they'd be quite effective. I think maybe like you know, Duolingo is probably not the ideal way to use it, but if you wanna reinforce learning or something that refers reinforced learning and usability, then if you use a badge in the right way that I think that helps.</p>
	<p>Participant 1</p>

	But also like the one the character I think would be quite good as well. It's a character that cannot keep up or something.
User Dislikes	<p>Participant 2 I will say that while I love a good competition, I'm not. I don't think it's particularly good for a learning environment that people should, you know, go against each other. They really should be helping each other.</p>
	<p>Participant 3 Duolingo in the past, although I don't use it anymore. I think it's effective in keeping you coming back. I think the business model of the linguists to have active users and sell advertisement, I don't think it's effective to make you learn anything at all.</p>
	<p>Participant 5 Yeah, because I use Duolingo for a while, but I just felt it was just drilling, words into my head rather than understanding why you say the word or why you put it in the sentence. ...It's just like because you do 3 minutes a day just to get rid of the notification thing and then you know it's not because you want to learn, it's because you want to keep on going.</p>
	<p>Participant 4 I tried to explain myself if I have a platform that gives certifications and I have a platform which is like Duolingo, which is just for a secondary purpose, something that you do like a hobby in your free time.</p>
	<p>Participant 5 I like earning badges. It's just that little push to get you going to and and and the extra thing I think you use properly, they'd be quite effective. I think maybe like you know, Duolingo is probably not the ideal way to use it, but if you wanna reinforce learning or something that refers reinforced learning and usability, then if you use a badge in the right way that I think that helps.</p>
	<p>Participant 3 Duolingo in the past, although I don't use it anymore. I think it's effective in keeping you coming back. I think the business model of the linguists to have active users and sell advertisement, I don't think it's effective to make you learn anything at all.</p>
	<p>Participant 5 Yeah, because I use Duolingo for a while, but I just felt it was just drilling, words into my head rather than understanding why you say the word or why you put it in the sentence. ...It's just like because you do 3 minutes a day just to get rid of the notification thing and then you know it's not because you want to learn, it's because you want to keep on going.</p>
	<p>Participant 4 I tried to explain myself if I have a platform that gives certifications and I have a platform which is like Duolingo, which is just for a secondary purpose, something that you do like a hobby in your free time.</p>
Testing and Analysis	<p>Participant 3 And they're like, how did you know that's the menu are like, Oh my God. OK, so now I'll write menu under the Burger menu with little letters.</p>
	<p>Participant 4 I think that usability is important for when it comes to also reviewing the product that has been published.</p>

	Participant 4 So I think that usability is important, but it's also important to track that the usability is going in the direction that you thought it for. But then maybe there is like a button that is fundamental and is missing and it's counterintuitive. I think that testing with people that are different from the developer is important.
	Participant 2 If we were a user for a different company with a different UI, we could analyse those and determine how effective those UI's are, and if they are not as effective, we could probably inform the company.
Usability learning needs	Participant 1 I think it should be something else about accessibility because that's usually it's forgotten. People forget at the beginning of making a website that needs to be accessible just sort of as a reminder that one needs to be done before you actually make the website live.
	Participant 2 I think that in terms of usability is quite important that while some people may know the theory behind it, most people don't usually have a field where they study that kind of theorems.
	Participant 3 Usability theories: Sorry for interrupting, definitely important for the designers.
	Participant 1 Uh, for the Polish cinema websites I was like, Oh my gosh, that's anyone, you know, checking that stuff because the, you know, the phone was so small or the ad was everywhere, you know, like, like from 2000.
	Participant 3 I had to do a lot of paperwork and a lot of bureaucracy in Spain like last year, and I don't think any developer in Spain studies any usability because the websites are like horrible to use there. I can't imagine these people that only study PHP and MySQL doing like websites where you have to do things and it's so not intuitive and it's just like it doesn't work. I'm sure it only works in the way that the developer thought you know and they or any other way.
	Participant 1 Uh, for the Polish cinema websites I was like, Oh my gosh, that's anyone, you know, checking that stuff because the, you know, the phone was so small or the ad was everywhere, you know, like, like from 2000.
Preferred Learning Environment	Participant 2 My personal experience is that I don't have the best memory, I must admit, so I usually do revisit some of my older work and information from previous years. And so I need to go back to specific years where that was the target of that of a module and ensure that I am.
	Participant 4 Platform that gives you a proper certificate that could be like you, Udemy or something. It's that the simply invest your money so you feel more serious about it. So I think there is more commitment.

Appendix 11 – Focus Group 3 Themes

Themes	Data
Preferred Learning Platform	<p>Participant 1</p> <p>Yeah, I've only used W3 schools for the learning resource and I think it's good if you know what you're like for me when I've done it, I can like learn one or like I find out the information I need.</p>
	<p>Participant 3</p> <p>I think things like scratch are quite popular because it's a very simple oversimplified in my opinion, but it's a very simple way of getting people to see an immediate effect of what they're doing and what they're learning, you know, so it's.</p> <p>So give an example I think is freecodecamp and and W3 schools.</p> <p>So yeah, they're quite good that they give you a kind of like sort of a curriculum almost.</p> <p>You can work your way through ...</p> <p>We might as well get this done with, you know, and and yeah, just work your way through and it's it's a good structure and build up and cause I've tried to jump from like base as I tried to skip the JavaScript and go into React like no, no.</p>
Preferred Game Elements	<p>Participant 1</p> <p>Progression definitely is my most important.</p> <p>I really need to see like how far away I am from the end, otherwise they're just feels endless. If Moodle had progression through your modules and like milestones along the way. Oh my goodness, you would see me more often, guys.</p>
	<p>Participant 4</p> <p>.. what comes to mind is point systems competition, but I think the the more simple implementations that you get the bigger bang for your buck out really are the things that give direction that make you feel like you're achieving things and moving towards something and it's not something it's something you can see.</p>
	<p>Participant 3</p> <p>Or maybe there's a limit but, but yeah, sort of like you know, you've got your main progression and like in a video game, you know, you've got your kind of in progression and you've got your side quests.</p> <p>It's kind of like, OK, you're really just learning the language, but there's a little badge because you've got every single verb question, right, you know?</p> <p>So maybe like little quizzes, it'd be good ..</p>
User Dislikes	<p>Participant 1</p> <p>I have never been able to do things on freecodecamp.</p> <p>I get so bored with like the interface and everything.</p> <p>It doesn't like engage me enough to do.</p>
	<p>Participant 4</p> <p>I guess at the time to Udemy as well, structure is important, but if there's no progression I'm a I don't care.</p> <p>I gotta be able to see where I'm going.</p>

