INTEGRATING EYE-TRACKING INSIGHTS WITH USER FEEDBACK: A UX EVALUATION OF WEBSITE LANDING PAGE

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WASIN ARTSAWAPONGTANET: INTEGRATING EYE-TRACKING INSIGHTS WITH USER FEEDBACK: A UX EVALUATION OF WEBSITE LANDING PAGE. ADVISOR: DR. SAROMPORN CHAROENPIT, 64 PP.

Eye-tracking technology has become increasingly important in user experience (UX) research due to its ability to capture precise data on how users interact with digital interfaces. While traditional feedback methods like questionnaires provide valuable insights into user perceptions and satisfaction, they are limited by subjective biases. Eye-tracking offers an objective way to measure user attention and engagement. In this paper, we explore the integration of eye-tracking technology with traditional questionnaires to assess user interaction on a redesigned landing page for a university faculty website. By combining these two methods, we aim to uncover the correlation between eye-tracking data and user feedback, particularly in how users process design elements such as layout, colors, and content organization. Using both qualitative and quantitative analysis, the proposed system evaluates user engagement to inform better UX design decisions. The findings demonstrate the feasibility of using eye-tracking as a complementary tool to traditional questionnaires, enhancing the understanding of user behavior and supporting more effective website design strategies.

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Chapter 1
Introduction

1.1 Research Background

The landing page of a website holds immense significance in the realm of the online world, serving as a crucial point for initial user interaction. It plays a vital role in shaping first impressions, influencing the perception of brands, products, and services. The laser-focused approach of this page is designed to enhance conversion rates by guiding visitors towards specific actions. Consequently, considerable effort is invested in enhancing the "user experience" of these pages.

The concept of user experience (UX) design, often associated with digital domains like apps and websites, may appear as a modern notion linked to the role of UX designers. However, the origins of this discipline are rooted in influences as diverse as the principles of Feng Shui dating back to 4000 BC and the ergonomic considerations of ancient Greece. These historical echoes continue to shape contemporary UX practices as they evolve.

Creating a compelling user experience reaps substantial rewards, deeply impacting visitor engagement and retention on digital platforms and websites. A seamless and intuitive interface encourages exploration, while intricate designs can quickly deter even the most patient users. A robust UX design directly translates into prolonged user engagement, improved conversion rates, and the cultivation of brand loyalty, recognition, and revenue generation.

To genuinely create satisfying user experiences, companies must understand their users Hence, the concept of 'customer-centric design' has gained widespread adoption, encompassing a blend of practices and processes aimed at soliciting customer feedback, understanding needs, and discerning preferences. While traditional methodologies like questionnaires and interviews have long been the cornerstone of this exploration, they are not without limitations. Concerns about data validity and accuracy arise from these approaches, as the same numerical rating from different participants might signify varying emotional intensities.

Gaze tracking technology enables researchers to monitor a user's eye movements, offering data on where users focus their attention, the sequence in which they view elements, and the duration of their focus. Conversely, user feedback provides contextual insights into users' perceptions, preferences, challenges, and suggestions as they engage with websites. By combining these two sources of information, UX professionals gain a deeper and more nuanced understanding of user behavior and interactions.

Our research will focus on conducting testing on three versions of the Master Program in Information Technology faculty's landing page, each designed differently based on UX theories. We will incorporate traditional questionnaires alongside eye-tracking methods to determine whether there is a positive or negative correlation between these three aspects, according to the relevant theories.

1.2 Objectives of the Study

The primary objective of this study is to investigate the relationship between eye tracking data and conventional questionnaire responses. This investigation involves conducting testing across three iterations of the faculty website landing page, which have been developed based on principles of user experience (UX) design. The goal is to uncover potential connections between eye tracking data and responses obtained through traditional questionnaires. Additionally, the study aims to assess the alignment between feedback of a positive or negative nature and existing UX theories.

1.3 Expected Result

Analysis between the eye tracking data and questionnaire responses. These correlations then should be subsequently evaluated against the established UX design theories to determine their alignment with anticipated positive or negative associations.

1.4 Scope and limitation

This study is centered on evaluating the effectiveness of three newly developed faculty website landing page versions in comparison to the current iteration. The primary aim is to assess the resulting improvements in user experience (UX) brought about by these new designs. The study involves the analysis of data collected using RealEye

(https://www.realeye.io/), an online eye tracking tool, alongside the distribution of traditional questionnaires for comprehensive data acquisition.

Nonetheless, the study is accompanied by several inherent limitations. The generalizability of findings is confined to the specific website and user group under examination, thus limiting broader applicability. Various external factors beyond design, such as individual user preferences and technological constraints, could potentially impact the interpretation of UX. Time constraints may hinder an exhaustive analysis of long-term user behavior patterns. Moreover, the subjectivity inherent in questionnaire responses may introduce biases. The capabilities of online eye tracking tools may not encompass the entirety of user behavioral nuances.

1.5 Definition of terms

Eye tracking - the recording and study of the movements of the eyes in following a moving object, lines of printed text, or other visual stimulus, used as a diagnostic procedure or a means of evaluating and improving the visual presentation of information.

Usability testing - A method used to evaluate how easy a product or service is to use. The tests take place with real users to measure how ‘usable’ or ‘intuitive’ a product or service is and how easy it is for users to reach their goals.

User Experience (UX) - All aspects of the user’s experience during the interaction with the company, its services, and its products.

User Experience Design - the process design teams use to create products that provide meaningful and relevant experiences to users. This involves the design of the entire process of acquiring and integrating the product, including aspects of branding, design, usability and function.

Chapter 2
Literature Reviews

The field of user experience (UX) research encompasses a wide range of methodologies, principles, and tools aimed at enhancing the design and usability of digital interfaces. In recent years, the integration of eye-tracking technology with traditional UX evaluation methods, such as questionnaires, has garnered increasing attention. This combination offers a more holistic understanding of user interaction by providing both objective data from eye-tracking and subjective insights from user feedback.

This chapter explores the foundational concepts and existing research on UX design, eye-tracking technology, and the use of traditional feedback mechanisms. It begins with an overview of key UX principles, including usability and the balance between pragmatic and hedonic quality, which are critical for understanding user satisfaction. The chapter also delves into the specific applications of eye-tracking technology in UX research, highlighting its role in measuring user attention, cognitive load, and interaction with visual elements. Furthermore, the review addresses the limitations of traditional feedback methods, such as questionnaires, and the value of combining these with eye-tracking data to gain deeper insights into user behavior.

Through this literature review, we aim to establish a comprehensive understanding of the relationship between visual attention (as measured by eye tracking) and user perceptions (as captured by traditional questionnaires), ultimately providing a foundation for the experimental study presented in this research.

2.1 User Experience

The concept of "User Experience" (UX) enjoys widespread recognition across numerous disciplines and among professionals, yet its precise definition remains subject to ongoing debate. The term encapsulates a broad spectrum of user interactions with systems, extending beyond mere usability to include emotions, sensations, and the overarching context of use. Historically, Donald Norman introduced the term in the 1990s, aiming to describe all aspects of a user's interaction with a system, integrating notions from activity theory, distributed cognition, usability studies, and emotional design to merge objective

usability aspects with emotional experiences [1]. Despite extensive discussions, achieving consensus on a universal definition of UX proves challenging due to its encompassment of varied, evolving concepts such as emotions, experiences, and aesthetics. Additionally, UX research spans diverse foci, from individual application experiences to collective user feelings across multiple platforms, further complicated by differing theoretical approaches ranging from practicality to emotional and design
psychology [2], [3].

Table 1: User Experience Perspective

Perspective	Description
UX as phenomenon	• Figuring out what UX is and isn't. • Recognizing different kinds of UX. • Explaining when and why UX happens.
UX as Field of Study	• Checking out how experiences happen, like how they form or what they're like for people. • Finding ways to make systems that give certain experiences to users. • Creating and trying out methods to design and check UX.
UX as Practice	• Imagining how UX fits into making things, like designs. • Making real examples of UX, such as models to show others what we want them to feel. • Testing UX to make sure it's good as we want it to be. • Building and sharing designs that create specific user experiences.

To find common ground, one seminal study defines UX as the "individual perceptions and responses resulting from the use or anticipated use of a product, system, or service" [4]. This definition emphasizes the complete evaluation of a product's usability and appeal through the user's perspective, highlighting the distinction in user satisfaction arising from interactions with various products and services, despite similar functionalities.

