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Designing Visually Engaging Online Learning Interfaces for Higher Education Students

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ABSTRACT

Interface design involves arranging elements that enable communication between users and systems, while visual design determines how this layout is presented aesthetically. A well-crafted visual design organizes information such as text, images, diagrams, and tables into a clear and engaging format could enhances user perception. The aesthetics of an interface can strongly influence users' first impressions, attention, satisfaction, and overall communication effectiveness. This study focuses on online learning interfaces in asynchronous environments, where instructors do not deliver materials face-to-face but rely on the platform to engage students. Without direct interaction, learners must stay engaged through an intuitive and visually appealing interface that encourages active participation and sustained learning. Therefore, it is crucial to design online learning applications that are not only functional but also engaging, as increased engagement can enhance learning outcomes and reduce student dropout rates. The objectives of this research are to identify interface design elements suitable for online learning platforms and to rank these the online learning interfaces based on students' preferences. A quantitative survey was conducted among students at higher education institutions, who acted as respondents. Online learning interfaces were designed based on identified design elements and were classified into three categories: Home Page, Title Page, and Note Page. Each category included five (5) design alternatives. Findings reveal that students prefer a combination of text, images, and videos for the Home and Note Pages, while a mix of text and images is favoured for the Title Page. These results provide practical guidelines for developing engaging online learning interfaces.

1. Introduction

The integration of technology into education has revolutionized traditional teaching and learning paradigms across the globe. The evolution of online learning has been significantly accelerated by global events such as the COVID-19 pandemic. Online learning is broadly defined as education facilitated through digital platforms where teachers and students interact in a virtual environment [1,2]. Studies have highlighted the benefits of online learning in supplementing traditional education

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methods, especially during crises. These benefits include flexibility, broader accessibility, and cost efficiency. However, challenges such as technological infrastructure, student motivation, instructor preparedness, and platform usability persist [3].

In Malaysia, the push toward online learning began gaining traction in the early 2010s, with the Ministry of Education promoting digital initiatives such as Massive Open Online Courses (MOOCs) to enhance access to quality education [4]. However, it was the unprecedented global COVID-19 pandemic that catalysed the widespread adoption and normalization of online learning as the primary mode of educational delivery [5]. Institutions at all levels, from primary schools to universities, were compelled to shift to online platforms, highlighting both opportunities and systemic challenges. Malaysia, with its diverse demographic and socio-economic backgrounds have resulted in considerable differences in online learning experiences across various student groups [6]. Access to technology, familiarity with digital tools, quality of course design, and institutional support have all played pivotal roles in shaping students' experiences [7]. Moreover, the design and usability of learning interfaces have proven to be crucial in facilitating student engagement, on the other hand, inadequate interface design may impede that engagement [8,9].

As online learning environments became the new norm, it became evident that student engagement was a crucial factor in determining success. Unlike face-to-face settings, online education requires a greater emphasis on self-motivation, digital literacy, and interaction through virtual platforms [10]. This shift necessitated a deeper understanding of the factors that drive engagement in online settings, as well as the impact of technological infrastructure, particularly the design of user interfaces [11]. Online learning offers educational content electronically with minimum face-to-face interaction, leading to reduced engagement, boredom, as well as restrained time spent on learning. Students might feel disconnected and less motivated to participate actively in their courses due to the lack of real-time interaction. In these situations, it becomes essential to develop online learning spaces that are both effective and engaging, as well as responsive to the need of students. Enhancing student engagement in online learning is through the user interface design is one of the effective ways. A well-designed and visually attractive interface can capture students' attention, maintain their interest, and promote active participation. An engaging interface contributes to improved learning outcomes, increased satisfaction, and reduced dropout rates. Therefore, it is essential to develop clear design guidelines that prioritize user engagement, helping to create online platforms that support meaningful and sustained learning experiences.

This paper is organized into several main sections. The literature review explores topics such as visual design, visual interfaces, aesthetics, design elements, and their relevance to online learning. The next section outlines the study's methodology, including the research methods and participant demographics. This is followed by the presentation of results, and finally, the conclusion highlights the main findings and their implications.