	Participant 3 I have the other apps that don't have the same kind of gamification elements and there might be other differences as well, but the definitely didn't pull you back.
Usability Testing	Participant 3 But there isn't a documented fallacy where you assume that other people have the same knowledge. That's why I think that you always need to like peer review or the theory as well.
	Participant 3 I don't like to generalize that much, so I think that the main thing for me would be more on the testing side of things. It's quite easy to kind of design something and get into the idea of like everyone will understand how this works and it's not always the case of course and like for example, a designed and uh, a NAV bar like a little user icon, the hover over to log in and immediately people reported that they didn't have to log in, which is actually a reasonable stumbling block.
Usability learning needs	Participant 4 For me would be the vastness of the information available. I don't ever feel like I was pointed towards 1 condensed concentrated resource with a clear pathway through the learning. All right, stuff that I'll generally miss to do with error handling like tooltips or a big one for me. I didn't use them very much and now I'm learning too because just like users need to orientate themselves with a NAV bar if there's nothing to inform them on what they're doing wrong with it, they're just not gonna know.
	Participant 3 And I suppose for me for the usability, there's always a baseline of, at least in theory, I should always consider disabilities and but other than that, yes.
	Participant 1 And if you apply it to like usability, then it could just be what the person is looking to create. Like if they're creating an app, it would be different to a website. Or, you know, if you're designing video and things like click those kind of things, you can see what you're doing in Taylor, what you're learning to the resource you're creating. Yeah, I definitely think that too, because there are so many different principles and theories and you don't know necessarily know which ones to apply Or which one do we prioritize and those kind of things? But when I'm designing for a different user group then I normally look back and see which usability principles will apply to them. And I think common mistakes and when I do projects would be probably when it comes to directly interacting with the user and things like error messaging and things like that and form filling.
	Participant 4 Important parts for me were learning actual solid concepts that I could apply. Let's call it would be all that useful if I didn't have the graph in my head. Same with the golden ratio. Same with the 6030 ten rule. You gotta have you got to communicate these with visual examples.

Learning Platform Content Ideas	Participant 1 I think if you were like when you're actually teaching ..., you gave the user like a couple of examples of websites and then you were like to ask which one they think is more usable and like has like his better usability.
	Participant 1 But you could do it like where one looks more attractive but isn't actually usable, and then one looks like not as good but is more usable and things like that just to and highlight like principles and study things that they weren't so far.
	Participant 1 And I think like simplifying things like simplify and all the information in a way that like can highlight where if you were learning about usability, maybe you could have like topics that show that you're like you've mastered these concepts, you're like developing these concepts and these are concepts that you've not explored yet and just to like see where you are on the learning, you're learning learning too.
Preferred Learning Environment	Participant 4 For me, it's just having a practical anger. If I can anchor it to something practical, then I'll think about it. But if I can't, then it's not gonna come to mind, because it's not gonna be useful in producing any kind of deliverable.
	Participant 3 So give an example I think is freecodecamp and and W3 schools. So yeah, they're quite good that they give you a kind of like sort of a curriculum almost. You can work your way through ... We might as well get this done with, you know, and and yeah, just work your way through and it's it's a good structure and build up and cause I've tried to jump from like base as I tried to skip the JavaScript and go into React like no, no. ... It kind of makes you more intrigued to reconnect to that and work your way through the different materials and and a connecting that back to maybe you don't feel like you've learned that much but but it's done quite well where like they'll be very basic words that you're gonna have covered in like say, part one wherever they call it and then in Part 2, they kind of assume you know that now and can work a little bit more. ... Now, you know, paying makes you more likely to go back and...
	Participant 1 Yeah, I need a little dark pattern in to get me through learning and it's like. And I think I don't think I've ever learned things on Duolingo that I would feel like I could then communicate in that language... It's kind of not like progressed far enough along, but I feel like that you learn more when you're actually speaking with somebody. ... It's just like it takes you slowly through it at your own pace. ... Uh, I used the Duolingo.... it takes you down in order which things to learn you don't like flip and like flip between lots of different things.

Appendix 12 – Focus Group Consent Form

Informed Consent Form

Examining the Effectiveness of Gamification in Enhancing Web Usability Learning

Edinburgh Napier University requires that all persons who participate in research studies give their written consent to do so. Please read the following and sign it if you agree with what it says.

1. I freely and voluntarily consent to be a participant in this research to be conducted by Violeta Lazarova, who is an undergraduate member in the Edinburgh Napier School of Computing.
2. I have been informed of the broad goal of this research study. I have been told what is expected of me and that the study should take about than 40 minutes to complete.
3. I have been told that my responses will be anonymised. My name will not be linked with the research materials, and I will not be identified or identifiable in any report subsequently produced by the researcher. I have been told that these data may be submitted for publication.
4. I also understand that if at any time during the session if I feel unable or unwilling to continue, I am free to leave. That is, my participation in this study is completely voluntary, and I may withdraw from it at any time without negative consequences.
5. In addition, should I not wish to answer any particular question or questions, I am free to decline.
6. I have been given the opportunity to ask questions regarding the study and my questions have been answered to my satisfaction.
7. I have read and understand the above and consent to participate in this study. My signature is not a waiver of any legal rights. Furthermore, I understand that I will be able to keep a copy of this consent form for my records.

Participant's Signature

Date

I have explained and defined in detail the research procedure in which the respondent has consented to participate. Furthermore, I will retain one copy of the informed consent form for my records.

Researcher's Signature

Date

Appendix 13 - Planning section

Planning

Methodology

Grounded theory (GT) is a research methodology that uses comparative analysis to discover or construct theory from methodically gathered and analysed data (Tie et al., 2019). This approach is particularly effective in interpreting complex findings resulting from quantitative research methods (Tie et al., 2019). Moreover, GT involves the creation of conceptual frameworks or theories through inductive data analysis (Tie et al., 2019). This methodology encompasses iterative approach to requirements gathering, where research questions are adapted as per previous research findings to dive deeper into understanding user needs (Tie et al., 2019), as illustrated in [Appendix 2](#). Finally GT offers the structure and flexibility essential for this research given the absence of specific hypotheses as the primary focus (Charmaz & Thornberg, 2020).

Moreover, aligned with GT, inductive data coding will be employed. This is a systematic categorisation process of qualitative data elements to uncover themes and patterns without predetermined expectations (Kyngäs, 2019).

Data Collection

Participant Demographics and Selection Process

The intended audience for the final deliverable is students specialising in computing courses in Scotland, aged between 18 and 70. Focus group participants will be expected to align with the specified target audience criteria. However, participants involved in the experiment should not be studying computing and, more specifically, should lack usability knowledge. The recruitment strategy will utilise multiple channels, including Teams, Email, Discord, LinkedIn, and in-person interactions, ensuring broad participation.

Focus group

A focus group involves gathering people to discuss a particular research topic based on their experiences (Sagoe, 2012). In this study, the focus group findings will provide insights into users' approaches to learning usability, the obstacles they encounter, their perspectives on gamified learning platforms, and their overall preferences concerning both learning methodologies and gamification. Using a focus group is an appropriate choice for this short-term project because it provides valuable

information inexpensively and quickly (Liamputtong, 2011). The research findings will serve as a foundation for guiding the design of the website, its content, and the pre-design graphical components (persona, user journey).

