Enhancing User Experience of Digital Design Learning Platforms through User Interface Improvements

A Thesis submitted in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

***in Design** by*

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under the supervision of

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DECLARATION

I, **Mrs. Syamala S. (Roll No. 226105005)**, a bonafide student of the Department of Design, Indian Institute of Technology (IIT) Guwahati, hereby declare that the work contained in this thesis titled ***'Enhancing User Experience of Digital Design Learning Platforms through User Interface Improvements'*** is carried out by me during my enrolment period as a student (July 2022 – July 2025) under the supervision of Dr. Abhishek Shrivastava, Associate Professor and Prof. (Dr.) Sougata Karmakar, Professor, Department of Design, Indian Institute of Technology (IIT) Guwahati, Assam, India. This work carried out for the award of Doctor of Philosophy (Design) is my original contribution done under the supervision of my supervisor. **It has not been submitted elsewhere for the award of any degree or diploma**. The guidelines provided by the institution have been duly followed while preparing this thesis, and I have confirmed the norms and guidelines prescribed in the institute's ethical code of conduct.

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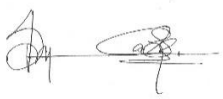

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CERTIFICATE

This is to certify that the work contained in this thesis titled ***'Enhancing User Experience of Digital Design Learning Platforms through User Interface Improvements*** ' has been carried out under our guidance and supervision. It is a bonafide research work of my research scholar, **Mrs. Syamala S, Roll No. 226105005**. This work, submitted for the degree of Doctor of Philosophy (Design), is original and contains no materials previously published or written by any other person for the award of any degree or diploma at the Indian Institute of Technology (IIT) Guwahati or any other institute or university. All the requirements (including mandatory coursework) as per the rules and regulations prescribed in the Ph.D. ordinance for submitting the thesis for the Ph.D. degree of the Indian Institute of Technology (IIT) Guwahati have been fulfilled by the candidate.

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Dedicated to

My Beloved Husband and Daughter

Dr. Sarath K. S. & Siddhi Sarath,

whose continued support and sacrifices have inspired me daily to keep pushing for my life's ambition.

My Parents

Smt. Prasanna Kumari & Shri Sakthivel R

whose unwavering support and drive throughout my life have inspired me to pursue education and continue evolving as a good human with moral values.

My In-laws

Smt. Radhamony & Shri Sasidharan Pillai

whose profound support helped me in commencing this research journey.

&

My divine God and Guru

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ABSTRACT

One of the essential components of the United Nations' Sustainable Development 2030 agenda is quality education for all and promoting lifelong learning. With the increase in technological and internet awareness, India is one of the fastest-growing consumers of digital education. E-learning addresses multiple challenges in traditional education, such as flexibility, accessibility, self-study, practicality, and cost-effectiveness. Users tend to favor interfaces that are both simple and pleasing. Both instructors and students prefer digital learning platforms with user-friendly design components. Unfortunately, poor user experiences can lower retention rates and reduce learner engagement. Thus, the user interface must be user-friendly, significantly influencing the user's perception of the software. Design education gives more value to critical thinking and skills among students, unlocking their creative and innovative potential. Design learning platforms are unique as they deliver content effectively and should be visually attractive and interactive. These platforms offer access to high-quality design education and facilitate self-paced, in-depth learning through engaging multimedia content. User experience, visual appeal, clarity, and interactive functionality are essential in effective learning within design education. Although many platforms are expanding their reach globally, they frequently fail to meet user expectations because of inadequate and inconsistent content being delivered and the design of the user interface.

The study employed various methodologies to look into and improve the user experience of digital design learning platforms. The analysis began with a detailed literature review, direct observation, and integration into the UX model to identify the key user interface elements that impact usability and engagement. These findings created a formal UX evaluation framework based on five key factors: visual design, interface design, content organization, functionality, and objectives. A visual analysis of three selected digital learning platforms focused on the five identified factors. Students participated in platform walkthroughs and provided structured feedback on each factor. A 31-item UX questionnaire was distributed to 23 design learners to check the reliability and validity. Cronbach's alpha value for all the factors is greater than 0.75, and a systematic content validity is established. Subsequently, a comparative usability evaluation involved 154 participants, including designers and engineers, and data were collected for assessment

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based on the five factors and overall user experience. Statistical and qualitative thematic analysis has been done to analyse the data thoroughly.

Expert interviews and analysis of web analytics data, including metrics like average session duration, bounce rates, and user behaviour patterns, were used to investigate the low-scoring platform thoroughly. The qualitative data were thematically organized to extract valuable insights regarding user expectations, platform limitations, and interaction challenges. The triangulated results from statistical testing, expert opinion, and web analytics converge to illustrate that the original platform had numerous usability issues. A revised version of the platform was developed, incorporating UI principles like the golden ratio, dynamic symmetry, consistent color schemes, and the reduction of cognitive load. The UX questionnaire was used to test the new interface, and the answers from users of both the old and new versions were compared. The results showed that all UX dimensions had statistically significant improvements, which confirmed the effectiveness of the redesign and supported the research hypothesis that making key UI elements better makes the user experience on digital design learning platforms much better. This research formulated a triangulated technique integrating user feedback, expert insights, and web analytics for a thorough UX assessment in design education platforms. This research listed a series of UI design recommendations that solve major usability issues in creative learning platforms, relevant to educational and design products. The current study can potentially improve accessibility and usability of the design learning platform, enhancing educational outcomes for students in underrepresented or remote areas. Facilitated the digital empowerment of design learners by optimising open-access educational resources, in line with the National Education Policy objectives to advance digital education infrastructure. The study may utilize the established UX evaluation methodology in non-design fields such as engineering, humanities, or medicine to assess its versatility across various educational environments.

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LIST of ABBREVIATIONS

ABBREVIATION	FULL FORM
UX	User Experience
UI	User Interface
UUEQ	User Usability Evaluation Questionnaire
SPSS	Statistical Package for Social Science
ANOVA	0Analysis of Variance
AI	Artificial Intelligence
EEG	Electroencephalogram
FMRI	Functional Magnetic Resonance Imaging
NEP	National Education Policy
USID	Universal Sustainable Innovative Design for Social Change
SUS	System Usability Scale
SUE	System Usability Evaluation

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1

Introduction

Abstract

E-learning has emerged as an essential element of modern education systems, characterized by its versatility, accessibility, and convenience. In developing nations, the domain of digital learning in design education remains insufficiently explored. Investigations about design learning platforms are distinct from those concerning conventional e-learning platforms. The *review underscored the current landscape of digital design education, the significance of UX/UI within digital platforms, and various techniques for usability evaluation. It also emphasized the critical nature of a multidisciplinary approach and an iterative design process, which are essential for ongoing assessment and refinement to enhance the user experience continually. Through this examination, we aspire to offer valuable insights into the relationship between UI design and user engagement in digital design platforms. This chapter discusses the importance of digital learning platforms, design learning, the role of UX/UI, research motivation, the background of the research area, research gaps, research questions, problem statement, and the aim & objectives.*

1.1 Background/ Present Scenario

Education serves as a cornerstone for realizing the complete potential of individuals, fostering an equitable society, and advancing national progress. A key element of the United Nations' Sustainable Development Goals for 2030 (UN, 2015) is providing quality education for all, alongside promoting lifelong learning. The NEP 2020 (Ministry of Education, 2020) envisions a transformative shift in education towards 'an education system underpinned by Indian values that directly contributes to India's sustainable

transformation into an equitable and dynamic knowledge society, ensuring high-quality education for all and establishing India as a global knowledge superpower.' The emergence of new circumstances demands innovative initiatives.

With rising technological advancement and internet penetration, India has become one of the largest consumers of online education. E-learning addresses several challenges associated with traditional education, such as flexibility, accessibility, autonomous learning, practicality, and cost-effectiveness (Katyeudo & de Souza, 2022).

According to statista, the revenue from the online learning platform market is projected to reach US$4.73 billion in 2023. It is anticipated to exhibit an annual growth rate of 19.94% from 2023 to 2027, resulting in an expected market volume of US$9.79 billion by 2027. Furthermore, the user base for online learning platforms is forecasted to rise to 244.0 million users by 2027, with user penetration anticipated to increase from 10.3% in 2023 to 16.6% by 2027. In a global context, as illustrated in Figure 1.1, the majority of revenue will be generated in China (US$41.73 billion in 2023), with India following as the second-largest contributor. Figure 1.2 depicts the accelerated growth of digital learning platforms in India (statista, 2023).

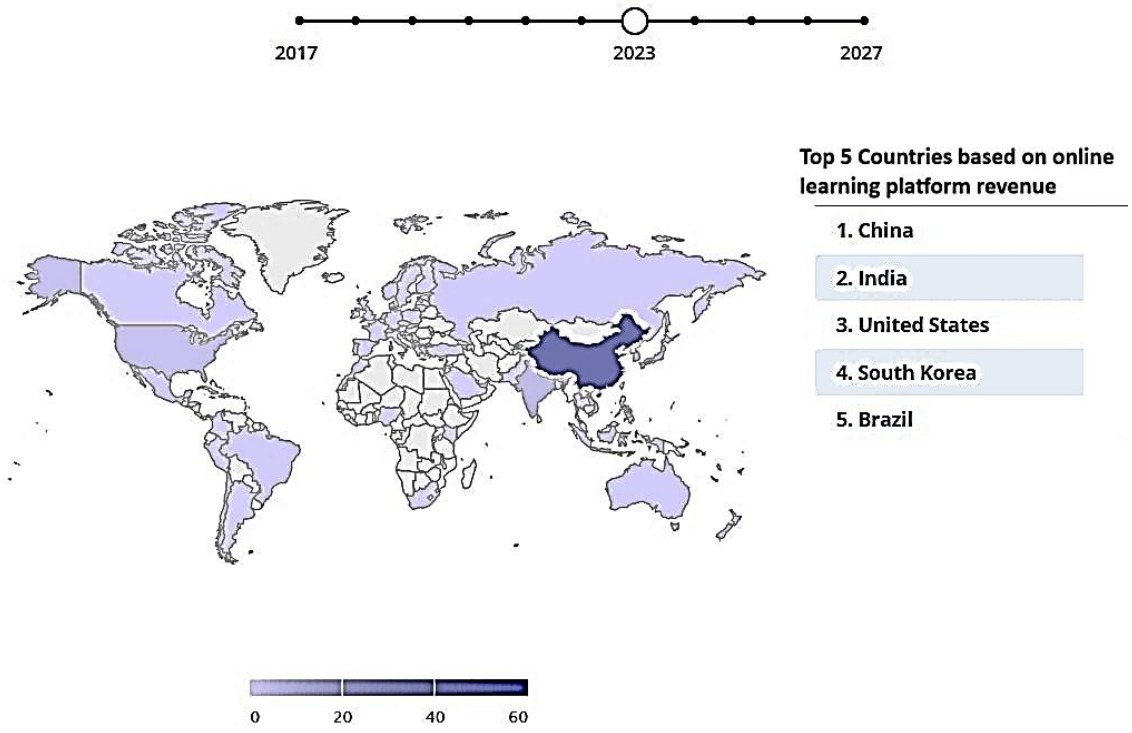

Figure 1.1. Global Scenario of Digital Learning [Source: Statistia]

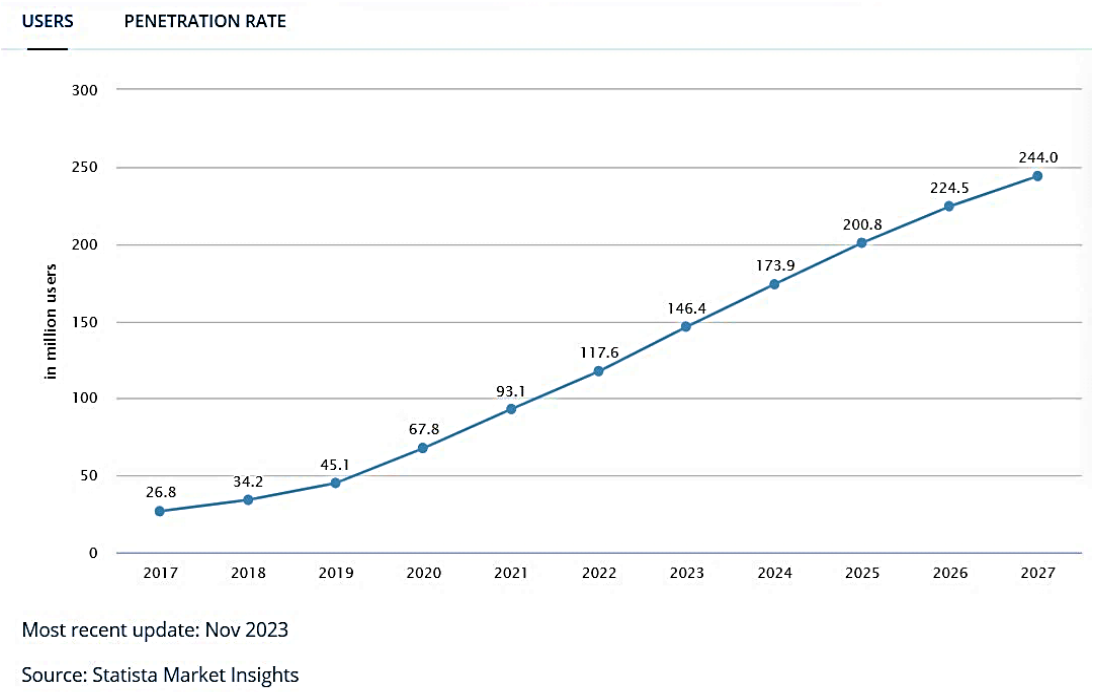

Figure 1.2. Growth of Digital Learning Platforms in India [Source: Statistia]

Design education cultivates values, critical thinking, and sensory skills among students, unlocking their creative and innovative potential. Design's positive social impact reaches far and wide, enhancing the quality of life (Gogu & Kumar, 2021a). There are about 2131 design colleges in India. Out of these colleges, 1,165 are privately owned, 315 are owned by the public/government, and public-private organizations own 122 colleges. Google Trends shows that the interest in digital design learning has gradually increased from 2018 to 2023, as shown in Figure 1.3 (Google Trends, 2023)

As stated by the Interaction Design Foundation in 2020, user experience encompasses the comprehensive process employed by creative teams to develop products that deliver meaningful and relevant experiences (Interaction Design, 2023). This concept is often discussed in conjunction with user interface and usability. There are numerous benefits associated with investing in user experience, which include enhancing user retention, acquiring and fostering loyal customers, improving user satisfaction, boosting overall productivity, and decreasing both development time and expenses.

Research indicates that approximately 68% of e-commerce users abandon a website due to poor user experience design. Furthermore, 44% of online shoppers are likely to share their negative experiences, while 62% are inclined to return to the website if the user experience is satisfactory.

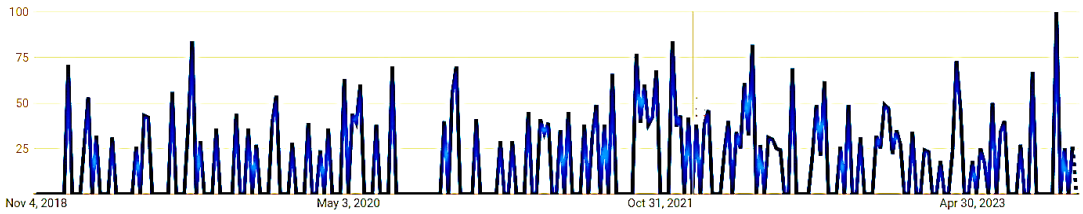

Figure 1.3. Digital Design Learning interest [Source: Google Trends]

Figure 1.4 illustrates this data, revealing that around 1.394 billion users leave websites with inadequate UX. This substantial figure underscores the necessity for continued exploration into its implications for e-learning platforms (Miya & Govender, 2022).

The considerable increase in global internet accessibility is a crucial contributor to the growth of the e-learning technology sector. E-learning enables individuals to learn at their own pace and convenience, effectively eliminating geographical constraints and catering to those with varying commitments, such as professional and familial duties (Vivekananthamoorthy et al., 2009). Nonetheless, the degree to which students are willing to adopt and engage with e-learning systems will significantly influence their efficacy (Süner-Pla-Cerdà et al., 2024). As the population of internet users continues to rise, it is anticipated that a larger number of students will turn to e-learning platforms for their educational needs (Rajasekaran et al., 2022). Digital education represents a worldwide movement, with projections indicating a compound annual growth rate of 20.5% for the e-learning market by 2030 (Polaris Market Research Report, 2024). The fourth Sustainable Development Goal of the United Nations aims to guarantee universal access to quality education and lifelong learning opportunities for all individuals. A thoughtfully designed user interface enhances engagement, facilitates navigation, and supports impactful learning experiences. Conversely, suboptimal UI design may impede access to resources and diminish motivation.

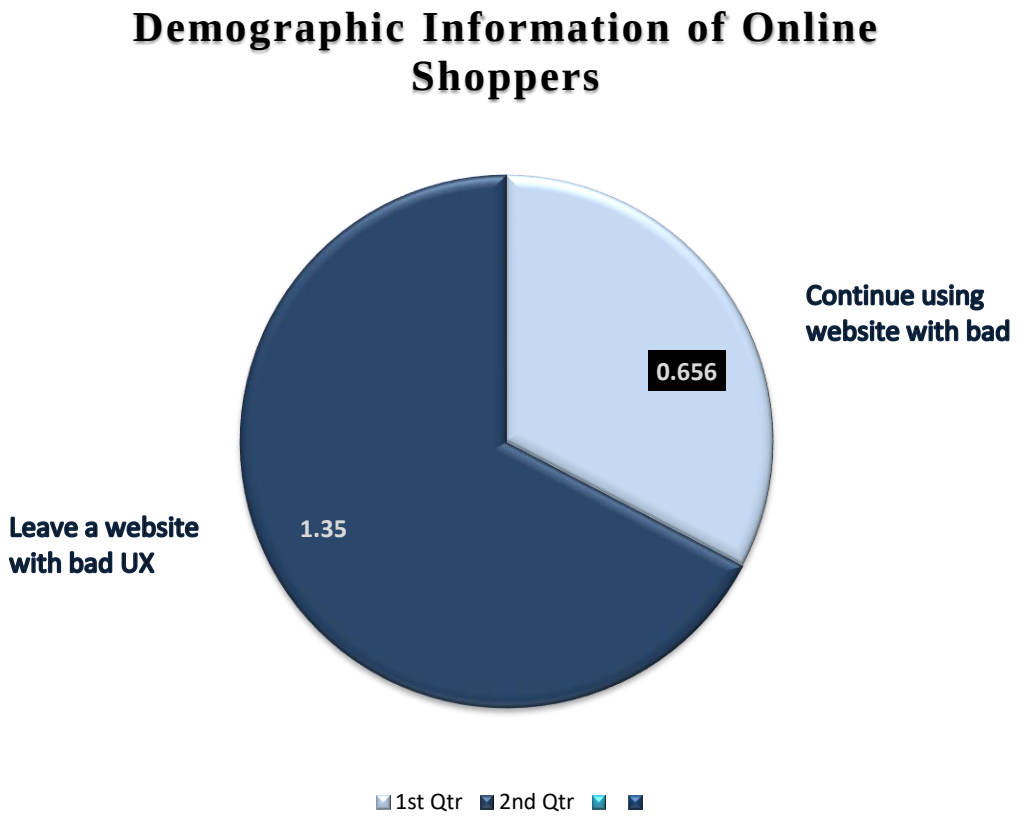

Figure 1.4. E-commerce users' web behavior (Miya & Govender, 2022)

E-learning presents innovative avenues for individuals with disabilities and international students to obtain high-quality education, thus widening the educational horizon. Incorporating multimedia and interactive components into e-learning platforms significantly boosts learner engagement and comprehension, facilitating the grasp of intricate concepts (Harrison et al., 2018). E-learning systems offer swift access to information, fulfilling the escalating demand for knowledge in a fast-changing world. However, it remains crucial to address challenges such as the digital divide and learner motivation to fully realize the educational potential of e-learning (Kapo et al., 2024; Matee et al., 2023).

Additionally, e-learning broadens access to design education for students who encounter geographical or personal constraints. It fully engages learners via interactive platforms, which provide notable advantages in design disciplines that necessitate visual and practical skills. Integrating digital tools in design education has become essential in preparing students to tackle contemporary design challenges (Amaral et al., 2023;

Dreamson, 2020).

Techniques such as interactive e-books enhance the comprehension and retention of complex design concepts, rendering the learning process more dynamic and accessible. A different analysis investigated the potential for design educators to weave the fundamental concepts of design studio pedagogy into blended learning. It has been established that users prefer engaging with straightforward user interface elements. User interface design is essential for mediating interactions between users and developers, thus enhancing user experience and website usability (Senevirathne & Manathunga, 2021). In digital learning platforms, usability and overall user experience are paramount(Liu et al., 2024). Usability concerns the efficiency with which users can execute tasks and achieve objectives, while user experience involves the interaction between the user and the service (Hasan, 2021).

Effective User Interface (UI) and User Experience (UX) are vital for engaging learners and ensuring optimal usability. This study identifies strategies to enhance UX through UI design within digital learning platforms, particularly in design education.

1.2 Literature Review

A detailed review of the literature on the relevant and closely associated topics is presented in the following subsections to help understand and connect with the research topic under consideration. The intended subject of research is from a UX/UI perspective. The review used online search engines like Web of Science, Scopus, Google Scholar, and Shodhganga. In addition to online search, reputed journals, printed books, and conferences were searched in the Laxminath Bezbaroa Central Library, Indian Institute of Technology (IIT) Guwahati.

This thematic narrative literature review was carried out with the purpose:

- To gain background on the research topic.
- To know the state-of-the-art status of the ongoing research in the selected domain.

- To identify the concepts relating to it, potential relationships between them, research design, methodology, and techniques used by other researchers to carry out their research in the selected domain.

- To identify the gap in earlier studies and further formulate research questions, aim, objectives, and research hypothesis.

1.2.1. Current State of Digital Design Education

The COVID-19 pandemic catalyzed a shift towards online instruction, yet even as things gradually return to normal, the use of social media for teaching, feedback, and learning continues to expand and evolve.

This study explores the relationships between online social networking, social connectedness, and learning within design education across online, offline, and blended learning environments. The paper presents findings derived from quantitative studies conducted across various design schools in India. Participants anonymously responded to an online survey using google form. The study assessed the extent to which course material was shared, discussed, and engaged across different social media platforms. Data analysis uncovered a notable correlation between perceived connectedness and engagement on social media with peers and the development of design creativity and learning among students (Gogu & Kumar, 2022).

Another study, in which the findings are from a mixed-methods approach, incorporates quantitative and qualitative methodologies. Sixty-three students from five distinct design schools across India participated anonymously in a questionnaire survey. This research evaluates the extent of students' social connectedness with their instructors and peers in online (Gogu & Kumar, n.d.)

There is a growing need for a new approach to design education, one that is open-ended and adaptable to the multifaceted nature of professional environments. This paper aims to explore innovative design education in India. Employing a case study methodology, the research centers on USID (Universal, Sustainable, Innovative Design for Social Change), a non-profit forum that fosters collaboration between design and technology communities. USID allows students from diverse disciplines to collaborate, explore, and create innovative design solutions for prevalent social issues. The ultimate goal is for this

model to benefit India and serve as a valuable resource for other nations, fostering a better quality of life and socio-economic development globally (Vivekananthamoorthy et al., 2009).

This research aims to delve into students' viewpoints from five design schools in India regarding their experiences with online courses and their perceived sense of social connection. The paper presents findings from a study involving quantitative and qualitative data. Furthermore, the paper highlights some of the elements of traditional face-to-face classrooms that students find most lacking in the online learning environment (Gogu & Kumar, 2021b).

Design education is usually done in a studio setting in two forms: the design activities, the results of those activities, and the design artifacts. These two form an essential role in the design process of education. Design artifacts include sketches, schemes, photographs, and prototypes. These 'objects of thought' together with the physical presence of design actors (students and tutors), assignment, and studio environment form a place of focus and inspiration. While digital learning has already going, design education is still not as readily available digitally as like other technical subjects. With studio-based learning at its core, design courses usually have small class sizes. They typically use project work and collaborative creative problem-solving for many possible solutions (Fleischmann, 2019; Stellingwerff et al., 2018).

1.2.1.1 Comparison of design education with science and engineering

Design education and science or engineering education have different focuses and approaches. Design education emphasizes applying design principles and problem-solving skills to create innovative solutions. It often incorporates experiential, active, and project-based learning methods. The existing engineering design process models presented by textbooks and researchers are reviewed here. It considers contemporary learning theories that align with the engineering design process regarding design cognition. The paper provides practical suggestions for using the engineering design process in the classroom (Delen & Yuksel, 2023).

On the other hand, science and engineering education primarily focus on acquiring scientific knowledge and technical skills. Science education is key in elementary,

secondary, and teacher education. Engineering education, especially at the undergraduate level, is the main focus of engineering design and design-based learning literature. However, a growing interest is in incorporating design and engineering principles into elementary and secondary education. Integrating high-level scientific research into college classes is an effective way to cultivate innovative talents (Sung & Kelley, 2022).

Design primarily concerns creating solutions to practical problems and meeting human needs. It involves a creative and iterative process where knowledge is often context-specific. It aims to produce tangible or intangible outcomes, such as products, services, systems, or experiences, that serve a specific purpose and address real-world challenges. It often focuses on user-centered solutions. It usually emphasizes hands-on, experiential learning and encourages collaborative thinking (Kim & Lee, 2023).

Science can be interdisciplinary; it typically follows the boundaries of scientific disciplines like physics, chemistry, biology, etc. Scientific findings are expected to be objective, replicable, and independent of personal biases. It relies on empirical evidence, systematic observation, and adherence to the scientific method to establish facts and theories (Avwiri, 2020).

1.2.1.2 Understanding Design Pedagogy, Barriers, and Frameworks

Pedagogy is an academic discipline that shows how knowledge is imparted in an educational context. It is the art or science of teaching education and instructional strategies or styles. Pedagogic features include analysis of learning needs, definition of learning goals, didactic content organization, selection of teaching methodologies, and learning assessment. It considers the interactions that take place during learning. Specific features are associated with design education's needs, making its pedagogy unique (Royalty, 2018). The simultaneous combination of theory and practice in studio environments, focus on theories of art and science, classroom activities based on teamwork and collaboration, problem-solving process with creative thinking, and opportunistic usage of multimedia materials and content are some of the unique aspects of design education. Studio culture is an integral part of design education (Rosa & Ferreira, 2023).

Another study examines pedagogical approaches across diverse learning environments, academic levels, and student demographics. It influences not only how educators teach design but also the socialization of students into design practices. Furthermore, it shapes professional behaviors and attitudes, which significantly impact the future of the design (McLain, 2022; Waks, 2001b). Design education can be improved to better prepare students for the workforce by addressing key challenges and implementing strategic initiatives. One challenge is the growing competition among institutions to acquire students, resulting in high expenses and inadequate financial aid (Waks, 2001a)

Another challenge is the need for a shift in culture for design education to adapt to student designers' changing attitudes and values. Additionally, design education should aim to improve the design literacy of the whole society and establish a new paradigm of interdisciplinary design education. Schools must also focus on helping students learn about themselves, understand their world, and feel empowered to tackle social problems innovatively (Brosens et al., 2023a). To improve the transition from high school to design school, it is essential to address first-year design students' academic preparation, curricular and pedagogical contrasts, support systems, and cognitive and emotional development. By addressing these challenges and implementing strategic initiatives, design education can better prepare students for the work (Crowther, 2013).

To solve all the problems of design education, the integration of many academic disciplines is necessary. Furthermore, there is a gap in the competencies of design students when working on social, environmental, and sustainable design processes. Lastly, the ongoing changes in the design industry, including emerging business models and new design markets, present a challenge in preparing the latest generation of designers (Dreamson, 2020; Durmus, 2015).

The rapid pace of technological progress renders knowledge quickly, demanding continuous self-improvement from employees to stay relevant and competitive. To retain a competitive edge, employers must regularly upgrade their workforce's skill sets, mirroring nations' need to elevate their collective skill base. This evolving paradigm has prompted numerous discussions advocating the shift from traditional educational models to the more adaptable and responsive concept of lifelong learning (B. S. et al., 1 C.E.). The online learning environment is pivotal in providing new learning through IT. In this paper, the ODLE learning framework has four components: Course, Instructor, Learner,

and Internet. The relationship between these components is further investigated (Chen & You, 2009).

Design education needs to strike a balance between teaching theoretical concepts and practical skills. Providing constructive feedback and facilitating design critiques can be difficult. Design educators must prepare students for interdisciplinary teamwork, which can be complex due to differing backgrounds and perspectives (Brosens et al., 2023b). Educators must stay updated with the latest design software, tools, and digital platforms, and ensure their students have the most relevant skills. Design pedagogy must address inclusivity and diversity in design, considering how designs impact diverse user groups and ensuring that design education is accessible and welcoming to students from all backgrounds. Developing effective assessment methods for design work, such as portfolios, presentations, and project-based assessments, can be challenging (Paskevicius & Irvine, 2019).

Additional obstacles in the design studio naturally result from the unique environmental, social, formative, and evaluative contexts. Ecological barriers include such issues as the distinction between private and public space, the lack of a traditional classroom setting, and the potential of unfamiliar tools or classroom norms. Social norms can also create comfort issues, particularly in the critique-oriented culture of the design studio; students must be willing to openly discuss the strengths and weaknesses of their classmates' work and receive feedback similarly. Formative barriers occur with social concerns but relate to the individual's development of personal design knowledge, thinking, and sense of personal process. Evaluation is connected with the other three categories of barriers. The assessment is accomplished through small groups or desk "crits," but is also commonly adapted to a larger setting through public critiques formed by the entire class or cohort (Crowther, 2013; Gray, 2011; McLain, 2022).

1.2.2. Understanding the role of UX/UI in Digital Learning

Valuable insights can be gained by analyzing existing UI/UX design recommendations and studying user interface usability and user experience in online platforms. The educational program created in this study is expected to be a valuable resource for beginners aiming to understand how to implement data-driven design methodologies (Borrelli & Perrella, 2021).

The design of online courses should focus on usability criteria such as information quality, system navigation, system learnability, visual design, instructional assessment, system interactivity, and responsiveness. This study addresses the challenge of developing an educational platform interface that maximizes effectiveness in achieving educational objectives. This study involves a theoretical analysis of established UI/UX guidelines for developing educational systems. Furthermore, the paper discusses standard web design components and identifies contemporary trends in designing educational platforms (Vlasenko et al., 2022).

Utilizing the design thinking process can enhance foundational knowledge and promote human-centered creativity in UX/UI design courses. In response to this change, the Ministry of Education's curriculum seeks to develop individuals with strong observation skills, inclusivity, and creativity, in addition to essential competencies (Faghih et al., 2013).

By conducting action research and using a prototype approach, the potential of problem-based learning can be explored, and educational programs can be designed effectively. This article addresses the essential challenge of effectively integrating usability principles into online educational resources. It focuses on six established criteria in usability design. It includes information quality, system navigation, system learnability, visual design, instructional assessment, and system interactivity (Giraldi et al., 2023).

The pandemic has significantly accelerated the adoption of e-learning, prompting a substantial change in curriculum development due to heightened dependence on technology. The study is about identifying the impact of user interface and leaner experience of digital learning platform (Handayani et al., 2020) .

In order to find out the general issues and related features a structured review focusing the usability of e learning platform in higher educational institutions covered research done during the past five years. The results pointout how important the user experience and interface design of e learning systems for improving the student learning outcomes. This study pinpoints how crucial UI and UX design is to impact the higher education’s e learning platform. (Miya & Govender, 2022a).

The relevance of user centered digital learning environments is the key focus of the study.