A deeper examination reveals two fundamental dimensions underpinning user experience during product usage: pragmatic and hedonic quality [5]. Pragmatic quality relates to a product's effectiveness in fulfilling its intended function, such as a clock's accuracy or a website's capability to provide pertinent information. Conversely, hedonic quality ventures into the emotional and psychological aspects, including personal growth, the establishment of meaningful connections, and the cultivation of uniqueness. This emotional dimension taps into core human aspirations beyond functionality, forming the essence of truly enjoyable experiences. Thus, the interplay between pragmatic and hedonic qualities culminates in user experiences perceived as "good," "enjoyable," or "positive."

2.2 Pragmatic and Hedonic Quality

The integration of aesthetics into the user experience (UX) dialogue has captured increased scholarly interest, underscoring its pivotal role alongside traditional metrics like usability and functionality [1]. UX, a multidimensional construct, encapsulates usability, quality, emotional engagement, and the experiential facets of technology interaction. The aesthetic dimension of web design, once underexplored, has emerged as a critical empirical inquiry area, highlighting its significance in enhancing website design and functionality [2], [3]. Poorly designed web pages, characterized by inadequate aesthetic appeal, often precipitate user dissatisfaction and attrition, adversely impacting business outcomes and revenue generation prospects [4], [5]. In contrast, aesthetically appealing web pages are instrumental in cultivating user trust and fostering positive brand perceptions [6]. This dichotomy accentuates the influential role of aesthetics in modulating online user behavior and perceptions.

Despite the foundational importance of usability in UX, it alone does not suffice to engender positive system quality evaluations [7]. Users' assessments of a system's quality are shaped by their goals—be they functional (pragmatic) or experiential (hedonic)—underscoring the necessity of a nuanced understanding of how users form holistic judgments about interactive products [8]. Tractinsky et al. propose two methodologies for web design aimed at optimizing UX: one grounded in screen design principles affecting user experience, and another focusing on the cognitive processing of web page features by users [9]. Hassenzahl's UX model posits that user perceptions of product attributes are influenced by the amalgamation of features with personal expectations, where both

pragmatic quality (usability) and hedonic quality (emotional satisfaction) play crucial roles in shaping user evaluations of a product's attributes [10]. The model further distinguishes between two variants of hedonic quality: stimulation, pertaining to novelty and challenge; and identification, related to the expression of personal values [11]. Such perceptions culminate in evaluative judgments concerning a product's appeal, beauty, and overall goodness, illustrating the complex interplay between aesthetics, usability, and the broader user experience construct.

2.3 User Experience (UX) design principle

User Experience (UX) design emerges as a multidisciplinary field dedicated to enhancing user satisfaction through an intricate understanding of users' needs, values, capabilities, and limitations. Fundamental to UX design is the improvement of usability, accessibility, and the overall pleasure users derive from their interactions with products or services. In today's digital landscape, where website landing pages act as critical interfaces for businesses, the strategic implementation of UX principles is paramount. The evolution of UX design is deeply rooted in empirically validated principles, including: Nielsen's usability heuristics, emphasizing simplicity and user autonomy [12], The Aesthetic-Usability Effect, linking aesthetic appeal with usability [13], Fitts's Law, regarding the efficiency of target sizes [14], Cognitive Load Theory, focusing on reducing the strain of information processing [15], The Gestalt principles, aimed at intuitive visual organization [16], Emotional Design, incorporating affective elements [17], Affordance Theory, providing intuitive design cues [18]. These principles collectively contribute to the creation of interfaces that are not only functional but also intuitive and engaging, thereby enhancing the interaction between users and technology. To translate these foundational principles into practical design choices, UX designers leverage a variety of strategies and guidelines:

2.3.1 Visual Hierarchy

Hierarchy is one of the important UX design principles as it shapes how the user navigates a product and directly impacts how easy or complicated the process is. The principles are related to information architecture and the visual hierarchy of individual pages and screens.

Information architecture refers to the sitemap; the overall structure and organization of the app and how the user navigates from one screen to another. Visual hierarchy considers how individual elements are laid out on a screen. More important elements can be emphasized by placing them at the top of the screen, using larger fonts or using different colors to help them stand out. Hierarchy helps the user to navigate your product [19] as it draws attention to the most important pages and elements, ensuring they can easily find what they need.

2.3.1.1 Contrast

Contrast is one of the effective ways to add visual interest to your page, and to create an organizational hierarchy among different elements that aid users in finding the information

2.3.1.2 Alignment

As is described in the Law of Continuity of Gestalt psychology, in the perceptual process, people usually tend to understand the object in the way that it is firstly perceived, to let the straight lines be straight and let the curve lines be curved. In the design of the interface, aligning the elements meets users' perception, and also delivers the information to users in a smoother way.

2.3.1.3 Proximity

When several items are in close proximity to each other, they become one visual unit rather than several separate units. Otherwise, their distance should be larger and look more like separate visual units. The basic purpose of proximity is to organize. To give an apparent view of the page structure and the hierarchy of information to users.

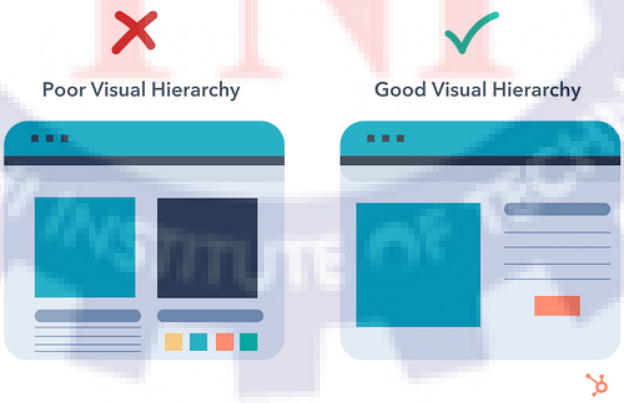

Figure.1 Example of visual hierarchy

2.3.2 Accessibility

Accessibility is about ensuring the product is accessible and usable for as many people as possible [20] including catering to the needs of people with disabilities, as well as understanding how different environments or situational factors might impact the user experience. To this end, you should remove obstacles from the design layout as much as possible.

2.3.3 Consistency

While designing a new product, it is essential to follow the UX design principle of consistency. Users expect products to share some similarities with other products they used before. This makes it easier for them to become familiar with the new product . By being consistent with what your users expect, the end result will be a product that's easy to use, with a very low learning curve for the user. If a product takes too much effort to understand, it's more likely to fail. That's why consistency in UX design is a crucial principle for the learnability of a product [21].

2.3.3.1 Repetition

The same elements repeat in the whole interface, which not only could lower the user's learning curve effectively, but also help users recognize the relevance between the elements.

2.3.4 Context

The design needs to offer users some context to smooth out possible frictions in the user's journey. Understanding who the users are and the context in which they will use the product. Context considers the circumstances in which the product will be used and how certain factors might impact the user experience [22]. Understanding the context around the interaction between your product and the end user will help you to factor in potential limitations (e.g. background noise, not being able to use hands while driving, etc) and design a better user experience.

2.3.5 User control

User control centers on giving the user the right amount of control over how they interact with a product. Jakob Nielsen, co-founder of the Nielsen Norman Group, cites

user control and freedom as one of the ten most important usability heuristics for web design. As explained on the NNG website: “Users select system functions by mistake and will need an obvious emergency exit to leave the unwanted action. In other words, support undo and redo.” [23] The principle of user control is all about helping users to correct or reverse errors without throwing the entire user experience into disarray. For example, having “Undo” and “Redo” functionality, providing “Cancel” buttons and clearly labeling alternative actions and routes the user can take if they want to change or revert their actions

2.4 Usability testing

Usability testing serves as a pivotal method to evaluate the ease of use of computer systems for people. Originating from Human Computer Interaction (HCI), it delves into the interaction between humans and computers, assessing how straightforward and appropriate a system is for users to perform specified tasks within a given environment [24]. This evaluation encompasses user interactions with the device, their efficiency in task completion, and the challenges encountered. Setting up usability tests requires creating a prototype system for users to engage with, defining the testing protocol, the tasks for the user, and the types of feedback to be collected. There are several approaches to conducting these tests: The user-based method involves direct user interaction with the system followed by feedback, which can be quantitative, such as task completion times, or qualitative, such as user satisfaction levels [25][26]. The evaluator-based method relies on observers identifying issues as users interact with the system [27]. The tool-based method employs software to identify usability issues, benefiting from advancements in technology that facilitate data collection through screen recordings, front-facing cameras, voice recordings, or webcams, obviating the need for extensive laboratory setups [28]. Despite technological advancements simplifying aspects of usability testing, challenges persist. Subjective feedback, such as personal feelings or ratings, varies widely among individuals, complicating the aggregation and comparison of data [29]. Additionally, the test environment can significantly influence user performance, necessitating careful consideration of testing conditions. The rapid evolution of technology also demands that usability testing methodologies adapt continuously to remain effective for new systems and devices [30]. Usability testing is indispensable for ensuring computer systems are user-

friendly, but recognizing its strengths and limitations enables more effective systems that genuinely meet user needs.