Moreover, the number of focus groups needed for research differs according to the project (Hennink, 2007). Generally, a single focus group is inadequate for answering complex research questions (Hennink, 2007). Instead, it is recommended to conduct three to four groups (Hennink, 2007). However, before making this decision, the project constraints and target audience must be considered. More than 80% of all themes in research can be identified in two to three focus groups, and 90% in three to six groups (Guest et al., 2016). Notably, conducting three groups is often sufficient to uncover the most prevalent themes in a dataset (Guest et al., 2016). Therefore, this research will aim to conduct three focus groups covering HE students with different studying experiences.

Prototyping

In the dynamic landscape of product design and development, the choice of prototyping method can significantly impact the success of a project (Dam & Siang, 2023). While low-fidelity prototypes have long been a valuable tool for early-stage concepts, including usability testing, they have many limitations (Dam & Siang, 2023). For example, when the testing process strongly emphasises user interaction and engagement with the system, the low-fidelity prototypes will not be able to offer an immersive experience (Dam & Siang, 2023). Therefore, after conducting focus groups, the next phase involves the creation of a high-fidelity interactive prototype (Pernice, 2016). This prototype will closely resemble the final product. High-fidelity prototyping offers a cost-effective and time-efficient solution for interface testing (Pernice, 2016). It enables detailed functionality and user experience testing, allowing designers to accurately assess real-world user interactions and responses (Pernice, 2016).

Functional Testing

Before conducting experiment research, a Quality Assurance approach will be applied to conduct functional testing. This will involve setting quality expectations, measuring, and enhancing quality (Quality, n.d.). The quality criteria will be documented in a table and assessed using a checklist to systematically evaluate interactive elements, navigation flow, and design consistency. Moreover, Accessibility testing will utilise Figma plugins to meet AAA standards for colour contrast and text readability (Leach, 2019).

Independent Measures Experiment

After developing a high-fidelity prototype, an experimental research phase will investigate the user's learning outcomes on a gamified online platform compared to a simplified learning environment. This process includes the creation of a pre-learning questionnaire to assess users' initial knowledge and a post-learning questionnaire to understand the extent of acquired knowledge. Using questionnaires as a research tool aligns with empirical data collection, involving structured questions designed to address specific research inquiries (Kelley, 2003). This approach is beneficial for its ability to generate a large amount of data quickly and at a low cost (Kelley, 2003).

Ethics

The planned research will uphold ethical standards, focusing on participant welfare across all methods, whether in-person or online. Participants will receive invitations to participate voluntarily, with no obligation to continue if they choose otherwise (McNeill, 1997). No payments or rewards will be offered to avoid the risks of inducement, emphasizing the voluntary nature of their involvement (McNeill, 1997). Before engaging with participant an Informed consent will be obtained. Participants will receive clear information about the project's objectives, data usage and storage, and potential risks, ensuring they can make an informed decision about their involvement (Lazar et al., 2017, p. 424). The study will employ transparent techniques to respect privacy and manage interactions ethically. Special attention will be given to privacy issues in online settings where the conversation will be screen recorded. For example, in such a setting there is a risk of household members walking into view of the camera which will be considered (Kalmus et al., 2023). Ethical practices will extend to post-research activities, including strict confidentiality in data handling and complying with data protection regulations (Government Digital Service, 2015). This approach ensures the research is conducted responsibly, safeguarding participant rights and needs. Moreover, following university policy, ethical approval will be obtained before commencing requirements gathering.

Project Management

Methodology

The project will adopt a hybrid approach, integrating the structured sequence of the Waterfall methodology with the flexible evolution of Agile practices, as illustrated in Figure 1. The waterfall is a traditional project management approach characterised by a linear and sequential progression, while Agile focuses on incremental development and adaptability (Lucidchart, 2019). Waterfall methodology is particularly suitable for this project due to its fixed deadline and the fact that a single individual will undertake it. This structure is vital for managing the workload effectively and delivering the project on schedule. However, the project also involves significant elements of primary data collection and testing, necessitating flexibility and responsiveness. To accommodate these aspects, the project will be broken down into weekly sprints. These sprints will allow for continuous assessment and adaptation during the research and evaluation phases, ensuring the project remains responsive to new insights and developments.

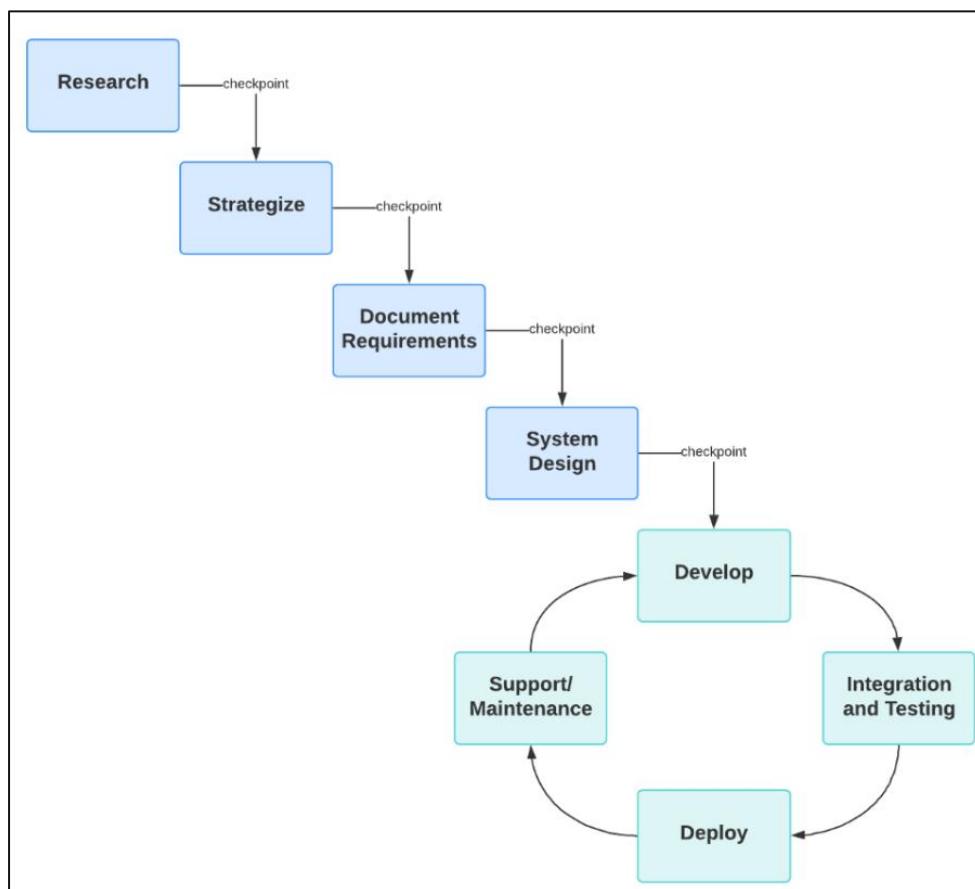


Figure 1 (planning): Agile-Waterfall hybrid method (Lucidchart, 2019)