A better user support system is important in this area due to the growing usage of digital learning, brought about numerous usability issues and perception among students. The study aims in developing, creating, deploying, and assessing a user focused digital learning environment and support system for graphical interface. (Abdul Aziz et al., 2022)

The user interface design generally helped to create educational environments, focusing on the digital e learning interfaces that are essential to the process of online learning. Although a significant portion of this subject pertains to conventional user interface design, there exist specific areas that present challenges where the distinctions between interface design and learning design become increasingly blurred (Rifai et al., 2023).

Another study examines the challenges students encounter in less developed countries. These challenges span from insufficient financial resources to acquire necessary technological equipment to a deficit in digital skills. Additionally, access to internet connectivity and suitable software poses significant obstacles for these students. The application's user interface represents the initial interface users encounter before interacting with its content (Devisakti & Ramayah, 2019).

They emphasize that a proficient UI allows users to utilize the available features effectively, thereby enhancing the overall user experience (UX). Students often have preferences that align with different user experiences and interface designs, which significantly influence their learning outcomes. Favorable user experience (UX) and user interface (UI) designs can assist students in achieving their desired learning outcomes. Research in the realm of UX within digital design learning has been somewhat limited (Joo, 2017).

This scarcity of attention directed towards UX in online courses is primarily due to the primary focus being on learning itself, often neglecting student satisfaction. Issues such as non-intuitive interfaces can considerably impact students' learning experiences and overall satisfaction (Senevirathne & Manathunga, 2021).

The factors influencing the acceptance of digital learning among the students are usability, lecturer characteristics, quality of system, the information provided, and available technical support. While, many studies employed the user satisfaction as a

major criterion for online learning platform but despite the fact that, some did not assess the usability of the digital learning system exactly. The major elements impacting the selection of digital learning systems are interface design, usability, information quality, user experience, personalization or user context, and other system concerns. (Zhang & Dang, 2015).

1.2.3. Usability Evaluation Techniques

The research has concentrated on examining the usability of digital learning platforms, highlighting their vital role in improving user experience and promoting better educational outcomes. An evaluation using the System Usability Scale on language and virtual learning environments has shown scores that fall short of acceptable standards. This outcome underscores the ongoing need for enhancements in platform design and usability with the rise of the internet and digital tools, the landscape of foreign language learning has evolved into a more accessible, enjoyable, and streamlined experience for users. Developers of these platforms are placing a premium on usability and quality while recognizing their critical importance. In 2021, the platform was tested with 3,200 students, who provided feedback on usability through the System Usability Scale. (Abuhlfaia & de Quincey, 2019; Rifai et al., 2023).

The Systematic Usability Evaluation method is a valuable approach for evaluating digital learning systems among the various assessment techniques that have been recognized. This methodology enhances the evaluation process by integrating a user testing approach with an innovative inspection tool. Furthermore, the heuristic evaluation proves effective in pinpointing usability challenges within e-learning platforms, as a select group of evaluators scrutinizes the user interface to assess its alignment with established usability criteria (Krawiec & Dudycz, 2020). Nielsen's heuristics are particularly prevalent in this domain, serving to highlight usability concerns and offering designers essential insights on how effectively the interface meets the expectations and needs of its intended users. (Mohammod & Hossain, 2015).

Reports indicate that specialists carried out a systematic evaluation in line with established guidelines by incorporating the user centered evaluations alongside student feedback regarding their comfort level with the system. This review process featured a walkthrough usability test with a memo test, a survey measuring usability satisfaction

and heuristic evaluation with teachers participating as test users. (Vlachogianni & Tselios, 2022). Another procedural aspect of the study consisted of inspection reviews aimed at measuring the system interface's alignment with established usability heuristics, also facilitating educational assessments. In a meta-evaluation conducted to compare two e-learning evaluation methodologies concurrently, the researchers contrasted expert heuristic evaluations with survey assessments conducted by learners (Yammiyavar & Deshpande, 2012).

Together, these studies underscore the crucial role of usability in enhancing digital learning platforms and offer valuable insights for their advancement. Researchers point out the need for more studies. They recommend a combination of methods over a single method in order to adopt an effective evaluation strategy. In our study, we review papers on learner characteristics, learner analytics, e-learning frameworks, related case studies, and how they improve the user experience of an e-learning platform (Mangaroska & Giannakos, 2019).

Another study examines whether learners from diverse demographic backgrounds have varying experiences with online open courses, particularly learning motivation, behavior, and outcomes. Its objective is to provide insights into enhancing the development and implementation of online open courses and public service platforms to generate more excellent societal value (Sheu & Shih, 2017). Additionally, it underscores the significance of online courses in promoting lifelong learning and fostering a culture of learning. The research paper examines performance in six crucial demographics: region, neighborhood socioeconomic status, previous educational background, age, gender, and disability status. It underscores the diverse nature of online learners in terms of physical, behavioral, and geographical diversity, underscoring the significance of considering the varied characteristics of learners (Parlakkiliç, 2022).

By testing learners' programming activities, clickstream data, and textual data, instructors can gain insights into their progress and difficulties. Furthermore, monitoring online learning engagement through multimodal behavioral data collection helps quantitatively evaluate learning engagement and assess the overall state comprehensively and automatically. Efficient methods for collecting complete behavior data, such as tracking user actions and retention times, further improve data collection efficiency (Amaral et

al., 2023; Bower & Vlachopoulos, 2018). This research explains the model for evaluating e-learner behavior and motivate students for improving their academic achievement. Another study among online learners concerns physical attributes, behavioral tendencies, and geographic disparities, thereby highlighting the critical importance of acknowledging and integrating the diverse characteristics of learners in the pedagogical process (Tomitsch et al., 2021).

The bounce rate is the percentage of users who leave the webpage shortly after clicking on an ad or accessing an e-learning platform, significantly impacts user engagement and learning outcomes. High bounce rates negatively affect user engagement by demonstrating swift departures from the website. (Khalid et al., 2024).Employing new techniques to minimize bounce rates can improve user retention and learning outcomes on the e-learning platform. When users leave quickly without engaging with their contents by a high bounce rate can impact negatively the user engagements and learning results on digital learning platforms. This may also detrimentally affect quality indicators such as platform ratings and educational effectiveness. To improve user experience,it essential for design processes to focus on minimizing bounce rates (Mittal & Dhari, 2019).

The effective utilization of technology plays an important role in influencing user retention and engagement within online communities. Research suggests that the enduring success of digital communities relies heavily on the strategic application of technology to foster user engagement and retention, the integration of technology along with personalized features, such as privacy settings and content management tools, positively impacts habit formation and perceived value, thus enhancing user retention in e-learning platforms (Casanova et al., 2020; Mark & Vogel, 2009). The creation of an analytic system aimed at foster innovative learning seeks to tackle challenges within e-learning settings and employs various strategies, including page view analysis and social network analytics, click-through rate evaluation, and predictive modeling to advance student learning and interaction on online platforms.(Awichanirost & Phumchusri, 2020; Vivekananthamoorthy, n.d.).

Google Analytics is the main technology used in a study to create online courses and analyze students learning patterns. To properly understand the data the study technique

integrates quantitative instruments with qualitative information gathered from focus interviews, groups, diaries, and document analysis. (Luo et al., 2016). This case study which focusses on a particular high school online course, gathered information from 785 distinct visitors between February 1, 2020, and September 16, 2020. The purpose of the visualisation tool is to help teachers understand how students behave in an adaptive e-learning environment. Data gathering, analysis, and visualisation make up the three elements of the tool. Information regarding student participation in the e-learning system is gathered through data collecting (Moissa et al., 2014). Google Analytics is frequently incorporated into MOOC systems, such as Coursera and edX. (Awichanirost & Phumchusri, 2020).

Web analytics played a significant role in evaluating digital learning models by examining different metrics. These metrics encompass session durations, rates of completion, page views, click-through percentages, user comments, and retention statistics. Research emphasizes the importance of correctly setting up these tools to capture relevant data, which includes user flow, traffic origins, engagement statistics, and conversion information (Domazet & Simović, 2020). Numerous case studies show how web analytics can assess digital learning environments, primarily concentrating on user engagement, fulfillment of educational goals, and the continuous enhancement of e-learning platforms. (Dovha et al., 2024).

Access to the Open Courseware open learning platform is available to users via the MIT courseware website. Information is collected through diverse approaches, including surveys, interviews, and web analytics (Carson, 2004). It's vital to evaluate e-learning frameworks to confirm they meet educational targets and ensure user satisfaction. This review concentrates on the methods, KPIs, and case studies that showcase best practices and common issues, based on recent studies in web analytics for the assessment of e-learning systems. (Giraldi et al., 2023; Shireen, 2018).

1.3. Scope of Work

This study aims to evaluate and improve the user experience of e learning platforms tailored for design education. The main objective is to evaluate the usability and interface of selected platforms, particularly focusing on redesigning the platform with the lowest scores. The research includes a comprehensive analysis of essential UX and UI elements relevant to digital design education platforms. This entails user-centric assessment surveys, statistical evaluations to understand usability perceptions, and a visual comparison of several selected platforms based on key criteria. Additionally, it gathers qualitative insights into user expectations, interaction behaviors, and design issues. The analysis also incorporates web analytics to study actual user behavior patterns. Finally, the project involves redesigning the interface using established design principles and assessing the improvements in user experience.

The research is conducted among students and professionals in design and engineering fields, with the results being analyzed to platforms that provide visual, interactive, and creative educational materials. The study offers recommendations for UX improvements but neglects to address technological development, content generation quality, or scalability issues of e-learning platforms. The emphasis continues to be on user interface design, usability evaluation, and experiential enhancements.

1.4. Research Gap and Research Questions

The existing literature on digital learning, design learning, the role of UX/UI, and usability evaluation techniques has identified significant research gaps. Haleem et al. conducted a review to understand the role of digital technologies in education, noting that technological advancements have made life easier for students. Jindal et al. pointed out the challenges and opportunities for online education in India, highlighting that key drivers for its growth include increased internet penetration, the low cost of online education, the ease of course completion, government initiatives, employer recognition, and efforts to bridge educational gaps.

Agrawal et al. analyzed and compared two of the world's most widely used MOOCs, edx.org and coursera.com, with India's own MHRD-funded e-learning initiative, NPTEL, which provides course materials to engineering students worldwide. Dang et al. noted

that the COVID-19 pandemic has accelerated the digitalization of learning processes through the use of MOOCs. This case study included qualitative inquiries and empirical surveys. Costa et al. studied the Moodle e-learning platform at a Portuguese university to assess the success of the teaching and learning process, utilizing content analysis and non-structured interviews. However, there remains a lack of research focused on digital design learning platforms.

Ji Young Park proposed an integrated framework with three key components: an interactive delivery structure, communication channels, and learning evaluations. Poovaiah et al. aimed to broaden the involvement of design education in India, while Katja Fleischmann explored the attitudes of design students towards studying design online, identifying barriers to online study and ways to reduce them. Students expressed a demand for greater flexibility in their higher education options. Technology emerged as a significant factor in design education. This inductive study used an online survey featuring both closed and open-ended questions to explore student attitudes, suggesting that MOOCs present a valuable opportunity to enhance education. Given that design is a project-based discipline with studio-based teaching as its core pedagogy, Gogu et al. compared online and face-to-face design education in terms of social connectedness between students and faculty. Colin M. Gray discussed barriers in design pedagogy.

Punekar et al. presented institutional experiences from three nationally recognized higher education institutions in India that collaborated to create a digital learning environment for design education. Chen et al. developed a framework for establishing an online design learning environment. Miya et al. examined the influence of UX/UI on e-learning, identifying gaps in understanding the factors that affect learning outcomes for users. Although there have been comparative analyses of e-learning platforms, critical studies focusing on the design of learning platforms remain scarce. The user experience of design platforms is still an area that requires further exploration. While research has been conducted on e-learning platforms and their impact on users, there is a lack of emphasis on design education and digital spaces.

Yammiyavar et al. discussed various usability evaluation strategies, including SUE methodology, heuristic evaluation, guideline-based evaluation, general findings, meta-evaluation, and an integrated approach, recommending the latter as an effective evaluation strategy. However, there has been limited research on the usability evaluation

of digital learning platforms specifically for design education. Dubey et al. conducted a study on user engagement in e-learning, examining key factors such as perception, hedonic motivation, usefulness, empowerment, and attitude in the learning process. Nevertheless, significant gaps remain in identifying the key factors relevant to designing learning platforms. Stellingwerff et al. researched ways to improve the online design education experience, detailing how to translate the qualities of a studio education setting into an online environment for design education. The research gap diagram is shown in Figure 1.5.

The following research gaps persist in the context of UX/UI for digital design learning research.

Research Gaps

- Presently, there is a limited emphasis on design-specific platforms and the relationship between user interface (UI) and user experience (UX) within digital design education. Existing research primarily focuses on these platforms' functionality and general user experience, leaving significant gaps in our understanding of how specific UI design elements influence overall UX, especially in the context of design education.
- Many digital learning platforms face usability challenges that can adversely affect the user experience. However, there are numerous studies on comparative digital learning platforms; research specifically targeting the design learning experiences is limited. This highlights the need for thorough evaluations of these platforms to enhance user experience.
- Most previous studies have concentrated on general e-learning platforms, prioritizing visual and experiential learning. It lacks a comprehensive and structured approach to evaluating these platforms based on their interface, content, and overall usability, particularly concerning established UX frameworks.
- While various platforms offer design education, the design of their interfaces has not been adequately evaluated for its impact on user engagement, learning outcomes, and overall satisfaction.
- Despite the increasing importance of digital platforms in design education, current literature reveals a notable gap in enhancing user experience (UX)

through platform recommendations.

Research Questions

From Figure 1.1, the following four research questions associated with the research gaps have been extracted:

R.Q. 1: What are the interface design factors that affect the user experience of digital learning platforms?

R.Q. 2: What are the differences or similarities among the available digital design learning platforms?

R.Q. 3: What are the strategies used for conducting usability evaluations of the available digital design learning platforms?

R.Q. 4: What strategies can be adopted to improve the UI design?

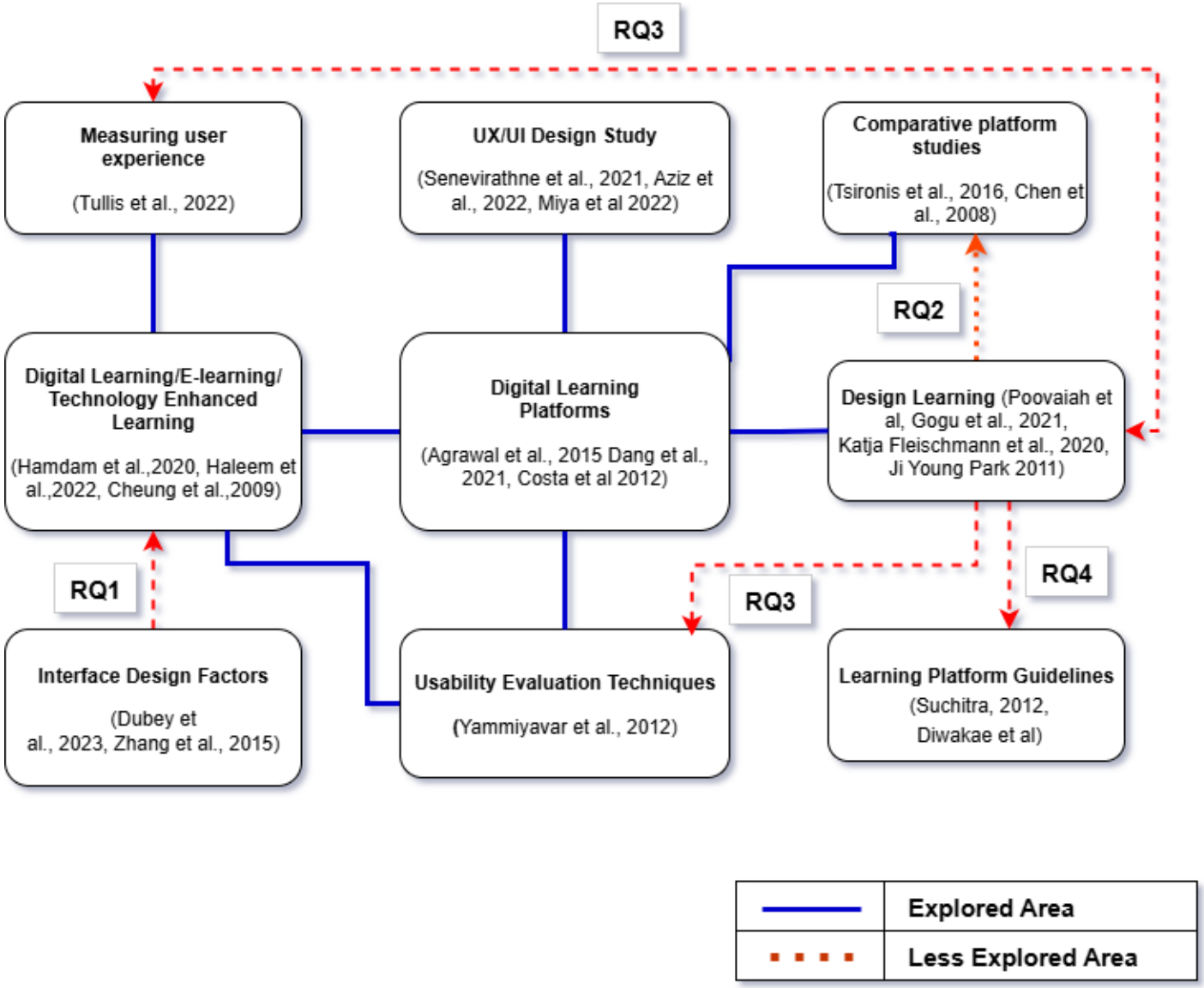

Figure 1.5. Research Gap Schematic Diagram (source: author)

1.5 Problem Statement

Digital learning platforms have transformed the educational landscape, offering learners flexibility, access to diverse content, and self-paced progression. However, the success of these platforms is not solely determined by the quality of educational content. Instead, it is largely dependent on the overall user experience.

Design education places significant emphasis on visual design and user navigation, leading to unique challenges. Many existing digital learning platforms struggle with engagement and feature complex interfaces, which can undermine the learning experience for design students. Although these platforms are capable of fostering creativity and creating visually appealing environments, when they do not meet the expectations of design learners, it can result in negative outcomes such as disengagement and a less intuitive user experience. Consequently, this can hinder the learning process and diminish motivation.

Moreover, subpar user interface design undermines learning objectives and increases cognitive load. It is crucial to explore the relationship between UI and UX design education transitions into digital realms. A comprehensive assessment of how key elements influence user engagement is necessary. Yet, particularly in the field of design education, there is a lack of understanding regarding the impact of user interface design on user experience.

This highlights the urgent need to investigate how user interface design affects UX and ways to enhance it to better support design-oriented learning platforms. By gaining deeper insights into these relationships, we can more effectively customize educational platforms to cater to the specific needs of design students.

1.6 Motivation and Justification for Choosing the Present Research

Digital education has profoundly transformed the delivery, accessibility, and experience of design learning. The growing popularity of e-learning platforms has intensified the focus on optimizing the learner's experience and ensuring content availability. However, design education faces distinct challenges due to its inherently visual, interactive, and exploratory characteristics, despite many platforms establishing benchmarks for material distribution in both technical and academic fields. This requires user interfaces that exceed mere functionality to foster creativity, intuitive navigation, and immersive involvement.

Despite the growing utilisation of digital design learning platforms, many provide an optimal user experience due to challenges associated with visual design consistency, interface complexity, content organisation, and restricted responses. As a design student and researcher, direct involvement with these platforms exposed usability issues that frequently distract learning flow and reduce engagement, particularly for learners familiar with flawless digital interfaces in other contexts. These experiences established the foundation to assess design learning platforms from a user-centric view comprehensively.

A significant gap exists in UX-oriented research concerning design-specific e-learning platforms, especially within the Indian setting. Most current usability studies concentrate on general e-learning systems, neglecting the specific requirements of creative education. This research addresses that gap by identifying critical interface design variables influencing user experience and employing systematic methodologies to enhance these platforms, including visual analysis, expert insights, and statistical evaluation. The study is relevant and timely due to the increasing reliance on digital platforms for design education since the pandemic, which requires improving the user experience in digital learning environments.

The reason for this research is also based on its practical implications. This study enhances academic literature by assessing existing platforms, applying evidence-based redesign strategies, and confirming their efficacy. It also offers practical recommendations for designers and educators, at the intersection of design education and technology. This research ultimately aims to enhance the quality and accessibility of design education through improved digital interfaces, ensuring that the user experience is facilitated.

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1.7 Aim and Objectives

***Aim**:* The study aims to enhance the user experience of digital learning platforms, focusing on design learning by improving user interface design factors.

Objectives: To fulfill the aim of the current research, the following objectives were set to achieve the goal:

- To identify the key interface design factors that impact the user experience of digital learning platforms.
- To compare various digital learning platforms used for design education by analyzing their user experience through explicit visual feature analysis.
- To evaluate the usability of existing digital design learning platforms using a structured UX questionnaire and assess the results.
- To investigate the user experience of a specific digital design learning platform through expert interviews and analysis of web usage data.
- To demonstrate user interface improvements on the selected platform and measure their impact on user experience.

1.8 Hypothesis

Improving key user interface factors such as visual design, interface design, content organization, functionality, and objective will lead to a significant enhancement in the user experience of design learning platforms.

1.9 Expected Outcome

The outcomes of the current research are listed below:

- The research aims to discover and validate the most significant user interface design variables that directly impact user experience in digital design learning platforms.

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- The study will conduct a visual analysis to comprehensively compare existing platforms, emphasizing particular elements in their interface designs.
- The quantitative survey will produce measurable data concerning user satisfaction and perceived usability across various platforms. This will encompass statistically significant disparities in user experience derived from structured assessment.
- The research will produce thematic insights from expert interviews and user input, categorizing essential pain points and expectations using qualitative coding and analysis.
- An in-depth analysis of one year of web analytics data from the design learning platform will validate practical usability concerns, incorporating a behavioral aspect into the results.
- The platform's interface design will be created based on the highlighted difficulties and design principles.
- The effectiveness of the redesign will be evaluated by comparing user responses before and after the redesign.
- The notion that enhancing UI elements improves overall user experience will be validated through statistical evidence.
- The research will culminate in actionable recommendations to improve the user interface and experience of digital design learning platforms, applicable in academic and professional development contexts.
- The study will enhance the academic field by connecting design education with UX research and will have practical implications for enhancing digital learning environments.

1.10 Scholarly outcome of Thesis

Table 1.1 summarizes the research questions, objectives, and associated scholarly outcomes as addressed in the individual chapters.

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Table 1.1: Research questions and objectives organized in various chapters and associated scholarly outcomes. (Source: author)

No	Research Question	Objectives	Publications
1	**RQ1:** What are the interface design factors that affect the user experience of digital learning platforms? **RQ3:** What are the strategies used for conducting usability evaluations of the available digital design learning platforms?	**Obj1:** To identify the key interface design elements that impact the user experience of digital learning platforms. **Obj3**: To evaluate the usability of existing digital design learning platforms using a structured UX questionnaire and assess the results.	Identifying Interface Design Factors Impacting User Experience in Digital Learning Platforms- A Pilot Study Authors: Syamala S, Abhishek Shrivastava, and Sougata Karmakar Journal: Social Sciences & Humanities Open, **Elsevier (Q1)** DOI: https://doi.org/10.1016/j.ssaho.2025.101662
2	**RQ3:** What are the strategies used for conducting usability evaluations of the available digital design learning platforms?	**Obj4:** To investigate the user experience of a specific digital design learning platform through expert interviews and analysis of web usage data.	Evaluating an E-Learning Framework for Enhancing Design Learning in India Authors: Syamala S, Abhishek Shrivastava, and Sougata Karmakar Conference: Research and Industrial Conclave-Integration 2024 DOI: will publish in **Springer Proceedings [In press]**

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3	**RQ2**: What are the differences or similarities among the available digital design learning platforms? **RQ3**: What are the strategies used for conducting usability evaluations of the available digital design learning platforms? **RQ4**: What strategies can be adopted to improve the UI for designing?	**Obj2**: To compare various digital platforms used for design education by analyzing their user experience through explicit visual feature analysis. **Obj3**: To evaluate the usability of existing digital design learning platforms using a structured UX questionnaire and assess the results. **Obj5**: To implement user interface improvements on the selected platform and measure their impact on user experience.	Enhancing User Experience in Digital Design Learning Environments through User Interface Improvements: A Comprehensive Approach Authors: Syamala S, Abhishek Shrivastava, and Sougata Karmakar Journal: Submitted to **IEEE Access,** 2025 **[Q1, SCIE] [Under Review]**

1.11 Outlines of the Thesis

The present research study has been divided into seven chapters. A summary of each chapter is discussed below:

Chapter 1: This chapter focuses on the present research study's introduction, background, and the urge/ need. The summary of current research about the research topic is discussed, along with the research gap and associated research questions. The aim, objectives, and hypothesis of the current study are highlighted in this chapter. A summary of research outputs (scholarly) is discussed in this chapter.

***Chapter 2*:** This chapter identifies key interface design factors that impact the user experience of digital learning platforms. In this chapter, a thorough literature review is carried out to get familiar with the current influencing factors in the work domain, the scope of improvement through direct observation, different UX models considered by other researchers, and Garret's UX model, which may be best suited to steer the study ahead.

***Chapter 3*:** This chapter studies different digital design learning platforms, platform selection, participant selection, and methodology adopted for explicit visual feature analysis. The three digital design learning platforms are selected for further research study are further denoted as platform A, B, and C. A comparative explicit visual feature analysis of three platforms is conducted.

***Chapter 4*:** This chapter discusses the usability evaluation process of selected digital design learning platforms. The pilot study includes user usability evaluation questionnaire development (UUEQ), reliability, and content validity testing. A comparative study among three digital design learning platforms is further conducted to identify the issues.

Chapter 5: This chapter investigates the user experience of a specified digital design learning platform through qualitative study and the analysis of web usage data. The results from these two studies give us a deeper insight about the low performing platform.

***Chapter 6*:** This chapter provides user interface improvements for the low-scoring platform through a triangulation approach. The platform is redesigned through new UI screens, and its statistical impact is measured. All factors shows significant

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improvements.

***Chapter 7*:** This chapter outlines recommendations for enhancing the user interface to improve the user experience of digital design learning platforms. It highlights the contributions, key insights, limitations, future scope, and conclusion.

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2

Identification of Key Interface Design Factors that Impact the User Experience of Digital Learning Platforms

Abstract

This study explores the critical user experience (UX) factors influencing digital learning platforms, specifically focusing on design education. The research identifies key usability and design elements that affect user interaction using a three-pronged methodological approach, systematic literature review, direct observation, and theoretical framework integration. Garrett's Five-Plane UX Model was employed to structure findings into five dimensions: Objectives, Functional Specifications, Content Organization, Interface Design, and Visual Design. Both general e-learning platforms and design-specific platforms were evaluated. The results provide a detailed UX factor map, a foundational tool for platform redesign and future UX evaluations in design education contexts.

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2.1 Introduction

Digital learning platforms are essential for disseminating knowledge, particularly in the evolving educational landscape following the pandemic. Despite their educational significance, many of these platforms experience low user engagement and retention levels due to deficiencies in user experience (UX) design. Consequently, it is critical to identify the interface factors that influence user satisfaction and performance. This chapter examines the key UX components that affect learner engagement and interaction, specifically emphasizing design-based e-learning environments. A comparative analysis between general e-learning platforms and those specifically tailored for design has been adopted to achieve a comprehensive understanding.

The remarkable expansion of global internet accessibility has been instrumental in advancing the digital learning technology sector. E-learning allows individuals to engage with educational materials at their own pace and convenience, effectively eliminating geographical constraints and catering to those with diverse obligations, including work and family responsibilities. Nonetheless, the willingness of students to adopt and engage with the e-learning platform will be pivotal in determining its success (Liaw, 2008). As internet users continue to rise, more students are anticipated to leverage e-learning solutions for their educational pursuits. Digital learning represents a worldwide phenomenon, and projections indicate that the compound annual growth rate of the e-learning market is set to reach 20.5% by 2030. The fourth goal established by the United Nations' Sustainable Development agenda is to ensure that quality education and lifelong learning opportunities are accessible to all individuals (UN, 2015).

Digital learning presents new avenues for individuals with disabilities and international students, facilitating access to high-quality education and broadening the educational landscape. Integrating interactive components and multimedia in e-learning significantly boosts engagement and comprehension, simplifying complex concepts (Abuhlfaia & de Quincey, 2019). E-learning platforms provide immediate access to information, catering to the growing need for knowledge in our fast-evolving society. To unlock the full educational benefits of e-learning, it is essential to tackle the digital divide and enhance student motivation. E-learning increases the accessibility of design education for those

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facing personal or geographical challenges.

By providing interactive environments, it keeps students engaged and offers considerable advantages for design careers that require both practical and visual skills. The integration of digital technology into design education has become vital for equipping students to confront modern design challenges.(Darmawan et al., 2022).

Virtual studios and group projects have made digital learning an indispensable tool for design students, aiding them in building essential skills and encouraging creativity and innovation. It also acts as a significant resource for lifelong learning and skill enhancement, especially in areas such as drawing that rely on real-life experiences (Güler, 2023). However, there are educators who express concerns regarding the potential loss of hands-on experience and face-to-face interaction offered by physical studios, even with the many positive aspects of e-learning. To ensure a well-rounded education in design, it is important to find a balance among different educational approaches(Hepburn & Borthwick, 2021).

Despite the fact that earlier research indicates the design curriculum provides greater flexibility in learning, e-learning in design education has not been thoroughly explored. This adaptability ensures that the design studio curriculum remains up-to-date and in sync with advancements in industry technology. Additionally, another investigation examined methods by which design educators might seamlessly integrate fundamental principles of design studio pedagogy into blended learning contexts (Fleischmann, 2021).

Users generally prefer straightforward interface components. The design of user interfaces facilitates interactions between users and developers, contributing to an improved user experience and enhancing the usability of websites. Elements such as typography, color schemes, imagery, and uniformity fall under the umbrella of visual design (Alshaykha, 2022). If the user interface is complex and challenging to navigate, it can frustrate users and impede their ability to achieve learning objectives. Hence, the user interface must emphasize user-friendliness, as it plays a crucial role in shaping the user's perception of the software. In digital learning platforms, usability and user experience are vital components.

Usability refers to the effectiveness of user actions and their successful execution, while user experience encompasses the comprehensive interaction between the user and the service. Considering end users' perspectives is essential in designing and developing an efficient and user-friendly e-learning platform (Lu et al., 2022) .

In light of the growing integration of digital platforms within design education, prevailing literature indicates a considerable deficiency in assessing and enhancing user experience utilizing established UX frameworks. Most research has concentrated on generic e-learning platforms supporting visual and experiential learning. This study seeks to address this shortcoming by implementing Garrett's five-plane UX model to evaluate the digital design platform, thereby providing a domain-specific perspective that has yet to be explored (S. S et al., 2025).

This research is guided by the identified gap to improve design-oriented learning platforms. An examination of various aspects related to e-learning and design has been conducted to pinpoint the critical interface design elements that affect the user experience of the learning platform. Observations and a comprehensive literature review comprise the methodologies employed in this study. The primary objective is to ascertain the factors that shape user experience within the design learning platform and to carry out a pilot study for a more in-depth exploration of these factors through developing and validating instruments for assessing user experience.

A large body of literature exists on key factors affecting general e-learning platforms. A brief review of the literature concerning design learning factors is also identified, along with e-learning factors, compiled in the following sub-sections. A literature review on existing UX models is covered. Foremost, the literature about e-learning and the factors affecting e-learning is presented to understand the domain and background of the current research clearly.