2.5 Likert Scale

The application of Likert scales in research is predominantly attributed to their efficacy in quantifying intricate perceptions and attitudes. The utilization of Likert scales is particularly noted in human-robot interaction studies, where they serve a critical role in accurately assessing respondents' perceptions and attitudes, aspects deemed essential in this domain [31]. Louangrath have showcased the effectiveness of Likert scales in managing discrete and frequently skewed response distributions, thus presenting them as a preferred method for collecting nuanced feedback in a structured format [32]. Furthermore, Dalka et al. have demonstrated the utility of Likert scales in enabling network analysis, revealing interconnected themes and variations within respondents' experiences, which underscores the versatility of Likert scales in delineating complex patterns from survey data [33]. Additionally, Liang et al. have applied Likert scales in evaluating dialog systems, capitalizing on their ability to procure self-reported user ratings critical for deciphering user experiences and preferences within conversational interfaces [34].

2.6 Eye tracking

Eye tracking technology has significantly advanced our comprehension of human emotional responses to environmental stimuli, marking a critical evolution in the fields of psychophysiology and neuroscience. Despite the variety of measurement techniques available, eye tracking has emerged as a particularly effective method in usability studies due to its precision and accessibility [35]. This technique, which provides detailed observations and analyses of eye movements, has found extensive application across various sectors, notably in UX research. S. Stellmach et al. embarked on a thorough investigation of remote eye-gaze tracking, exploring its historical development and calling attention to the need for ongoing innovation within this technology [36]. Their work laid the groundwork for understanding the complexities of eye movement analysis. N. Veeravalli. further highlighted eye tracking's transformative impact on understanding user navigation and interaction within digital spaces, demonstrating its utility in refining UX and interface design [37]. Veeravalli provided an in-depth examination of eye tracking's

benefits in enhancing website usability, showcasing how eye movement data can inform actionable insights for web development and design. Sharma et al. introduced a novel approach to gaze tracking, utilizing standard RGB cameras to challenge traditional methods reliant on specialized equipment [38], a development complemented by Krafka et al.'s creation of the GazeCapture dataset, which signified a move towards more accessible eye tracking solutions [39]. George expanded the application of eye tracking beyond conventional uses, linking eye movements to broader cognitive and emotional processes, indicating its potential across various disciplines from psychology to marketing [40]. Sun et al. presented an advanced binocular eye tracking system, illustrating its applicability in virtual and augmented reality environments, thus indicating the future direction of eye tracking technology [41]. Lukander offered a comprehensive review of eye tracking's practical applications, distinguishing between its everyday use and specialized applications in fields such as clinical studies or sports [42]. Reddy and Reddy discussed the potential of integrating eye tracking technology into mobile devices, suggesting a future where eye tracking becomes an integral part of daily digital interactions [43]. Finally, Yang et al. introduced vGaze, a sophisticated system for real-time gaze tracking during video playback, exemplifying the ongoing innovation within this field [44]. The extensive body of literature on eye tracking within UX research depicts a rapidly evolving domain, from its basic beginnings to the latest state-of-the-art applications, cementing eye tracking's role as a vital tool in the endeavor to enhance user experience. Looking forward, eye tracking is set to continue its integration with various aspects of human cognition, emotion, and behavior, promising to unveil deeper insights into the user experience.

2.7 Cognitive load

The exploration of cognitive load, particularly focusing on its measurement and implications, has garnered increasing interest within educational psychology and human-computer interaction realms. At the heart of these discussions lies Cognitive Load Theory (CLT), which elucidates how individuals process and manage information, presenting a pivotal framework for educational material design and interaction analysis. Zu et al. ventured into the depths of CLT, shedding light on its fundamental principles and identifying three distinct types of cognitive load: intrinsic, extraneous, and germane [45]. The intrinsic load is directly related to the complexity of the content itself, extraneous load

is the unnecessary cognitive burden imposed by the instructional design, and germane load refers to the cognitive effort devoted to learning and comprehension. Their pioneering research, utilizing eye-tracking technology, unveiled a significant correlation between these cognitive load types and eye movement metrics, highlighting eye-tracking's potential as a quantifiable measure of cognitive load. Building on this foundation, M. C. Sáiz-Manzanares et al. [46] introduced a novel approach to cognitive load assessment using pupil information, where eye tracking recordings were temporally segmented to classify cognitive load through a distribution of pupil sizes. Their methodology marked a significant improvement in accuracy over traditional eye-tracking metrics, suggesting its utility in applications such as early warning systems for cognitive overload. J. Zagermann et al [47] addressed the challenges of measuring cognitive load through pupil dilation, advocating for standardized data processing routines amidst the proliferation of eye-tracking technology in research. They developed CEP-Web, an open-source platform offering advanced data processing tools for pupillary data analysis, thereby enhancing the precision of cognitive load studies. Cho shifted the analytical focus from pupil dilation to eye blinks, proposing a method to assess task difficulty through the physiological patterns of spontaneous blinking, employing time-frequency representation and LSTM networks for a more nuanced analysis [48]. S. Martin expanded cognitive load research to incorporate real-time feedback mechanisms, developing a system capable of estimating cognitive load states through eye-tracking glasses, demonstrating its application in optimizing user interfaces and learning environments [49]. Lastly, Lagomarsino et al. explored cognitive load assessment in manufacturing, introducing a vision-based method for evaluating cognitive load in assembly tasks, offering a novel perspective on cognitive ergonomics in complex task settings [50]. These advancements in cognitive load measurement using eye-tracking technology underscore a rich and evolving research landscape. As technology advances, the applications and implications of this research are poised to broaden, reaffirming the significance of cognitive load theory in enhancing educational strategies, interface design, and overall human-computer interaction.

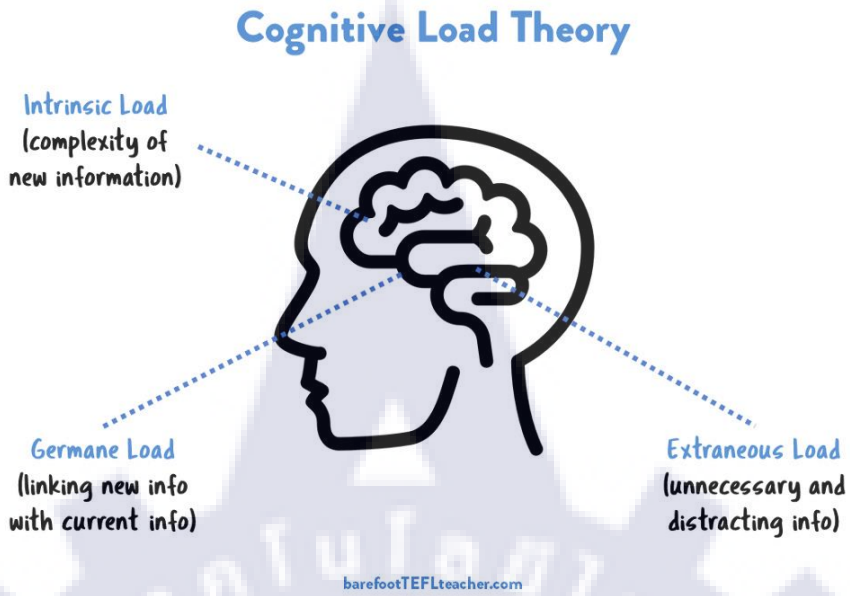

Figure 2: Cognitive load theory [51]

2.8 Fixation

In eye tracking research, fixation data analysis is instrumental in uncovering insights into user behavior and cognitive processes. Sharma et al. emphasized the significance of fixation duration and count in analyzing high-resolution satellite imagery, noting that longer fixation durations often signal regions demanding higher cognitive effort due to their complexity or novelty. Conversely, an increased fixation count may indicate heightened user interest or areas of difficulty, prompting repeated visits for further information processing or due to confusion [52]. Stellmach et al. delved into fixation sequence and dispersion, illustrating that a linear fixation sequence typically denotes systematic reading or processing, while a non-linear sequence suggests search or scan activities. Dispersion patterns of fixations—concentrated versus scattered—can differentiate between focused attention and broader exploratory behavior [53]. Leveraged time to first fixation as a metric to evaluate user engagement. Elements capturing attention quickly, indicated by shorter times to first fixation, are presumed to be more engaging or visually compelling. In contrast, longer times may point to challenges in element discoverability or issues with the visual design's hierarchy. Bhattacharya and Gwizdka applied fixation heatmaps to web search tasks, revealing that areas with dense and frequent

fixations likely represent high user interest or significance. Lesser fixated areas might be overlooked or considered irrelevant, signaling opportunities for design optimization [54]. Rahman et al. combined visual saliency maps with fixation data for a refined classification of eye-tracking data, finding a strong alignment between predicted saliency and actual fixations, suggesting these regions inherently draw user interest. This approach advances beyond conventional fixation analysis, integrating predictive modeling to enhance understanding of visual attention dynamics [55]. These investigations collectively highlight the nuanced role of fixation data in eye tracking research, offering a holistic view of user interaction and cognitive engagement with digital interfaces. Through detailed examination of fixation metrics—duration, count, sequence, dispersion, and initial engagement—alongside advanced techniques like heatmaps and saliency modeling, researchers can glean critical insights for enhancing user experience and interface design. Such analyses not only pinpoint where users direct their gaze but also unravel the cognitive underpinnings of their engagement with digital content [56].