Planned Timetable

For effective project management, Gantt charts have been employed to visualise the project main tasks (Figure 2). Gantt charts are widely recognised as a valuable tool for displaying activities and

events against time (*Gantt.com*, n.d.). As per the Gantt chart, this project will go through five main stages: User-centered research, Design, Testing, Experimental research, and Evaluation. All stages have sub-stages and specific tasks assigned. The stage's timeline may vary depending on external factors. Therefore, the Gantt chart will be used to outline tasks and time expectancy, but a Kanban board will be utilised during the project development to manage daily tasks. Kanban boards streamline assignments and prevent overload by giving project managers real-time process status (Hennigan, 2022). Moreover, a kanban board is a great management tool when working in an agile environment (Dalton, 2018).

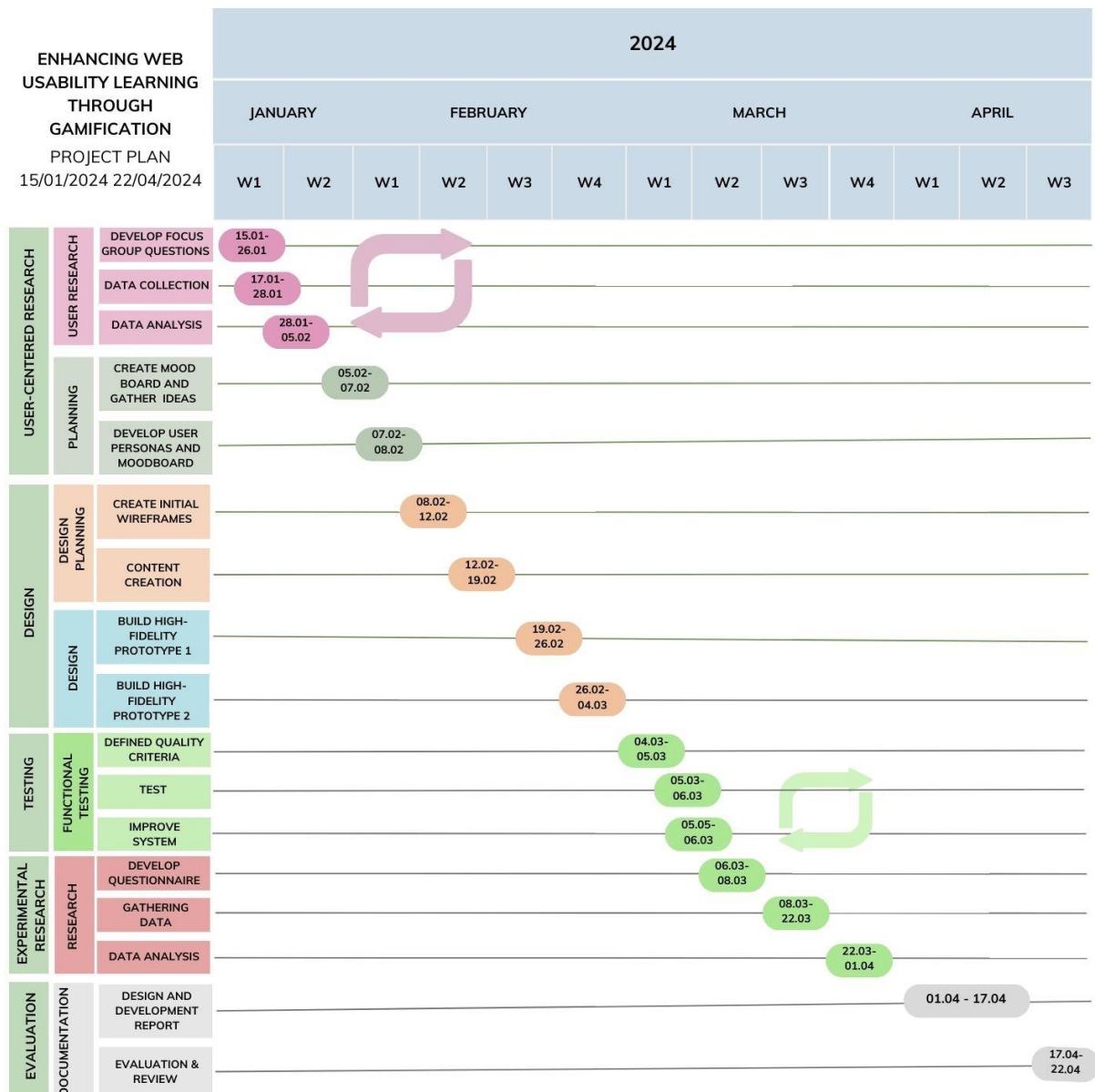


Figure 2 (planning): Gantt chart

Risk Management Strategy

Risk assessment is crucial to project management because it helps organisations identify potential threats, evaluate their impact, and proactively implement measures to mitigate or manage risks (Hampton, 2014). Business risks are typically categorised into three main groups: natural, human and economic causes (Business Risks, n.d.). These risks manifest in five main types, each with unique challenges and consequences. These are strategic, operational, financial, compliance, and reputation risks (Business Risks, n.d.). The risk management plan for this project will consider all risk groups, encompassing risk identification, assessment, and response.

A risk register document will be used throughout the project's life cycle to monitor and update the risk management strategy (figure 3 and figure 4).

Type	Cause	Effect	Impact	Likelihood	Importance	Response type	Response
R	Ineffective Gamification Integration	Experiment failure	50	50	●	Mitigate	Test gamification features with users for feedback
R	Diminished Value Over Time	Reduced platform effectiveness over time	80	50	●	Mitigate	Prioritise lasting content and adaptable gamification
R	Over-reliance on Game elements	Learner demotivation	50	30	●	Mitigate	Diversify gamification elements; Align with objectives
R	Cheating Within the Gaming Environment	Ineffective learning experience	70	20	●	Mitigate	Implement anti-cheating mechanisms
R	Learner Frustration Due to Gamification Techniques	Learner may get frustrated	50	50	●	Mitigate	Use User Onboarding Messages and targeted gamification
R	Limited Insight into Long-Term Gamification Impact on Learners	Reduced platform effectiveness over time	60	20	●	Watch	Conduct ongoing research and user feedback
R	High Costs Associated with Game Development and Maintenance	Diminished value over time	70	50	●	Avoid	Prioritise cost-effective solutions; Plan for sustainability
R	Failure to Recognise and Address Diverse User Preferences and Motivations	User disengagement	70	50	●	Mitigate	Conduct user research; Tailor gamified experiences
R	Inadequate Documentation Management Leading to Loss of Critical Paperwork	Loss of critical paperwork	100	20	●	Watch	Implement systematic documentation process
R	Non-compliance with legal requirements, such as accessibility regulations or copyright infringements	Legal penalties and reputation damage	80	30	●	Avoid	Stay informed about relevant laws; Conduct accessibility testing
R	Missing deadline due to illness or external disasters	Delayed project timelines	100	20	●	Mitigate	Implement contingency plans
R	Tool Dependency	Tool malfunction or unavailability can disrupt the workflow or result in the loss of work.	50	50	●	Mitigate	Identify alternative tools
R	Lack of knowledge	Learning curve affects task completion	80	80	●	Avoid	Find training resources and ask for help if needed
R	Time Constraints	Constrained time frame in a non-linear project may result in the risk of not meeting the established deadline.	80	50	●	Mitigate	Focus on essential tasks due to time constraints
R	Financial Constraints	The inability to access paid software/tools may lead to a slowdown in project progress	40	70	●	Avoid	Identify and utilise open-source tools