2.2 Literature Review

A robust understanding of user experience (UX) in digital learning platforms necessitates a multidisciplinary review of existing literature. This section explores three core areas: factors impacting general e-learning systems, factors unique to design learning platforms, and UX frameworks that provide a theoretical basis for evaluation and redesign. The goal

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is to identify how interface design can be optimized to enhance the learning experience across different educational domains.

The inclusion criteria are based on publication type, date, language, and platform context as categories. Peer-reviewed journals and conferences published in English from 2010 to 2025 are included in the study. Papers focusing on e-learning, educational tools, or digital learning are considered for inclusion. The exclusion criteria focused on papers without end users, studies on non-digital without a focus on UI/UX, and studies without full-text access. Initially, the databases were searched using the keywords, and 60 relevant articles were found. Based on the inclusion and exclusion criteria, 35 articles are shortlisted. From the articles, 32 relevant factors are extracted under two categories: general e-learning and design learning factors affecting user experience.

2.2.1 Factors Affecting E-learning and Design learning

Digital learning platforms have revolutionized the educational environment, providing learners unparalleled flexibility, a wide array of content, and the ability to progress at their own pace. Nonetheless, the success of these platforms extends beyond the mere quality of educational materials. Instead, it is significantly influenced by user interaction quality, interface design, and the overarching user experience. Numerous empirical and theoretical studies have underscored critical user experience (UX) elements that significantly affect the efficacy of general e-learning systems. The evolution of e-learning technologies continues to advance, resulting in platforms with more intuitive interfaces and easily accessible content. The design of the interface can play a crucial role in shaping students' learning outcomes. Therefore, accurately identifying the end-user needs is crucial for developing an engaging Graphical User Interface (GUI) (Zardari et al., 2021).

The five primary elements that significantly influence user satisfaction with e-learning platforms include learnability, guidance, flexibility, visibility, and interaction. Learnability is determined by how effectively the screen design aids students' cognitive and educational processes. Additionally, the flexibility inherent in e-learning screen design empowers students to customize their study experiences based on their preferred format, subject matter, schedule, and learning environment.

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The clarity of the interface aids students in navigating the platform, identifying interactive elements, understanding course features, and effectively engaging with multimedia content. The assistance that e-learning platforms offer to students in overcoming challenges is termed guidance. Incorporating animations, multimedia, interactive menus, drag-and-drop options, and video elements into e-learning settings is referred to as interactivity. While each of these components boosts user satisfaction, flexibility can have various effects.(Dubey et al., 2023).

The usability of a web interface is crucial for users to adopt it successfully which measures how effectively and efficiently specific users can use a product to accomplish particular goals in a specified context while ensuring satisfaction (Kember et al., 2010). A distinct study highlighted several critical factors for assessing the usability of a virtual laboratory learning platform, including content organization and readability, navigation and hyperlinks, user interface design, performance, and effectiveness, alongside pedagogical usability. The overall acceptance level of the website, including the pedagogical usability parameters, is deemed good (Yammiyavar & Deshpande, 2012). In a subsequent research endeavor, the constructs selected for examination in the context of an e-learning study amongst university students encompassed attitude, influence of the instructor, influence of peers, self-efficacy, emotional attachment, sense of belonging, involvement, grit, usage, and performance (Devisakti & Ramayah, 2019).

One prominent area of investigation is self-efficacy, which addresses a learner's belief in their ability to perform a task successfully. Prior studies have established a positive relationship between self-efficacy and the study habits of students (Bandura, 1988). Motivation is recognized as a complex factor in determining academic achievement among students. Previous research has indicated that factors related to instructors can significantly impact learning outcomes. Both teaching strategies and various course-related elements can greatly affect students' experiences. Additionally, a course's flexibility and overall quality have been shown to influence learner satisfaction significantly. Behavioral intention describes an individual's readiness to utilize an information system or technology. It is well-recognized as a dependent variable in analyses focusing on accepting new information technologies. The study also encompasses additional factors such as perceived playfulness, usefulness, ease of use, and individual disposition. The popular metric for information systems and technology

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adoption, known as perceived playfulness, assesses how much users perceive the technology and information system to be enjoyable (Dubey & Sahu, 2022; van der Heijden, 2004; Zhang & Dang, 2015).

A separate study explored the various factors influencing e-learning. The factors under consideration include hedonic motivation, perceived usefulness, perception, attitude, and empowerment related to student engagement (Dubey et al., 2023). However, the statistical analysis indicates that both perception and empowerment concerning e-learning did not significantly affect student engagement within this specific demographic. Future research initiatives could gain from experimental approaches incorporating additional variables such as information quality, self-efficacy, and service quality to further investigate student engagement. Furthermore, e-learning and design learning factors identified through direct observations encompass content quality, readability, interactivity, levels of computer literacy, feedback mechanisms, critical thinking skills, as well as color and layout considerations (Mao & Queiroz, 2024).

User experience (UX) in e-learning platforms has been widely researched, with several studies highlighting critical factors that influence learner satisfaction, engagement, and usability. Additionally, Liaw (2008) and Keller (1987) emphasized the role of interactive elements, learner control, and clear instructional objectives as major contributors to positive e-learning experiences (Keller, 1987; Liaw, 2008).

Multimedia learning theory supports including audio-visual content to enhance retention and comprehension. Usability principles from Nielsen (1995) also stress the importance of interface design, including feedback, user control, and consistency, which directly influence how learners interact with digital platforms (Jakob Nielsen, 2024). Design education, particularly in digital environments, introduces unique UX requirements. Unlike general academic content, design learning relies heavily on visual engagement, creative exploration, and tool-based interaction. As per Löwgren & Stolterman (2014), design pedagogy must foster reflective practice and experiential learning, which demands dynamic, media-rich, and adaptive interfaces.

Norman (2013) suggest that platforms supporting design education must go beyond content delivery and enable iterative experimentation, peer feedback, and visual literacy

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development. Visual hierarchy, layout harmony, and affordances take on added importance in these contexts, influencing both cognitive and emotional engagement (Don Norman, 2013) .

To build a foundational understanding of factors influencing user experience (UX) in digital learning platforms, the literature review was conducted. Scholarly articles from IEEE Xplore, ACM Digital Library, Springer, ScienceDirect, and Google Scholar were reviewed. Keywords used for search are ‘factors affecting e-learning’, ‘UX of learning platforms’, ‘design learning attributes’, and ‘usability in e-learning. From this review, two sets of factors, named e-learning and design learning factors, emerged. These findings provided theoretical grounding for initial UX categories, which were then validated and extended through empirical methods.

2.2.2. Direct Observation

To complement the literature findings with real-world insights, direct observations were conducted among ten selected student participants having UX expertise or platform experience who interacted with two platforms: D'Source and NPTEL. Participants were observed while performing predefined learning tasks such as:

- Navigating to specific course topics
- Viewing multimedia content
- Accessing downloads or assignments
- Using platform tools

Informal feedback was gathered through observation and a think-aloud approach, where the user freely expressed his/her thoughts and feelings while working on the given task. Thematic coding of observations into 15 general and design-specific factors. The observational patterns confirmed that design learners have higher expectations for visual structure, tool intuitiveness, and creative flexibility, beyond general usability needs. Table 2.1 classifies the identified e-learning and design learning factors from both the literature review and direct observation.

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Table 2.1 Factors affecting E-learning and Design learning

Literature Review		Direct Observation	
E-learning factors	**Design learning factors**	**E-learning factors**	**Design Learning Factors**
Flexibility	Creativity	Self-paced learning	Student-centred
Motivation	Pedagogical approach	Collaborative learning	Clarity
Learnability	Active learning	Lifelong learning	Interactive learning
Memorability	Enjoyment	Academic support	Feedback
Navigation	Experiential learning	Connectivity	Visual layout
Accessibility	Curiosity	Content quality	Color
Effectiveness	Critical thinking	Feedback system	
Efficiency	Learner-centric approach	Computer literacy	
Satisfaction	Design thinking	Language support	
Pedagogical aspects	Problem-solving		
Cognitive load	Studio reflection		
Visibility	Use of multimedia		
Consistency	Typography		
Ease of use	Responsive design		
Usefulness	Project-based		
Findability	Interaction		

2.2.3. UX Frameworks and Models

Numerous frameworks have been proposed to evaluate and guide UX in interactive systems. Nielsen's Usability Heuristics (Jakob Nielsen, 2024), a rule-based approach focused on interface-level usability but limited in addressing deeper structural and pedagogical alignment. Morville UX Honeycomb Model highlights qualities such as usability, accessibility, and value, yet does not provide a temporal or layered development view. However, Garrett's Five-Plane UX Model (Garrett, 2011)offers a uniquely structured and hierarchical framework. It breaks down UX into five planes: Strategy, Scope, Structure, Skeleton, and Surface. It ranges from abstract to concrete interface elements. This makes it suitable for educational platform analysis, as it bridges both pedagogical objectives and interface design in a logical flow. The factors connected

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with learning goals and user needs are mapped with the strategy plane. The factors associated with key functionalities and assignments are mapped to the scope plane. The course flow, navigation, and modules are associated with the structure plane. The layout, interface response, and controls are associated with the skeleton plane. The visual appeal, color, and typography are associated with the surface plane.

2.3. Theoretical Framework Integration Methodology

Most earlier studies have focused on various issues without adequately addressing the fundamentals of the UX model. To gain a deeper insight into user experience, this research merges specific interface design elements with broader objectives. The study employs Garretts five plane model, which encompasses all aspects of user experience to evaluate UX (Mathew Mjindi, 2024). Compared to Normans design principles or Nielsen heuristics, Garrett model provides a more organized framework for assessment and design (Krawiec & Dudycz, 2020). It serves as an effective instrument for measuring user experience by systematically linking user challenges to different planes.

Design educators and researchers of researchers enhanced and clarified the essential elements of user experience. By seamlessly incorporating this model into a framework, a comprehensive and organized perspective on the various aspects of user experience was achieved. The foundation of Garrett's User experiance paradigm is influenced by expert opinions, aiming to enhance user centered technologies. While previous studies have examined UX characteristics, they did not integrate these findings into a cohesive framework. Figure 2.1 shows Garretts Five Plane model is used here for addressing the gap. This approach enabled us to convert our literature review and observational findings into five dimensions.

Drawing from the elements of user experience presented in Garrett's five-plane model, we identified five key factors for our study, including visual design, interface design, content organization, functionality, and objectives. Our questionnaire was developed with a user experience perspective to capture these factors effectively. By aligning the identified factors with the UX model, we ensured that the questionnaire comprehensively addressed all dimensions of user experience. The mapping of the five UX factors is

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shown in Table 2.2.

Table 2.2. UX factors mapped to Garret's plane

Garrett's UX Plane	**Integrated UX Factor**	**Justification**
Strategy Plane	Objectives	Learning goals and user needs alignment
Scope Plane	Functionality	Platform features, tools, and interactivity
Structure Plane	Content Organization	Logical structuring and modular delivery
Skeleton Plane	Interface Design	Navigation clarity, interaction layout
Surface Plane	Visual Design	Typography, color, layout, visual engagement

This model was applied in subsequent stages of platform analysis and redesign to ensure conceptual consistency and complete coverage of user experience needs.

2.4.Results and Discussion

The study employed a combined approach of systematic literature review and direct user observation to identify the principal factors that affect the user experience of digital learning platforms, with a special emphasis on design education environments. The outcome of this analysis led to the identification and refinement of five key UX factors: Visual Design, Interface Design, Content Organization, Functionality, and Objectives. Each factor was derived from recurring themes found across academic sources and validated through behavioral cues observed in users engaging with digital platforms.

The insights from the literature review and observation were thematically coded using qualitative analysis. Overlapping aspects were grouped, refined, and merged into five

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relevant core UX factors across e-learning and design learning contexts. The factors connected with visual layout, color, and typography are labelled under the key factor "Visual Design". Findability, navigation, button, layout, and accessibility related factors are grouped under the key factor "Interface Design". The factors related to content quality, search, and cognitive load are all categorized under the key factor "Content Organisation". Multimedia, interface, feedback, and project-based learning are grouped under "Functionality". At last the factors related to knowledge and creativity are shous as “Objective”.

Garrett's Five-Plane UX Model effectively structures user experience into a hierarchy, distinguishing between strategic and interface-related layers, and represents the final step in unifying the five UX criteria. This mapping framework facilitated the identification of challenges and guided the redesign process while offering a systematic approach that encapsulated all essential UX attributes. A holistic perspective of UX in digital learning platforms emerged from the integration of literature observations and conclusions. Figure 2.1 illustrates how the five UX criteria are woven into this framework.

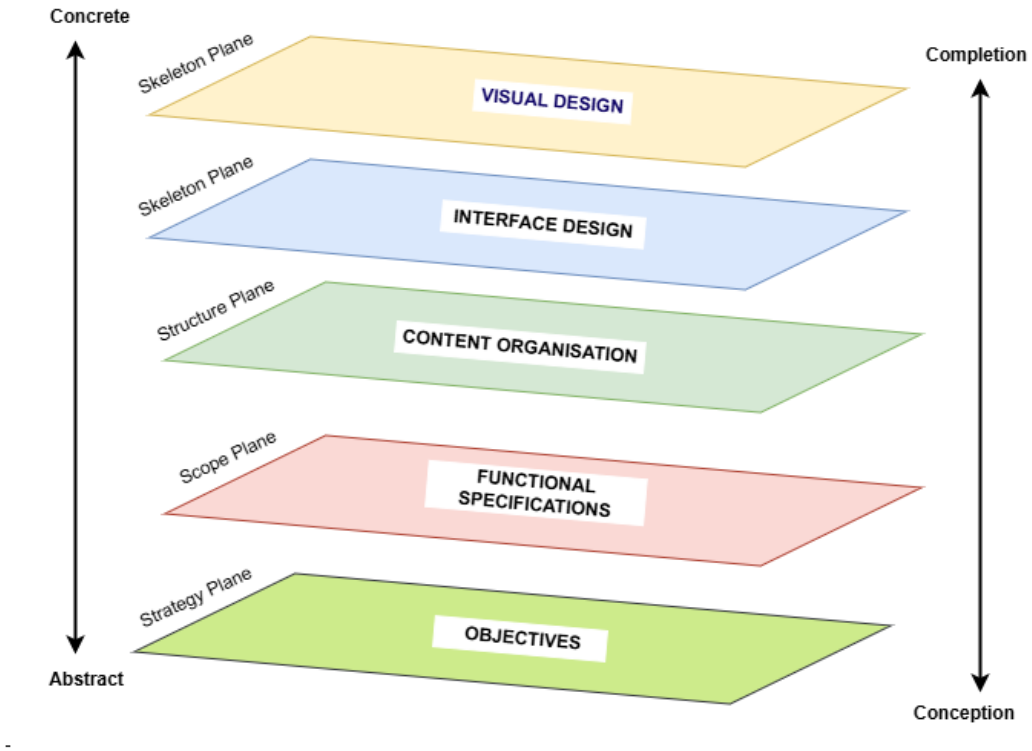

Figure 2.1. Factors integrated into the user experience framework

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The research highlights that generic e-learning platforms prioritize the breadth and efficiency of content. However, they fall short in aspects such as originality and visual appeal, which are crucial for design education. In contrast, the design learning platform focuses on design-related content but suffers from poor navigation and imagery, resulting in a less user-friendly experience.

By categorizing UX elements into specific groups and aligning them with Garrett's framework, the research provides a comprehensive view, that are mentioned below:

- A tool to assess existing platforms.
- A design guide for developing or improving platforms tailored to design learners.
- A framework for evaluation that balances usability with pedagogical goals.

By embedding the five UX factors into this model, the study ensures that future platform redesigns remain grounded in user experience best practices while supporting creativity and pedagogical structure.

2.5.Conclusion

This chapter presented the outcomes of recognizing and enhancing UX facets by analyzing user behaviour and theoretical principles. The key UX components within digital learning environments have been categorized into five dimensions: visual design, interface design, content organization, functionality, and objectives. Their systematic integration into Garrett's five-plane model provides a comprehensive framework for assessing and improving the user experience, particularly in the context of digital design education platforms.

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3

Platform Selection and Explicit Visual Feature Analysis

Abstract

This chapter discusses the selection of e-learning platforms suitable for user experience analysis in detail. Subsequently, a thorough evaluation of visual elements is carried out based on five key UX factors: visual design, interface design, content organization, functionality, and educational goals. Three platforms were identified as particularly relevant for effective instructional content delivery. Students conducted a systematic visual analysis employing a comparative framework inspired by Garretts Five Plane UX Model, focusing on the platforms' functional and visual attributes. The findings highlight significant discrepancies in user experience among the platforms, demonstrating the need for pedagogically aligned and improved user experiance solutions within the context of digital design education..

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3.1 Introduction

As the landscape of digital education continues to evolve, online learning platforms are integral to spreading knowledge and engaging users. With the shift from traditional classrooms to virtual environments, the effectiveness of these platforms hinges not only on the quality of the content but also on the design and ease of use of their interfaces. This is particularly important in design-oriented education, where learning is fundamentally visual, interactive, and influenced by context. Therefore, assessing the visual and interface attributes of digital learning platforms is vital to ensure they cater to the needs of learners, especially in fields related to design.

This chapter offers a visual comparative analysis of leading digital learning platforms, evaluating them according to five essential criteria: Interface Design, Visual Design, Content Organization, Functionality, and Objectives. These criteria were derived from a observational studies, literature review, and the use of Garretts Five plane Model of UX to create a coherent analytical framework. Furthermore, user insights were collected through participant evaluations, in which users engaged in tasks relevant to these criteria.

The chapter opens with an overview of the methods used for selecting platforms and recruiting participants. A detailed comparative analysis is then performed on three platforms viz. D'Source (Platform 1), MIT Open Courseware (Platform 2), and NPTEL (Platform 3)—evaluating them through the lens of five UX dimensions. The results are thoroughly examined, providing valuable insights into how platforms focused on design can enhance usability, foster engagement, and boost pedagogical effectiveness.

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3.2. Platform Selection

During the preliminary stage of the research, a variety of digital learning platforms were examined, such as Coursera, Udemy, Interaction Design Foundation, D'Source, NPTEL, MIT Open Courseware, and Khan Academy. Based on predetermined criteria—namely, an emphasis on design education, accessibility, content quality, and institutional credibility—three platforms were ultimately chosen. The platforms that were not selected were either insufficiently focused on design education, lacked free access, or operated on commercial models that did not align with the academic objectives of this study.

This study investigates three leading digital learning platforms—D'Source, MIT Open Courseware and NPTEL selected for their significant impacts on design education, accessibility, and diverse strategies for interface design and content arrangement. D'Source operates as an initiative backed by the Indian government, aimed at enhancing design education by showcasing outstanding student projects and scholarly work from India's top design schools. This platform offers crucial insights for assessing user experience in local educational settings, as it preserves and elevates indigenous design practices and regional creative methodologies through its extensive digital archive (Punekar et al., 2016).

MIT Open Courseware has achieved global recognition for its well-structured educational resources, consistently high quality, and dedication to open learning. The platform stands out with its user-friendly navigation, wide-ranging design topics, and immediate access to premium teaching resources, solidifying its position as a leading figure in open educational resources (Carson, 2004). NPTEL is a prominent Indian e-learning platform supported by the Ministry of Education, incorporating design education as part of its comprehensive technical curriculum. Created through partnerships with India's top engineering colleges, the platform has secured its status as a dependable source of meticulously developed academic content organized in coherent course formats (Agrawal et al., n.d.).

The selection of these three platforms was informed by specific evaluative criteria such as their focus on design-centric educational content, alignment with accredited academic programs, and commitment to offering free access to educational materials. These

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attributes render them especially appropriate for a comparative study of how digital platforms can successfully enhance design education through intentional interface design and content organization. Platforms requiring a mandatory subscription are excluded from the selection. By including these three platforms, we are able to conduct a comparative study of design education from local, national, and international perspectives. (D'Source, 2023; MIT OpenCourseWare, 2023; NPTEL, 2023)

3.3. Participant Selection

Students enrolled in undergraduate or postgraduate programs in disciplines such as design and engineering were selected using purposive sampling. Students with prior exposure to at least one digital learning platform were selected. Thirty students were selected for the study.

This ensured that the feedback reflected natural user behaviour in realistic learning scenarios. A mix of undergraduate and postgraduate students was included to capture variations in design maturity and user expectations. The purpose of the explicit visual analysis was to evaluate platforms not just for usability, but for visual engagement, creative affordance, and interface intuitiveness elements, particularly relevant to design education.

3.4 Methodology

To ensure consistency and depth in platform analysis, participants were given a task sheet comprising real-world academic scenarios they might encounter while using a digital learning platform. It contains 7 tasks to be completed. Each task directly maps to one or more of the five UX dimensions. Tasks were designed to expose limitations in navigation, engagement, interactivity, or alignment with learning goals. Participants needed to independently explore interfaces, complete structured tasks, and identify issues without step-by-step instructions.

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The tasks are listed below.

Task 1: Find a course that matches your topic of interest.

Task 2: Assess the layout of the homepage.

Task 3: Access multimedia learning materials.

Task 4: Follow a specific learning module.

Task 5: Search for a particular topic using the search function.

Task 6: Review the platform's goals or mission statement.

Task 7: Identify the interactive elements available.

Each task directly corresponds to one or more of the five UX dimensions, which facilitates organized data collection. These tasks represent common actions that a student may undertake during self-directed online learning. By standardizing the tasks across different platforms, we can ensure both objective and relative evaluations. The tasks are specifically designed to reveal limitations in areas such as navigation, engagement, interactivity, and alignment with learning goals. Table 3.1 shows the description of tasks done to identify the visual feature analysis.

Table 3.1. Task Description

Task No.	Task description	Primary UX factor assessed	Rationale for factor relevance
Task 1	Locate a course based on a topic of interest without using the search bar.	Interface Design, Content Organization	Assesses how intuitive the navigation is and how clearly the content is categorized for topic discovery.
Task 2	Evaluate the homepage aesthetics—visual consistency, typography, color harmony, and layout balance.	Visual Design	Directly targets aesthetic aspects such as layout structure, color scheme, typography, and visual hierarchy.
Task 3	Access multimedia content (videos, PDFs, etc.) and evaluate how it loads or functions.	Functionality, Interface Design	Test interactive features, media tools, and how smoothly users can play, download, or engage with learning materials.
Task 4	Follow a logical course/module path and observe structure or progression cues.	Content Organization, Objectives	Evaluates how well the platform structures content in a sequence and whether learning goals or outcomes are clearly conveyed.
Task 5	Use search or filters to locate a specific topic.	Interface Design, Functionality	Assesses how effectively users can perform targeted searches, how usable the filters are, and the responsiveness of the interface in this context.
Task 6	Locate and interpret the platform's mission or goal statement.	Objectives	Evaluates the clarity of the platform's purpose and how well it aligns with learner expectations, especially important in education platforms.
Task 7	Identify and interact with visual elements (e.g., buttons, sliders, icons, interaction tools).	Functionality, Visual Design	Assesses clarity of affordances, consistency in interaction cues, and visual feedback mechanisms, all critical to supporting user control and engagement.

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3.4 Results and Discussion

The visual feature analysis was conducted across the three selected digital learning platforms, using the five key factors such as visual design, interface design, content organization, functionality, and objectives. Participants evaluated each platform through structured tasks, and their feedback was thematically analyzed to generate insights. Figure 3.1 shows the visual feature analysis of selected three platforms.

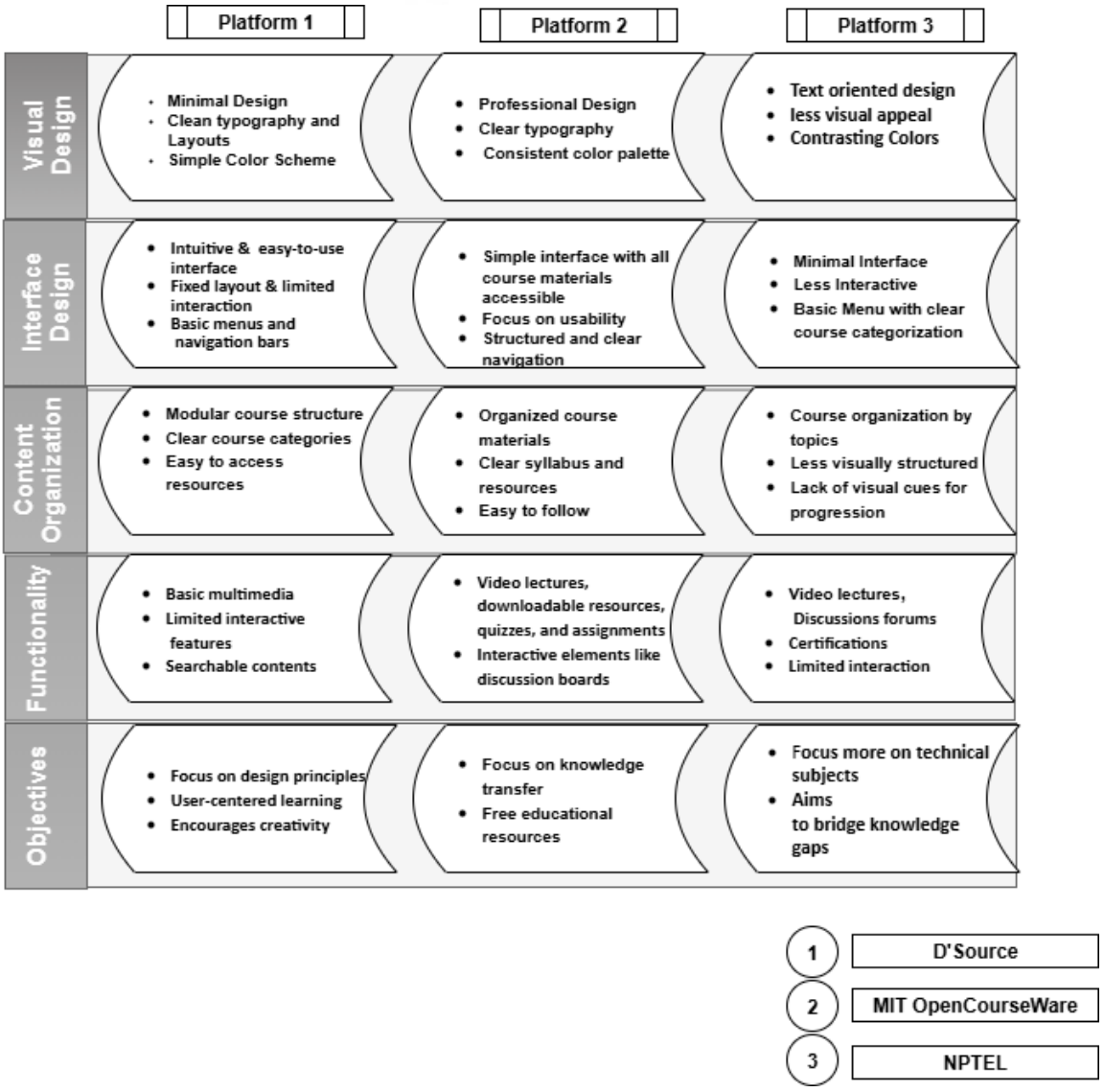

Figure 3.1. Visual Platform Feature Analysis

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Students expressed that a compelling visual structure is crucial for learning engagement, particularly in creative fields. Platform 2 was rated higher for visual coherence, while Platform 1 requires improved hierarchy and dynamic design elements to meet user expectations in a design-centric context. Participants emphasized that intuitive interface design is critical for reducing cognitive load. Platform 2 performed best in this regard, offering a user-friendly structure. Platform 1 showed potential but lacked interactivity. Platform 2 outperformed both platforms with its course layout and materials. While Platform 1 shows strength in modularity, visual indicators for progress tracking are limited. Needs a redesign to improve clarity in course navigation and content sequencing. Modern learners expect engaging digital environments. Platform 2 was praised for supporting multiple learning styles. In contrast, Platform 1 and Platform 3 must enhance functional features to encourage active learning and feedback. Platform 1's strength lies in its pedagogical foundation rooted in design thinking. However, it fails to translate these goals effectively through the interface and interaction. Students noted that aligning platform features with stated objectives remains a challenge, especially when interaction and visual design are not supportive. This visual analysis reveals that Platform 2 is highest across all five UX factors, showcasing a robust, learner-friendly interface, organized content, and interaction-rich functionality.

3.6.Conclusion

The comparative visual feature analysis of three platforms reveals distinct strengths and shortcomings across five critical UX factors: visual design, interface design, content organization, functionality, and learning objectives. Among the three, Platform 2 emerged as the balanced platform, offering a professional and user-friendly experience with clearly structured content and interactive features that support effective learning.

Platform 1, although built with a strong focus on design education and creativity, falls short in translating its pedagogical objectives into an engaging user experience. The platform lacks visual hierarchy, responsive interactivity, and intuitive navigation. Platform 3, technically sound and content-rich, suffers from low visual appeal, limiting its effectiveness for design-focused educational needs.

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This study emphasizes the urgent need for Platform 1 to incorporate user experience (UX) design principles and modern interface features to better meet its target audience's needs. The findings underscore the importance of aligning functional and aesthetic elements with educational objectives, especially on platforms that prioritize the arts. This analysis establishes a groundwork for targeted redesign efforts while enhancing our understanding of how to improve digital learning spaces for an enhanced user experience.

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4

Usability Evaluation of Existing Digital Design Learning Platforms

Abstract

In this chapter, a comprehensive exploration of a pilot study is explained, which assessed user experience by crafting and validating various tools. It is important to note that there exists a distinct gap in research within the design fields, despite a tendency for recent pilot studies to target the healthcare industry. Consequently, a pilot test of the platform was executed to verify the survey's validity and ensure its reliability. The research leverages UX Garrett's five-plane model, which delineates five factors that exhibited a Cronbach's alpha value surpassing 0.75, affirming their reliability and appropriateness for extensive research applications. In this analysis, expert agreement (I-CVI) was computed and determined to achieve acceptable levels of content validity. This study elucidates crucial user interface (UI) and user experience (UX) characteristics that profoundly affect student satisfaction and engagement in design learning environments. It includes a statistical comparative analysis of three digital learning platforms focusing on design education. Using one-way ANOVA and post hoc tests, the study assesses the significance of the identified factors across the three platforms.

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4.1 Introduction

As technology and internet awareness increase, India has become one of the fastest-growing consumers of digital education. E-learning addresses various challenges in traditional education, including flexibility, accessibility, self-study, practicality, and cost-effectiveness. (Dhananjaya et al., 2024). Users generally prefer interfaces that are simple and visually appealing. Both instructors and students appreciate digital learning platforms that feature user-friendly design elements. However, a poor user experience can lead to lower retention rates and decreased learner engagement. Therefore, the user interface (UI) must be user-friendly, as this significantly impacts the user's perception of the software (Bennett & Mekler, 2024).

Design education fosters values, critical thinking, and sensory skills in students, unlocking their creative and innovative potential. Design learning platforms are distinct because they deliver content effectively while being visually appealing and interactive. These platforms play a crucial role in today's educational landscape, serving as a vital link between theoretical knowledge and practical application. They provide access to high-quality design education and enable self-paced, in-depth learning through engaging multimedia content (Poovaiah, n.d.) .

User experience (UX) plays a vital role in design education, encompassing visual appeal, clarity, and interactive functionality. Although numerous platforms are expanding their global presence, they frequently struggle to meet user expectations due to inconsistent content delivery and subpar user interface design (Darmawan et al., n.d.). The Interaction Design Foundation defines user experience as the overall process that creative teams use to develop products that provide meaningful and relevant experiences, which shows the relation of interface design with usability (Interaction Design, 2023).

Many digital learning platforms face usability challenges that can detrimentally affect user experience (Lim et al., 2012). Despite a plethora of research on digital learning environments, a substantial gap remains in understanding the systematic design of effective learning experiences within these contexts. This highlights the urgent need for thorough evaluations of platforms that can improve user experience. Current literature often does not utilize systematic methods when evaluating these platforms, especially in relation to interface quality, content organization, and overall usability – particularly

when assessed through recognized user experience frameworks (Liapis et al., 2023). The present study fills this gap by executing comparative usability evaluations of both domestic and international platforms, gathering insights from both users and experts.