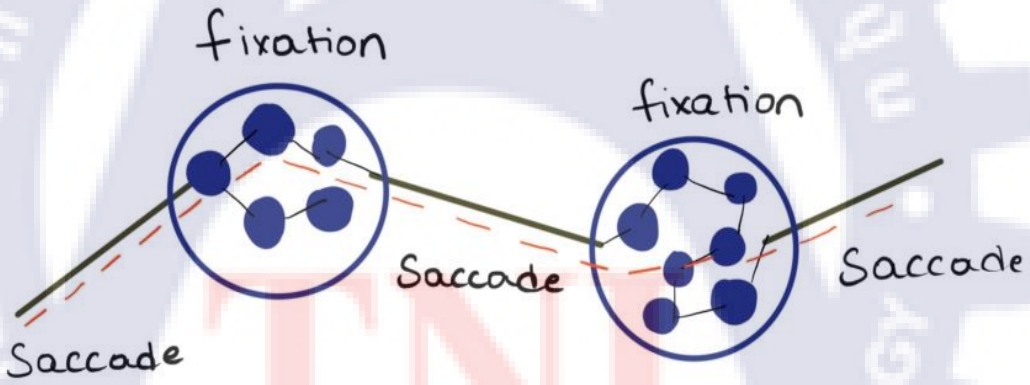

Figure 3: Fixation example [57]

2.9 Area Of Interest (AOI)

The concept of Area of Interest (AOI) plays a pivotal role in eye tracking research, offering detailed insights into how users interact with and process visual stimuli. In "A User Study of Visualisations of Spatio-Temporal Eye Tracking Data," B. Claus et al define AOIs as specific regions within visual stimuli—such as distinct objects or text—that garner particular attention from researchers [56]. Their study evaluated eye movement data from participants viewing advertisements and numerical gambles, assessing the efficacy of

four visualization techniques: scarf plot, scanpath, space-time cube, and chord diagram. Notably, the first three techniques incorporated predefined AOIs, whereas the scanpath relied on unfiltered eye movement data. The research revealed that visualizations with AOIs generally achieved higher accuracy in participant responses than those without, underscoring the value of AOIs in enhancing the clarity and effectiveness of visual data representation. The study posited that while no single visualization technique proved universally superior, a tailored approach—potentially involving user studies—might be essential for selecting the most appropriate visualization based on the specific data set and research objectives. Further exploring AOI's utility, Fuhl et al. discussed its application in diverse fields, from driver observation to art history, through their work "Area of Interest Adaption Using Feature Importance." This study introduced a machine learning-based methodology to dynamically adapt and refine AOIs according to eye tracking data, significantly enhancing the precision of analysis. The algorithm's ability to iteratively adjust AOIs based on calculated feature importance demonstrated marked improvements in classification accuracy over traditional, static AOI definitions. This advancement indicates the potential of integrating automated, data-driven techniques to optimize AOI utilization in eye tracking research, facilitating more nuanced and accurate investigations [58]. The varied applications of AOI, as demonstrated by B. Claus et al underscore its significance in eye tracking and UX/UI research. These studies collectively highlight AOI's role in refining data visualizations, improving research methodologies, and enhancing the overall user experience. The incorporation of AOIs not only augments the accuracy of information conveyed but also propels the field towards more sophisticated and adaptable research techniques, promising to advance our understanding of user interaction and cognitive processing within digital environments [59].

2.10 Heatmaps

The utilization of heatmaps represents a pivotal method in user experience (UX) studies, providing an intuitive visual representation of data collected from eye tracking. This visualization technique maps user attention and engagement by displaying areas of a webpage that receive the most focus in warmer colors, thereby offering insights into user behavior without necessitating extensive quantitative analysis. Heatmaps serve as a bridge between quantitative eye-tracking data and

qualitative user feedback, offering a nuanced understanding of user interactions with web interfaces. Heatmaps are grounded in the principle that visual attention, as measured through eye movements and fixations, is a proxy for cognitive engagement and interest. This concept is supported by Duchowski [60], who argues that eye tracking offers direct insights into the cognitive processes of users, with heatmaps simplifying this complex data into an accessible format for UX researchers and designers. In UX research, heatmaps are primarily used to assess the effectiveness of website layouts, design elements, and content placement. By highlighting areas of high user engagement, heatmaps facilitate a user-centered design approach, allowing for iterative improvements based on direct visual evidence of user behavior. R. A. Grier [61] demonstrated the application of heatmaps in evaluating webpage layouts, finding a strong correlation between areas of high visual attention and increased user engagement metrics such as time on page and conversion rates. The integration of heatmaps with user feedback offers a comprehensive approach to UX evaluation. While heatmaps reveal "where" users look, user feedback addresses "why" certain elements attract attention or fail to do so. Relying solely on quantitative eye-tracking data may lead to misinterpretations of user intent; thus, combining these insights with qualitative feedback provides a more holistic understanding of user experience. As noted by Nielsen and Pernice, this integrated methodology enables designers to tailor web interfaces to better meet user needs and preferences, ultimately enhancing the overall user experience [62]. Recent advancements in eye-tracking technology have enhanced the accuracy and feasibility of generating heatmaps, making this tool more accessible to UX researchers. However, limitations exist, particularly in interpreting heatmap data without considering the broader context of user interaction. It's crucial to acknowledge that areas of high engagement on a heatmap do not always signify positive user experiences; rather, they may also indicate confusion or frustration. Therefore, the integration of heatmaps with user feedback and contextual analysis remains essential for accurate UX assessment.

Figure 4: Heatmap [63]

2.11 Design & Analytic tools

In this research, the primary tools utilized include Figma, Excel, and an online eye-tracking program known as Realeye.io. Realeye.io distinguishes itself as an innovative online eye-tracking service, providing valuable insights into webcam-based eye-tracking techniques. As previously mentioned, [64], this tool has demonstrated remarkable accuracy, with measurements ranging from 90 to 156 pixels across different screen positions, averaging at 113 pixels in accuracy. This level of precision underscores the tool's effectiveness in generating reliable eye-tracking data, particularly suited for studies conducted outside traditional laboratory environments. The diverse demographics of participants and the variety of testing conditions explored in this evaluation highlight Realeye.io's versatility in real-world applications, signifying a notable advancement in the domain of remote eye-tracking research. Excel is employed extensively in UX/UI research for the organization and analysis of both qualitative and quantitative data. Its robust functionality supports the transcription and categorization of user feedback, usability test result analysis, and the compilation of data into practical insights. Excel aids in identifying behavioral patterns and trends through coding, theming, and affinity mapping techniques, thereby facilitating the creation of user personas and informing design decision processes. The adaptability of Excel in data handling and visualization positions it as an indispensable instrument in the UX/UI research arsenal.

Figma emerges as another essential tool, renowned for its collaborative capabilities that streamline the design and testing of user interfaces. It enables swift prototyping, usability testing, and the efficient sharing of outcomes with stakeholders. The platform's support for real-time collaboration ensures that design teams can operate cohesively, making Figma a critical component of the iterative design cycle. This aids significantly in refining user experiences informed by detailed research insights, further enhancing the value of Figma in the context of UX/UI development.