Figure 3 (planning): General Risk Register

A	B	C	D	E	F	G	H
Type	Cause	Effect	Impact	Likelihood	Importance	Response type	Response
R	Using external tools to transcribe collected data	Data bridge due to third party privacy policy or data bridge	100	50	●	Mitigate	Regularly assess and ensure compliance with privacy policies of external tools; explore alternative transcription tools if necessary.
R	Unpredictable participant schedules	Delay in data collection, potential dropout of participants	60	70	●	Watch	Plan multiple time slots, offer scheduling flexibility, and use online scheduling tools.
R	Internet connectivity issues, audio/video glitches, platform compatibility.	Data loss, compromised quality of insights.	80	40	●	Avoid	Conduct technology checks, provide clear instructions on technical requirements.
R	Lack of active participation in Focus groups	Reduced data quality	80	80	●	Watch	Develop open-ended questions, use engaging techniques, and provide incentives
R	Privacy and Legal Bridges	Legal and ethical issues.	100	20	●	Avoid	Collect only essential data; Inform participants
R	Unintentional disclosure of sensitive information.	Legal and ethical issues.	100	40	●	Avoid	Communicate the purpose, adhere to data protection regulations, ensure secure data storage.
R	Facilitator's personal biases	Influence on discussion direction	80	60	●	Avoid	Develop strategy, use stratified sampling.
R	Unintended expansion of discussion topics	Difficult-to-analyse data leading to Increased workload, potential data misinterpretation.	60	60	●	Avoid	Clearly define discussion scope, guide participants back to main topics.
R	Lack of clarity in participant responses.	Inaccurate conclusions.	70	50	●	Avoid	Use clarifying questions, pilot test questions.
R	Unforeseen disruptions (power outages, interruptions)	Data loss	70	10	●	Watch	Have contingency plans, consider recording sessions as a backup.
R	Recruitment Challenge	Compromised research conclusiveness	30	70	●	Accept	Implement a diverse recruitment strategy including in-person and online methods. Accept the possibility of inconclusive findings due to time constraints

Figure 4 (planning): Data Collection Risks Register

As part of the risk management strategy, all known risks will be recognised, and risks deemed high in likelihood and impact will be recorded on a Risk Register. The Risk register will employ a heat map to determine each risk's importance. A heat map illustrates the significance of project risks where green indicates lower severity and frequency, while yellow and red show higher risk levels (figure 5) (Hampton, 2014).

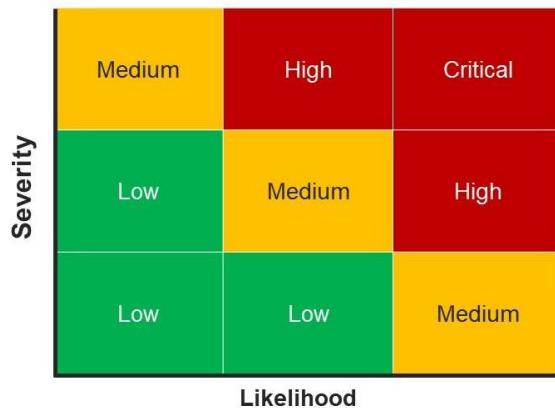


Figure 5 (planning): Heat map with three levels of impact and likelihood

The risk management strategy is informed by insights from a MoSCoW analysis, allowing for prioritising risks based on the criticality of project requirements. Additionally, project constraints have served as indicators, highlighting uncertainties and essential risks crucial for success. Finally, the project will leverage external tools offering benefits for the project, as well as additional risks. These risks have been considered within the risk strategy.

Project Constraints

This project plan aims to achieve maximum results while adhering to the project's constraints. The known constraints are illustrated in figure 6.

Constraints	Description
Financial Restraints	The project operates without funding; therefore, no paid software and design tools will be utilised.
Time Constraints	Given the project's short-term duration from January to April, it must prioritise essential tasks and embrace a practical approach to achieve success within the limited timeframe.
Documentation Requirements	The project emphasises comprehensive documentation, which will demand dedicated attention and resources.
Skill Dependency	The project relies on one person's knowledge, implying potential limitations. The project plan will address this by accommodating a learning curve for specific tasks.

Figure 6 (planning): Project Constraints

Task prioritisation using MoSCoW Analysis

Tasks will be organised using MoSCoW analysis (figure 7). The analysis is based on the findings of the literature review and considering the project's objectives and limitations. This approach ensures that critical project requirements are fulfilled, should-have features are incorporated, and any extra elements are addressed, if possible, to achieve project success within the given timeframe. Moreover, the prioritisation of certain elements in the "should-have" and "could-have" categories may be subject to adjustment based on the findings from the focus group, allowing for a dynamic and responsive approach to project development. Finally, this document will outline plans for the essential and important tasks, providing a clear guide project completion.