This paper aims to explore the effect of digital learning user interface design on the educational experiences of learners, specifically within design education platforms. By undertaking this analysis, we hope to discover significant insights regarding the critical relationship between UI design attributes and learner involvement in online design education.

4.2 Preliminary Study

4.2.1 Participant Sampling Procedure

The initial phase utilized purposive sampling to select participants who had relevant experience with digital learning platforms. The eligibility criteria required participants to be currently enrolled in design-centric academic programs and to have previous experience with digital educational tools. This pilot study followed a quantitative approach, ultimately including 23 design students from Indian institutions. Although 36 individuals with design experience initially took part in the survey, thorough data quality assessments resulted in the exclusion of 13 respondents due to incomplete or inconsistent answers, leading to a final count of 23 participants (S. S et al., 2025).

Before distributing the questionnaire to a group of 23 chosen students, researchers improved it by carrying out a content validity assessment with subject matter experts. To ensure the sample was adequate for factor analysis, we conducted KMO and Bartlett's tests. The findings from these statistical evaluations confirmed that the sampling was appropriate and that it was suitable to proceed with factor analysis. Overall, the results suggest that the dataset has a robust internal structure that supports the use of dimensional reduction techniques.

The present sample size adequately fulfills the research goals for this initial phase. As is customary in pilot studies, the number of participants is less than what will be needed for the main study, as the focus is primarily on validating the research tools and methods rather than on achieving statistical generalizability. Participants were selected based on

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two main criteria: (1) involvement in design education programs, and (2) familiarity with e-learning platforms. This empirical study captures perspectives from both students and professionals while using a mixed-methods approach.

4.2.2 Pre-Test and Pilot Test Methodology

The research team executed a detailed pre-test ahead of the pilot study. This essential phase involved both specialists and potential participants in filling out the questionnaire to reveal any existing issues (Hashim et al., 2022). The pre-test fulfilled two crucial functions: verifying that participants comprehended each questionnaire item and addressing any difficulties before the survey instrument was completed (Mayer, 2021). To mitigate response bias, the questionnaire employed a balanced array of questions framed positively and negatively.

A panel of five domain experts conducted initial assessments of the data collection tool to identify possible deficiencies. Faculty members dedicated to design education at the involved institutions evaluated the content validity of the questionnaire. These specialists provided structured feedback using validation forms and engaged in subsequent interviews. Through targeted discussions and meetings, they offered comprehensive insights and suggestions concerning the various aspects addressed in the questionnaire. In light of this expert feedback, the researchers made modifications to multiple questionnaire items to improve clarity and enhance comprehension for respondents.
The following are the six steps of questionnaire evaluation by experts.(Yusoff, 2019)

1. Form creation for content validity
2. Expert panel selection
3. Content validation
4. Review of items and domain
5. Item score Generation
6. Index Calculation.

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4.2.3. Data Collection Method

Our investigation involved the creation of a new questionnaire, systematically organized into three sections. The first section is dedicated to the collection of participants' demographic details. The second segment encompasses 31 specific items rooted in six distinct constructs, purposefully developed for the pilot study. Each item is crafted using a five-point Likert scale, permitting participants to denote their level of agreement ranging from '1' (strongly disagree) to '5' (strongly agree). We took care to eliminate double-barreled and ambiguous inquiries. The third section contains two open-ended questions. Engagement in the study was contingent upon securing informed consent, and the project was sanctioned by the university's ethical review board (Appendix A. 1 and Appendix A. 2).

The questionnaire was meticulously crafted to adhere to various standards, encompassing content relevance, linguistic precision, logical coherence, diversity of question types and formats, as well as an awareness of personal data collection sensitivities. To improve clarity and foster participation, each survey item is restricted to a maximum of twenty words per sentence (Oppenheim, 2008). The language employed is deliberately selected to correspond with the cognitive and understanding capacities of the respondents, underscoring the study's commitment to methodological integrity and participant inclusivity.

The preliminary study was conducted to evaluate the efficacy of our assessment instrument within a digital design framework. In contrast to conventional e-learning environments, design-oriented learning platforms require particular emphasis on visual components, interface architecture, navigational elements, content presentation, creativity, and user engagement. As a result, we enhanced the questionnaire to accurately reflect the user experience (UX) factors relevant to design students.

To ensure easy access and prompt completion of the survey, we meticulously reviewed the questionnaire distribution procedure to confirm that emails were delivered and received correctly. Participants were required to answer the current question in order to proceed to the next one, which helped to minimize the risk of missing data in the primary study. Respondents had the option to exit the survey at

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any time during their participation. The collected data were subsequently processed for further analysis.

The pilot test was conducted over the course of two weeks. During this period, participants received clear instructions either by email or in person. They interacted with the design platform for a minimum of 20 minutes, completing tasks that included exploring the homepage, watching a video module, downloading resources, and using the search feature.

Students who met the selection criteria gathered for an introductory session about the study and were given one week to engage with the platform. The following week, they received a survey link via email, accompanied by a cover letter detailing the study's objectives, confidentiality measures, and response guidelines. A reminder email was sent two days later, informing them that the survey would take approximately ten minutes to complete and emphasizing that participation was voluntary. Additionally, a permission form for study participation was collected. The detailed methodology for conducting the pre-test and pilot test is depicted as phase 1 and phase 2 in the accompanying Figure 4.1.

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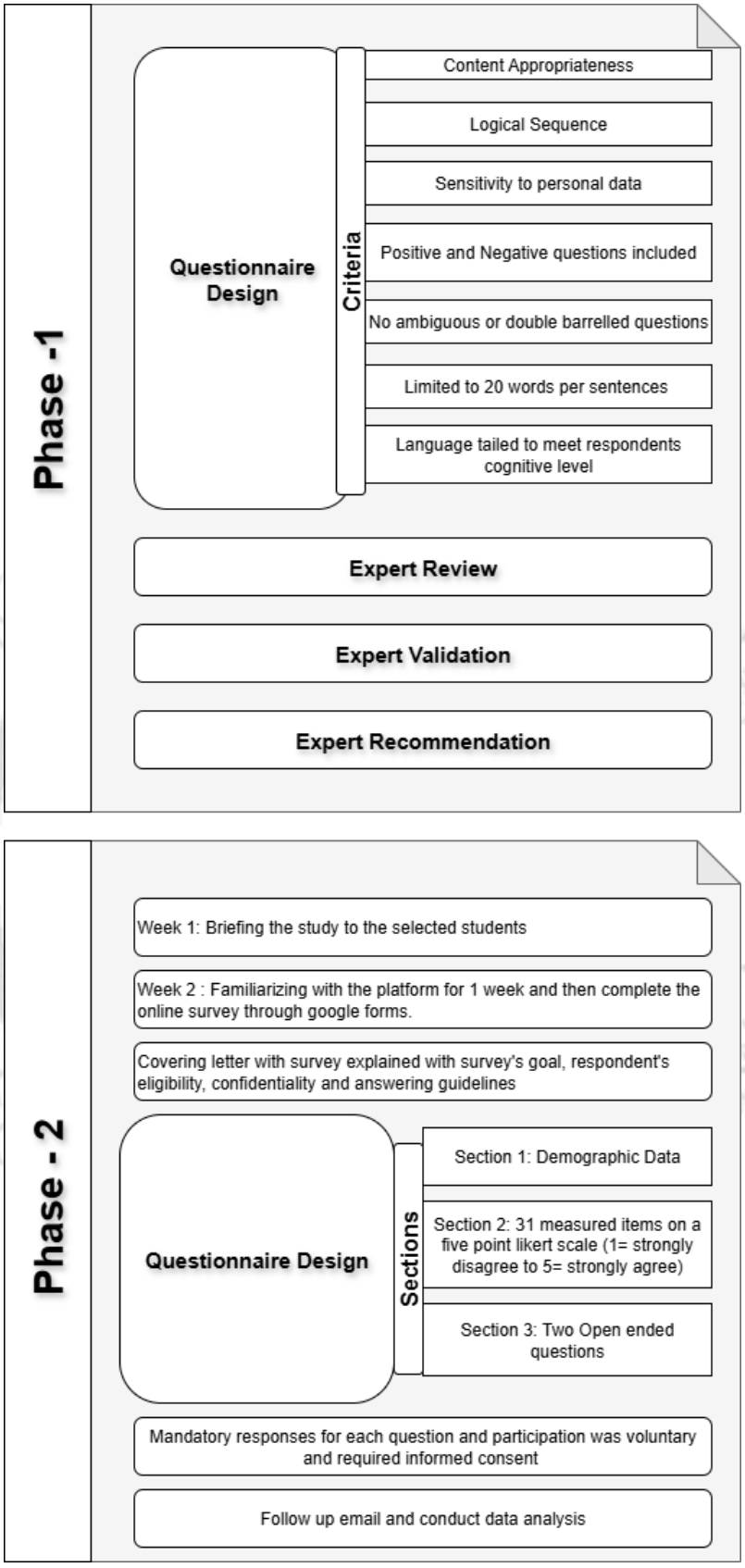

Figure. 4.1. Pilot Test Methodology Diagram [Source: author]

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4.2.4 UUEQ Reliability and Content Validity

Reliability refers to the consistency between variables and is considered a crucial prerequisite for validity. It is important to prioritize reliability before conducting an assessment of validity. In this research, we used Cronbach's alpha to measure the consistency of the scale, applying a statistical method specifically designed to evaluate the reliability of research constructs. As shown in Table 4.1, the Cronbach's alpha values for all identified constructs exceed 0.75, indicating that the constructs have reliability and internal consistency. This, in turn, reinforces the validity of the research findings. The measured items for the study are shown in Appendix A. 3.

Table 4.1: Cronbach's alpha values

Construct	**Cronbach alpha**
Visual Design	.759
Interface Design	.817
Content Organization	.750
Functionality	.787
Objectives	.850

Content validity refers to the extent to which the components of an assessment tool are relevant to and accurately reflect the intended concept within a specific evaluation context. Establishing content validity involves several key steps: preparing an expert evaluation form, assembling a panel of experts, conducting the content validation phase, gathering critical feedback from experts, calculating scores, and ultimately determining a value for content validity.

The expert evaluation form is designed to give reviewers a clear understanding of the task. During this process, the relevance of each item is assessed using a scoring system, which is shown in Table 4.2.

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Table 4.2: Relevance in the scoring system

Score	Degree of Relevance
1	irrelevant
2	somewhat relevant.
3	quite relevant
4	highly relevant

Experts are selected for the panel according to their specific areas of expertise. A meeting is organized via email to facilitate direct interaction with these experts, during which they receive instructions and an evaluation form. To ensure prompt responses, systematic follow-ups are conducted. Experts provide invaluable feedback on the data collection questionnaire to enhance the relevance of the items. All recommendations are meticulously considered to enhance the assessed elements. Each expert assigns a score to every item, which is then used to establish the validity index. To ensure scalability, content validity must be demonstrated. A questionnaire exhibits strong content validity if its item-level content validity index is at least 0.78, and its scale-level content validity index values exceed 0.8 and 0.9, as determined by the universal agreement method and the average method. These assessments derive from expert recommendations.

The expert agreement in this study was computed during the analysis phase of this study, demonstrated a satisfactory level of content validity (Yusoff, 2019). Additionally, the average universal agreement and average I CVI scores for all items exceeded the satisfactory threshold, affirming the content validity of the questionnaire scale. A total of five experts provided their assessments regarding relevance, as detailed in Appendix A.4, which illustrates the item-level content validity.

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4.3. Comparative Study

4.3.1 Participant Selection and Data Collection Methods

In order to ensure that the participants in the study possessed relevant experience with digital learning, purposeful sampling was utilized. Eligible candidates included students enrolled in computer engineering or design courses who had prior experience with digital learning platforms. The study was conducted in a controlled environment, where each participant used a fixed-size laptop to explore the platforms. Participants were assigned to one of three digital learning platforms. The study sample consisted of 154 students from India and focused on quantitative analysis.

The questionnaire used in the study was refined through a content validity review conducted with experts before being administered to the participants. Tests for sample adequacy and factorability indicated sufficient sampling adequacy, and validated factor analysis suggested that the dataset had an appropriate internal structure for dimensional reduction. This empirical research adopted a mixed-method approach.

4.3.2 Comparative Platform Evaluation Process

In our study, we developed the User Usability Evaluation Questionnaire (UUEQ). This questionnaire was designed to meet high standards of content appropriateness, linguistic clarity, and logical consistency, while also being sensitive to the collection of personal data. Each survey item is limited to twenty words to enhance clarity and encourage participant engagement. The language is tailored to align with the cognitive levels of the respondents.

The UUEQ is divided into three sections: the first section gathers demographic data, the second contains 31 items across five factors, utilizing a five-point Likert scale (ranging from '1' for strongly disagree to '5' for strongly agree). Care has been taken to avoid double-barreled or ambiguous questions. The third section includes two open-ended questions.

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The main phase of the study focused on evaluating the usability of three digital design learning platforms using the finalized questionnaire. Participants included design and engineering students with prior experience using digital learning platforms. To maintain user experience consistency and eliminate device type variability, the evaluation was conducted in a controlled environment, with each participant using their own laptop. Since mobile usage can influence interaction patterns and usability, this approach ensured that the feedback reflected a standardized desktop or laptop experience.

Participants had access to the assigned platform for a two-week exploration period. During this time, they were encouraged to navigate the site, review learning materials, and interact with various features. Each participant was assigned to one of the three platforms to prevent cross-influence. Participants received an email with the UUEQ survey link after the exploration phase. This email included a covering letter outlining the study's objectives, eligibility criteria for respondents, confidentiality assurances, and guidelines for answering the questions. Participants were given four weeks to engage with the platform and submit the questionnaire. The diagrammatic representation of the comparative study is shown in Figure 4.2.

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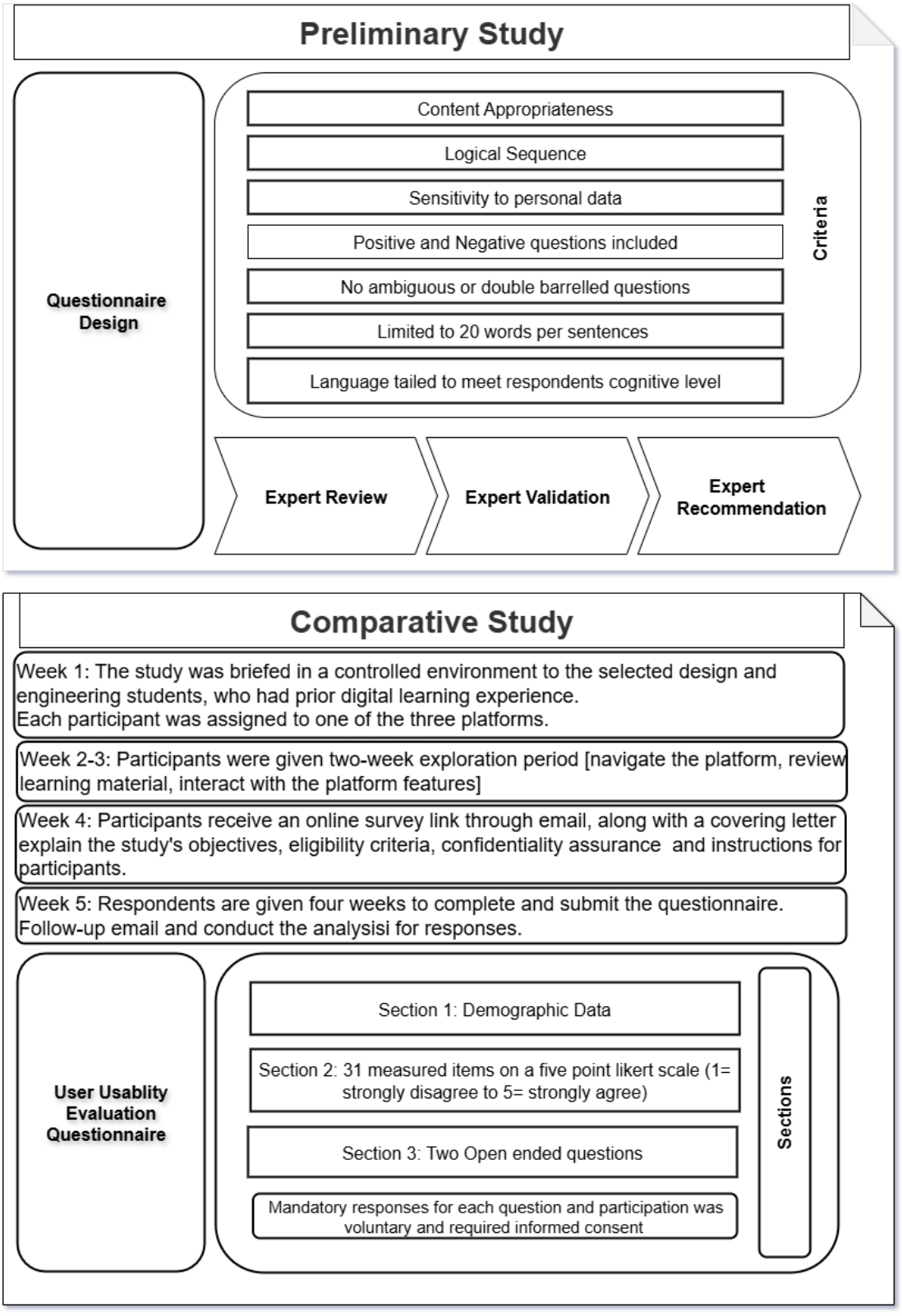

Figure 4.2. Preliminary and Comparative Study Methodology Diagram [Source: author]

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The questionnaire was structured using a 5-point Likert scale, focusing on user interface (UI) factors that influence user experience (UX). It included two open-ended questions at the end. A follow-up email was sent to participants, informing them that completing the questionnaire would take approximately ten minutes and that participation was voluntary. To ensure easy access and prompt completion of the survey, the distribution procedure was carefully reviewed to confirm that all emails were successfully delivered. Participants were required to answer each question before moving on to the next one, which helped minimize the potential for missing data in the primary study. Respondents were allowed to exit the survey anytime during the response process. The gathered data were then processed for further analysis. This survey data served as the primary input for evaluating differences in user perception across the platforms. Among the three platforms evaluated, Platform 1 showed a lower user experience in the comparative study.

4.4 Results and Discussion

4.4.1. Pilot Study Results

The sample data analysis was conducted using the SPSS software, known as the Statistical Package for the Social Sciences. A frequency test was performed to assess the responses provided by participants. The demographic data revealed an equal representation of female and male respondents. Most participants fell within the age range of 24 to 29 years, followed by those in the 18 to 23 age bracket. All respondents were students enrolled in public universities, pursuing studies in design. Descriptive statistics related to the data are presented in Appendix A.5, while the normal distribution of the summative scores is illustrated in Table 4.3.

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Table 4.3: Normal distribution for the summative scores.

Statistic	Value
N	23
Mean	70.6957
Std. Deviation	13.70944
Minimum	55.00
Maximum	103.00
Skewness	1.281
Kurtosis	1.111
Kolmogorov-Smirnov	0.172

The responses for each measured item are displayed graphically in Figure 4.3. The X-axis represents the measured items, while the Y-axis shows each item's mean and standard deviation. Each question offers five possible responses: Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), and Strongly Agree (5). This graph analyzes the mean responses for 31 items. Notably, items vd1, vd4, vd6, vd7, id5, id7, co5, fn3, and ob2 have mean response values of less than 3.0. In contrast, the remaining items have mean response values above 3.0. The overall user experience is rated at 3.04, indicating a moderately satisfactory user experience.

From this analysis, it is apparent that significant improvements are needed in several areas: the color scheme, layout, icons, interface design, adaptability to different screen sizes and devices, the addition of design exercises and quizzes at the end of topics, and particularly in enhancing user engagement with the platform. Figure 4.4 visually compares UX factors based on participant responses, making it easier to assess these elements.

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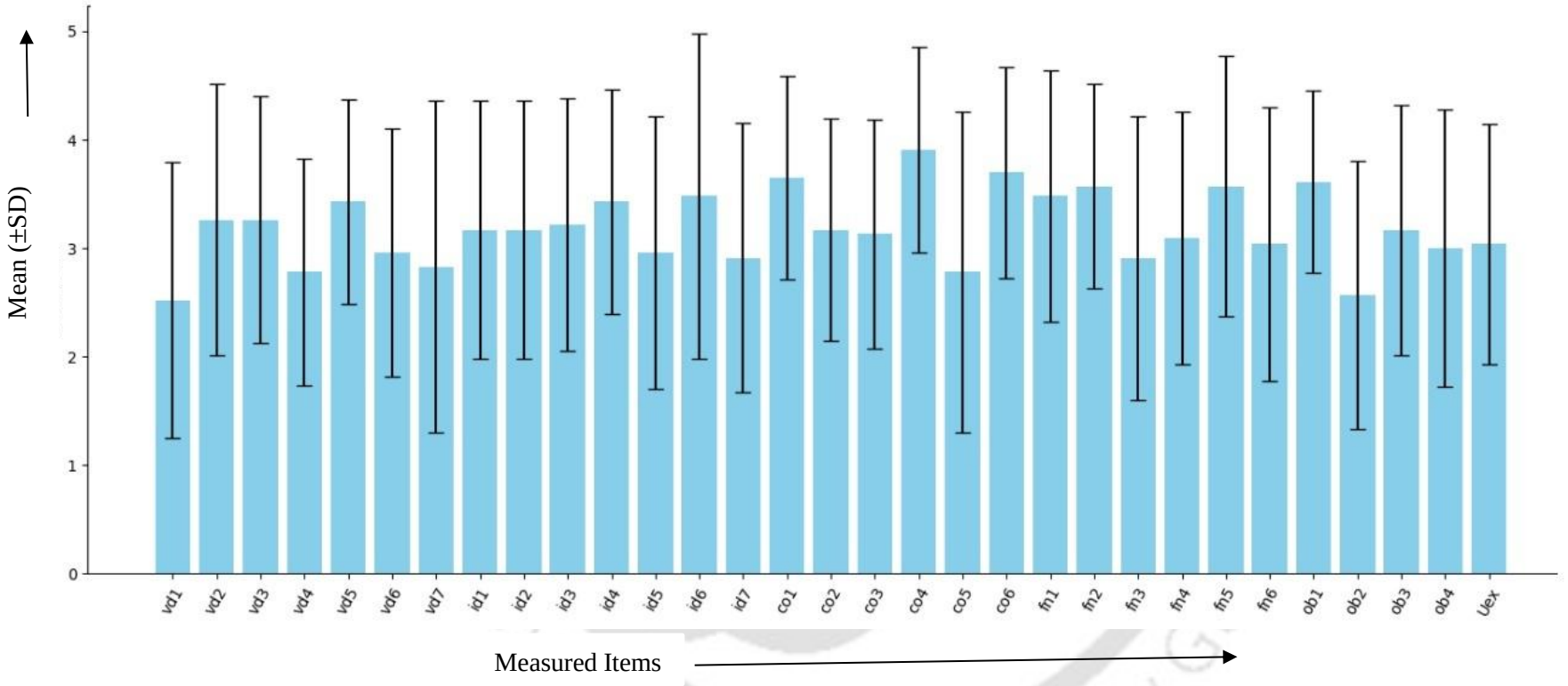

Figure 4.3. Response mean and standard deviation of measured items

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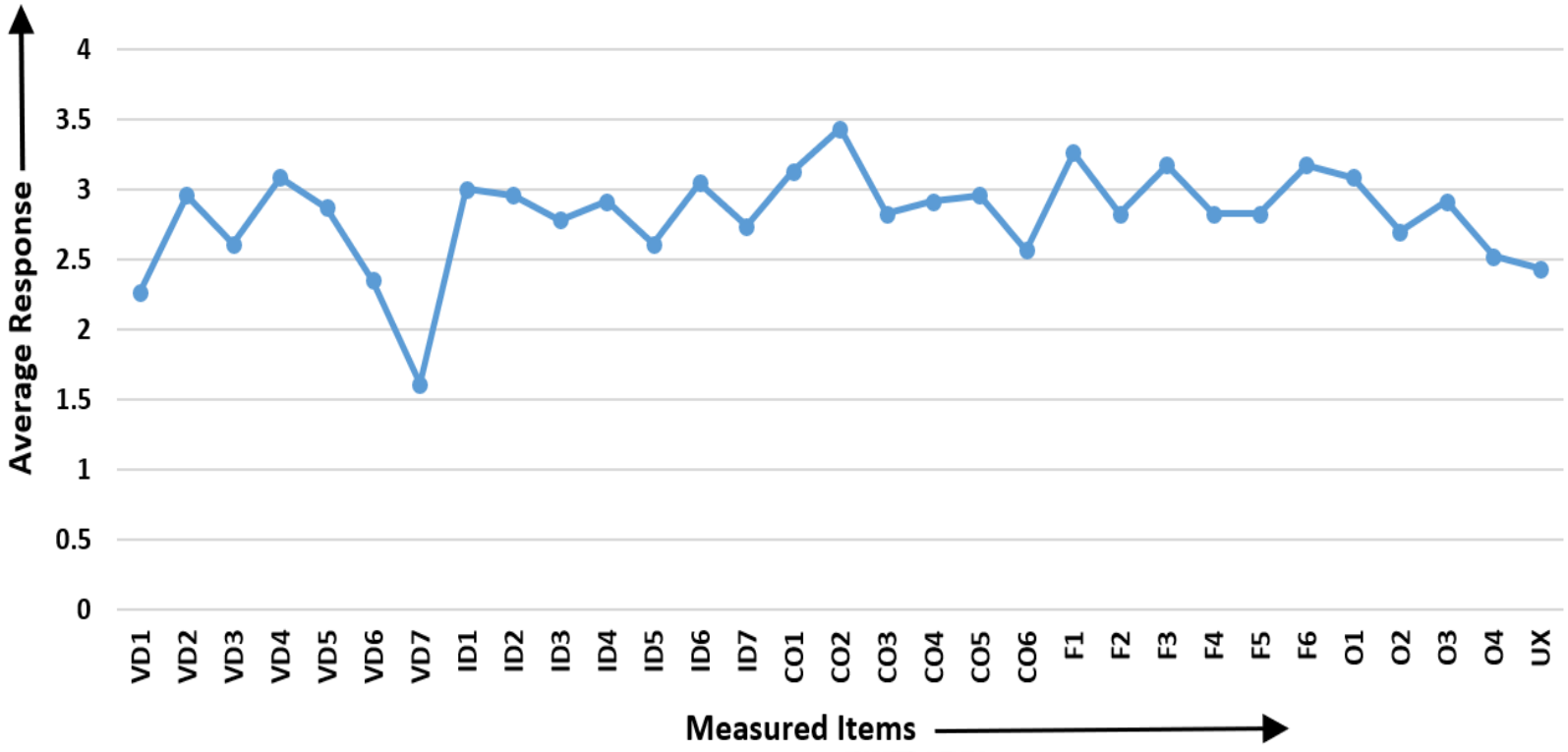

Figure 4.4. Average Responses corresponding to each measured item

The methodological rigor employed in the pilot study, particularly during the content validity process, significantly enhanced confidence in the instrument's effectiveness. By engaging expert evaluations and establishing statistical thresholds for both reliability (with a Cronbach's alpha exceeding 0.75) and content validity (with an Item-Level Content Validity Index, or I-CVI, of 0.78 or higher), a strong foundation was laid for the main study.

Furthermore, the pilot study emphasized the importance of early testing in identifying flaws in the instrument and addressing user experience gaps. The platform fulfills certain usability standards; however, there exists ample scope for advancement in essential domains for design students, as shown by the average user experience rating of 3.04. Key areas for improvement comprise alignment with learning goals, interactive features like quizzes and design assignments, visual clarity, and user engagement. These findings underscore the importance of specific initiatives aimed at boosting the platform's usability, which will in turn more effectively meet students' needs and improve overall user satisfaction.

4.4.2. Comparative Study Results

A total of 165 individuals, comprising participants with engineering and design expertise, engaged in the survey. After data collection and a thorough assessment for completeness, eleven respondents were removed due to inconsistent or inadequate answers. Ultimately, 154 valid responses were collected across three platforms: 51 from Platform 1, 53 from Platform 2, and 50 from Platform 3. This data provides a comparative analysis of user interface (UI) factors across the platforms, offering insights into user experience from the perspectives of participants with relevant academic and technological backgrounds. Descriptive statistics related to the data are represented in Appendix A.6.

The statistical comparative analysis was conducted using SPSS software (Statistical Package for the Social Sciences). Reliability testing for all factors was performed using Cronbach's alpha to evaluate the internal consistency of the items. The overall value for the scale was calculated, and the item-total statistics table was carefully examined to

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ensure consistency for each item. Two items (id6 and fn1) were removed to improve reliability. A systematic procedure was adopted to ensure the content's validity. Additionally, no data entry errors were found, as all scores fell within the range of 1 to 5.

Before performing any statistical analysis using SPSS, a normality check was conducted on the survey data to validate further testing. Histograms and Q-Q plots were employed to examine the distribution of responses for each factor. Although some variables had p-values below 0.05, the distributions were approximately normal, and the sample size was sufficient to satisfy the assumptions for the ANOVA test.

A one-way ANOVA was conducted to determine if statistically significant differences exist in the identified factors, including visual design, interface design, content organization, functionality, and objectives across the three digital learning platforms. The participants' demographic details are provided in Table 4.4. The findings from the descriptive analysis, ANOVA, and Post Hoc Tukey HSD Test are summarized in Table 4.5.

Table 4.4. Demographic details of the comparative study

Variable	Category	Platform 1	Platform 2	Platform 3
Gender	Male	53%	47%	50%
	Female	47%	53%	50%
Age	18-23	37%	13%	48%
	24-29	22%	26%	14%
	30-35	27%	23%	24%
	36 and above	14%	38%	14%
Participants	Designers	53%	51%	52%
	Engineers	47%	49%	48%

The ANOVA results show that the platforms were not perceived equally among the five factors. A post hoc comparison using Tukey's HSD is necessary to determine which groups differ significantly. There was a significant difference in visual design among the three groups, $F(2, 151) = 6.29$, $p = .002$. The effect size was medium (Eta squared $\eta^2 = .077$), indicating that the group types accounted for 7.7% of the variance in visual design.

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Multiple comparisons using Tukey's HSD showed that the visual design score for the Platform 3 group (M = 3.74, SD = 0.73) was significantly higher (p = .003) than that of the Platform 1 group (M = 3.21, SD = 0.84). However, no significant differences regarding visual design were found between the Platform 1 and Platform 2 groups (p = .162) or between the Platform 3 and Platform 2 groups (p = .285).

Regarding interface design, no significant differences were observed among the three groups, F (2, 151) = 1.62, p = .201. The effect size was small (η^2 = .021), explaining 2.1% of the variance.

A significant difference was found regarding content organization, F (2, 151) = 4.406, p = .014, with a small to medium effect size (η^2 = .055), indicating that group types accounted for 5.5% of the variance in content organization. Tukey's HSD revealed that the content organization score for the Platform 2 group (M = 3.80, SD = 0.73) was significantly higher (p = .028) than that for the Platform 1 group (M = 3.45, SD = 0.74). However, no significant differences were found between the Platform 1 and Platform 2 groups (p = .889) or between the Platform 3 and Platform 2 groups (p = .082) regarding content organization.

Regarding functionality, no significant differences were detected among the three groups, F (2, 151) = 0.524, p = .593, with a minimal effect size (η^2 = .007).