2. Literature Review

A compilation of past studies has been reviewed in this section. It is maintained throughout the research process to ensure the information stays current and relevant. This section will discuss about the previous studies done regarding visual design, visual interface, learning interfaces, components of a well-designed learning interface and so on.

2.1 Visual Design

Visual design involves the purposeful use of visual elements to convey information clearly and improve user experience in areas such as advertising, scientific communication, and environmental analysis. It combines creativity, visual appeal, and practical function, making it an essential component of the overall design process. Visual design is a broad discipline that focuses on the use of visual elements such as colour, typography, imagery, and layout to enhance aesthetics and communicate ideas clearly across various mediums, including print, advertising, branding, and digital platforms [12].

In comparison, visual interface design is a more specific area that refers to the visual components of a user interface in digital products such as websites, mobile applications, or software [13]. While visual design defines the overall appearance and style of a product, visual interface design applies these principles within interactive environments to ensure that visual elements are both attractive and functional. It emphasizes clarity, usability, and consistency in how users interact with on-screen content. Therefore, visual interface design can be considered a specialized subset of visual design, focused on supporting user interaction in digital contexts.

This study focuses on three (3) main visual elements: text, image, and video. It examines how each element, both on its own and together, contributes to visual communication and user experience. Text is instructional or semantic input in visual design meaning it defines meaning, context, or style, while images are core visual elements such as photos, illustrations, textures, icons, it defines the look and feel of a design. Video adds motion, time, and interaction to visual content and is a growing part of digital and user interface (UI)/user experience (UX) design.

2.2 Visual Interface

Visual interfaces are interfaces that heavily relied on graphical elements such as icons, diagrams and forms ensuring user can directly interact with the interfaces using pointing devices like mouse or fingers. These interfaces usually offer near real time feedback and often use visual languages to present information systematically. Visual interface components are vital elements of user interfaces that helps in the interaction of user and the digital system. As well as for designing effective and engaging user interfaces. These components consisting of colour, layout, images and text. Each are playing a significant role in how users are perceiving and interacting with the interfaces. A deep understanding of these elements can improve the clarity, accuracy and the effectiveness of the information transfer.

On the other hand, text element is a key element as it is used for most of the content. Text remains a critical medium for communication and instruction in interactive systems Typography, font sizes and spacing ensure that the text is readable visually appealing. 15 to 40 characters per line for Chinese text, and 30 to 80 characters per line for other languages is the best character numbers to use according to Tang and Liu [11]. Wang [6] stated that text style also reflects brand identity and personality. Images enhance the meaning and emotion of an interface. Using the right images will aid user to connect more to the applications. As for the colour, it plays a major role in how users feel and what they perceive. Colours in the background of an interface will helps in highlighting key areas, such as the use of contrast or brightness [11]. Consistent use of a colour palette also indicates a brand image, for example in Apple or Nike brand [14].

The arrangement of elements on a screen, guides the user's attention and affects how easy it is to use the interface is what is consider as the layout. Simple layouts work well for finding information quickly, while moderately complex ones are better for exploring or analysing content [8]. Effective

layout design involves balancing visual elements to create a harmonious and functional interface like the golden ratio for aesthetic appeal [8]. Factors such as user preferences, cultural differences, and accessibility requirements can significantly influence the effectiveness of visual interface components. On the whole, recognizing these enables designers to develop interfaces that are both aesthetically pleasing and accessible to a diverse range of users. Aesthetic design focuses not only on how a product looks and feels but also on how it functions overall. This includes the flow of interaction, how well the design works, how smoothly it is created, and how easily the content fits within it [15].

2.3 Design Elements

Design principles and elements form the foundation of basis of visual design work. Elements such as lines, texture, space, form, and volume can be combined to produce visually engaging compositions. When these elements are arranged in an intentional and consistent manner, they create patterns that lead to the fundamental concepts of visual design [16]. These components work together to establish design principles that guide the overall visual experience, influencing how users perceive and interact with an interface.