MoSCoW analysis

Web Usability Education Platform

Project length: 3 months

Deadline: 22/04/2024

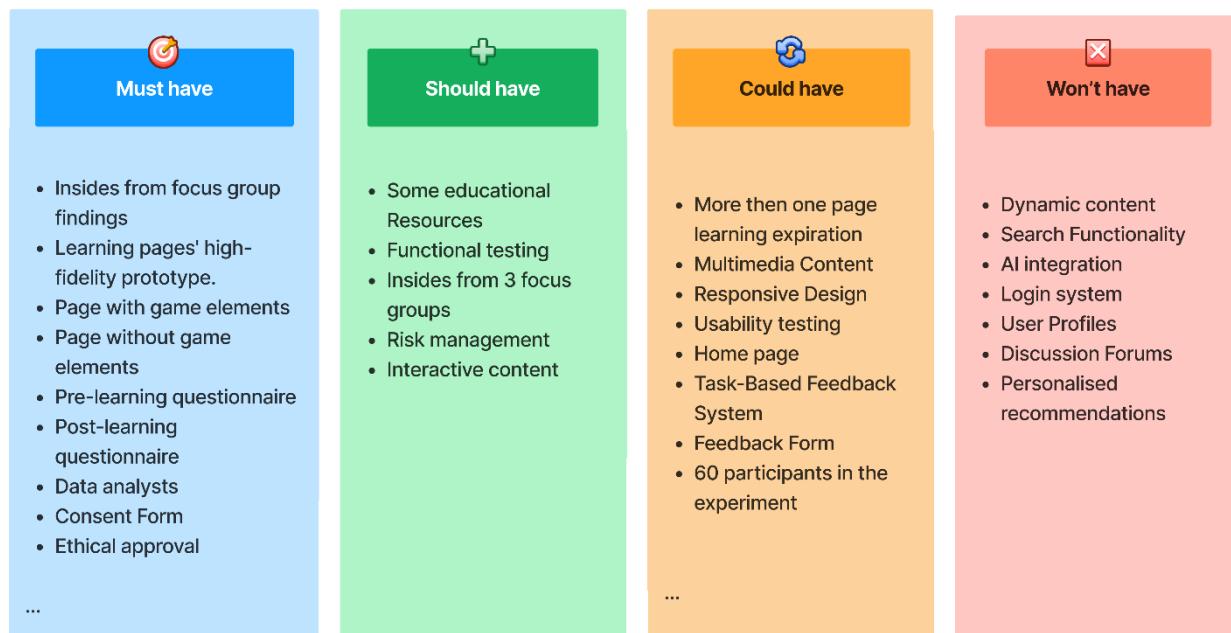


Figure 7 (planning): MoSCoW analysis for managing requirements.

Required Tools

To successfully execute the project, a set of tools will be utilised to support various aspects of the project, including research, development, project management, and communication. Figure 8 illustrates the essential tools needed for the successful completion of the project.

Category	Tools
Research Tools	<ul style="list-style-type: none"> Microsoft Forms will be employed to create and conduct surveys and questionnaires. Microsoft Teams and cockatoo.com will be used to transcribe recorded data.
Design and Development Tools	<ul style="list-style-type: none"> Figma: Figma will be the primary design tool for creating prototypes, wireframes, and design documentation. Adobe Illustrator: Adobe Illustrator will be used for graphic design and illustration. Adobe Rush: Adobe Rush will be employed for video editing if needed. Canva: Canva will serve as an additional design tool for creating visual content.
Project Management and Collaboration Tools	<ul style="list-style-type: none"> Zube.io: Zube.io will be the project management tool for task planning, tracking, and collaboration among team members. Microsoft Teams and email: Platforms like Microsoft Teams and email will be used for internal and external communication, including project updates and stakeholder engagement. calendly.com : calendly.com will be used to schedule meetings.
Functional testing tools	<ul style="list-style-type: none"> Stark Accessibility Tool: Accessibility testing plugins compatible with Figma will be integrated to ensure the platform's accessibility compliance.

Figure 8 (planning): Required tools.

Final Deliverable

The main objective of this project is to develop a high-fidelity prototype for a targeted learning path, incorporating game elements and emphasising human-centric design principles. This prototype will undergo evaluation in comparison to a non-gamified learning experience. The conclusive deliverables will encompass the high-fidelity prototype of the gamified learning page and a comprehensive Research Findings Analysis Report.

Appendix 14 – Personal Diary: Scoping Document

Weekly Diary Entry		Week 1
Date	18.09.2023	
Outcomes from Last Week's Meeting	My project idea received approval, allowing me to proceed with the project contract	
Weekly Accomplishments	<ul style="list-style-type: none"> I completed the Learning Contract and asked for feedback. Participated in the meeting with the supervisor. 	
Questions	<ol style="list-style-type: none"> I am uncertain about the "Evaluation and Review section in the Learning Contract? Are there specific guidelines for starting the scoping document? 	
Learning	Acknowledged the value of weekly meetings with the supervisor	
Action Plan	Next week's agenda includes drafting a table of contents and beginning research (exploring online information and examining potential competitors)	
Weekly Diary Entry		Week 2
Date	25.09.2023	
Outcomes from Last Week's Meeting	I reserved good feedback on the contract and will not need to make any changes	
Weekly Accomplishments	<ul style="list-style-type: none"> I have created a comprehensive table of contents. I conducted competitor research and identified one competitor. I thoroughly examined their website, noting their techniques and capturing unfamiliar vocabulary for further investigation. 	
Questions	<ul style="list-style-type: none"> I need help adding new entries to the Moodle diary. Should I comment on the first entry, or is there a more effective solution? Do you have any suggestions for refining the draft table of contents? After exploring the approach of one competitor, what are your thoughts on the ideas I'm considering adopting? <p>(Note: Competitor notes and the draft table of contents have been sent via email.)</p>	
Learning	Acknowledging areas where knowledge is lacking and posing relevant questions. I learned about psychological principles in UX design that were unfamiliar to me.	
Action Plan	In the upcoming week, I will begin work on the scoping document. Specifically, I will commence the search for relevant literature and systematically add findings to a Data Extraction Table.	
Weekly Diary Entry		Week 3
Date	29.09.2023	
Outcomes from Last Week's Meeting	During our discussion, we concluded that there are more effective tools for communication than the Moodle diary. Consequently, I will use a Word document for weekly entries shared via email.	

	Additionally, we discussed the diary's structure, deciding to include details from the last meeting and an action plan for better project management. Feedback on my table of contents led to renaming the "Summary" section to "Conclusion." The meeting concluded with an in-depth examination of the competitor's findings. I received valuable guidance on terminology, encompassing Cognitive Biases, Status Quo Bias, Losing Fallacy, Loss Aversion, and the Framing Effect, which holds potential for integration into the final product.
Weekly Accomplishments	<ul style="list-style-type: none"> Created a Data Extraction Table Started reading relevant literature and populating the Data Extraction Table. Explored diverse approaches to project diary entries. Successfully revamped the diary, implementing enhanced formatting and transferring entries from the initial two weeks into a Word document, improving overall organisation.
Questions	<ul style="list-style-type: none"> Should I include completed work in the diary as a form of evidence, or is it satisfactory to share it with you via email or discuss it during our meetings? Is the table format a suitable choice for my diary entry? Do you recommend incorporating elements from reflective models, or does my current management approach meet your expectations?
Learning	Recognised the value of the Data Extraction Table.
Action Plan	Continue populating the Data Extraction Table

Weekly Diary Entry Week 4	
Date	09/10/2023
Outcomes from Last Week's Meeting	In the previous week's meeting, we discussed my Data Extraction Table, recognising that I had been overly focused on new technologies, which are not the primary emphasis of my work.
Weekly Accomplishments	I adjusted my approach by delving into more relevant articles and refining the Data Extraction Table to align with the specific requirements of my project.
Questions	n/a
Learning	Reflecting on the importance of seeking feedback, I realised the value of obtaining a fresh perspective on work, especially when venturing into new territory. Before our last meeting, I was confident in my approach, assuming it was ideal for the purpose. However, seeking feedback broadened my understanding and provided a new angle to my work.
Action Plan	Continue populating the Data Extraction Table and writing the Introduction section of the Scoping document.