Similarly, there was no significant difference in objectives among the groups, F (2, 151) = 2.705, p = .070; this value was close to the significance threshold. However, Tukey's HSD indicated a significant difference between the Platform 3 group (M = 3.65, SD = 0.81) and the Platform 1 group (M = 3.25, SD = 0.92), p = .043, suggesting better clarity and alignment of objectives in Platform 3. No significant differences regarding objectives were found between the Platform 1 and Platform 2 groups (p = .349) or between the Platform 3 and Platform 2 groups (p = .534). The effect size (η^2 = .035) was small, accounting for 3.5% of the variance.

Table 4.5: ANOVA and Post-Hoc comparison results

Factor	Platform 1 (M±SD)	Platform 2 (M±SD)	Platform 3 (M±SD)	ANOVA p-value	Statistically Significant?	Post Hoc Significant Differences (Tukey's HSD)
Visual Design	3.21±0.84	3.50±0.67	3.74±0.73	**0.002**	**Yes**	Platform 3 >Platform 1 (p=.002) Compared to Platform 2
Interface Design	3.30±0.84	3.51±0.61	3.56±0.83	0.201	No	None
Content Organization	3.40±0.75	3.48±0.65	3.80±0.72	**0.014**	**Yes**	Platform 3>Platform 1 (p=.015) Compared to Platform 2
Functionality	3.24±0.88	3.29±0.71	3.40±0.87	0.593	No	None
Objectives	3.25±0.92	3.48±0.76	3.64±0.81	0.070	No	None

The ANOVA results indicated statistically significant differences among the platforms regarding visual design ($p = 0.002$) and content organization ($p = 0.014$). Post hoc comparisons using Tukey's HSD test showed that Platform 3 had significantly higher scores than Platform 1 in visual design and content organization. Although no significant differences were found for interface design, functionality, and objectives overall, a noteworthy post hoc difference was identified between Platform 3 and Platform 1 regarding objectives, even though the overall ANOVA result was non-significant.

These findings suggest that while the platforms are generally comparable across several dimensions, Platform 3 has a significant advantage in visual presentation and content structuring from the learners' perspective. Figure 4.5 presents a graphical comparison of the mean user ratings for the three platforms across key factors. The graph shows that Platform 3 received higher mean ratings in all categories than the other two. Furthermore, Platform 1 requires targeted visual presentation and structural design improvements.

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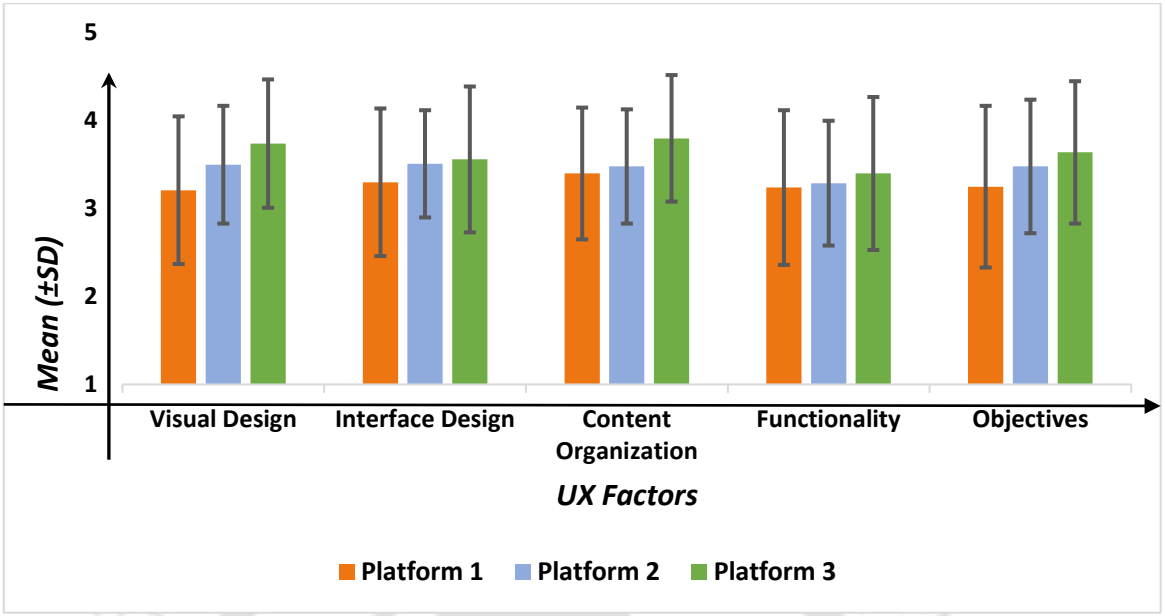

Figure 4.5. Graphical comparison of interface design factors across three platforms

Figure 4.6 presents a radar chart that compares the mean and standard deviation scores for overall user experience across three platforms, based on ratings of various interface design factors. The chart shows mean values along the outer axes and corresponding standard deviations along the inner axes for each platform.

Among the platforms, Platform 2 achieved the highest mean user experience score of 3.89, followed by Platform 3 at 3.70 and Platform 1 at 3.47. Regarding response consistency, Platform 3 (SD = 0.76) and Platform 2 (SD = 0.776) demonstrated low variability, indicating stable user perceptions. In contrast, Platform 1 exhibited the highest standard deviation (SD = 1.02), suggesting a wider range of opinions regarding its usability.

The triangular distribution illustrated in the radar chart emphasizes that Platform 2 offers a higher average user experience and relatively low response variability. Conversely, Platform 1 underperforms both in terms of average user experience and consistency. The findings emphasize the necessity for usability improvements in Platform 1 to provide a more dependable user experience.

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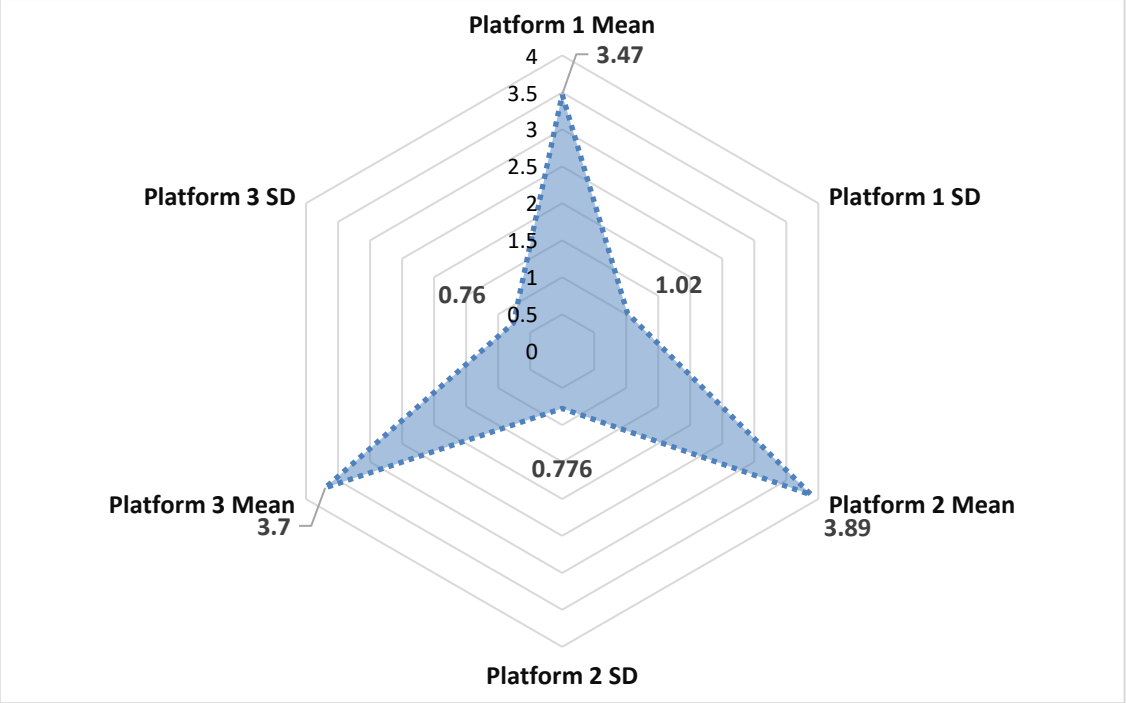

Figure 4.6. Overall user-experiences

This investigation assesses the usability of three digital design learning platforms, analyzed from a consumer viewpoint. The study focuses on five primary aspects: visual design, interface design, information layout, functionality, and goals. The results provide crucial insights into the usability of each platform. Statistical findings highlighted considerable differences in user feedback, particularly relating to visual design and content organization.

The layout, color palettes, and general visual appeal of Platform 3 were deemed more captivating and effective for learning by users, as shown by its highest average scores. The content and its organization were also highly rated. These results emphasize how vital visual design and content organization are in determining users' perceptions of the usability of digital learning platforms.

In contrast, Platform 1 exhibited low performance ratings in all categories, demonstrating an urgent need to advance its visual design, clarify goals, and better organize content to boost the overall user experience. This study shows how even small tweaks in design and structure can significantly affect user satisfaction and platform utility. The information

gathered can serve as a guide for refining the user interfaces and designs of platforms dedicated to digital design education.

4.5. Conclusion

The thorough methodology applied in the pilot study, notably in the phase of content validity, increased trust in the instrument's effectiveness. By integrating expert evaluations and establishing reliability benchmarks (with Cronbach's alpha set at over 0.75) and content validity standards (with an Item-Level Content Validity Index of 0.78 or higher), a robust foundation was created for the main study. The pilot also emphasized the significance of early testing in identifying instrument flaws and user experience gaps. With an average usability rating of 3.04, the platform meets specific standards but requires improvements in visual clarity, user engagement, and alignment with learning objectives.

This study examines consumer perceptions of three digital design learning platforms across five factors: visual design, interface design, information organization, functionality, and objectives. The results revealed significant differences in user ratings, especially in visual design and content organization. Platform 3 received the highest ratings for its layout, color schemes, and navigation, while Platform 1 scored relatively low, indicating an urgent need for design and content structure improvements. Overall, the data illustrates the multifaceted aspects of usability, showing that even small enhancements in design can greatly affect users' platform preferences and their overall happiness.

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5

Investigation of a Specific Digital Design Learning Platform

Abstract

This chapter delves into the research conducted on a specific digital design learning platform. While quantitative data provides measurable outcomes, qualitative insights are essential for a deeper understanding of users, as they capture their real-life experiences. An exploration of user experience issues for Platform 1 was carried out through in-depth expert interviews and feedback sessions with students. Our analysis aimed to deepen our understanding of how the platform functions and its usability. User interaction data was collected, analyzed, and interpreted systematically for the web analytics assessment of Platform 1. This research evaluated data gathered over the course of a year and used Google Analytics for visualization. Information regarding learner demographics, study patterns, and platform technology utilization was compiled.

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5.1 Introduction

For a deeper insight into users' needs and motivations, qualitative analysis investigates the richness of their lived experiences, in contrast to quantitative data that yields clear and measurable outcomes. To conduct a detailed qualitative analysis of user experience issues related to Platform 1, we collected in-depth insights through expert interviews and interactive feedback sessions with students. This examination aimed to enhance our understanding of the platform's functionality and user-friendliness, revealing subtleties that mere numbers cannot adequately represent.

Advanced web analytics were used for Platform 1's evaluation, which collected, examined, and interpreted user interaction data in a methodical and thorough manner. We examined and visualised data collected over a one-year period, from June 17, 2023, to June 17, 2024, by utilising Google Analytics' robust features. Important details on student demographics, a range of learning styles, and platform technology usage trends were all included in this extensive dataset. Using this method gives us a deeper and more complex insight of user behaviour than what is possible with regular web server log files (Özen et al., 2017).

5.2. Platform 1 Study

The platform serves as an open digital learning space dedicated to design education in India and is operated under the National Mission Project for Education through Information and Communication Technology (NME-ICT) (Punekar et al., 2016). Its primary objectives include providing digital content related to design, fostering collaboration in a social environment that enhances design and higher education, and developing a comprehensive digital repository of design resources. The homepage offers a variety of features such as courses, resources, case studies, showcases, tools, a gallery, and videos created by design professionals specifically for design students. The platform is structured by different design disciplines, enabling users to navigate content through category-based exploration and a search function. Its interface facilitates visual browsing, implements tag-based filtering, and supports video-based learning. The user experience

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(UX) evaluation highlighted several critical factors, such as the clarity of visual hierarchy, interface responsiveness, content accessibility, interaction quality, navigation ease, and the congruence of learning materials with defined objectives. The UML use-case diagram for this platform is depicted in Figure 5.1, while the roles and responsibilities of the platform's actors are detailed in Table 5.1.

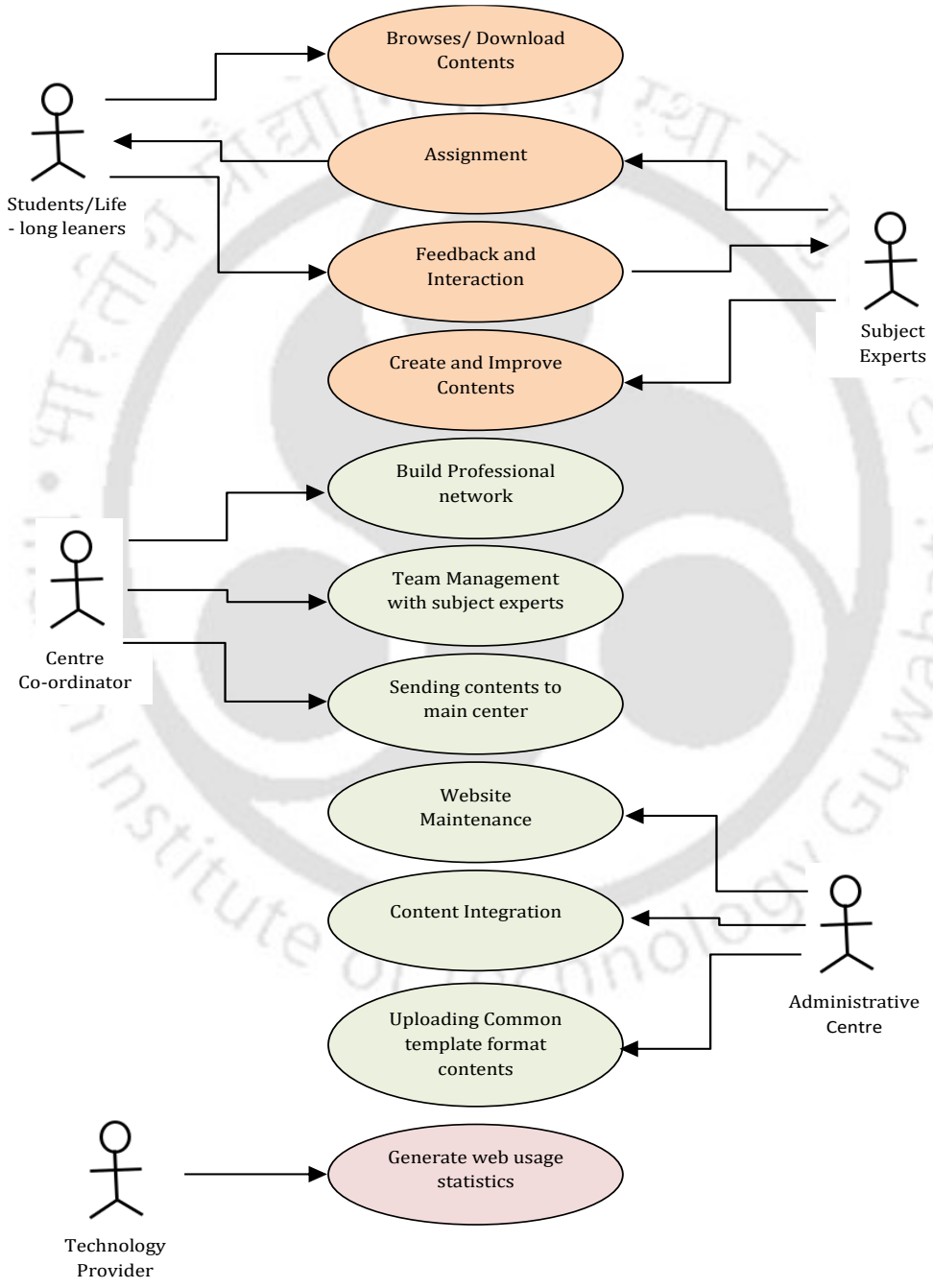

Figure 5.1. Use Case Diagram of Design Learning Platform (Source: author)

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Table 5.1. Roles and Responsibilities of Actors in the Platform

Sl No.	Actors	Role and Responsibilities
1.	Administrative Centre	Managing the web portal Integrating content Using a standard template for content submission, providing creative freedom Offering Pan-Indian coverage for content Uploading content to the website
2.	Centre Coordinator	• Establish the team • Collaborate with subject experts and resource people • Become connected with local designers, subject matter experts, and other professional organizations. • Send all content to the main center
3.	Subject Expert	• Content contributed to the website • Content focuses on India • Headings: courses, resources, case studies, showcase, gallery, and videos • Create content, assign tasks • Gather student feedback to improve content
4.	Students/Lifelong Learners	• Browse or download content to learn • Submit assignments • Provide feedback on courses
5.	Technology Providers	• Maintaining the website • Monitoring user actions • Providing technology support for content creation • Periodically generating web usage statistics

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5.2.1. Evaluation through Expert and Student feedback

A comprehensive qualitative study focused on user experience issues related to Platform 1 involved gathering detailed insights through expert interviews and interactive feedback sessions with students. The analysis was performed using ATLAS.ti, a data analysis software. Fifty-four textual documents were collected, including expert opinions and student feedback, which were imported into the document manager. The summary of experts' and students' comments is shown in Appendix A.7. The screenshot of the document manager is shown in Figure 5.2.

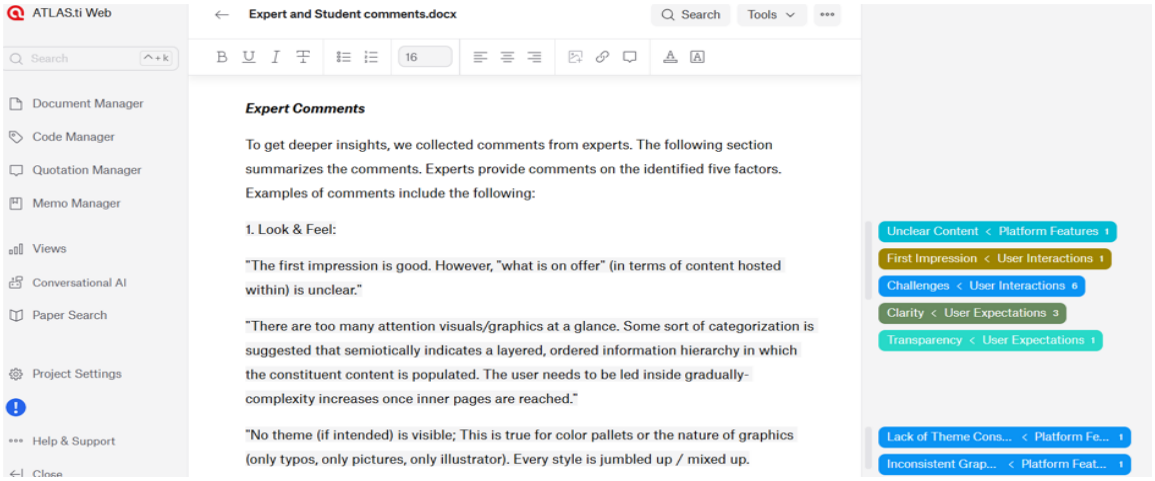

Figure 5.2. Screenshot of document manager

The pre-processing step involved cleaning the data and organizing each document based on relevant factors. An open coding approach was used with the code manager. Text segments of interest were highlighted and coded line by line according to their content relevance. In total, 376 codes were generated from 54 documents. Some recurring issues identified include an unstructured content layout, an inconsistent color palette, difficulty finding courses, and navigation problems. Code groups were created to categorize codes into broader analytical themes. Three dominant thematic groups were identified: platform features, user expectations, and user interactions, with code counts of 146, 164, and 174, respectively. Each theme encompasses a set of related codes. The platform features a theme with design elements, such as visual hierarchy and interface layout.

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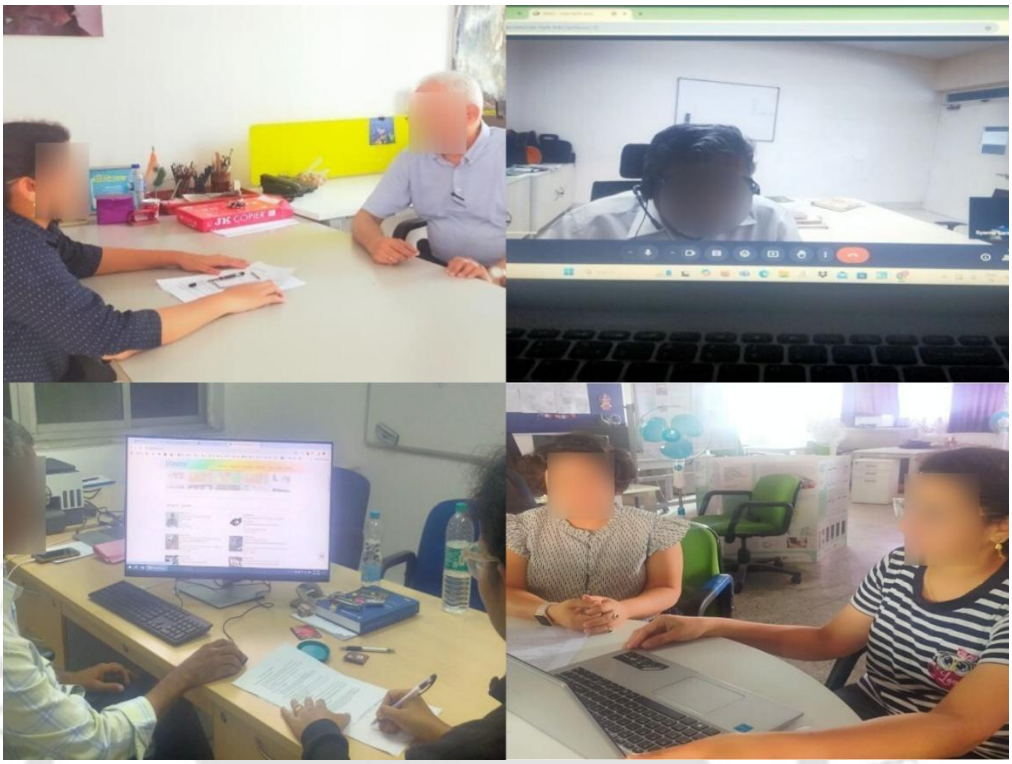

Figure 5.3. Images of expert interviews

Figure 5.4. Students' feedback data collection images

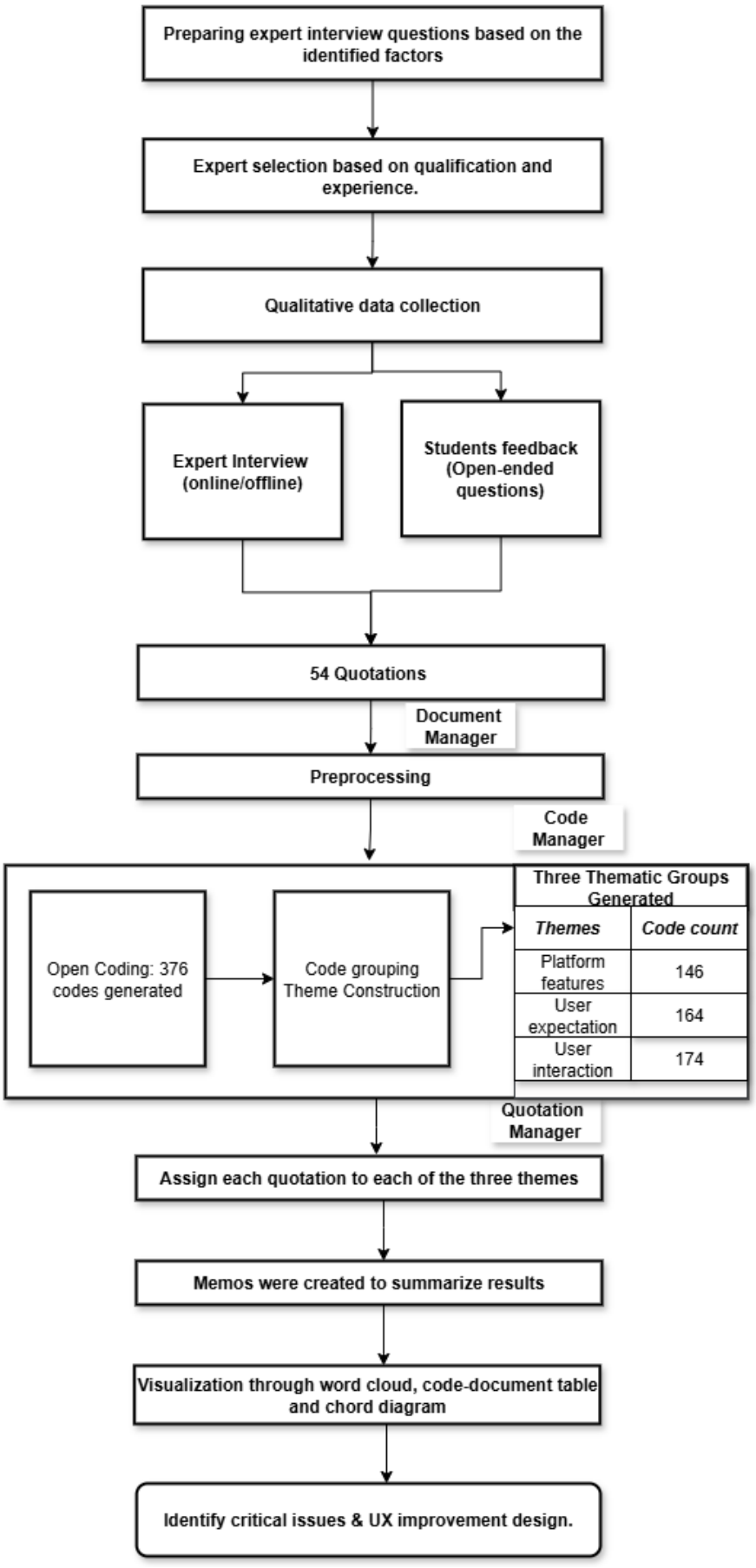

Figure 5.5. Qualitative analysis methodology diagram (Source: author)

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User expectations revealed preferences concerning the content depth and the learning materials' structure. User interactions provided valuable behavioral insights, including challenges related to navigation and engagement with the content. The quotation manager was used to classify each quotation into one of three themes based on relevance. Throughout the coding process, memos were drafted to encapsulate the findings. Word clouds and code document tables offered supplementary frequency data, reinforcing the identified themes and comments. Visual patterns derived from these tables facilitated the identification of interconnected issues, thereby informing the prioritization of user experience redesign efforts and subsequent UX improvement strategies. Figures 5.3 and 5.4 illustrate the images of expert interviews and student feedback. The methodology employed for qualitative analysis is illustrated in Figure 5.5.

5.2.2. Platform Evaluation through Web Analytics Data

The evaluation of Platform 1 using web analytics follows a systematic approach to collecting, analyzing, and interpreting user interaction data. This study utilized Google Analytics to examine and visualize data gathered over a one-year period, from June 17, 2023, to June 17, 2024. Information was collected on learner demographics, learning behaviors, and technology usage on the platform. This approach provides a more comprehensive understanding of user behavior compared to traditional web server log files.

The dataset includes information on engagement time, regional distribution, language preferences, technology usage, page views, and bounce rates for both new and returning users. Effective visualization methods, such as line charts, pie charts, bar charts, and map overlays, enhance our understanding of demographics, user behaviors, and patterns in technology usage. The data indicates that a significant number of platform users are from India, where users exhibit short interaction periods and high bounce rates. This represents the first web analytics study conducted in India for a digital learning platform focused on design education.

Website data analysis can be categorized into three areas: user data, acquisition data, and engagement data. User data reveals the locations, language preferences,

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technological information (such as browsers, devices, and operating systems), and online behaviors of our website visitors. Engagement metrics, including bounce rate, page views, and average time spent on each page, help us understand how users interact with the website. Sources of website traffic include direct URLs, referral domains, organic searches, emails, and social networks. Each channel has important analytics, such as new sessions, users, pages per session, and average session duration. Figure 5.6 visually illustrates the web analytics data collection process.

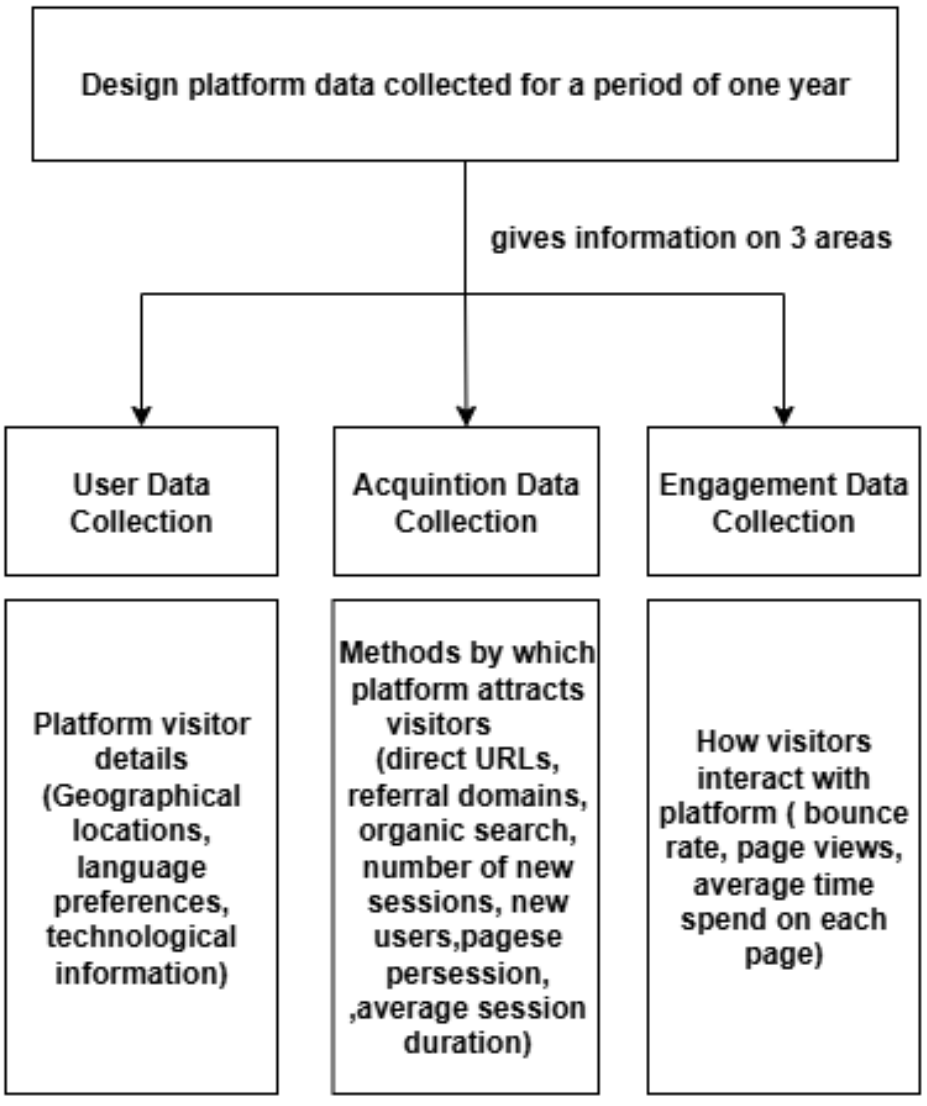

Figure 5.6. Data collection process by web analytics. (Source: author)

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5.3 Results and Discussion

5.3.1 Qualitative Analysis Results

The findings reveal that the platform's features are inconsistent and lack a clear visual hierarchy and navigation structure. Users require an improved experience, a well-defined layout, and more interactive content. The poor visual and interaction design impairs user engagement and negatively impacts long-term usage. These insights align closely with the quantitative findings, particularly as Platform 1 shows a lower user experience compared to other platforms. Figure 5.7 presents the word cloud generated from expert interviews, while Figure 5.8 shows the word cloud derived from student comments. A total of 54 quotations were collected from experts and students, leading to the generation of 376 codes, which are categorized into three themes: platform features, user expectations, and user interactions. It is shown in Table 5.2.