According to Gatto *et al.,* [17], design elements represent the essential components required to create a visual composition. They are the tangible aspects that form the basis of aesthetic communication and serve as the building blocks for effective visual expression. In interface design, it is essential for designers to organize these components, including text, images, icons, and layout, in a manner that is both functional and logical, as well as aesthetically pleasing and engaging. Successful design requires careful consideration of how these elements interact in a layout to direct user attention, improve understanding, and support usability. The designer's role is to create visual balance and flow, making sure that the interface conveys its intended message clearly while maintaining an aesthetically pleasing and user-friendly experience. Table 1 shows the design elements studied in online interface design.

Table 1
Design elements studied in online interface design

Study	Design Elements Used
Hafidz *et al.,* (2024) [18]	Navigation, Layout/Structure, Accessibility Features, Style Guide/Branding, User-Centred Design (UCD)
Qi and Xu (2024) [19]	Icon, Text, Colour, Layout
Faudzi *et al.,* (2023) [20]	Navigation, Layout/Structure, Typography, Progress Indicators, Context-Aware Tools
Ruf *et al.,* (2022) [21]	Colour, Aesthetic Appeal
Ghai and Tandon (2022) [22]	Consistency, Layout/Structure, Colour, Typography, Graphics, Aesthetic Appeal
Nordin *et al.,* (2021) [23]	Colour, Graphics/Visuals
Shi *et al.,* (2021) [24]	Navigation, Layout/Structure
Nordin *et al.,* (2020) [25]	Navigation, Layout/Structure, Colour, Typography, Graphics/Visuals
A. Latiff *et al.,* (2019) [26]	Navigation, Text, Image, Icon, Audio, Content, Colour, Input/Output Support, Feed

Nine (9) peer-reviewed studies from 2019 to 2024 were analysed to highlights several repeated patterns of design elements used in interface design for online learning environments. Navigation and layout or structure were the most commonly used elements, found in five (5) studies, suggesting their vital role in guiding users through digital content and supporting intuitive interaction.

While, colour was also featured in six (6) studies, highlighting its importance in creating visual hierarchy, emotional tone, and user involvement. Typography or text appeared in five (5) studies, emphasizing the significance of readability and the structuring of written content. Whereas, aesthetic

appeal was incorporated in three (3) studies, showing the recognition that visually appealing interfaces can positively influence user perception and user perception and satisfaction.

Visual elements like graphics, icons, and text were also common, indicating that multimodal material improves clarity and supports diverse learning preferences. Fewer studies included advanced or specialized elements like progress indicators, context-sensitive tools, accessibility features, audio, and user-focused design, pointing to emerging trends in creating more inclusive and adaptive learning experiences. Study by A. Latiff *et al.,* [26] stands out for its thorough integration of various design elements, including multimedia and interaction features, indicating a complete approach to interface development. Overall, the findings suggest that successful online learning platforms rely on a combination of clear structure, thoughtful visual design, and increasingly personalized or inclusive features to support engagement and learning outcomes.

Five (5) design elements were chosen in this study are video, text, image, position, and column as seen in Table 2. The analysis of previous studies revealed that these design elements appeared more consistently across online learning interfaces. This indicates their effectiveness in supporting learning outcomes and improving interface clarity. Therefore, these elements have been chosen as the main to be applied in the online learning interfaces design for this study.