Weekly Diary Entry Week 5	
Date	15/10/2023
Outcomes from Last Week's Meeting	Discussed different approaches to crafting a scoping document, which helped me decide to start the process with the literature review rather than starting with the introduction. This choice aims to avoid potential rework.

Examining the Effectiveness of Gamification in Enhancing Web Usability Learning

Weekly Accomplishments	Expanded the content in the Extraction table and started writing of the literature review.
Questions	Is it a good idea to start my literature review with a broad explanation of UX, followed by gamification, learning techniques, challenges in web usability, and the future of UX design?
Learning	Embraced a new approach to writing.
Action Plan	Complete the literature review.

Weekly Diary Entry		Week 6
Date	23.10.2023	
Outcomes from Last Week's Meeting	Discussed feedback on literature review draft	
Weekly Accomplishments	Complete first half of literature review	
Questions	Is the structure of my titles appropriate?	
Learning	Explored gamification theories, design considerations for gamification in online learning, gamification elements, and user group preferences regarding gamification.	
Action Plan	Complete literature review draft	

Weekly Diary Entry		Week 7
Date	30.10.2023	
Outcomes from Last Week's Meeting	I received examples of introduction section structures	
Weekly Accomplishments	I completed literature review draft	
Questions	Feedback on Literature review	
Learning	If I were to start over, I'd begin with the introduction before diving into the literature review. It would provide a better roadmap, helping me avoid getting lost in the literature topics and requirements. On the other hand, my efforts have given me a great understanding of the existing literature, making it easier to restructure my findings.	
Action Plan	Write introduction section	

Weekly Diary Entry		Week 8
Date	06.11.2023	
Outcomes from Last Week's Meeting	N/A	

Examining the Effectiveness of Gamification in Enhancing Web Usability Learning

Weekly Accomplishments	Completed the introduction section
Questions	Feedback on Introduction
Learning	How to structure scoping document
Action Plan	Improve and finalised the literature review

Weekly Diary Entry Week 9	
Date	13.11.2023
Outcomes from Last Week's Meeting	N/A
Weekly Accomplishments	I improved and finalised the literature review
Questions	Questions: The assessment brief mentions using an 11pt font size. Should I do this or stick with our previous decision of using a 12pt font for better readability?
Learning	I have been learning how to cite and reference using APA 7 correctly, and I've also explored the referencing system on www.scribbr.com
Action Plan	Start drafting the project plan.

Weekly Diary Entry Week 10	
Date	20.10.2023
Outcomes from Last Week's Meeting	During our meeting, we discussed my project plan draft, and I adjusted it to ensure its flow.
Weekly Accomplishments	I successfully drafted the project plan and meticulously refined it, achieving in its final version. This involved a thorough examination of the project's structure and content to guarantee its completeness and coherence.
Questions	n/a
Learning	Received valuable feedback from my supervisor, prompting a closer examination of plan connections and order. This enhanced my understanding of project flow and introduced research-specific vocabulary like "Independent Measures Experiment."
Action Plan	Final week - first part of the project (refining the scoping document)

Appendix 15 – Personal Diary: Dissertation

Date: 22.01.2024

Accomplished Tasks:

During this week, I prepared questions and conducted a rehearsal for the upcoming focus groups. Additionally, I successfully organised and completed the first focus group.

Reflection on the Week:

In the initial focus group, I invited college students to participate, but encountered hesitancy among some of them. To address this, I suggested that their involvement could be a valuable learning experience, emphasising their freedom to leave the meeting at any time. Although 5 out of 8 intended participants joined online, only three remained by the session's end, with just two actively participating.

Upon reflection, I recognised the mistake in suggesting they could leave and later discussed this with my supervisor. Furthermore, I acknowledged another error in assuming the participants, as college students, had a solid understanding of usability and gamification. Consequently, I had to provide a brief introduction to these concepts. My supervisor pointed out that presenting new information shifted participants into a learning mode, hindering their engagement. Unfortunately, my presentation didn't steer the discussion towards the intended topic, but some valuable information did emerge.

Action Plan:

Conduct two additional focus groups.

Refine participant recruitment strategies to ensure a more engaged and informed group.

Avoid introducing new information during the session to maintain focus on the intended discussion topics.

Continuously assess and adapt facilitation techniques based on feedback and observations from each focus group.

Date: 29.01.2024

Accomplished Tasks:

This week, I successfully conducted two additional focus groups. To enhance participant engagement and understanding, I specifically invited students in their 3rd and 4th university years with prior knowledge of usability and gamification. Due to time and resource constraints, I utilised Teams and personal emails for invitations, suggesting two possible time slots.

Reflection on the Week:

The second focus group consisted of five participants, the discussion began with the standard introduction of the consent form and participant rights. Knowing all the participants from my modules and working as a student demonstrator eliminated any initial awkwardness. The conversation flowed smoothly, starting with the topic of gamification, and sharing experiences. Questions were adapted from the first focus group to gain clearer insights into my research questions. The discussion seamlessly transitioned from gamification to usability, evolving from semi-structured to unstructured questions. Participants were actively engaged, especially in exploring ways to improve usability through gamification.

The second focus group, also conducted online, had four active participants with similar backgrounds. Questions were drawn from the discussion, and the conversation started with usability learning needs rather than gamification and shifting to gamification preferences. This led to a different discussion on ideas for a usability learning platform with game elements. Participants emphasised aspects they found unhelpful, providing valuable insights for structuring content and interaction in the design process.

Action Plan:

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Start analysing the collected data to draw conclusions and insights. This includes choosing an appropriate approach for analysis and then discussing the findings.

Date: 05.02.2024

Accomplished Tasks: This week, I learned about quantitative data analysis methods and decided to use Thematic analysis to understand the data from focus groups. I read papers and books suggested by my supervisor, drew conclusions, and started writing my dissertation.

Reflection on the Week: I feel confident discussing quantitative data analysis and making decisions independently for similar projects.

Action Plan:

Next week, I will analyse and document data from Focus Group One.

Date: 12.02.2024

Accomplished Tasks:

This week, I edited transcripts from Focus Group 1, listened to the conversations, highlighted relevant information, created codes, and organised content into themes. I incorporated these details into my dissertation, refined its structure, and wrote the introduction.

Reflection on the Week:

While the transcription editing was slow and repetitive, analysing data and concluding became intriguing. My experience with Thematic analysis highlighted its benefits as I learned things that were not obvious initially.

Date: 19.02.2024

Accomplished Tasks: I separated all data from focus groups 2 and 3 into codes and teams and completed the focus group section.

Reflection on the Week: Found data coding to be more time-consuming and complex than expected.

Action Plan: Start working on the design.