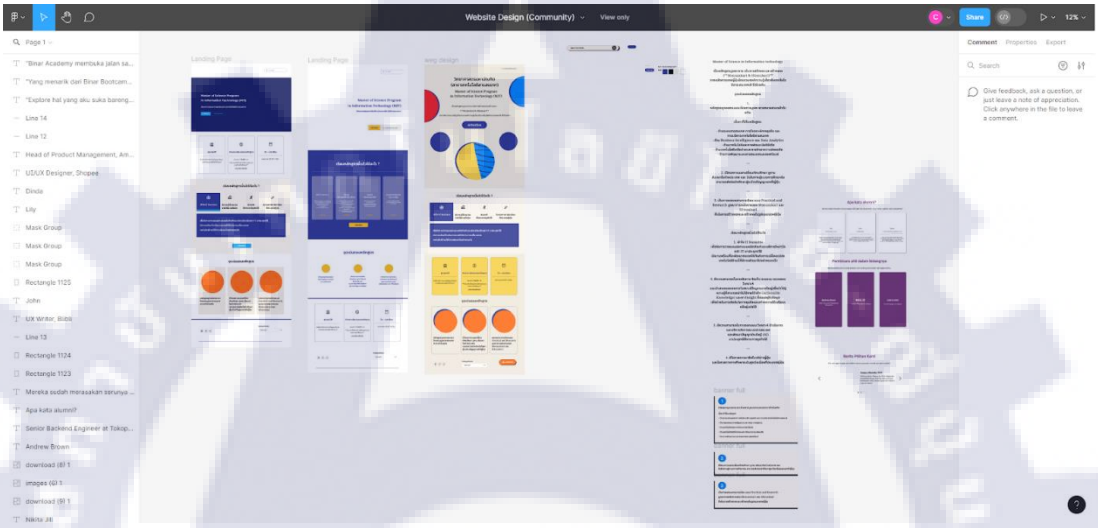

Figure 5: Figma

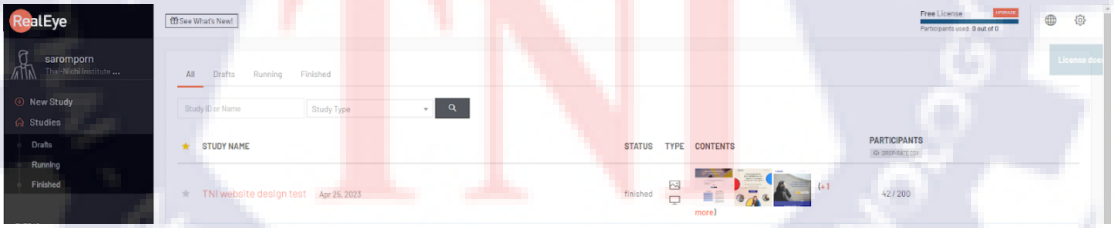

Figure 6: Realeye.io

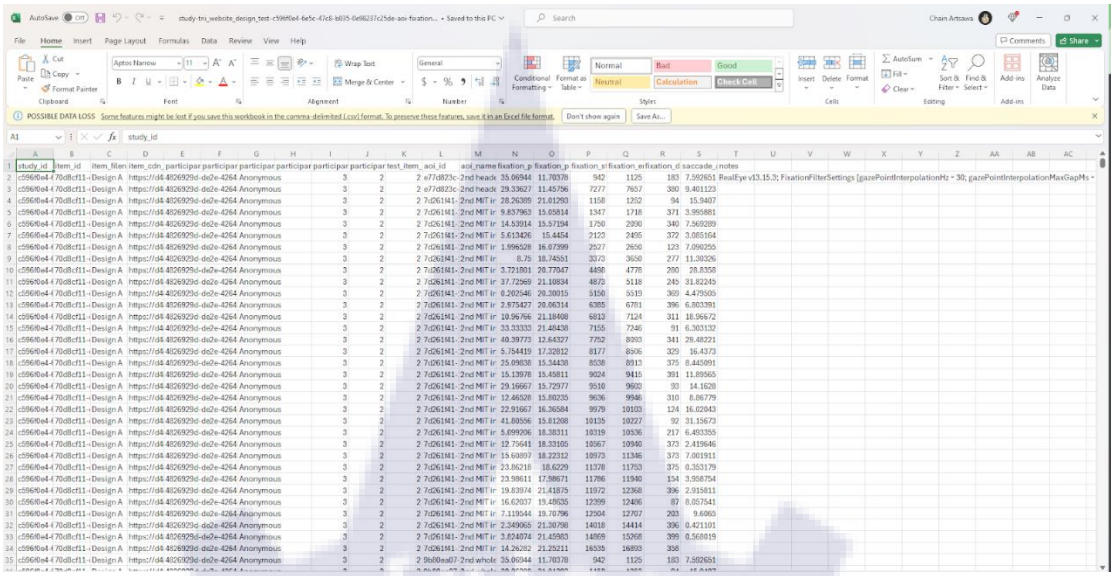

Figure 7: Excel

2.12 Summary

In this literature review, I explored the multifaceted aspects of User Experience (UX) research, delving into its definitions, attributes, and the balance between pragmatic and hedonic qualities. I examined the evolving role of aesthetics in UX, particularly in web design, and analyzed various approaches to enhancing user experience. My review also highlighted key UX design principles, including visual hierarchy, accessibility, consistency, context, and user control, and discussed the complexities of usability testing, especially in capturing subjective user feedback. A significant portion of my review was dedicated to the application of eye tracking in UX research, underscoring its value in understanding user engagement and behavior. Additionally, I explored Cognitive Load Theory (CLT) in the context of UX, using eye tracking as a tool to measure cognitive load. Finally, I delved into the use of fixation, Area of interests, Heatmaps to gain deeper understanding of the users. My research, however, diverges from the existing literature by specifically focusing on the direct impact of various design elements such as color, font, layout, imagery, and wording on user interaction and experience. Unlike broader explorations in existing literature, my study uniquely correlates these design elements with established UX principles to assess their alignment with theoretical expectations. This approach is distinct in its

application of a mixed-methods strategy, integrating both quantitative (eye tracking) and qualitative (questionnaires and interviews) analyses. Furthermore, the emphasis on natural user interaction with website prototypes, rather than assigning specific tasks, offers a more authentic emulation of real-world user behavior. This aspect of my research methodology provides deeper insights into how users organically engage with and perceive different design elements, setting my study apart from more conventional UX research approaches.

Chapter 3
Methodology

This study primarily focused on how different design elements influence user interaction and experience. We aimed to correlate these variables with established UX design principles to determine if they align with theoretical expectations. To explore these aspects, we designed an experiment that combined quantitative analysis through eye tracking and qualitative methods such as questionnaires and interviews. This approach was intended to reveal the relationship between the user's cognitive load and their interaction with the interface.

Project timeline:

	Task	Start	End	Dur
	Thesis:	6/18/23	1/19/24	152
1	Problem Statement	6/18/23	6/30/23	10
2	Literature review	7/1/23	8/31/23	44
3	Conduct Preliminary interview	8/17/23	8/31/23	11
4	Research and data gathering on existing design	8/17/23	8/31/23	11
5	Questionnaire design	9/1/23	9/7/23	5
6	Participants recruitment	9/1/23	9/15/23	11
7	Testing period	9/15/23	9/30/23	11
8	Analyze and conclude the research	10/1/23	11/30/23	42
9	Prepare the Thesis	11/1/23	1/10/24	49
10	Final Submission	1/19/24	1/19/24	1

Figure 8: Timeline

3.1 Research Process

The research process for this study was designed to investigate the relationship between eye-tracking data and traditional questionnaire feedback to assess user interaction on a redesigned faculty landing page. The overall methodology combined both qualitative and quantitative approaches, using eye-tracking to capture objective data on user behavior, and questionnaires to gather subjective insights. This mixed-methods approach allowed for a comprehensive analysis of user experience.

3.1.1 Preliminary Interviews and Requirement Gathering

The research process began with a series of preliminary interviews aimed at gathering requirements for the redesign of the landing page. A total of 20 participants, including undergraduate students and faculty members, were interviewed to understand their expectations and experiences with the existing website. The interviews provided valuable insights into areas needing improvement, such as navigation, visual design, content clarity, and calls-to-action.

3.1.2 Development of Prototypes

Based on the feedback from the preliminary interviews, three different landing page prototypes were developed: Design A, Design B, and Design C. Each prototype incorporated various UX principles, such as visual hierarchy, readability, and layout optimization. The prototypes differed in color schemes, font usage, content organization, and user interface elements to test which design would yield the most favorable user interaction and feedback.

3.1.3 Participant Recruitment

Forty-two participants were recruited to test the prototypes. These participants were sourced from both the faculty's student population and external participants through online recruitment methods. They represented a diverse group in terms of age, educational background, and familiarity with digital interfaces, ensuring a comprehensive evaluation across different demographics.