Figure 5.7. Word cloud generated for expert interviews

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Figure 5.8. Word cloud generated for students' comments

Table 5.2: Themes and codes separated from qualitative data collection

Platform Features	User Expectations	User Interactions
Absence of Engaging Animations	Accessing Course Contents	Absence of real-time examples
Absence of Navigation Arrows	Actions Visibility	Accessing Courses
Architecture	Additional Video Content	Accessing Lectures
Attention visuals/graphics	Arrows in carousel	Accessing Platforms
Actions Visibility	Automated Quizzes	Assignments
Categorization	Better user experience	Browsing
Cluttered UI	Categorized Themes	Carousel Navigation
Collaborative Assignments	Clean UI	Categorization of Content
Color and visual language change	Clear Categorization of Content	Certificate Download
Consistent Design Elements	Clear font hierarchy	Cluttered UI
Content Types	Clear Information Architecture	Community discussion group
Course Selection	Clear Interface	Course Selection
Course Categorization	Clear Searching Logic	Course Views
Curiosity generation	Collaborating partners	Determining next video

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Font hierarchy	Collaborative Assignments	Discussion
Gradient design	Color theme	Documents
Fonts	Comments	Easy access to courses
Homepage Design	Community Building	Exercise
Inadequate Color Scheme	Consistent Design	Explaining Concepts
Information Architecture	Curiosity generation	Faculty Discussion
Information Classification	End Chapter Exercises	Feedback
Interactive Q&A sessions	Enhanced Learning Experience	Finding Relevant Topics
Lack of arrows in carousel	Enhanced Search Filters	First Impression
Lack of Clarity	Faculty Discussion	Interaction
Interface	Focus on learning	Interaction Challenges
Lack of Classification	Good User Experience	Jumbled Styles
Lack of modern features	Good Visuals	Lack of Clarity
Lack of navigation buttons	Improved usability	Lack of Engaging Visuals
Lack of suggestion-based search	Information architecture	Lack of Interactivity
Lack of User-Friendly Features	Insightful Content	Landing Page
Limited feedback	Interactive Features	Language selection
Logging In	Interactive Q&A sessions	Layout issues
Poor user experience	Intuitive Platform	Limited Content
Readability	Live Interaction	Limited engagement opportunities
Scrolling	Micro-interaction	Limited Interactivity
Typography change	Navigation	Navigation Challenges
Typo weight	Ordered information hierarchy	Poor Hierarchy
UI/UX Improvement	Page Navigation	Problematic Hierarchy
UI Visuals	Personalized Experience	Readability
Unclear Content	Practical applications	Search Function
User-friendly navigation	Real-time feedback	Typography change
Visually Appealing UI	Search Suggestions	Typo weight
Visually unattractive course names	Upload Images and Documents	UI Improvements
	Video-based content	Unprofessional look
	Video Lectures	User Needs Assessment
	Visual Consistency	Validation Needed
	Visual Language	Video Lectures
	User-Friendly Interface	
	Visually Appealing UI	
	Visually attractive logos	

5.3.2 Analysis from web analytics data

The analysis reveals that the majority of platform users are from India, exhibiting relatively short engagement periods and a high bounce rate. The data includes engagement metrics, user metrics, and acquisition metrics. Key findings indicate there are 741,698 active users and approximately 717,164 new users. The engagement rate stands at about 25.23%, with an average engagement time per active user of 0.039312. Additionally, 562,122 new users were acquired through organic search, with roughly 506,402 users based in India. The total number of web platform users is approximately 727,830.

Demographic analysis shows that about 727,830 users visited the platform between June 17, 2023, and June 17, 2024. As the platform was developed in India as part of a government project, the largest user base is from India, comprising 506,402 users. Most Indian users are located in Bengaluru, Mumbai, Pune, and Chennai. The website also attracts users from the USA, the Philippines, the UK, and Canada. Out of 727,830 users, 692,537 use English as their primary language for learning design courses. Spanish is the second most used language, with 4,858 users, followed by Chinese, which has 3,157 users. Approximately 50.9% of users are male, while 49.1% are female. The majority of users fall within the 18-25 age range. The web analytics data is shown in Table 5.2.

An analysis of learner behavior shows that the platform recorded approximately 1,863,488 page views from 727,830 users. However, the average engagement time for active users is relatively low. This lack of engagement may be due to several user interface factors, including color choices, typography, readability, layout, design, and overall usability.

The platform's bounce rate is approximately 72.64%, significantly higher than the optimal standard of less than 60%. This situation highlights the need for a comprehensive usability evaluation to uncover the underlying causes of this behavior. Enhancing the user interface could help improve user retention and the overall experience, which can be achieved through both quantitative and qualitative methods involving the platform's users.

Data on technology usage reveals how students access the platform using electronic devices, web browsers, and operating systems. This data compares technology use over a specific period to identify any changes. Mobile devices are the most popular means of accessing the course, with Android being the most commonly used operating system, followed by Windows. There has been an increase in the use of Chrome, while Internet Explorer usage has significantly decreased.

The data indicates that the current digital design learning platform attracts learners from all continents, with a notable concentration in countries such as India, the US, the Philippines, the UK, Canada, and Australia. To gain a better understanding of the platform, a survey that incorporates both quantitative and qualitative aspects should be conducted among Indian users.

There is a significant increase in the demand for e-learning, and the platform's global reach needs to be taken into account. The analysis focuses on learner behavior on the platform. Among 741,698 website visitors, it was found that there is a lack of in-depth engagement, minimal further interactions, and an average visit duration of less than 39 seconds. Indian learners show higher engagement with the platform compared to international users, indicating that user interface design plays a crucial role in enhancing user experience. Figure 5.9 shows platform users by country, and Figure 5.10 shows platform users' engagement data.

Further research on Indian users is essential to identify issues related to platform usage. Factors such as visual design, interface design, and content quality are directly linked to user experience (UX). A study examining how an improved user interface (UI) leads to enhanced UX is necessary to foster better interactions on the platform.

High bounce rates indicate challenges in initially engaging users, while low levels of user interaction may suggest underlying problems with the interface or content organization. Various technologies are employed for online learning, revealing that most users access the platform via mobile phones. An additional study on the factors influencing e-learning is needed to further enhance the user experience.

The analysis of Platform 1 using web analytics provided valuable insights into user

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engagement, learning outcomes, user satisfaction, and platform usability. The findings underscored the importance of interactive content, visual design, and improved UI design. The web analytics data collected from the platform contributes to its effectiveness, learner experience, and educational impact, ultimately supporting the success of its learners globally. Technical problems, internet connection issues, device compatibility, or browser settings may have influenced data accuracy and learner experience metrics. Relying solely on web analytics data only partially accounts for the factors that influence user interface, engagement, and usability. Figure 5.11 and Figure 5.12 show snapshots of returning users' data and engaged sessions for each user for a period of 7 days.

Table 5.2: Web analytics data

Data	Count
Total active users	7,41,698
New users who interacted with the site or launched the app for the first time (event triggered: first open)	7,17,164
Engaged Session (Session lasting longer than 10 seconds, or with a critical event, or with two or more screen or page views)	2,24,170
Total Sessions (Sessions that began on the site or app)	8,88,464
Engagement Rate	25.23%
Engaged Sessions per User	0.31
Average Engagement Time per Active User	0.039312
Number of User-Triggered Events	34,90,320
New Users from Organic Search	5,62,122
Largest User Base- India	5,06,402
Returning Users (Users who have initiated at least one previous session)	52,000
Web Platform Users	7,27,830
Primary Operating System (Android) users	3,85,674

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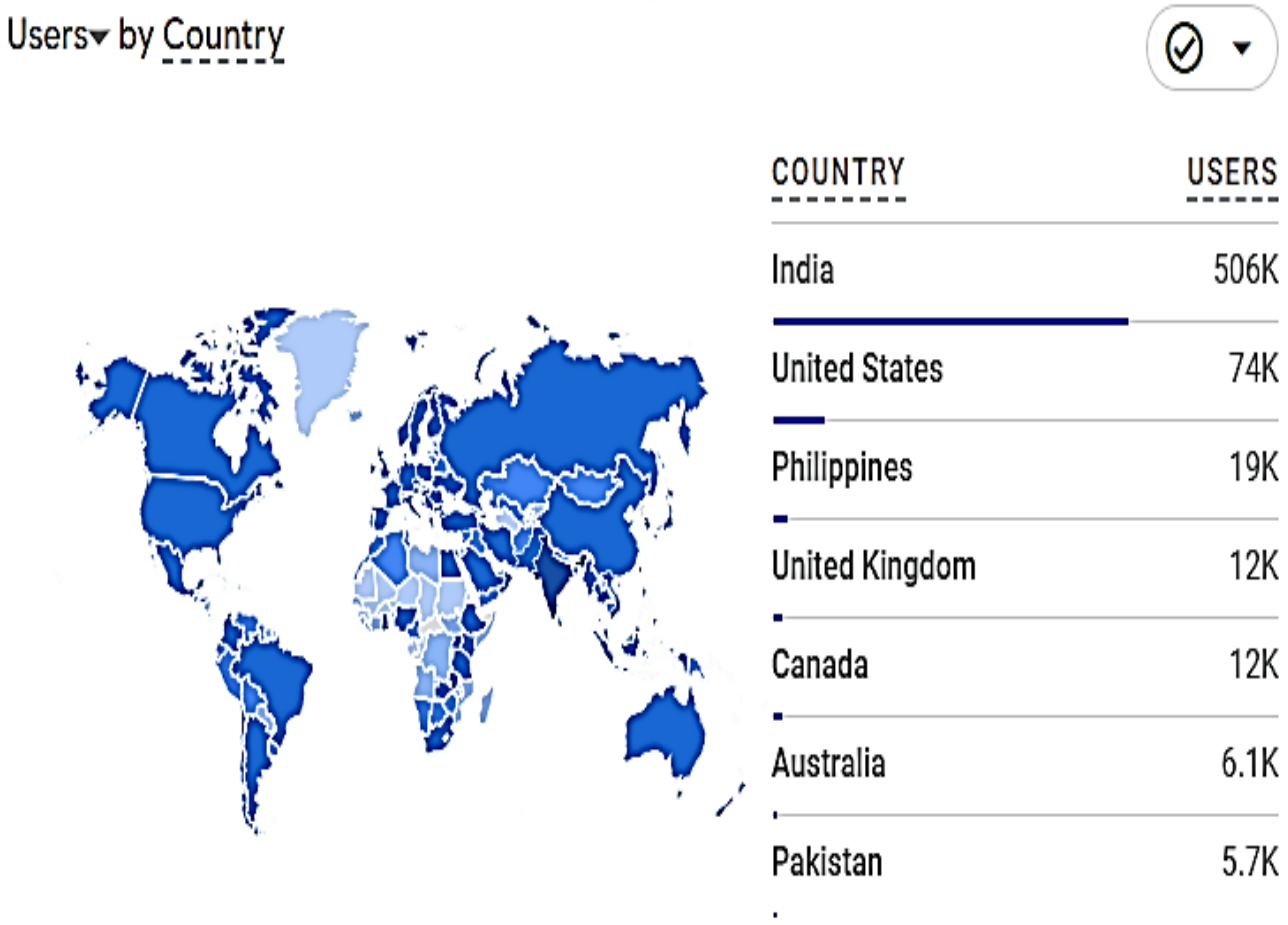

Figure 5.9. Platform users by country [Source: Google Analytics]

	Country	Users	New users	Engaged sessions	Engagement rate	Engaged sessions per user
		727,830 100% of total	**717,685** 100% of total	**224,170** 100% of total	**25.23%** Avg 0%	**0.31** Avg 0%
1	India	507,500	498,581	180,667	27.99%	0.36
2	United States	74,214	73,717	8,589	10.79%	0.12
3	Philippines	18,896	18,834	5,677	25.01%	0.30
4	United Kingdom	12,446	12,364	2,459	16.89%	0.20
5	Canada	12,258	12,241	2,125	15.49%	0.17
6	Australia	6,148	6,112	1,368	19.28%	0.22

Figure 5.10. Platform users' engagement data [Source: Google Analytics]

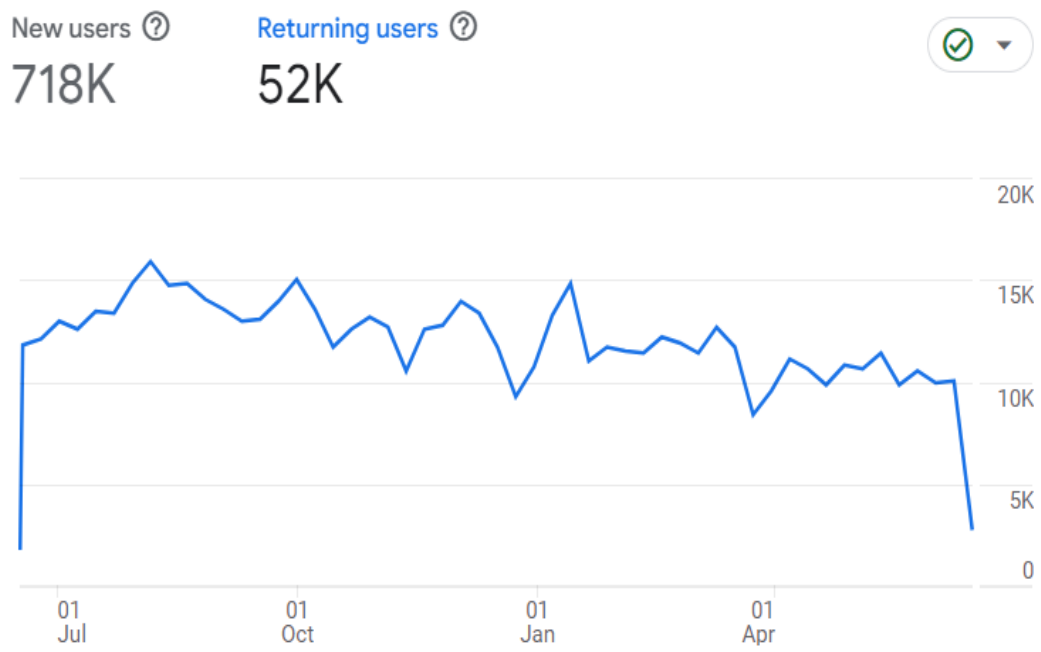

Figure 5.11. Retention Users Data [Source: Google Analytics]

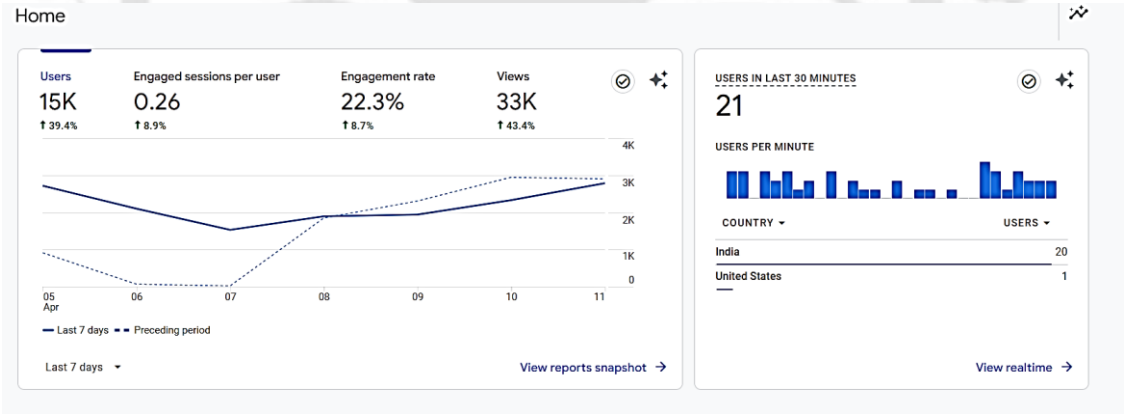

Figure 5.12. Engaged sessions per user [Source: Google Analytics]

The integration of qualitative feedback from both professionals and students, alongside data from web analytics, provided a comprehensive understanding of the platform's usability. Experts in design education emphasized the importance of visual clarity, enhanced navigation, an improved learning experience, and the need to eliminate inconsistencies in content structure and interface. Repeated concerns raised by students

revolved around problems like visual clutter, hurdles in content accessibility, and insufficient engagement possibilities.

Data from web analytics highlighted significant bounce rates, shorter average session times, and erratic user navigation, reinforcing these conclusions. The patterns of interaction observed by users mirrored what educators and learners had noted. These challenges were further substantiated through triangulation techniques. The insights garnered were integral to the platform's redesign.

5.4 Conclusion

This chapter provides a comprehensive analysis of web analytics data alongside qualitative feedback from both experts and students, offering insights into the platform's usability. Design education professionals highlighted the importance of enhanced navigation, improved visuals, and a more effective educational experience. They also pointed out the need to address structural inconsistencies in the interface and content. Student feedback revealed ongoing challenges such as visual clutter, difficulties in content accessibility, and limited engagement opportunities. These insights were further supported by web analytics data, which indicated uneven user flow, high bounce rates, and shorter average session lengths. Such patterns in user behavior align with the comments from both educators and learners.

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6

Evaluating User Interface Improvements

Abstract

In this chapter, a triangulated method is discussed to highlight the advancement of user experience evaluation in the realm of digital learning. This approach synthesizes online analytics, participant qualitative contributions, and the User Usability Evaluation Questionnaire (UUEQ). Each component offers specific benefits, and their combination significantly enhances the context, validity, and depth of usability metrics.

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6.1 Introduction

To assess digital learning environments effectively, the UUEQ was specifically developed to focus on essential elements such as visual design, user interface design, content organization, operational functionality, and overarching objectives. Conventional assessment tools often overlook significant platform-specific insights. The survey promotes critical analysis and minimizes response bias by featuring both positive and negative aspects. This approach enhances the validity of the tool and ensures its relevance to the target user groups, particularly design and engineering students familiar with digital learning environments.

By analyzing Platform 1, we set out to refine the user interface of digital learning platforms. As an established platform, it not only acted as a benchmark but also helped us grasp the necessary design and development strategies for user interfaces in the realm of digital design education. Our focus was on how four crucial design concepts were integrated into Platform 1's graphical user interface and the subsequent enhancements that resulted from these changes.

6.2 Triangulation Approach

User interactions provide open-ended responses and qualitative feedback that enrich the questionnaire, offering valuable contextual insights unattainable through numerical scales alone. By uncovering deeper user issues, interface frustrations, and expectations, this feedback contributes to design improvements that transcend mere measurements. Concurrently, web analytics data collected over one year offers behavioral insights into user engagement, session duration, bounce rates, and device usage patterns. This information not only supports user feedback but also highlights any usability issues.

When these three methods are combined, they create a triangulation strategy that significantly enhances the internal validity and reliability of the findings. Unlike single-method evaluations, which may miss certain usability aspects, triangulation allows for the cross-verification of data and the identification of patterns that might otherwise remain hidden. The triangulation approach is illustrated in Figure 6.1.

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A one-way ANOVA analysis, followed by post hoc tests, revealed that user responses regarding the identified UX/UI factors for Platform 1 were significantly lower than those for Platforms 2 and 3. This finding highlights an urgent need to enhance the interface of Platform 1, making it more user-friendly by improving all aspects of its UX/UI, including visual design, interface design, content organization, functionality, and objectives.

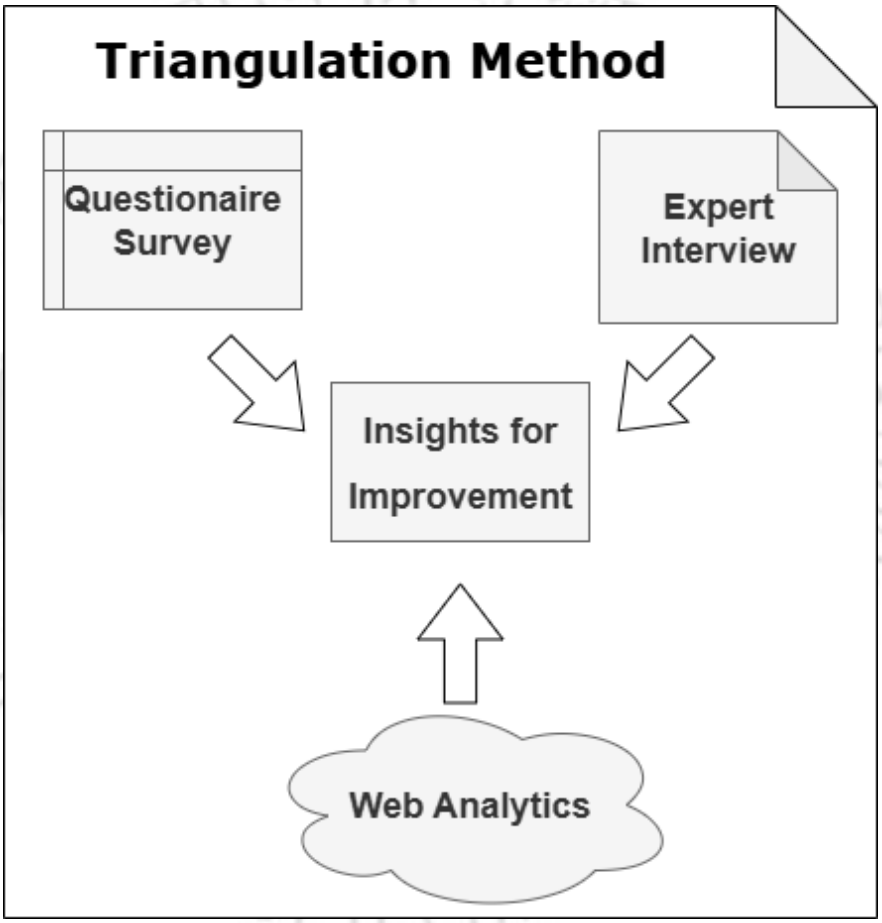

Figure 6.1. Triangulation Approach

6.3. Redesign Process

Platform 1 was selected for a redesign due to its performance in a comparative analysis of key user experience (UX) factors, particularly in visual design and

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content organization. Both qualitative and quantitative findings supported this decision. The major improvements required include the color scheme, readability, button positions, layout, visual categorization, information hierarchy, course organization, search menu enhancement, navigational tools, content categories, feedback mechanisms, logo redesign, addition of design exercises to courses, font hierarchy adjustments, critical thinking elements, and collaborative features.

The redesign is crucial to address significant usability challenges and improve the overall learning experience for design students who depend on interaction and visual coherence. Changes were implemented based on established design principles, quantitative research findings, expert opinions, and student feedback. Several core design concepts guided the redesign process, including:

Theory of Cognitive Load: By providing organized and clear information, the cognitive load on users is reduced. The webpage was streamlined, content was organized into modular sections, and consistent navigation patterns were upheld.

Golden Ratio: This design principle employs the ratio of 1:1.618 to create visually pleasing and harmonious compositions. It is utilized in the arrangement of visual elements to achieve an optimal balance between content density and white space.

Color Application: This principle leverages color to create contrast and enhance the overall visual appeal of designs. This technique can diminish visual clutter, enhance readability, and fortify the overall visual identity.

Dynamic symmetry: This design idea employs a grid system to create balance, harmony, and visual interest in projects. It organises picture placements and interface grids, establishing a seamless and engaging visual progression.

6.4. Identified issues

From the UUEQ Survey

Color scheme, readability, button positions, layout, icons, interface design, navigational tool, labels, descriptions for content category, content hierarchy, adaptability towards different screen sizes and devices, adding feedback, the addition of design exercises to courses, critical thinking, and collaborative features.

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Table 6.1. Platform Issues and Redesign Benefits

Key factors	Issues from UUEQ	Issues from Expert Interviews	UX Issues Solved	Design Principles Applied	Benefits of Redesign
Visual Design	Inconsistent color scheme, Poor readability	Too many visuals, visual categorization, ordered information hierarchy needed, improve visual appeal, and UI color palette	Poor color, layout, and visual appeal	Golden Ratio, Color Usage, Typography hierarchy applied (H1>H2> body)	Clean, attractive, readable screens
Interface Design	button positions, unclear layout, icons, navigational tool,	absence of navigation arrow, font hierarchy, side navigation panel, and scrolling	Confusing layout, missing navigation	Dynamic Symmetry to place UI elements, call to action Button (Start, Download), Responsive UI	Smooth interaction and consistent navigation
Content Organisation	labels and descriptions for content category, discipline-wise categorisation	course categorization, mixed contents	Discipline-wise course organisation	Grid Layout to organise courses, filtering tools (Discipline), Visual Grouping (exercises, media, quizzes)	Logical, easy-to-follow learning structure
Functionality	adding feedback, the addition of design exercises to courses, lack of interactive tools	improve search menu, add search suggestions, design exercises, and feedback in courses	No quizzes, no tools, overwhelming layout	Reduced Cognitive Load (Index, design exercise, quizzes, Progressive bar,	Interactive, clear, and user-friendly learning tools
Objectives	critical thinking, collaborative features	To improve user interaction, a consistent design is needed.	Passive learning, A sign in added for assignment evaluation and discussions	Emotional Design, User-Centered Design	Engages creativity, supports active design learning

From Expert Interview

Too many visuals, visual categorization/ ordered information hierarchy needed, course categorization, improve search menu, add search suggestions, mixed contents, improve visual appeal and UI color palette, missing attractive logo, absence of navigation arrow, font hierarchy, side navigation panel, scrolling, difficulty in information finding, design exercises and feedback in courses, navigation challenges, improve user interaction, consistent design needed.

The issues identified from UUEQ and expert interviews, applied design principles to the redesign platform screens, and the benefits of redesign are shown in Table 6.1. The redesigned version of the platform features several significant enhancements. These include a refreshed color scheme, organization by discipline, the introduction of design exercises, a hover effect, and a new requirement for users to sign in in order to provide evaluations and leave comments. The content has been reorganized to reduce clutter, and a new quiz section has been added. Additionally, a progress bar has been implemented to enhance the user experience, increase opportunities for interaction, and eliminate redundant content. These improvements aim to boost usability and overall engagement on the platform.

6.5. Results and Discussions

6.5.1. Redesign Analysis

To evaluate the impact of the interface enhancements, we compared the usability of the original Platform 1 (https://www.dsource.in/) with its redesigned version, focusing on key factors measured by the User Experience Questionnaire (UEQ). An independent sample t-test was conducted to identify differences in user experiences before and after the redesign. We recruited twenty-seven participants for the original Platform 1 and thirty participants for the redesigned version. Group Statistics related to the data are presented in Appendix A.8.

The analysis revealed statistically significant improvements across all factors ($p < 0.001$ for all comparisons), as illustrated in the accompanying Table 6.2. Notably, the overall user experience rating increased.