Date: 26.02.2024

Accomplished Tasks: I gathered design ideas, created a homepage and logo, and decided on the content topic. I initially considered creating an introduction section of the platform but decided to do usability errors based on the focus groups' findings.

Reflection on the Week: I'm happy that the focus group gave me a new perspective. Creating content that challenges students will likely make it easier for me to find suitable participants for the research.

Action Plan: Begin writing the content of the learning platform.

Date: 04.03.2024

Accomplished Tasks: Completed the text content of the learning platform.

Reflection on the Week: I learned a lot about usability errors.

Action Plan: Will work on the design of the page.

Date: 11.03.2024

Accomplished Tasks: Completed the design of the gamified page.

Reflection on the Week: I discovered that some planned interactions weren't implementable in Figma, which slowed down the work.

Action Plan: Create the non-gamified page of the training.

Date: 18.03.2024

Accomplished Tasks: Created the non-gamified page of the training.

Reflection on the Week: The week went as expected.

Action Plan: Create a survey and test for participants.

Date: 25.03.2024

Accomplished Tasks: Created a survey and test for the participants and sent invitations to students to find participants.

Reflection on the Week: Writing test questions was more complicated than expected. As well as that, I realised that access to potential participants was limited due to finishing lectures for the year and the easter holidays.

Finally, my initial two participants found the first survey confusing, with one admitting to using Google. Consequently, I had to provide more directions and include an "I don't know" answer option. As a result, I had to exclude the data from these participants' responses.

Action Plan: Find participants for the survey and start working on the dissertation.

Date: 01.04.2024

Accomplished Tasks: Worked on the dissertation and made some changes as per my supervisor's feedback. Also started working on the design section.

Reflection on the Week: I need to finish the document sooner to get feedback on time, which is frustrating due to the difficulties in finding participants in the experiment.

Action Plan: Complete working on the dissertation.

Date: 08.04.2024

Accomplished Tasks: I started on the independent measure experiment method and finished the focus group and self-reflection sections.

Reflection on the Week: I found the independent measure part very difficult as it was a new topic, so I completed the more familiar sections first.

Action Plan: Work on the independent measure methodology, discussion, and conclusion sections.

Date: 15.04.2024

Accomplished Tasks: I completed the independent measure section, as well as the discussion and conclusion sections.

Reflection on the Week: Last week was intense. I wish I hadn't had the most challenging part at the end, but I'm relieved it was completed on time.

Action Plan: Get ready for the presentation.

Examining the Effectiveness of Gamification in Enhancing Web Usability Learning

Appendix 16 – Kanban Board

Screenshot of the zube Kanban Board interface showing a list of tasks and their details.

Filters:

- select all
- Update Selected Cards
- Move Selected Cards

Tasks:

ID	Description	Archive	Assignee	Labels
#36	Analyse the qualitative data	Archive	[User]	Independent Measures Experiment Research
#35	Gather qualitative data	Archive	[User]	Independent Measures Experiment Research
#34	Plan and organise the independent measures data gathering procedure	Archive	[User]	Independent Measures Experiment Organisational
#33	Create a booking system for participants to book a slot	Archive	[User]	Independent Measures Experiment Organisational
#26	Find participants for the experiment	Archive	[User]	Independent Measures Experiment
#25	Post-Experiment Survey: Designing a test	Archive	[User]	Independent Measures Experiment
#24	Pre-Experiment Survey: Designing a Test	Archive	[User]	Independent Measures Experiment
#23	Post-Experiment Survey: Designing a Questionnaire	Archive	[User]	Independent Measures Experiment
#15	Explore qualitative data analysis techniques in research.	Archive	[User]	Focus Group Document Research
#11	Change presentation and questions for 2nd Focus group	Archive	[User]	Focus Group Document Organisational
#8	Organise 3rd Focus Group	Archive	[User]	Focus Group Meeting Organisational
#7	Analysing findings from 3rd focus group	Archive	[User]	Focus Group Research
#6	Analysing findings from 2nd focus group	Archive	[User]	Focus Group Research
#5	Analysing findings from 1st focus group	Archive	[User]	Focus Group Research
#4	Organise 2nd Focus Group	Archive	[User]	Focus Group Meeting Organisational
#2	Organise 1st Focus Group	Archive	[User]	Focus Group Meeting Organisational
#1	Create Presentation For Focus Group	Archive	[User]	Focus Group Document Idea
#21	Complete the design of the non gamified platform.	Archive	[User]	Design
#20	Complete the design of the gamified platform.	Archive	[User]	Design
#32	01.04.2024	Archive	[User]	Weekly Diary
#31	25.03.2024	Archive	[User]	Weekly Diary
#30	18.03.2024	Archive	[User]	Weekly Diary
#29	11.03.2024	Archive	[User]	Weekly Diary

Export JSON: Export JSON

<input type="checkbox"/>	#28	04.03.2024	Archive	[User]	Weekly Diary
<input type="checkbox"/>	#27	Edit the Introduction section	Archive	[User]	
<input type="checkbox"/>	#22	Pre-Experiment Survey: Designing a Questionnaire	Archive	[User]	
<input type="checkbox"/>	#19	26.02.2024	Archive	[User]	Weekly Diary
<input type="checkbox"/>	#18	19.02.2024	Archive	[User]	Weekly Diary
<input type="checkbox"/>	#17	Dissertation	Archive	[User]	Document
<input type="checkbox"/>	#16	12.02.2024	Archive	[User]	Weekly Diary
<input type="checkbox"/>	#14	05.02.2024	Archive	[User]	Weekly Diary
<input type="checkbox"/>	#13	29.01.2024	Archive	[User]	Weekly Diary
<input type="checkbox"/>	#12	Date: 22.01.2024	Archive	[User]	Weekly Diary
<input type="checkbox"/>	#10	Questions	Archive	[User]	question
<input type="checkbox"/>	#9	Gathering Design Materials	Archive	[User]	
<input type="checkbox"/>	#3	Ethical Approval form	Archive	[User]	Document

Appendix 17 – Microsoft Form

The screenshot shows the Microsoft Forms homepage. At the top, there's a navigation bar with three dots, the word "Forms", and three icons: "New Quiz", "New Form", and "Quick import". Below this is a section titled "Explore templates" with three cards: "Feedback and evaluation survey" (image of people at a table), "Registration and application form" (image of hands on a laptop keyboard), and "Academic research and study" (image of a person reading a book). Below the templates are navigation tabs: "Recent" (selected), "My forms", "Filled forms", "Shared with me", and "Favorites". Under "Recent" are four cards for forms: 1. Examining the Effectiveness of Gamification in Enhancing Web Us (by Lazarova, Violeta, 8 responses), 1. Post-Training Survey (by Lazarova, Violeta, 8 responses), 2. Examining the Effectiveness of Gamification in Enhancing Web Us (by Lazarova, Violeta, 8 responses), and 2. Post-Training Survey (by Lazarova, Violeta, 8 responses).