Table 2
Five (5) selected design elements

Element	Authors / Year	Findings
Text - Written content including font, size, spacing, and alignment	Ram and Zhao (2022) [27]	- Dynamic text boosts engagement - Full words improve recall
	Günay (2024) [28]	- Typography affects reading and emotions - Good font, size, spacing improve readability
	Tang and Liu (2021) [11]	- Optimize characters per line for readability - Line length varies by language
Image - Visual elements like photos, illustrations, or diagrams	Zhang (2022) [29]	- Images clarify complex info- Evoke emotions to aid memory - Combine with text and interactivity
	Bader *et al.,* (2022) [30]	- Images improve learning and performance
	Schroeder and Cenkci (2018) [31]	- Text near images reduces cognitive load - Integrated visuals aid learning
Video - Moving visual media that may include animations or recorded clips	Tymchenko *et al.,* (2021) [32]	- Graphics make interfaces engaging - Help convey info quickly
	Tang and Liu (2021) [11]	- Animated graphics increase engagement by 15–30%
	Deng and Gao (2023) [33]	- Embedded questions boost engagement - Interactivity aids comprehension
Layout / Position - The spatial arrangement of elements on the interface	Thwairan (2024) [34]	- Organizes content - Improves navigation and info access
	Yang and Xu (2022) [35]	- Simple layouts better for searching - Medium complexity suits information extraction
	Huo and Wang (2022) [36]	- Layout enhances clarity and appeal - AI can optimize layout
Column - Vertical divisions used to organize content visually	Namoun (2018)[37]	- Three-column layouts encourage deep reading - Faster search, higher preference
	Güler (2023) [38]	- Grid modules improve pacing and motivation - Clear sections support self-regulation
	Wang *et al.,* (2024) [33]	- Double-column layouts improve reading efficiency

2.4 Online Learning

Online learning, commonly known as e-learning, is a process that takes place over digital platforms where educational content is delivered electronically without requiring face-to-face interaction. According to Arkorful and Abaidoo [39], this type of learning enables access to education through online systems, encouraging innovative methods of interaction and engagement. Kim, Lee, and Choi [40] define e-learning as providing organized course material online in presentation, allowing a flexible and accessible option compared to conventional classroom methods. One of the key advantages of this approach is its assistance of individualized learning, enabling students to interact with content at their own speed and corresponding to their unique learning styles. It also provides flexible scheduling, enabling learners to balance their studies with other commitments.

Asynchronous online learning, a common format within e-learning, does not require real-time interaction with instructors. Instead, learning materials are made available online for students to access on their own. This arrangement offers considerable freedom, as students can choose when and how they engage with the content, promoting independent learning and more accountability for their educational progress.

The Malaysian experience with online learning during the COVID-19 pandemic reveals both significant challenges and emerging opportunities. Romli *et al.,* [4] found that mobile technologies and hybrid models have become integral to sustaining educational activities. Furthermore, Kamaludin and Sundarasen [5] emphasized that Emergency Remote Teaching (ERT) exposed pedagogical and technological weaknesses in Malaysian higher education institutions.

While urban students benefited from more robust internet connectivity, students in rural areas faced ongoing issues such as limited bandwidth, lack of devices, and minimal digital literacy. Policy initiatives that emphasize digital inclusivity, infrastructure investment, and continuous pedagogical innovation are critical for the future of Malaysian online education.

2.5 Engagement

Student engagement plays a vital role in ensuring effective online learning experiences. Several studies have shown that various interrelated factors affect engagement levels, such as individual motivation, instructor involvement, peer interactions, access to technology, and the overall quality of the learning environment [10,41]. In mobile applications, first impression users receive is from the interface, thus it is crucial in student performance. Interfaces that are effective should immediately capture user attention, especially in the case of students. Perrig *et al.,* [42] discovered that both user experience and performance are significantly improve with visually appealing smartphone applications. This suggests that the initial visual appeal of an application can enhance both user engagement and learning outcomes. Quesenbery [43] emphasized that engagement is influenced by how media elements are utilized, how content is presented, and the types of graphics used, which are all of key components of visual design.

3. Methodology

The methodology outlines the research design, data collection methods, and participant demographics in order to design engaging online learning interfaces. The study methodology consists of seven (7) steps as depicted in Figure 1.

Fig. 1. Flowchart of study implementation

The first step is the past research review, a comprehensive review of past literature is conducted to establish a theoretical foundation and identify key design considerations. This step ensures that the current work builds on confirmed principles while addressing existing gaps in the field. The second step is determining design elements. Based on the literature review, essential design elements are determined, such as text, image, video and column that influence usability and learner engagement are identified. The third step is designing the interfaces where these identified elements guide the design and development of a functional prototype tailored specifically for online learning environments.