3.1.4 Eye-Tracking Testing

The eye-tracking phase of the research was conducted using the RealEye platform, an online eye-tracking tool. Participants were asked to navigate each prototype naturally while the system tracked their eye movements, recording metrics such as fixation points, gaze duration, and areas of interest (AOI). This data was used to assess which elements of the design captured the most attention and how users navigated the page.

3.1.5 Questionnaire Feedback

After completing the eye-tracking test for each prototype, participants were asked to fill out a structured questionnaire. The questionnaire included both closed-ended questions, rated on a Likert scale, and open-ended questions to capture detailed qualitative feedback on various aspects of the design, such as content clarity, visual appeal, and overall user interest.

3.1.6 Data Collection and Analysis

The data from the eye-tracking tests and questionnaires were combined to form a comprehensive dataset for analysis. Quantitative data from the eye-tracking tests provided insights into user behavior and interaction with different elements of the landing page, while the qualitative data from the questionnaires revealed users' perceptions and preferences. This mixed-methods approach allowed for a deeper understanding of the user experience across all three prototypes.

3.1.7 Iteration and Testing

In the initial round of testing, a technical issue with the eye-tracking tool necessitated adjustments to the research process. The revised methodology involved using static images of the prototypes in the eye-tracking tests to ensure accurate data collection. Following this adjustment, the study was repeated, with participants evaluating each prototype in sequence to ensure consistency in the findings.

3.1.8 Final Evaluation

The results from both the eye-tracking and questionnaire data were analyzed to determine which design provided the best user experience based on both objective and subjective measures. This evaluation informed the final conclusions and recommendations for the redesigned landing page, highlighting which elements were most successful in capturing user attention and enhancing overall user satisfaction.

Research Process

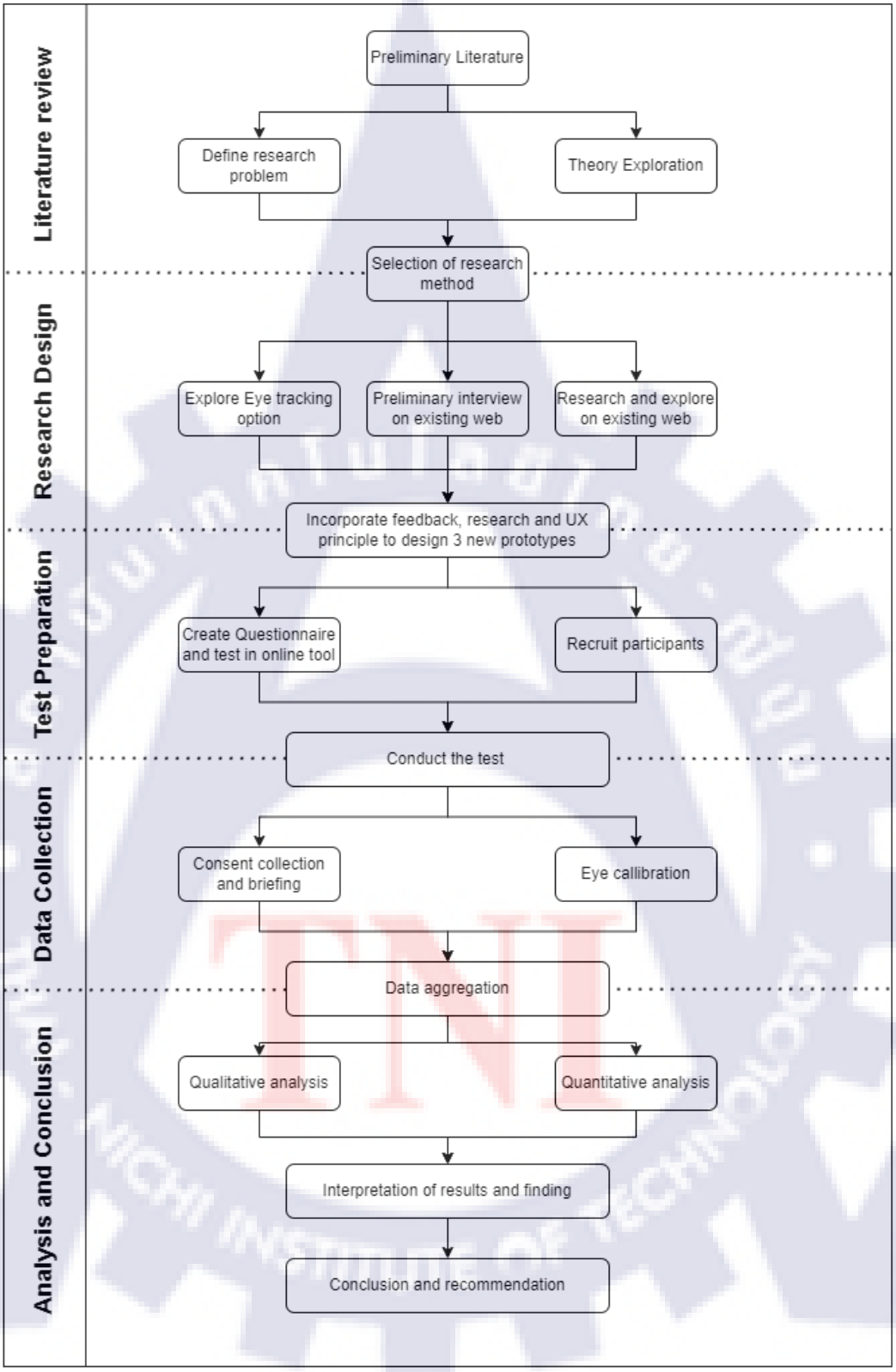

Figure 9: Research Process

3.2 Preliminary Interviews (Requirement gathering)

After we decided to conduct the test on the faculty website, we started by interviewing 10 undergraduate students and 10 faculty staff and teachers asking them about their knowledge and their experience with the website and how they would like to improve the website and any suggestions that they have on what to change on the website to make it more attractive. The interview consists of the question below:

- What are your first impressions of this website?
- Do you feel there is anything unique about what this website offers?
- What are the key factors that influence your interest?
- What are your biggest doubts or hesitations about this website?
- Do you know what the faculty have to offer?

Expanding on the feedback and analysis, it's evident that the website's design currently fails to meet modern user experience standards. Users described the design as "outdated" and "robotic," which suggests a lack of engaging, human-centered design elements. This perception negatively impacts the user's connection with the website, making it feel impersonal and detached.

The criticism about the content being dense and lengthy is particularly concerning. It indicates that the website fails to communicate its message effectively. Users struggle to understand what the faculty offers, which is a fundamental flaw in any educational website. This issue is compounded by a lack of clear content hierarchy, leading to information overload without guiding the user's journey through the website.

The four identified improvement areas are interlinked and critical for remedying these issues. Navigation and Structure need to be intuitive, helping users find information quickly and efficiently. Visual Design and Readability are about creating an aesthetically pleasing and easy-to-read interface, using typography, color, and spacing effectively. Clear Calls-to-Action are essential for guiding users to interact with the website in meaningful ways, whether it's applying for programs or seeking more information. Finally, a well-defined Content Hierarchy will organize information in a logical, user-friendly manner, making the website more navigable and less overwhelming.

3.3 Prototypes

After the requirement gathering process and self study on the content of the website. We came up with 3 different prototypes: Design A, B, and C.

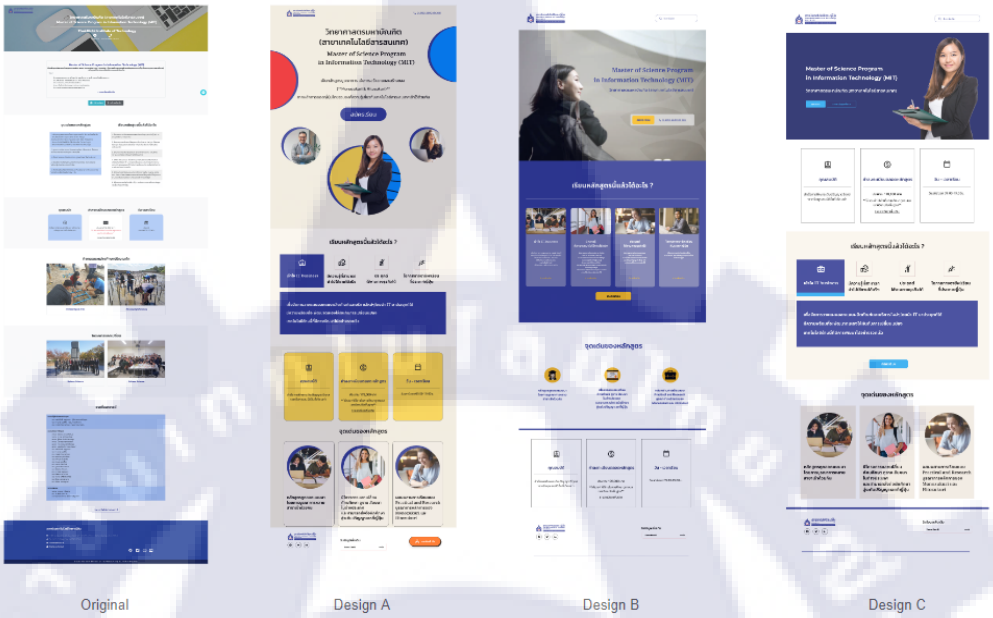

Figure 10: The prototypes

Based on preliminary interviews, we identified 5 key Areas of Interest (AOIs) deemed crucial by students upon visiting the faculty website. These AOIs guide our investigation into how different website elements influence user engagement and experience:

Header: This area serves as the website's primary navigation hub, prominently featuring the logo and menu options. It acts as the initial point of contact for visitors, offering quick access to various site sections.