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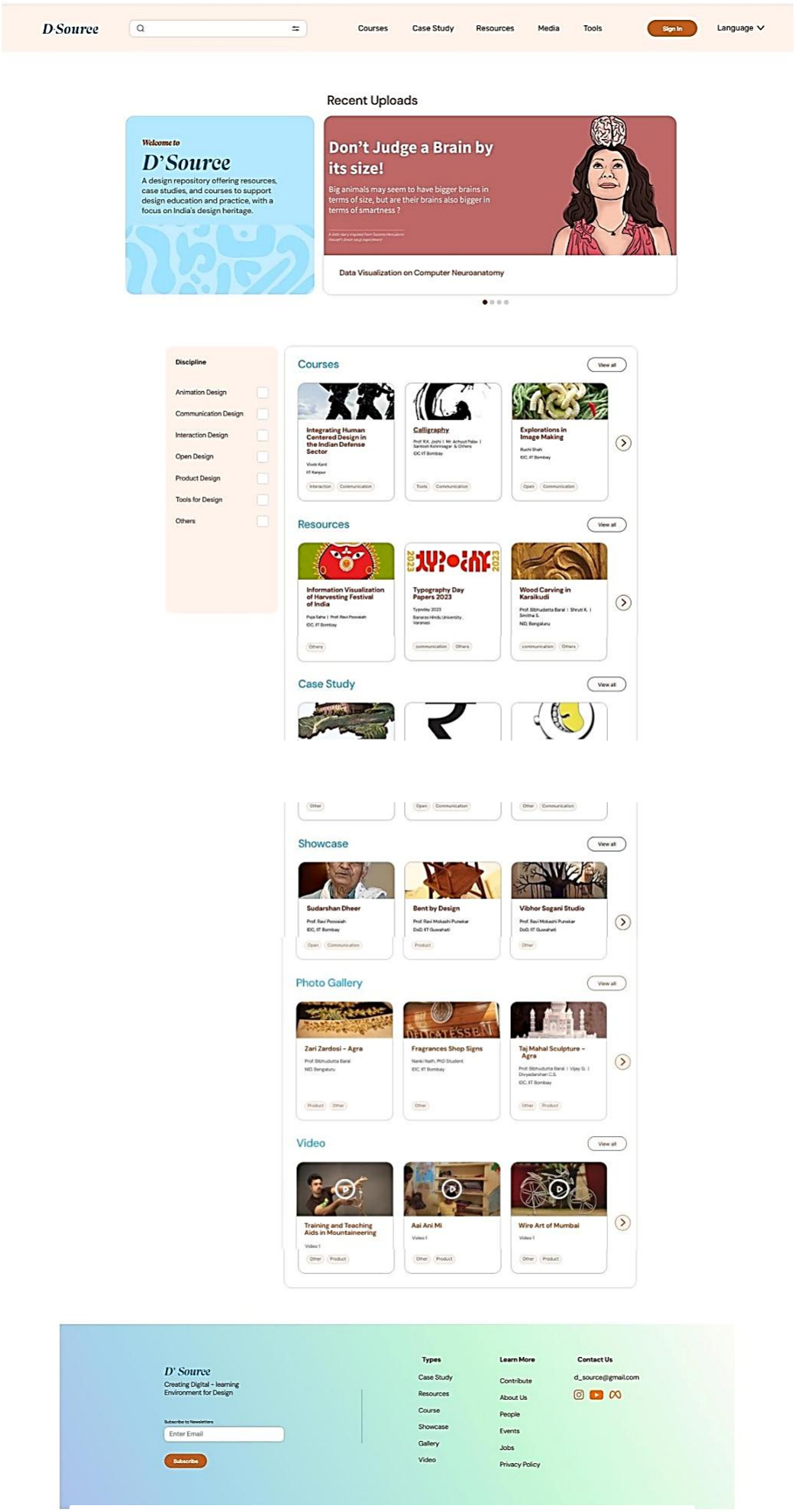

Figure 6.2. Redesigned screen 1

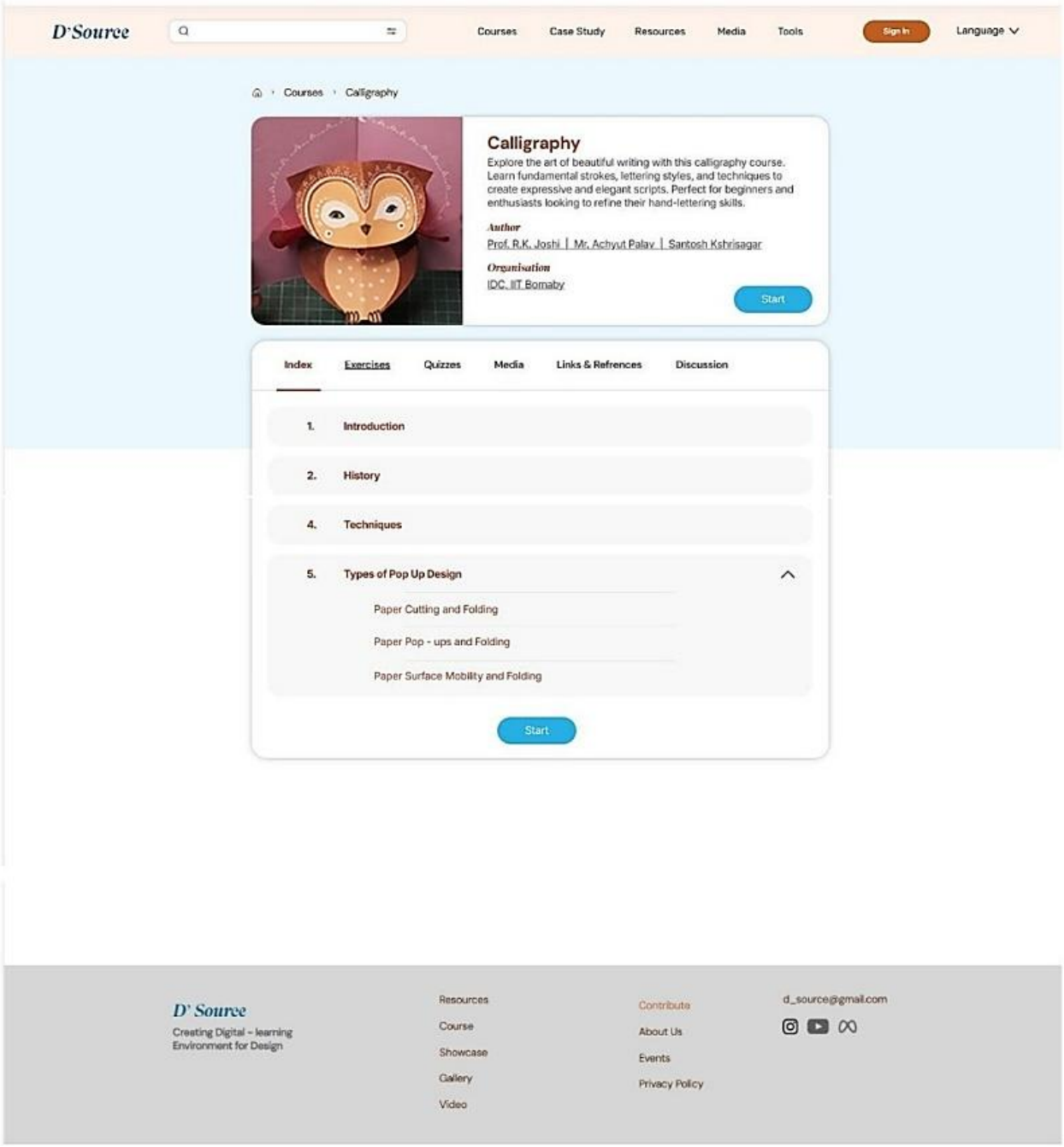

Figure 6.3. Redesigned screen 2

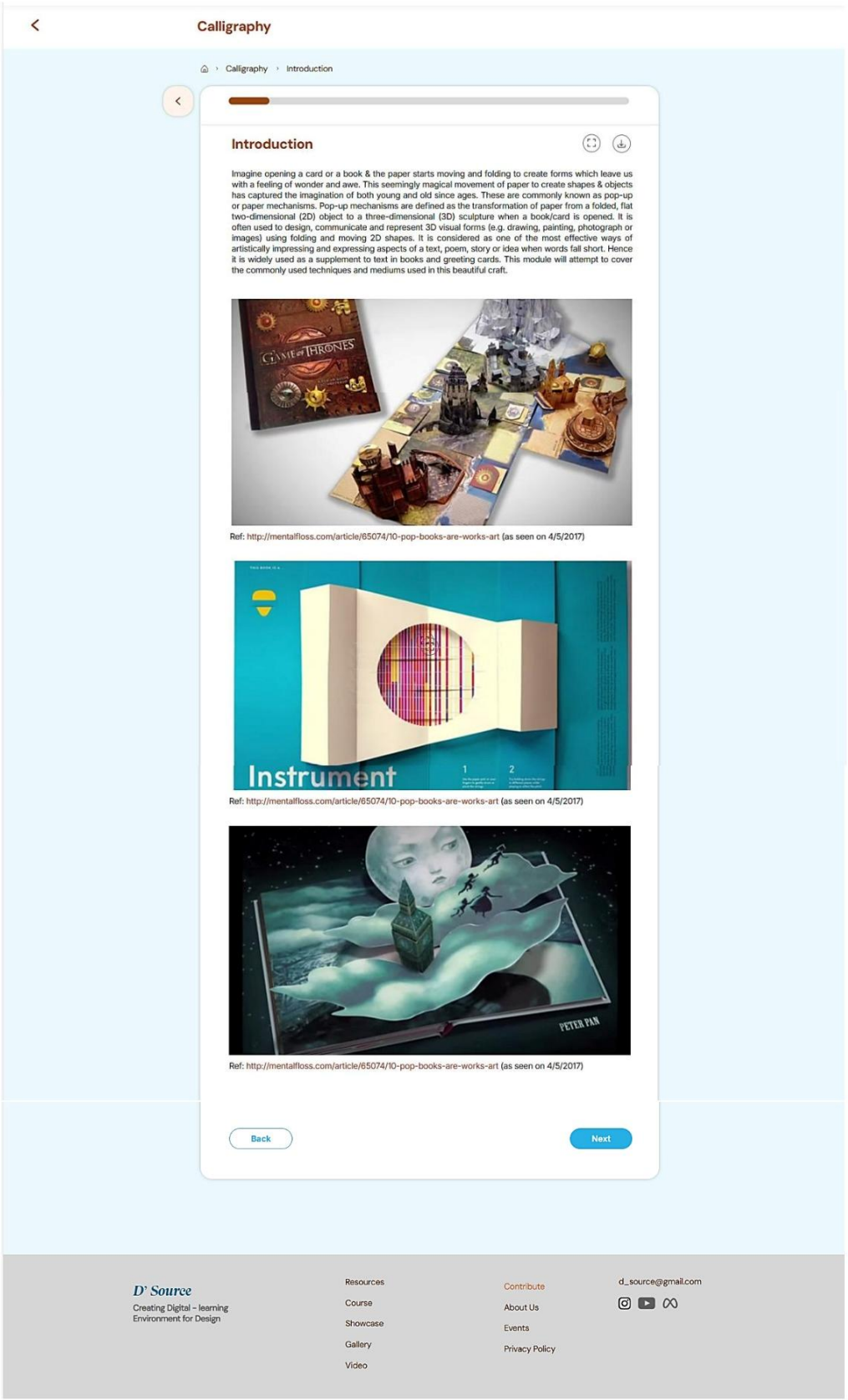

Figure 6.4. Redesigned screen 3

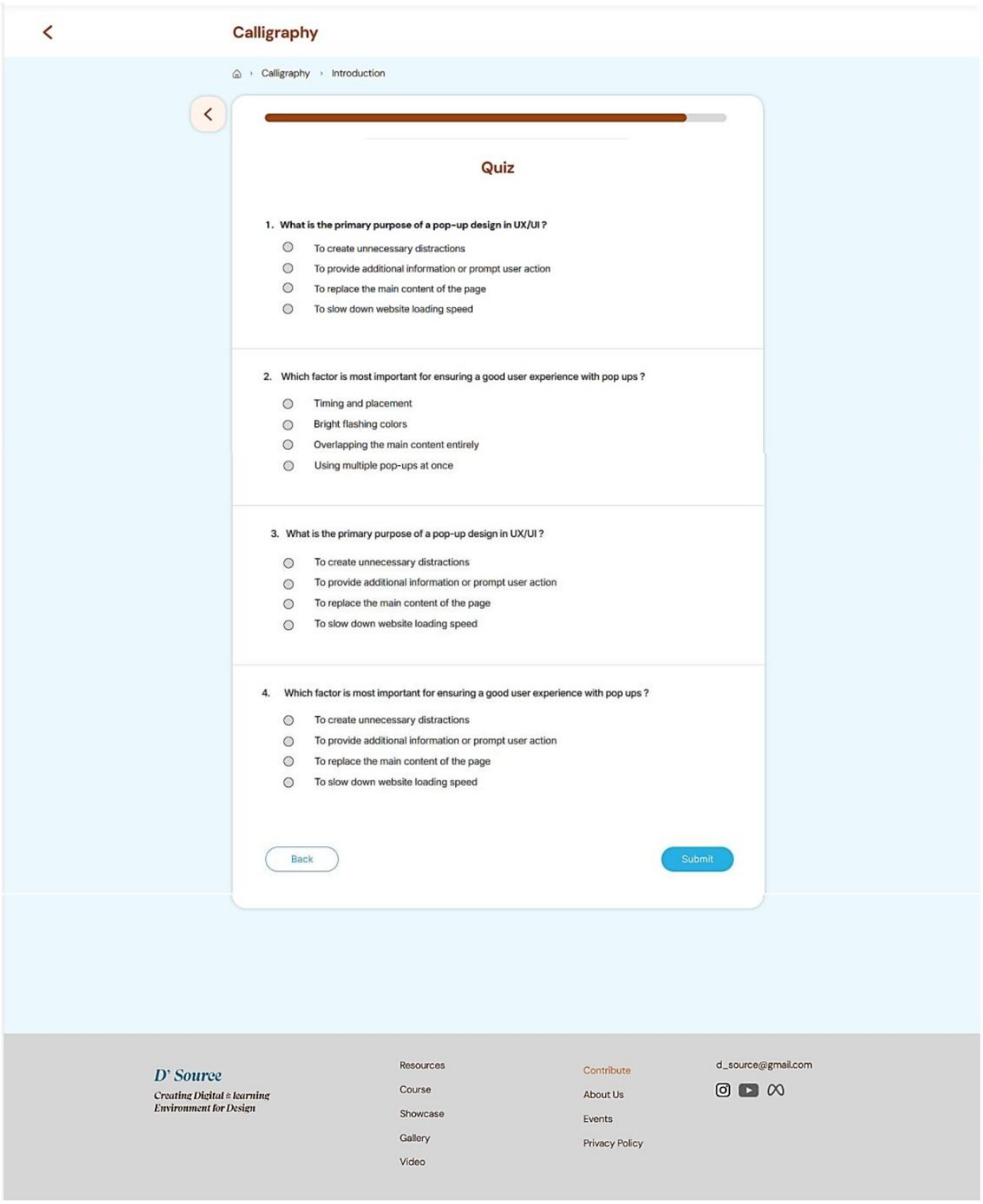

Figure 6.5. Redesigned screen 4

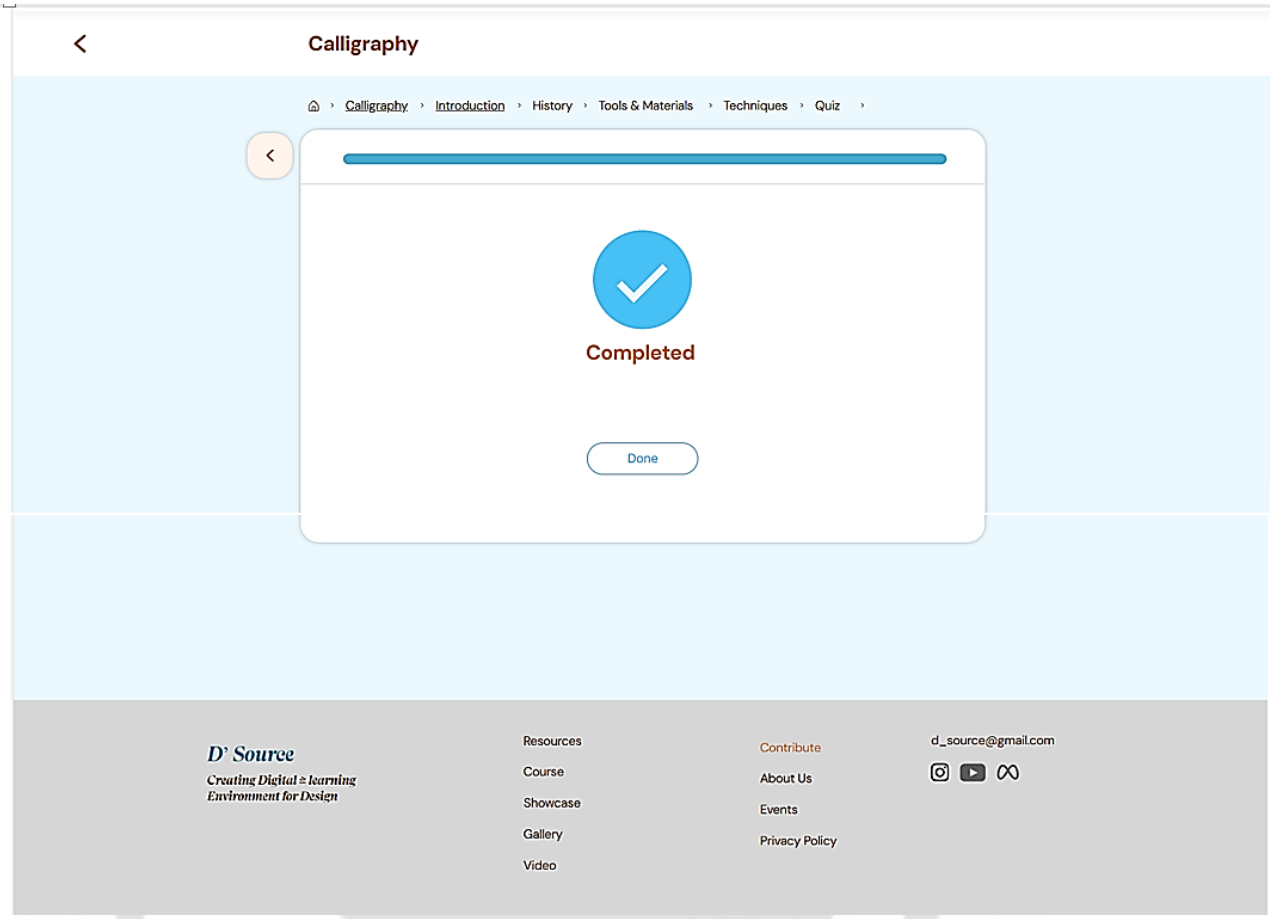

Figure 6.6. Redesigned screen 5

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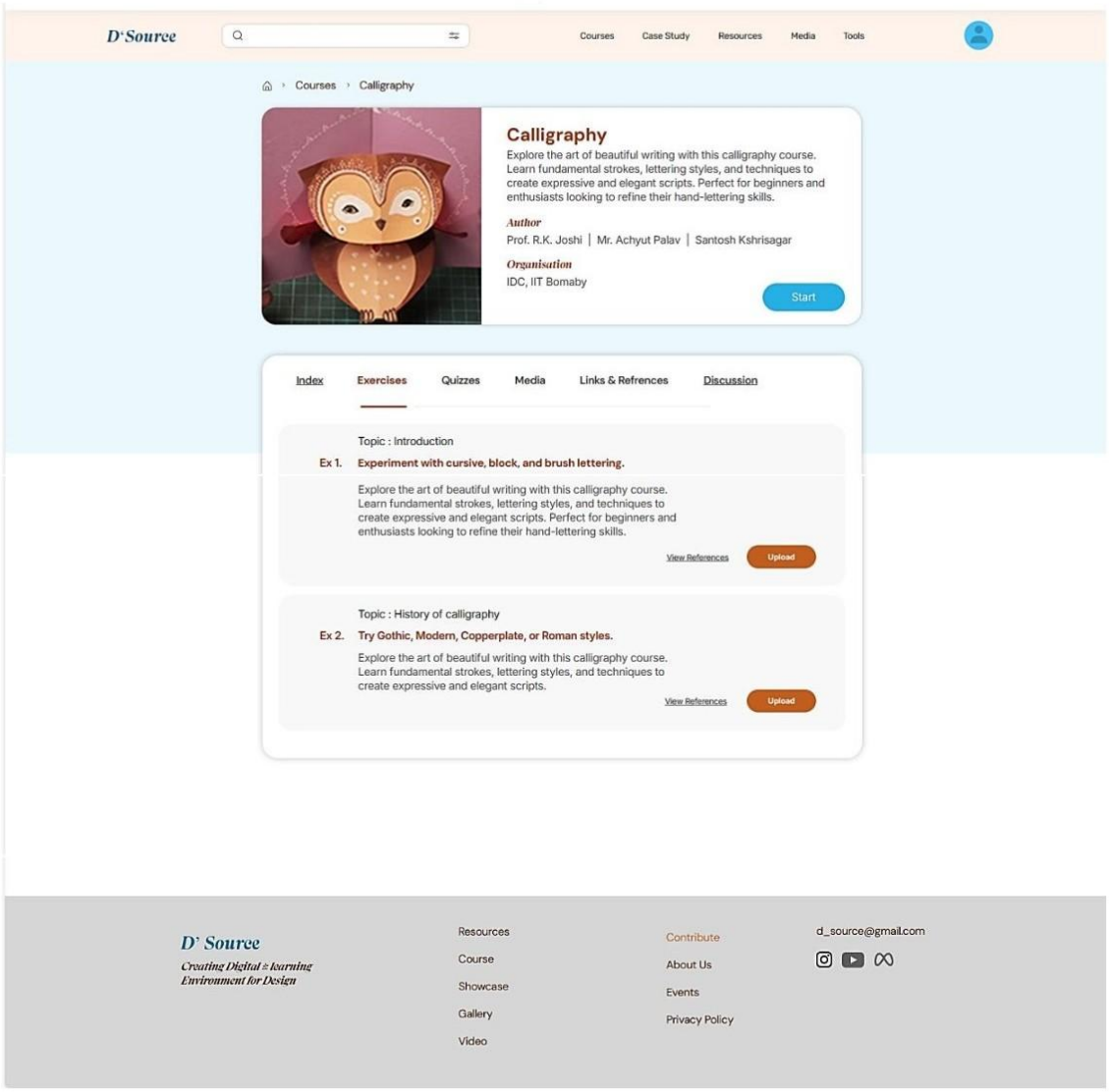

Figure 6.7. Redesigned screen 6

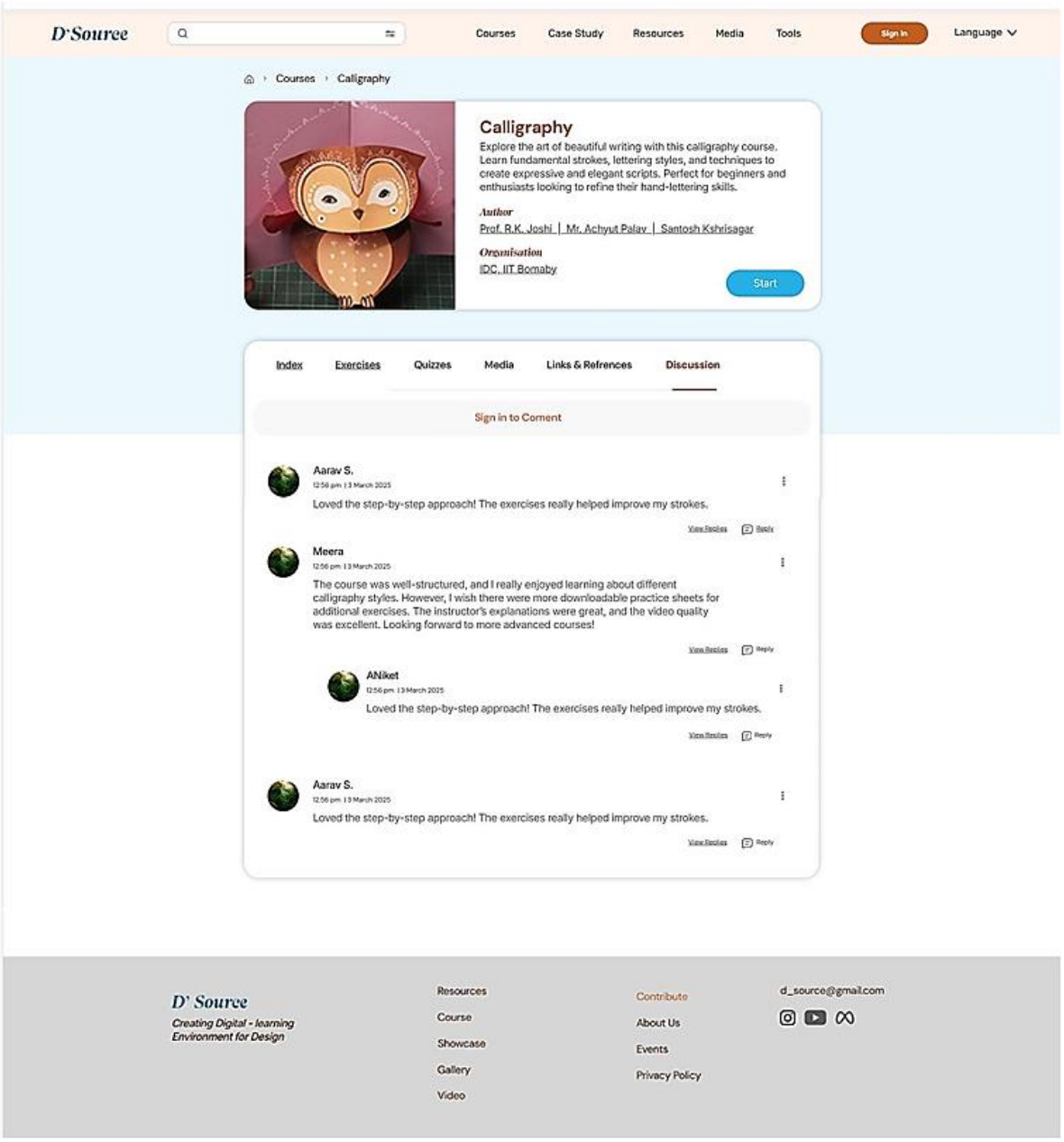

Figure 6.8. Redesigned screen 7

Levene's test results indicated homogeneity of variances for most factors; however, significant differences in variance were observed for interface design, content organization, and visual design. These findings demonstrate that the redesign enhanced the user experience across all dimensions. Furthermore, they suggest that improvements in interface layout, content structure, and visual appeal can significantly elevate the user experience of a digital design learning platform. The redesigned screens for platform 1 are shown in Figures 6.2 to 6.8.

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Table 6.2. Comparison table of the redesigned platform versus the original platform

Factor	Platform 1 (M±SD)	Redesign Platform 1 (M±SD)	p-value	Statistically Significant?
Visual Design	3.00±0.83	4.16±0.47	<.001	**Yes**
Interface Design	3.24±0.87	4.28±0.39	<.001	**Yes**
Content Organization	3.32±0.75	4.51±0.42	<.001	**Yes**
Functionality	3.11±0.71	4.39±0.41	<.001	**Yes**
Objectives	3.11±0.84	3.95±0.54	<.001	**Yes**
Overall User Experiences	3.19±1.08	3.97±0.68	.002	**Yes**

Platform 1 underwent a comprehensive visual and structural redesign based on expert recommendations, student feedback, design principles, and quantitative results. The redesigned version effectively addressed the identified issues. T-test results confirmed a statistically significant improvement across all assessed factors. These findings support the effectiveness of integrating visual design principles in digital design learning platforms.

A comparative analysis between the original and redesigned versions of the platform demonstrates that targeted interface improvements significantly enhance the user experience in digital design learning environments. Significant enhancements were observed in all key factors, including visual design, interface design, content organization, functionality, objectives, and overall user experience. Specifically, content organization and interface design received higher evaluations (M=4.51 and M=4.28, respectively) compared to the original platform (M=3.32 and M=3.24, respectively). This suggests that content hierarchy, navigation flow, and page structure improvements can

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directly influence user satisfaction and usability.
Overall user experience ratings increased from 3.19 to 3.97, indicating that the redesign positively affected users' perceptions and confirmed the effectiveness of this study's UX-centered design methodology.

Alongside enhancing data reliability, the triangulated approach aids in understanding usability across various platforms. Analyzing both Indian and global audiences shows that users' expectations can differ based on their cultural or technological contexts. Therefore, a multifaceted strategy offers a more nuanced and valuable insight into user experience.

6.6. Conclusion

This study presents a systematic approach to assessing user experience on design learning platforms. However, it is limited by the absence of experiments involving redesigns on alternative platforms and the need for longitudinal studies to ensure lasting usability improvements. The study significantly enhances the field of user experience in digital design education by demonstrating how Garrett's five-plane UX strategy can be applied to evaluate and enhance design-focused digital platforms.

This examination utilizes a triangulated approach to evaluate usability by integrating web analytics, qualitative insights from professionals and students, and quantitative analysis methods such as surveys, ANOVA, and t-tests. Additionally, it creates a systematic comparison framework for assessing design learning platforms from regional, national, and international perspectives. The study also details an easy redesign technique that includes significant design concepts like dynamic symmetry, color theory, cognitive load theory, and the golden ratio. Post-redesign t-testing is performed to assess the effectiveness of this methodology.

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7

Discussion and Conclusion

Abstract

In this chapter, we explore the aims and objectives of the investigation, as well as the study's final conclusions. It also encompasses an evaluation of the objectives fulfilled, the hypothesis tested, discoveries made, contributions provided, limitations identified, opportunities for future research, and the final conclusions reached.

7.0 General Discussion and Recommendations

By employing usability evaluation methods, design principles, and a systematic redesign approach, this initiative intends to elevate the user experience on platforms dedicated to digital design learning. It relies on Garrett's five-plane user experience model as its core framework. The reliability of the usability evaluation questionnaire, featuring the five discovered variables, was substantiated by a Cronbach's alpha exceeding 0.75.

The study conducts a statistical comparative analysis of three digital learning platforms focused on design education. A triangulation method is used for data collection, incorporating questionnaire surveys, expert interviews, and web analytics data. One-way ANOVA and post hoc tests are performed to determine the significance of the identified factors across the three platforms. Additionally, qualitative studies and web analytics provide deeper insights into user experience.

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The redesign, grounded in established design principles, significantly improved user experience. The findings indicate that to enhance the user experience of any design learning platform, it is essential to address factors such as visual design, interface design, content organization, functionality, and learning objectives. Academic institutions and digital learning platform managers will find these insights valuable.

The results highlight the need for ongoing user-centered evaluation in developing educational technology and support previous studies on learning experience design and human-computer interaction. This research underscores the importance of a multifaceted approach to design and assessment in digital design learning platforms and suggests avenues for future research.

7.0.1. Initial literature review and research gap identification

Many digital learning platforms encounter usability challenges that can negatively impact the user experience. While numerous studies have examined these platforms, research specifically focused on designing learning experiences remains limited. This highlights the need for comprehensive evaluations to enhance user experience more effectively. Previous research often lacks a structured approach to assessing these platforms in terms of their interface, content, and overall usability, particularly regarding established UX frameworks.

The objective of this study is to conduct a comparative usability analysis of local and international platforms from the perspectives of both experts and users. We aim to systematically assess the impact of e-learning user interface (UI) design on the learning experiences of users, particularly within the context of design education platforms. Through this analysis, we seek to provide valuable insights into the relationship between user engagement on digital design platforms and UI design.

The literature review has highlighted the current status of digital design education, the importance of UX/UI in these platforms, and various methods of usability assessment. Additionally, the review underscored the importance of an iterative design process and a multidisciplinary approach, both of which are essential for ongoing evaluation and enhancement of user experience.

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The impetus for this investigation arises from the necessity of systematically bridging current gaps using a thorough and methodical approach. We aim to examine how design learning platforms can enhance user engagement through the application of efficient evaluation techniques, analyzing user interface components as outlined by Garrett's UX model. Additionally, the study will concentrate on targeted redesigns, using Garrett's five-plane model as its foundational framework to enhance design learning platforms.
There is limited focus on design-specific platforms and the relationship between user interface (UI) and user experience (UX) in digital design education. Most existing research emphasizes functionality and overall user experience without adequately exploring how specific UI design elements influence overall UX, especially in the context of design education. While various platforms offer design education, their interface designs have not been thoroughly evaluated regarding their impact on user engagement, learning outcomes, and overall satisfaction.

Despite the growing significance of digital platforms in design education, the literature reveals a notable gap in assessing and enhancing user experience (UX) using established UX frameworks. Most studies have concentrated on general e-learning platforms, prioritizing visual and experiential learning. There is a lack of research focusing on a mixed-methods approach for platform evaluation.

This study seeks to fill these gaps by applying Garrett's five-plane UX model to evaluate digital design platforms, providing a domain-specific perspective that has not been previously examined. The lack of empirical usability evaluations and analysis of redesign impacts further complicates efforts to enhance the digital learning experience for design students. students.

7.0.2. Preliminary Evaluation

As highlighted in the study, the critical design elements of an interface that affect user experience on an e-learning platform comprise visual design, interface design, content organization, functionality, and objectives. It is worth noting that the average ratings for both visual and interface design fell below 3.0, suggesting a pressing need for improvements in these domains. These subpar scores contributed to inadequate color

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schemes, deficient layouts and icons, insufficient adaptability, and the suboptimal integration of interactive content. These findings underscore the vital importance of visual and interactive elements in enhancing the overall usability of the platform for learners.

The methodological rigor implemented during the pilot study, particularly regarding the content validity process, significantly enhanced trust in the efficacy of the instrument. A robust foundation was established for the principal research by engaging expert evaluations and establishing statistical benchmarks for reliability (with Cronbach's alpha exceeding 0.75) and content validity (I-CVI being at least 0.78). Additionally, the pilot study highlighted the critical role of preliminary testing in detecting deficiencies within the instrument and addressing shortcomings in user experience.

The platform has attained a user experience rating of 3.04, indicating that it fulfills certain usability criteria; however, significant improvements are needed in various critical aspects pertinent to design students. Key areas that require enhancement include user engagement, visual clarity, the incorporation of interactive features such as design exercises and quizzes, alongside a comprehensive alignment with established learning objectives. To better cater to the needs of students and to elevate user satisfaction, these insights underscore the urgent need for strategic initiatives aimed at refining the platform's user experience.

7.0.3 Comparative Usability Evaluation

In alignment with Garrett's UX paradigm, this research provides empirical evidence for the incorporation of critical elements into the UX evaluation model. Through the integration of web analytics, expert interviews, and statistical analysis, we can achieve a comprehensive comprehension of user experience on digital design learning platforms. The study examines user perceptions regarding the usability of three distinct platforms, highlighting five essential components: functionality, objectives, information organization, interface design, and visual aesthetics.

These findings yield significant new insights into the usability of the platforms in question. The statistical analysis illuminated considerable variations in user assessments,

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particularly in relation to the organization of content and visual design elements. Platform 3 emerged as the top-rated option, perceived by users as more engaging and conducive to learning, owing to its strategic layout, harmonious color schemes, and overall visual design. The organization and navigation of the content were also highly rated.

This analysis highlights the vital importance of content arrangement and visual appeal in influencing users' perceptions of usability within online learning frameworks. In stark contrast, Platform 1 garnered low evaluations in every category assessed, underscoring an urgent need for enhancements in its content organization, clarity of objectives, and visual design to foster a better overall user experience. The research demonstrates that usability is a nuanced concept, and that even minor tweaks in design and structure can considerably affect platform preference and user satisfaction. The knowledge acquired from this study can guide improvements in user interfaces and graphical designs of digital design education platforms.

7.0.4 Qualitative and Web Analytics Data Evaluation

The combination of web analytics metrics with qualitative insights from both experts and students facilitated a comprehensive evaluation of the platform's efficacy. Immediate attention is required to rectify inconsistencies identified within the interface and content layout. Specialists in the field of design education have reiterated the importance of visual clarity, effective navigation, and the enhancement of the learning experience. Furthermore, consistent feedback from students brought to light enduring issues such as visual clutter, accessibility difficulties regarding content, and a lack of interactive engagement opportunities.