Following this, the prototype is developed and prepared for evaluation as shown in Figure 2. Once the prototype is complete, empirical data is collected through surveys. The survey was conducted through face-to-face meeting with the participants, and utilising Likert scale for the rating. Next, in data analysis step, the data is analysed using quantitative methods to understand the relationship between interface design and student's feedback.

Fig. 2. Prototype of online learning interfaces

Lastly for the result, it presents insights on how the design interface influence students' response. These results not only validate the effectiveness of the prototype but also offer usable findings for improving the design of online learning platforms more broadly.

3.1 Participants

A total of 115 undergraduate and postgraduates' students from Universiti Malaysia Terengganu (UMT) was recruited as respondents for this study The participants were chosen to reflect a wide range of demographics, especially with regard to age, gender, and level of technological proficiency. The participants consist of 65 females and 50 males, showing a fairly balanced gender distribution. Undergraduate and postgraduate students ranged from 21 to 50 years making up the age of participants, capturing perspectives from both younger and more experienced adult learners. Participants reported varying levels in terms of technological background ranging from complete beginners (0 years) to highly experienced users with over 16 years. This enabled the research to collect valuable insights into how various design elements of online learning platforms are understood and engaged with by different user profiles.

3.2 Materials

The online learning interfaces for this study design are designed based on the combination of design elements as shown in Table 3. The interfaces are comprised of 15 interfaces organized into three (3) main categories: Homepage, Title Page, and Note Page. Each category contains five (5) interfaces. The design elements used in these interfaces are gathered from the literature reviewed conducted at the beginning of this study. The selection of design elements was based on the most frequently utilized components in interface design. These elements include video, text, images, positioning, and columns.

The interfaces were presented to participants during the data collection process using a survey, in which they viewed each design and provided their ratings based on the scale 1 (highest rank) to 5 (lowest rank). Most designs use a single-column layout focused primarily on text, either independently or alongside images and occasionally videos. Images are often placed above or alongside text to boost visual appeal and draw attention. Title pages show more variation in their layout, with one to three rows used to organize text and images, suggesting a need for more detailed presentation. Videos are less frequently included and are typically centred to increase viewer engagement. Overall, the designs emphasize simplicity and clarity, with a preference for single-column layouts to improve readability and effective content delivery.

Table 3
Combination of design elements for Homepage, Introduction page and Learning page

Design	Types of Interfaces	Details		
		Elements	Position	Column
1	Homepage	Text	Only text	1
2	Homepage	Text, Image	Text over image	1
3	Homepage	Text, Image	Image over text	1
4	Homepage	Text, Video	Image (middle)	1
5	Homepage	Text, Image, Video	Image over text and image (middle)	1
6	Title page	Text	Only text in 1 row	1
7	Title page	Text	Text in 2 rows	2
8	Title page	Text	Text in 3 rows	3
9	Title page	Text, Image	Text & image in 2 rows	2
10	Title page	Text, Image	Text & image in 1 row	1
11	Note page	Text	only text	1
12	Note page	Text, Image	Image over Text	1
13	Note page	Image	only image	2
14	Note page	Image, Video	Image over video (middle)	1
15	Note page	Text, Image, Video	Image, text, video (middle)	1

The online learning interfaces design are illustrated in Figure 3 for the Homepage, Figure 4 for the Title page and Figure 5 for the Note page.