Introduction: Located just below the header, this section provides foundational information about the faculty, including its name and a brief overview of what the faculty represents. This segment aims to quickly acquaint visitors with the faculty's core identity and offerings.

What You Get: In this segment, the faculty outlines the benefits of joining the program, detailing the advantages and opportunities available to students. It's designed to convey the tangible value students can expect from their participation.

Unique Selling Point (USP): This critical section highlights the distinct features and strengths of the faculty's program, emphasizing what sets it apart from alternative options. It's tailored to capture the interest of prospective students by showcasing the program's unique advantages.

Admin Details: This practical section provides essential administrative information, such as class schedules, course fees, and enrollment procedures. It targets those seeking detailed logistical information to make informed decisions about joining the faculty.

Each AOI represents a pivotal component of the website's design, collectively contributing to the overall user experience by addressing specific user needs and interests.

Table 2: AOI Percentage

AOI Percentage	Original	Design A	Design B	Design C
Header	8.2%	11.9%	9%	5.2%
Introduction	10.9%	9.3%	18.6%	15.3%
What do you get	4%	19.4%	25.7%	21%
Unique Selling Point (USP)	4%	14.2%	14.6%	15.3%
Admin details	9.8%	18.7%	15.3%	20.8%

3.3.1 Original Design

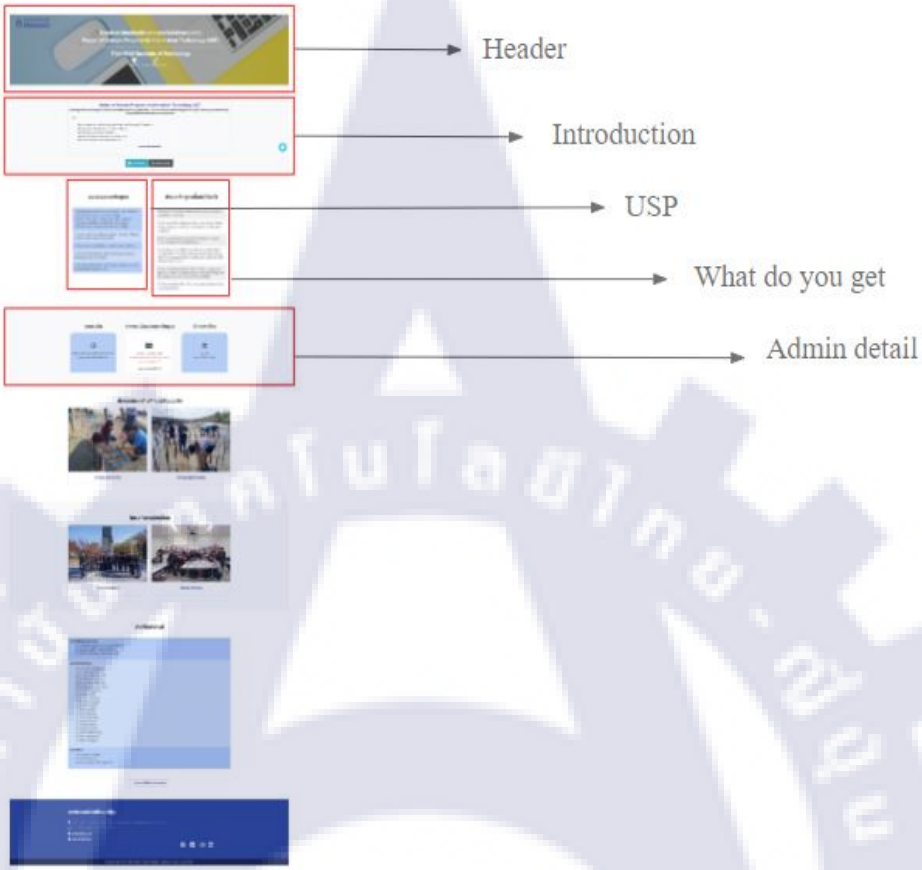

Figure 11: Original Website

Original design is the current version of the faculty website that we use as a baseline for the redesign.

3.2.2 Design A

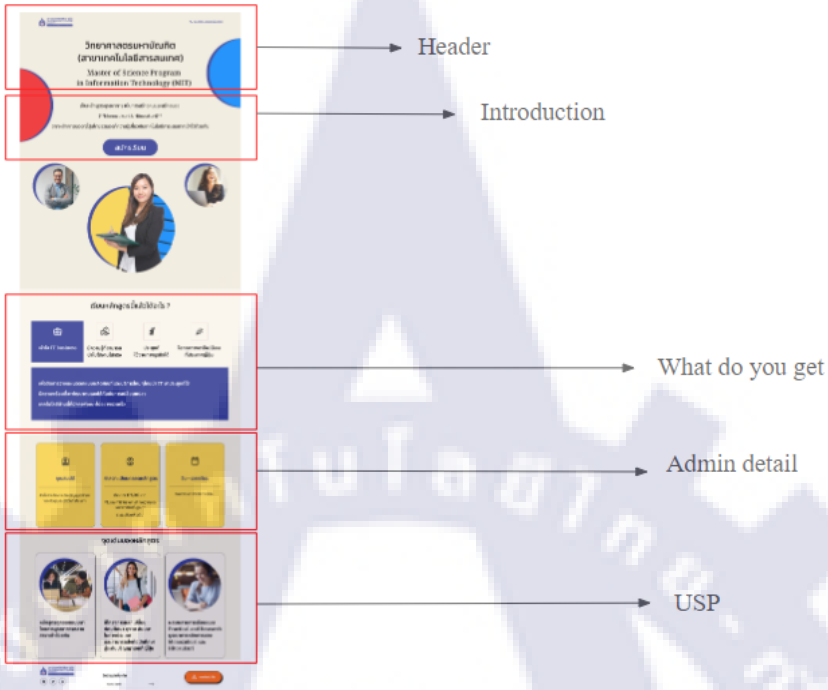

Figure 12: Design A

"Design A" is examined for its transformative approach in user experience (UX) design, characterized by the integration of bold colors and large, rounded shapes that rejuvenate the interface. This modernization effort effectively counters prior critiques regarding its dated aesthetic, offering an engaging and intuitive visual hierarchy. The introduction of oversized icons and prominent headings transitions the page from a "robotic" feel to a more human-centric design [1]. By segmenting content into distinct sections, this visual strategy enhances usability, rendering the information volume more manageable and elucidating the faculty's offerings [4]. The utilization of vibrant color contrasts, alongside strategic alignment, ensures essential elements like the 'Apply Now' button are emphasized, guiding user focus and prompting action [2]. Such design decisions not only appeal aesthetically but are also functionally beneficial, crafting an interface that is straightforward to navigate. The consistent use of design elements and icons throughout Design A establishes a coherent visual language, thereby minimizing cognitive load and easing the learning curve for users, in line with Nielsen’s usability principles [1]. This

reimagined design addresses the issue of content density by organizing information into digestible blocks, facilitating a more fluid user journey across the site. Emphasizing critical actions through contrasting colors and enlarged buttons, Design A highlights essential user pathways and adheres to Fitts's Law by making interaction targets more pronounced and accessible [3]. Additionally, emotional design elements are embedded within Design A, leveraging shapes and colors that are poised to evoke positive emotional reactions, thus promoting an immersive and agreeable user experience, as advocated by Norman's theory [6].