The analysis of web analytics data indicated elevated bounce rates, reduced average session durations, and inconsistent user traffic throughout the website, which substantiated these findings. The noted patterns of user interaction were in accordance with the observations reported by both educators and learners. The triangulation approach further augmented the evidence related to these issues.

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7.0.5 Redesign Evaluation

The insights gathered formed the foundation for the platform redesign. The updated version significantly enhances the user experience, illustrating the value of integrating feedback with behavioral data to inform design decisions. This approach will foster design improvements and offer methodological insights for future evaluations of digital learning platforms.

Platform 1 underwent a visual and structural redesign based on expert suggestions, student feedback, design principles, and quantitative results. The updated version successfully addressed the identified issues. The t-test results confirmed a statistically significant improvement across all assessed factors, supporting the effectiveness of applying visual design principles in digital design learning platforms.

The comparative analysis between the original and redesigned versions of the platform shows that targeted interface improvements can significantly enhance the user experience in digital design learning environments. Significant improvements were observed in all key factors, including visual design, interface design, content organization, functionality, objectives, and overall user experience. Content organization and interface design received higher evaluations (M=4.51 and M=4.28, respectively) compared to the original platform (M=3.32 and M=3.24, respectively). This suggests that enhancements in content hierarchy, navigation flow, and page structure can directly influence user satisfaction and usability. The overall user experience ratings increased from 3.19 to 3.97, indicating that the redesign positively affected users' perceptions and affirming the effectiveness of the UX-centered design methodology used in this study.

The triangulated approach enhances data robustness and helps interpret usability across different platforms. This is particularly important in contexts where individuals may have varying expectations shaped by their cultural or technological backgrounds, as seen between Indian and global audiences. Therefore, a multidimensional approach provides a more nuanced and practical understanding of user experience.

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7.1. Recommendations for the Improvement of UI and UX

The following recommendations are put forth to improve the user interface (UI) and the overall user experience (UX) of digital design learning environments based on an examination of user perceptions, comparative usability evaluations, and redesign evaluations:

1. To clear up the visuals, use consistent colour schemes, current fonts, and large layouts.
2. Use white space wisely to make text easier to read and improve the overall look.
3. Line up learning goals, calls to action, and content modules with the visual hierarchy.
4. Make sure the image, colours, and icons used for branding are the same across the platform.
5. Use clear menus and icons with labels to make the layout easier.
6. Make layouts have features like discussions, tracking progress, and saved materials.
7. Let users know when they've done something, like sharing a file or finishing a lesson.
8. Set up a content structure with precise units, subtopics, and a flow that goes from one to the next.
9. Add progress bars so people can learn about complicated topics in small steps without getting too confused.
10. Give users search and filter tools to make it easy to find information.
11. Putting in quizzes, exercises, and feedback for each lesson will help people interact with each other more.
12. Add individual sign-in and commenting so that people can work together to learn.

7.2. Salient Findings

The following are the salient findings of the present research regarding the improvement of UI design to ensure the UX of digital design learning platforms from an HCI perspective:

- Presently, there is a limited emphasis on design-specific platforms and the relationship between user interface (UI) and user experience (UX) within digital design education. Existing research primarily focuses on these platforms' functionality and general user experience, leaving significant gaps in our understanding of how specific UI design elements influence overall UX, especially in the context of design education.

- Many digital learning platforms face usability challenges that can adversely affect the user experience. However, there are numerous studies on comparative digital learning platforms; research specifically targeting the design learning experiences is limited. This highlights the need for thorough evaluations of these platforms to enhance user experience.

- Most previous studies have concentrated on general e-learning platforms, prioritizing visual and experiential learning. It lacks a comprehensive and structured approach to evaluating these platforms based on their interface, content, and overall usability, particularly concerning established UX frameworks.

- While various platforms offer design education, the design of their interfaces has not been adequately evaluated for its impact on user engagement, learning outcomes, and overall satisfaction.

- The key factors affecting user interface design for improving the user experience of digital learning platforms are visual design, interface design, content organization, functionality, and objectives based on Garret's UX model.

- User experience differs across different platforms. Statistical analysis indicates a significant disparity among platforms regarding visual design, interface design, content organisation, functionality, and objectives.

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- The platform's redesigned version demonstrated marked enhancement in all five dimensions relative to its original iteration.

- Qualitative insights uncover profound usability challenges, including inconsistent layouts, insufficient interaction feedback, and inadequate visual hierarchy.

- Web analytics confirm behavioural shortcomings such as elevated bounce rates and diminished session durations.

The UI redesign, grounded in design principles, facilitated improvements in visual design, interface design, content organization, functionality, objectives, and overall user experience.

7.3.Addressing Research Gaps and Fulfillment of Objectives

Objective 1: To identify the key interface design factors that impact the user experience of digital learning platforms.

A comprehensive literature review was conducted using academic databases such as IEEE Xplore, Google Scholar, and ScienceDirect to fulfill this objective. This review examined UX challenges and design requirements in general e-learning platforms and design-specific learning environments. The analysis identified recurring themes such as visual appeal, ease of navigation, content clarity, functional tools, and alignment with educational goals. These insights were synthesized and aligned with Garrett's Five-Plane UX Model**,** which provided a structured lens to categorize the findings into five critical UX factors: Visual Design, Interface Design, Content Organization, Functionality, and Objectives**.** These five dimensions formed the foundation for the entire study and helped define the criteria for further platform evaluation and redesign. The detailed discussion is given in Chapter 2.

Objective 2: To compare various digital learning platforms used for design education by analyzing their user experience through explicit visual feature analysis.

This objective was addressed by conducting a structured visual analysis of three digital platforms. These platforms were selected for their diversity in focus: Platform 1 is design-oriented, platform 2 offers general academic content, and platform 3 focuses on technical subjects. A group of student participants with a background in design

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education was selected to perform specific observational tasks on each platform. These tasks were designed to examine the platforms through the lens of the five identified UX factors. Participants evaluated layout consistency, navigation logic, visual hierarchy, multimedia use, and alignment with learning goals. This process enabled a comparative understanding of how each platform performed in supporting design-based learning experiences. The detailed discussion is given in Chapter 3.

Objective 3: To evaluate the usability of existing digital design learning platforms using a structured UX questionnaire and assess the results.

To quantitatively assess platform usability, a 31-item structured questionnaire was developed based on the five UX factors. The questionnaire underwent expert validation to ensure Reliability and content relevance. Student users were then asked to interact with the three platforms and respond to the questionnaire. The responses were statistically analyzed using SPSS (Statistical Package for the Social Sciences) software. One-way ANOVA was employed to determine if significant differences existed among the platforms across each UX factor, followed by a Tukey post hoc test to identify specific group differences. The results showed statistically significant differences, particularly highlighting Platform 1's weaknesses in interactivity and visual appeal, thereby validating the qualitative insights gathered earlier. The detailed discussion is given in Chapter 4.

Objective 4: To investigate the user experience of a dedicated digital design learning platform through expert interviews and analysis of web usage data.

This objective focused on understanding Platform 1 user experience from both qualitative and behavioral data perspectives. Expert interviews were conducted with professionals from fields including HCI, UI/UX, and design education. Using ATLAS.ti software, 376 codes were generated from 54 quotations and categorized into three themes: Platform Features**,** User Expectations, and User Interactions. Simultaneously, a web analytics study of Platform 1 was conducted over a one-year period. Metrics such as bounce rate, page views, average session duration, and acquisition sources were analyzed. This triangulated approach offered a holistic view

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of platform performance, highlighting issues such as poor content discoverability, limited engagement, and outdated visual design, thus confirming the need for UI improvements. The detailed discussion is given in Chapter 5.

Objective 5: To demonstrate user interface improvements on the selected platform and measure their impact on user experience.

Based on the findings from the literature, platform analysis, user feedback, expert opinions, and web data, Platform 1 was redesigned to address its identified shortcomings. The redesign applied established design principles such as the golden ratio**,** dynamic symmetry**,** color theory**,** and cognitive load reduction strategies**.** A new interface prototype was developed, incorporating improvements across all five UX factors. To measure the effectiveness of these changes, a new group of students was asked to evaluate the redesigned platform using the same questionnaire. An independent-samples t-test was conducted to compare pre- and post-redesign scores. The statistical results showed significant improvements across all UX dimensions, confirming the positive impact of the redesign on user experience.

7.4.Testing of Hypothesis

The hypothesis for this research was as follows:

Hypothesis:. *Improving key user interface factors such as visual design, interface design, content organization, functionality, and objective will lead to a significant enhancement in the user experience of design learning platforms.*

This hypothesis was formulated based on the literature analysis and initial findings that underscored the significant impact of user interface (UI) elements on overall user satisfaction and learning efficacy in digital learning environments. The objective was to completely investigate if specific UI enhancements could substantially enhance user experience (UX) within a design learning platform.

A comparative usability research was done to assess the hypothesis between two iterations of a digital design learning platform—Platform 1 (original version) and its

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modified platform. The redesign was guided by recognized usability challenges from expert evaluations and student input, UI design principles such as the golden ratio, dynamic symmetry, and cognitive load theory. A systematic questionnaire consisting of items related to five UX/UI factors such as visual design, interface design, content organization, functionality, and objectives was employed to collect user responses. An extra metric assessed is overall user experience. Responses were gathered using a 5-point Likert scale. Independent samples t-tests were employed to analyze the data and compare the mean answers between the original and revised platforms. This statistical test was chosen because of the existence of two independent user groups.

The statistical study demonstrated a significant enhancement ($p < 0.05$) in all five UI aspects and in the overall user experience post-redesign. This suggests that users viewed the new platform more favorably regarding visual aesthetics, user interaction, content organization, system functionality, and clarity of learning objectives. The results substantiate the premise that the quality of user interfaces directly and quantifiably influences user experiences in digital design learning platforms. Enhancements grounded in human-centered design principles not only improved particular UI aspects but also fostered a more integrated and efficient user experience.

The data validated the hypothesis. A higher overall user experience rating was achieved as a result of the statistically significant improvements in all key user interface factors that were demonstrated by the redesigned platform. The usability and effectiveness of design learning platforms can be significantly improved by concentrating on UI improvements, particularly those that are informed by design heuristics and cognitive principles, as these results affirm.

This result serves as evidence-based validation for the integration of structured design methodologies into platform development and underscores the critical role of UI design in educational technology.

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7.5.Novelties of the Study

The novelties attributed to the present research are discussed below:

- Current research has identified the unique needs of digital design learning platforms for the improvement of UX/UI. Further redesign has been made based on five factors: visual design, interface design, content organization, functionality, and objectives, and a significant improvement in terms of UX was obtained.
- In the current research, the triangulation method has been used to identify UI related issues of the selected design learning platform based on user response, experts' opinion, and web analytics data.
- This is the first of its kind research where comparative evaluation analysis of digital design learning platform can be carried out.
- Specific recommendations have been made for the improvement of UI to ensure the UX of any digital design learning platform.

7.6. Contributions of the Study

A summary of all the key contributions imparted by the current research is provided below:

(a) Theoretical Contribution

Contribution to Knowledge Domain

This research formulated a triangulated technique integrating user feedback, expert insights, and web analytics for a thorough UX assessment in design education platforms. It identified and validated five domain-specific UX dimensions (visual design, interface design, content organisation, functionality, and aims) specifically designed for digital design education.

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Contribution for Design Academia

Provided a comparative analysis framework suitable for academic research.

(b) Practical Contribution

Contribution to Design Practice and UX/UI Industry

This research listed a series of UI design recommendations that solve major usability issues in creative learning platforms, relevant to both educational and design products. It also exhibited the quantifiable effect of applying design principles to enhance user interfaces. Developed an effective UX evaluation framework for scholarly research, facilitating UI/UX enhancements in education.

Contribution to society

The current research has the potential to improve accessibility and usability of the design learning platform, enhancing educational outcomes for students in underrepresented or remote areas. Facilitated the digital empowerment of design learners by optimising open-access educational resources in accordance with the National Education Policy objectives aimed at advancing digital education infrastructure.

7.7.Limitations and Future Scope of Work

This study investigated user perceptions of usability in digital design learning platforms, focusing on five key factors. Insights from a comparative analysis, feedback from both professionals and students, and web analytics data revealed usability issues within the platform, leading to a targeted redesign. Additionally, the research introduced a validated approach for assessing and enhancing the user experience. However, the current study has certain limitations and shortcomings. Some of these limitations are discussed below, and the future scope of work is determined based on these findings.

- The research focused mainly on three platforms, hence constraining the applicability of the results to other forms of digital design learning platforms.
- User feedback was predominantly collected from students and experts in India, thus introducing cultural and contextual biases that may not accurately represent global user behavior.
- The sample size may be increased in subsequent investigations.
- The proposed design modification has been tested with Figma and Wix Studio. Real-time implementation of the design on the web portal is yet to be done. So its usage and thereby Google Analytics could not be generated.
- A new approach can be used in methodology, including AI tool-based analysis. Also, objective analysis using biosignals such as eye tracking, EEG, and FMRI
- Subsequent studies may utilize the established UX evaluation methodology in non-design fields such as engineering, humanities, or medicine to assess its versatility across various educational environments.
- The current methodology can efficiently function as an iterative design and development framework for various digital learning systems.

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7.8.Conclusion

E-learning plays a crucial role in modern education by providing versatility, accessibility, and convenience. However, digital learning in design education, especially in developing countries, remains largely unexamined. This research aims to identify the factors that affect user experience in design learning platforms and to conduct a preliminary study to validate the assessment instrument. The study confirms the reliability of five identified factors with a Cronbach's alpha greater than 0.75. Expert evaluations, measured through the Item-Level Content Validity Index (I-CVI), will also help validate content quality. The research highlights key UI/UX features that significantly influence student satisfaction and engagement.

Furthermore, this study seeks to enhance user experience on digital design learning platforms by employing usability evaluation methods and redesign processes based on Garrett's five-plane model of user experience. It includes a comparative analysis of three platforms, using a triangulation method for data collection that incorporates questionnaires, expert interviews, and web analytics. One-way ANOVA and post hoc tests were conducted to assess the significance of various factors, while qualitative studies provided additional insights. The findings suggest that improving user experience requires attention to visual design, interface design, content organization, functionality, and educational objectives.

These insights will be valuable for academic institutions and managers of digital learning platforms. The research emphasizes the importance of ongoing user-centered evaluations in educational technology and advocates for a comprehensive approach to design and evaluation in digital design learning platforms while also suggesting directions for future research.

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APPENDIX – A.1

Institute Human Ethical Committee Approval

Institute Human Ethics Committee
भारतीय प्रौद्योगिकी संस्थान गुवाहाटी
INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
North Guwahati, Guwahati- 781 039

File ref: IITG/RnD/IHEC/2024-25/03
Date: 08.07.2025

Certificate of Approval/Clearance

To
Dr. Abhishek Shrivastava &
Prof. Sougata Karmakar
Department of Design
Indian Institute of Technology Guwahati
Guwahati-781039, Assam, India

The Chairperson and the members of Institute Human Ethics Committee of Indian Institute of Technology Guwahati have considered the project titled **"Strategies for enhancing user experience of digital learning platforms for design education"** in the meeting convened on 29.08.2024 and 13.09.2024 and given its approval for the same for conducting the above-mentioned study with the following conditions.

The approval remains valid for a period of one year. In case the study is not initiated within one year, the Ethics Committee should be informed about the same and fresh approval should be obtained subsequently.

The Project Investigator (PI) should inform the Ethics Committee immediately about any Serious Adverse Event occurring during the course of the study or if any changes are made to the protocol or patient consent form. The PI is responsible at all times to conduct the study in accordance with the National Ethical Guidelines for Biomedical and Health Research Involving Human Participants established by the Indian Council of Medical Research (ICMR).

Deputy Chairperson of IHEC &
Dean R&D, IITG

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APPENDIX – A.2

Participant Consent Form

CONSENT FORM-I

Project/Study Title	**Strategies for Enhancing User Experience of Digital Learning Platform for Design Education (Tentative Title)**
Name of PI of the project/study	Dr. Abhishek Shrivastava, Assistant Professor, Department of Design, IIT Guwahati Dr. Sougata Karmakar, Professor, Department of Design, IIT Guwahati
Purpose of the study	Questionnaire survey - To conduct usability evaluation of the available digital design learning platform using ux questionnaire and expert interview.
Procedures	Participants will have to provide information on the following features: 1. General demographic data 2. Available digital design learning platforms 3. Visual design 4. Interface design 5. Content organisation 6. Functionality 7. Objectives 8. User experience Photography and videography of the interview, students, and expert activity on the platform will be taken to support the study and for documentation.
Potential Risks and Discomforts	No potential risks and discomforts will occur during the experiment. Neither any drug will be administered nor will any invasive procedure will be followed.
Confidentiality	An undertaking will be given that the data collected will be anonymous and kept confidential, and no identifiable information will be published.
Right to Withdraw and Questions	You have the right to decide whether to participate in research, including the right to withdraw your participation. Participants do not need to provide reasons for not participating or discontinuing their participation.
Statement of Consent	You are at least 18 years of age; you have read this consent form along with the purpose and procedure of the experiment. You are interested in participating without any pressure. You are willing to give explicit consent for video recording if needed.
Signature and Date	Name of the participant: Signature: Date:

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APPENDIX – A.3

UUEQ- Measuring Items

Construct	Items
Visual Design	The color scheme used in the platform is visually appealing.
	The written text of the platform lacks readability.
	The imagery and visuals used in the platform are of high quality.
	The layout of the platform is clean and uncluttered.
	The consistency in the visual elements across the platform creates a unified look.
	The icons of the platform are difficult to use.
	The interface of the platform lacks a professional look.
Interface Design	Navigating through different sections of the platform is straightforward, with appropriate prompts and cues.
	The navigation menu of the platform is well organized with information hierarchy and grouping.
	The buttons of the platform are not appropriately positioned.
	The platform provides clear feedback on interaction with the interface elements.
	The platform's interface is less adaptable to different screen sizes and devices.
	The platform interactive elements, like forms, quizzes, and tools need to be updated to the modern styles.
	It's difficult to find navigational tool on the platform.
Content Organization	The organisation of contents on the platform follow a logical structure.
	The content hierarchy make it difficult to drill down into specific topics.
	It lacks clear label and descriptions for content categories.
	The search functionality helps to find the desired content.
	It lacks a design exercise at the end of the topic.
	The information on the platform is structured to support your learning process.
Functionality	The platform requires incorporating more videos for practical design skill enhancement
	The platform facilitates user engagement through reading resources and videos.
	The platform does not provide user engagement through quizzes.
	The platform does not provide user engagement through project activities and its reports.

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	The platform offers content in different languages through a language selection tool
	There is no proper feedback mechanism regarding user experience on the platform
Objectives	The features provided on the platform meet the learning objectives of e-learning programs on design.
	The interface of the platform is very engaging for the user.
	The sequence of content delivery lacks effective critical thinking
	The platform lacks to build a learning community among its users through collaborative features
User Experience	Overall, I am satisfied with the experience of using the platform.

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APPENDIX – A.4

Relevance assessment on the item scale by five experts

Items	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Experts in Agreement	I-CVI	UA
VD1	1	1	1	1	1	5	1	1
VD2	1	1	1	1	1	5	1	1
VD3	1	1	1	1	1	5	1	1
VD4	1	1	1	1	1	5	1	1
VD5	1	1	1	1	1	5	1	1
VD6	1	1	1	1	1	5	1	1
VD7	1	1	1	1	1	5	1	1
ID1	1	1	1	1	1	5	1	1
ID2	1	1	1	1	1	5	1	1
ID3	1	1	1	1	1	5	1	1
ID4	1	1	1	1	1	5	1	1
ID5	1	1	1	1	1	5	1	1
ID6	1	1	1	1	1	5	1	1
ID7	1	1	1	1	1	5	1	1
CO1	1	1	1	1	1	5	1	1
CO2	1	1	1	1	1	5	1	1
CO3	1	1	1	1	1	5	1	1
CO4	1	0	1	0	1	3	0.6	0
CO5	1	1	1	1	1	5	1	1
CO6	1	0	0	1	1	3	0.6	0
CO7	1	1	1	1	1	5	1	1
F1	1	1	0	1	0	3	0.6	0
F2	1	1	1	1	1	5	1	1
F3	1	1	1	1	1	5	1	1
F4	1	1	1	1	1	5	1	1
F5	1	1	1	1	0	4	0.8	0
F6	1	1	1	1	1	5	1	1
F7	1	1	1	1	1	5	1	1

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O1	1	1	1	1	1	5	1	1
O2	1	1	1	1	1	5	1	1
O3	1	1	1	0	1	4	0.8	0
O4	1	1	1	0	1	4	0.8	0
O5	1	0	1	1	1	4	0.8	0
O6	1	1	1	1	1	5	1	1
O7	1	1	1	1	1	5	1	1
UX	1	1	1	1	1	5	1	1
						S-CVI/Avg	0.94	
Proportion relevance	1	0.92	0.94	0.92	0.94	S-CVI/UA		0.81
	Average proportion of items judged as relevance across the 5 experts 0.94							

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APPENDIX – A.5

Descriptive Statistics of Pilot Study

	N	Minimum	Maximum	Mean	Std. Deviation	CI Lower	CI Upper
vd1	23	1	5	2.52	1.275	1.969	3.071
vd2	23	1	5	3.26	1.251	2.719	3.801
vd3	23	2	5	3.26	1.137	2.768	3.752
vd4	23	1	5	2.78	1.043	2.329	3.231
vd5	23	2	5	3.43	.945	3.021	3.839
vd6	23	1	5	2.96	1.147	2.464	3.456
vd7	23	1	5	2.83	1.527	2.170	3.490
id1	23	1	5	3.17	1.193	2.654	3.686
id2	23	1	5	3.17	1.193	2.654	3.686
id3	23	1	5	3.22	1.166	2.716	3.724
id4	23	1	5	3.43	1.037	2.982	3.878
id5	23	1	5	2.96	1.261	2.415	3.505
id6	23	1	5	3.48	1.504	2.830	4.130
id7	23	1	5	2.91	1.240	2.374	3.446
co1	23	2	5	3.65	.935	3.246	4.054
co2	23	1	5	3.17	1.029	2.725	3.615
co3	23	1	5	3.13	1.058	2.672	3.588
co4	23	2	5	3.91	.949	3.500	4.320
co5	23	1	5	2.78	1.476	2.142	3.418
co6	23	2	5	3.70	.974	3.279	4.121
fn1	23	1	5	3.48	1.163	2.977	3.983
fn2	23	2	5	3.57	.945	3.161	3.979
fn3	23	1	5	2.91	1.311	2.343	3.477
fn4	23	1	5	3.09	1.164	2.587	3.593
fn5	23	1	5	3.57	1.199	3.052	4.088
fn6	23	1	5	3.04	1.261	2.495	3.585
ob1	23	2	5	3.61	.839	3.247	3.973
ob2	23	1	5	2.57	1.237	2.035	3.105
ob3	23	2	5	3.17	1.154	2.671	3.669
ob4	23	1	5	3.00	1.279	2.447	3.553
Uex	23	1	5	3.04	1.107	2.561	3.519

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APPENDIX – A.6

Descriptive Statistics of the Comparative Study

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
VD	D'Source	51	3.2101	.84436	.11823	2.9726	3.4476	1.71	5.00
	NPTEL	50	3.7400	.73054	.10331	3.5324	3.9476	2.29	5.00
	MIT	53	3.5013	.67393	.09257	3.3156	3.6871	2.14	5.00
	Total	154	3.4824	.77769	.06267	3.3586	3.6062	1.71	5.00
ID	D'Source	51	3.3072	.84022	.11765	3.0709	3.5435	2.00	5.00
	NPTEL	50	3.5633	.83496	.11808	3.3260	3.8006	1.33	5.00
	MIT	53	3.5189	.61033	.08384	3.3506	3.6871	2.50	5.00
	Total	154	3.4632	.77009	.06206	3.3406	3.5858	1.33	5.00
CO	D'Source	51	3.4052	.74555	.10440	3.1955	3.6149	2.17	5.00
	NPTEL	50	3.8033	.72897	.10309	3.5962	4.0105	2.50	5.00
	MIT	53	3.4874	.65929	.09056	3.3057	3.6691	2.50	5.00
	Total	154	3.5628	.72713	.05859	3.4470	3.6785	2.17	5.00
FN	D'Source	51	3.2431	.88572	.12403	2.9940	3.4923	2.00	5.00
	NPTEL	50	3.4080	.87688	.12401	3.1588	3.6572	1.40	5.00
	MIT	53	3.2943	.71425	.09811	3.0975	3.4912	2.00	5.00
	Total	154	3.3143	.82505	.06648	3.1829	3.4456	1.40	5.00
OB	D'Source	51	3.2598	.92596	.12966	2.9994	3.5202	2.00	5.00
	NPTEL	50	3.6450	.81455	.11520	3.4135	3.8765	2.00	5.00
	MIT	53	3.4811	.76090	.10452	3.2714	3.6909	2.25	5.00
	Total	154	3.4610	.84508	.06810	3.3265	3.5956	2.00	5.00

Descriptives

uex

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
D'Source	51	3.47	1.027	.144	3.18	3.76	1	5
NPTEL	50	3.70	.763	.108	3.48	3.92	2	5
MIT	53	3.89	.776	.107	3.67	4.10	2	5
Total	154	3.69	.875	.070	3.55	3.83	1	5

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APPENDIX – A.7

Summary of Comments

Expert Comments

To get deeper insights, we collected comments from experts. The following section summarizes the comments. Experts provide comments on the identified five factors. Examples of comments include the following:

1. Look & Feel:

"The first impression is good. However, "what is on offer" (in terms of content hosted within) is unclear."

"There are too many attention visuals/graphics at a glance. Some sort of categorization is suggested that semiotically indicates a layered, ordered information hierarchy in which the constituent content is populated. The user needs to be led inside gradually-complexity increases once inner pages are reached."

"No theme (if intended) is visible; This is true for color pallets or the nature of graphics (only typos, only pictures, only illustrator). Every style is jumbled up / mixed up.

It does not have a discernible color identity of its own."

2. Interface Design:

“There seems to be no attempt to have any classification or categorization framework. Information architecture seems to be "added as you grow." For a user trying to make a categorization attempt, the site does not help. Remembering what is consumed becomes diluted. "

“A person seeking a particular information set may either not find it or get thrown off the searching logic.

Content is, therefore, a matter of visual aesthetic excitation in terms of variety but has no underlying knowledge structure. Everything is all mixed up."

In knowledge displaying website, consistency as well as an identifiable frame work makes it not only to navigate but also to consume information.

What is the purpose of the Site? There are many successful knowledge displaying platforms. For example – Wikipedia has a common visual thread and information architecture.

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The standard timeline or categorization template could be used if platform 1 was meant as an archive.
If platform 1 wants to be more than a "pretty picture" surfing site, then much more needs to be conceptualized afront."

3. Information Architecture:
“Information architecture is not discernible. Arranging contents using gestalt on a screen is one thing grouping them into a predetermined architecture is another thing."
"A true knowledge resource needs to have an Index (like a good book) using which one can cross-refer 2-3 different hosted projects to find interlinks."
"Find out what the user wants from the site; find out what the user enjoys most in the present website; Find out the level of the users' interest in terms of depth of 'content' v/s breadth of content. Find out how a user uses or intends to use the information/resource hosted. Find out if interactive searching can be built into the navigation."

4. Functionality:
"Finding what I want in not more than three clicks or layers of navigation."
"Understand at a glance the site's underlying classification of the information.
Increased depth of knowledge (not just pretty, pretty visual but also scientific severe explanations behind them."
"Give users what they cannot find from other websites/knowledge sources. (users are willing to pay for useful, exclusive, applied knowledge tips/information/".

5. Purpose & Objectives:
"Host both depth as well as breadth of design knowledge. (hardly does it host anything on serious design research. If the intent of platform 1 is to be a "social surfing site for school kids then the depth of content may be just about OK.) Validations of several contents need to be done. Many of the content are just opinions, loosely expressed. Design is not only art; it is a science, too!"
"Do you want platform 1 to be a collaboration platform? Or do you want it to be a repository of design projects executed by design students and faculty?
If you want platform 1 to foster community through collaboration, give visitors opportunities to teach other visitors. 'Meaning' (semantics) increases a visitor's learning curiosity.

Student Comments

To get deeper insights, we collected comments from some design students. The following section summarizes the comments. Examples of comments include the following:

“Platform logo, course logo missing, course name is not effective or visually attractive”

"The side menu providing quick navigation to different steps inside a project is quite helpful. While the field categories hidden under the "hamburger menu" are easy to miss on the desktop view. The global menu (top menu) should also feature topic categories as submenus, but they are omitted; this makes content discovery a bit difficult."

“Although the website features a diverse range of topics from different sources, its design lacks creativity and is uninteresting. While new users may initially engage with the platform and explore its content, they may not revisit it as often as intended due to the lack of a lasting impression."

“Platform 1 has work from premium institutes, which is very insightful for the learning design students, but the user experience is not that good."

"The search does not provide any search suggestions."

"The hero carousel has no arrows to view the previous or next image or content displayed."

"An unappealing color scheme is used."

“So many colors distract the users. Also, it's not easy to focus and look for a particular section."

"Problematic is learning paths ways, the specialization of content is lacking. New content is missing."

"Needs better visual and course categorization.".

"Make the user experience personalized for the students."

"Add a suggestion-based search."

"Add arrows in the carousel."

"Create a proper hierarchy in the video page where one video is on one line to give clear information of which video to play next, rather than just reading the label and deciding."

"Different content types in the home page instead of having the same CTA element visual treatment can have differences in treatment based on video content based on size differences of thumbnail to show it's a video clearly."

"Improve the UI color palette."

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"A proper color theme and search menu can be more organized. Zooming in and out distorts the website. A proper hierarchy in the font can be done."

"Put a menu bar constant for navigation, put latest news and design trends on the homepage."

“categorize based on themes, too much data crowded, conduct user testing with tasks"

“Gradient design due to plain colors, change color scheme, typo weight is not proper, visually not appealing, curiosity generate in 1st-page hero page, reference faculty with profile photo and details, collaborating partners with logo. Micro-interaction, typography change, colors and visual language change needed,"

"No separation of data. No grouping of data. Insufficient hierarchy. Page breakers are necessary."

Group Statistics of the Redesign Study

Group Statistics

	grp	N	Mean	Std. Deviation	Std. Error Mean
VD	D'Source Old	27	2.9947	.82778	.15931
	Redesign	30	4.1667	.46870	.08557
Interface_Design	D'Source Old	27	3.2407	.87013	.16746
	Redesign	30	4.2778	.38738	.07073
CO	D'Source Old	27	3.3210	.74954	.14425
	Redesign	30	4.5056	.42092	.07685
FN	D'Source Old	27	3.1111	.70892	.13643
	Redesign	30	4.3933	.41184	.07519
OB	D'Source Old	27	3.1111	.84448	.16252
	Redesign	30	3.9500	.53900	.09841
uex	D'Source Old	27	3.19	1.075	.207
	Redesign	30	3.97	.669	.122

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LIST OF PUBLICATIONS

1. S, S., Shrivastava, A., & Karmakar, S. (2024). Identifying interface design factors impacting user experience in digital learning platforms- A pilot study. Journal: Social Sciences & Humanities Open, 11, 101662. https://doi.org/10.1016/j.ssaho.2025.101662 **[Q1, Elsevier**]

2. S, S., Shrivastava, A., & Karmakar, S. (2024) Evaluating an E-Learning Framework for Enhancing Design Learning in India. *Proceedings of RIC 2025, IIT Guwahati*. **[SPRINGER] [In Press]**

3. S, S., Shrivastava, A., & Karmakar, S. (2024). Enhancing User Experience in Digital Design Learning Environments through User Interface Improvements: A Comprehensive Approach**.** IEEE Access Journal [**Q1] [Under Review].**

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