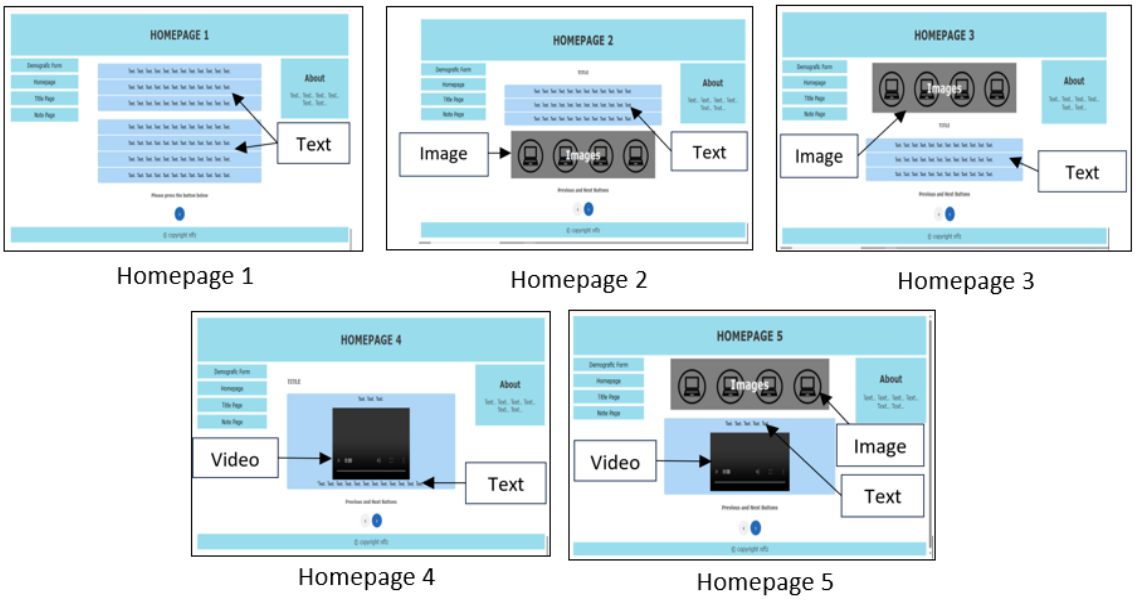

Fig. 3. Interfaces for Homepage

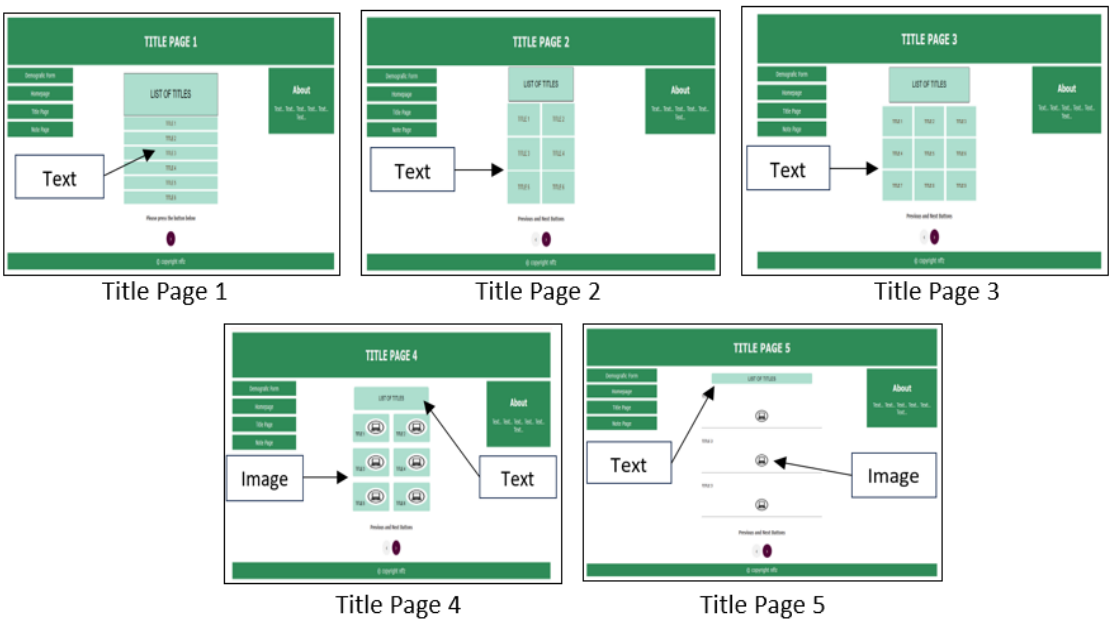

Fig. 4. Interfaces for Title page

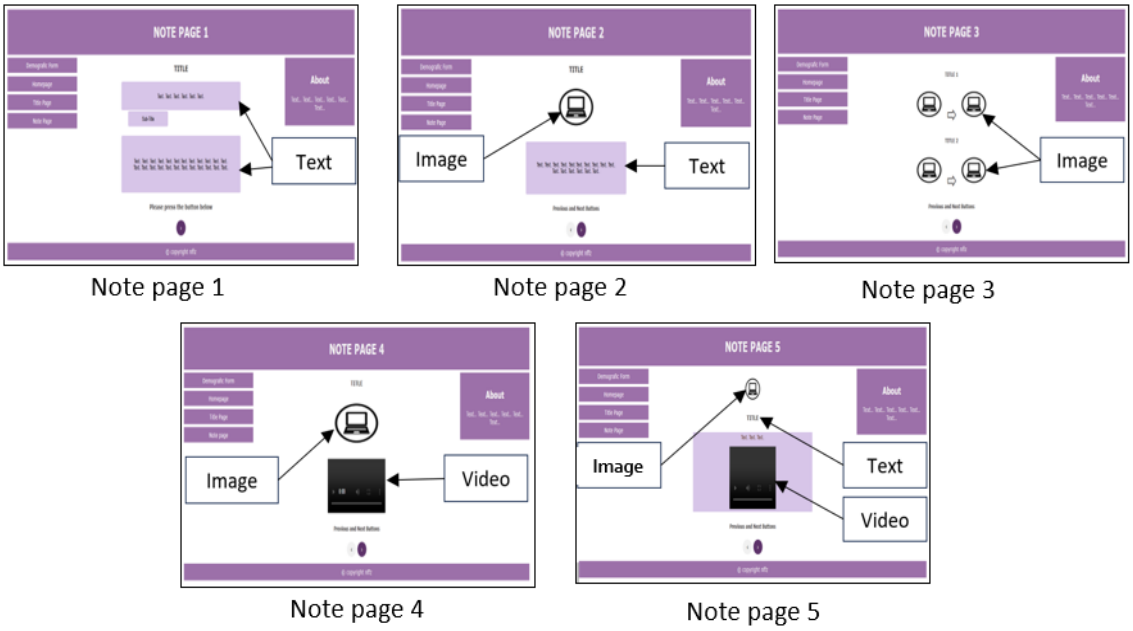

Fig. 5. Interfaces for Note page

3.3 Data Analysis

The mode is a statistical measure that identifies the value occurring with the highest frequency within a dataset. In other words, it represents the most frequently selected value for a given data set and can be applied to both numerical and categorical data. This characteristic makes it suitable for summarizing qualitative variables, such as survey responses. In this study, the mode was employed for result calculation during the data analysis process. The ranking employed a Likert Scale, with one (1) representing the highest value and five (5) the lowest value. Participants were asked to rate each interface on a scale of one to five, where a rating of one (1) signified the most preferred or effective interface, and a rating of five (5) denoted the least preferred or effective. This method allowed for a

comparative evaluation of the interfaces according to participant feedback. The highest-ranked interface was determined by calculating the frequency of participants assigning it a rating of one (1). The interface with the greatest number of "most preferred" ratings was considered the top choice.

4. Results and Discussion

Table 4 represented the result of the ranking based on the participants selection for the online learning interface. The ranking is as followed; 1 the highest and 5 the lowest rank. The result of the analysis indicates that student's preferences among the interfaces are interface H5, T5 and N5.

Table 4
Result of interfaces ranking.

Interface / Ranking	H1	H1	H1	H1	H1	T1	T2	T3	T4	T5	N1	N2	N3	N4	N5
1	20	5	6	12	72	23	16	14	16	46	25	15	13	8	54
2	6	26	33	49	1	6	26	29	44	10	19	25	28	35	8
3	33	26	33	11	12	9	14	51	19	22	11	24	36	25	19
4	11	37	18	30	19	38	35	15	18	10	19	33	22	30	11
5	45	21	25	13	11	39	24	6	18	27	41	18	16	17	23

The analysis for the homepage category indicates that interface H5 was the most preferred option, receiving 72 out of 115 votes. This design incorporated a combination of text, image, and video elements. It was followed in preference by H1, H4, H3, and H2. The suggests that students valued the combination of multimedia components to create a visually appealing and informative first impression. The findings support the idea that an effective homepage should balance aesthetics with functionality, as this combination appears to enhance user engagement from the initial interaction.

In the title page, interface T5 is voted by 46 students, which combines text and image in a single-column layout, emerged as the most preferred option. This was followed by T1, T2, T3, and T4, with T3 and T4 receiving equal preference. Results show that students preferred clear, organized title page designs, with single-column layouts reducing distractions and aiding focus. This supports the idea that simplicity and structure enhance comprehension and engagement.

For the note page, students preferred interface N5 with 54 votes, which also includes a combination of text, image, and video. The following preferred interfaces were N1, N2, N3, and N4. Results suggest that students value multimedia integration in content-heavy pages, as it aids various learning preferences and maintains engagement. N5's element combination likely enhanced accessibility and retention, highlighting the importance of varied media in educational interfaces.

The results, stresses the significant role that visual design and multimedia elements played in influencing students' preferences and engagement in online learning environments. From the three (3) types of interfaces, the design that incorporated a combination of text, images and video were constantly rated highest by students. Specifically, interface H5 (homepage), T5 (title page), and N5 (note page) emerged as the most preferred across all categories. These findings suggest that students favour designs that integrate multiple elements, particularly visual and multimedia components, in a clear and organized layout. The H5 and N5 interfaces, both of which include multiple media elements in a single-column layout, highlights the value of combining simplicity with engaging content. This verifies the finding by Perrig *et al.,* [42], who found that aesthetically pleasing applications not only improve user satisfaction but also enhance task performance. Furthermore, T5 interface that combines text and image in a single-column format, supports the idea that students value simplicity

and structure, especially when first encountering new content. This in in line with Quesenbery's [43] statement that engagement is formed by how media elements are used, how content is presented, and how effectively graphics are incorporated.

Meanwhile, interfaces that are too crowded or lacking in visual stimulation almost always received lower rankings, indicating that very plain designs may reduce interest or cognitive engagement. This can also be attributed by the students' familiarity with multimedia rich environment in online platforms. The use of video, though less frequent, seem to have positive impact on students' perception when strategically placed. To sum it up, the findings underline the importance of considerate visual design in online learning environments. Interfaces that are partially balance on visual richness and simplicity are positively received by students. This indicate that developers should focus on the combination of images and videos in a structured, easy to read layouts to maximise students' engagement and learning effectiveness.

5. Conclusion

In conclusion, this study utilised a quantitative research methodology to thoroughly investigate the impact of design elements chosen on students' engagement with online learning interfaces. The data gathered through the survey, allowed for measurable analysis of user perceptions and preferences. A total of 115 participants composed of students of higher education, took part in the study. These participants contributed to diverse demographic and experiential backgrounds ensuring that the findings would be more applicable across various learner profiles.

In the research design, 15 prototypes of online learning interfaces were created, each incorporating different combinations of five (5) targeted design elements. These prototypes were carefully design and distributed across three (3) main categories signifying standard online learning environments which are the Home Page, which serves as the entry interface; the Title Page, often the initial content-based interaction; and the Note Page, which supports detailed learning content and user engagement. This arrangement is for the test on how variations in visual and functional design affect user experience, perceived usability, and engagement. The study was able to identify patterns and preferences related to aesthetic appeal, clarity, layout, and overall effectiveness of the interface designs, by analysing students' preferences and feedback across these prototypes.

Finally, the results of this study offer practical design suggestions for developers and instructional designers working on online learning platforms. Specifically, the findings act as a set of experimental guidelines for creating engaging, intuitive, and student-centred interfaces that can improve student interaction and satisfaction during online learning experiences.

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