This detailed evaluation demonstrates how Design A embodies a significant shift towards improving the UX design by marrying aesthetic appeal with functional efficacy. Through careful consideration of visual hierarchy, color contrasts, and the strategic use of design elements, Design A not only resolves previous usability issues but also paves the way for a more engaging and user-friendly interface.

3.2.3 Design B

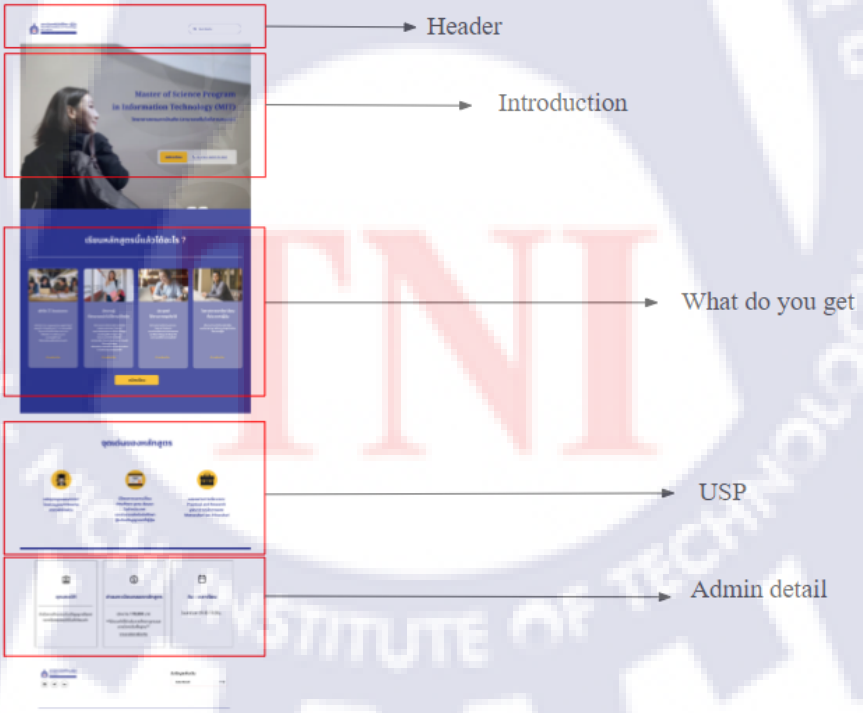

Figure 13: Design B

Design B distinguishes itself through a minimalist and contemporary UX approach, opting for a subtle color scheme and clean lines, diverging significantly from Design A's vibrant aesthetic. This strategy responds to previous criticisms about the site's dated look by introducing a professional and streamlined layout that negates any "robotic" ambiance [1]. By employing clear, consistent typography and meticulous alignment, Design B substantially improves content legibility, effectively organizing what was once a complex and cluttered information architecture [4]. In contrast to Design A's lively and rounded visuals, Design B opts for visual blocks that segment content areas distinctly, enhancing navigability and structural clarity. These blocks facilitate an intuitive content progression, guiding users through the site with greater ease and coherence [5]. Emphasizing accessibility, Design B utilizes easily readable fonts and a muted color palette, ensuring the site's content is approachable for a broad audience, aligning with principles of inclusivity as outlined in Fitts's Law [3]. Moreover, Design B thoughtfully incorporates user feedback through the integration of prominent calls to action, thereby elevating user autonomy. This aspect of design not only clarifies decision-making pathways but also simplifies the reversibility of actions, augmenting the site's interactivity. The navigational experience offered by Design B is marked by its straightforwardness, presenting users with clear options and pathways, contrasting with Design A's more engaging and visually stimulating presentation [1]. Overall, Design B articulates a UX solution that achieves an advancement in usability and aesthetic appeal over the original design while presenting a distinct alternative to Design A. By weaving together fundamental UX design principles, Design B crafts an enhanced user experience that emphasizes a professional look, simplicity, and clarity. This approach renders it particularly apt for an academic setting, embodying a balanced amalgamation of usability, aesthetic refinement, and user-centric design [1]-[7]. In summarizing the contributions of Design B, it's clear that its UX strategy successfully merges aesthetic subtlety with functional clarity, adhering to established UX principles while addressing specific user feedback and accessibility standards. This balanced approach positions Design B as a compelling alternative in the realm of UX design, tailored to meet the expectations of users seeking a professional and straightforward online experience.

3.2.3 Design C

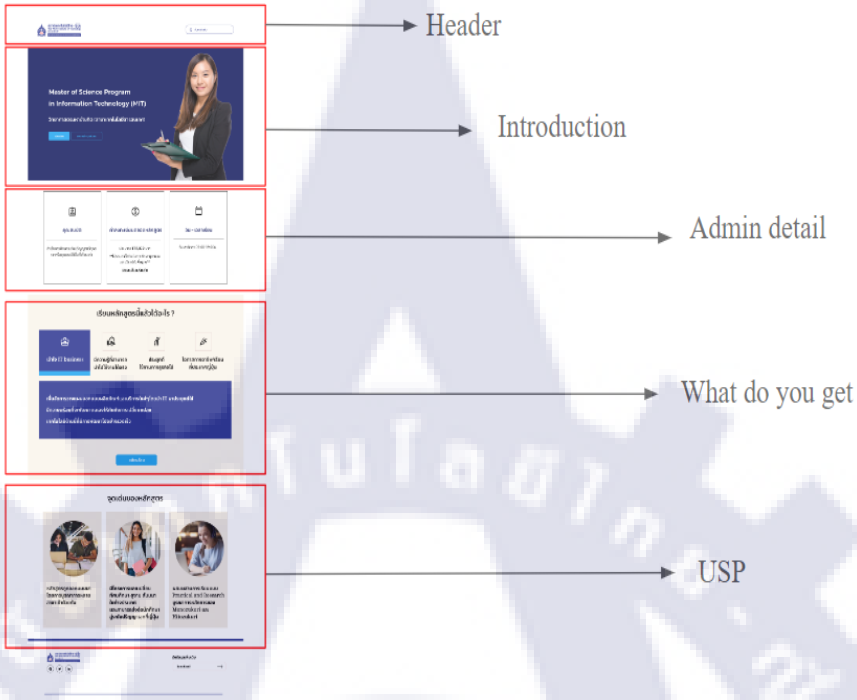

Figure 14: Design C

Design C emerges as a sophisticated and professional interface, uniquely positioned for users in search of a serious educational platform. It adeptly utilizes strategic white space and alignment to ensure content flow is clean and engaging, rendering dense information accessible and simplifying navigation. This approach presents a stark contrast to Design A's lively and dynamic aesthetic and Design B's muted, block-focused structure, offering an alternative that underscores subtlety and sophistication [5]. By integrating more explicit navigational cues, Design C significantly bolsters user control, incorporating clear calls to action and reversible features that adhere to Nielsen's principles of user autonomy [1]. In contrast to Design A's reliance on oversized icons and vibrant color sections and Design B's commitment to structured typography, Design C adopts a measured use of contrast and alignment to convey a professional image suitable for an academic setting [2]. The navigational strategy in Design C is characterized by a clear visual hierarchy, effectively guiding the user's attention through the content in alignment with Gestalt principles [5]. This design ensures a seamless user interaction with the website, facilitating

an intuitive experience that distinguishes it from the more segmented layout of Design A and the subdued segmentation observed in Design B [1]. The emphasis on user control within Design C is evident through its streamlined navigation pathways and the clear presentation of user action options. This design responds adeptly to user feedback, enabling intuitive site engagement and fostering user empowerment and ease of use. Such design considerations are reflective of Gibson's theory of affordances, highlighting the importance of intuitive interaction cues in the environment [7]. Ultimately, Design C offers a user experience that skillfully balances aesthetic appeal with functional efficiency. Although it departs from the stylistic choices of Designs A and B, it maintains the essential progressions made over the original design, adeptly catering to user preferences for clarity, control, and professionalism within an academic context [1]-[7]. Design C's strategic integration of UX principles effectively marries professional aesthetics with intuitive functionality, ensuring it meets the evolving needs of users seeking a sophisticated educational platform. This balance of design elements demonstrates a keen awareness of user expectations and the critical role of UX design in creating engaging, user-friendly digital environments.

3.4 Questionnaire

The questionnaire was designed to get both qualitative and quantitative data from the users for each landing page. We plan to ask participants to complete a questionnaire divided into two sections. The first part collected essential demographic data, such as age, gender, educational background, and interest in continuing academic studies. This information was vital to investigate any potential links between these demographic elements and their interactions with the website. The second part of the questionnaire delved deeper into various facets of the user experience, covering seven crucial areas: Content Understandability, Presentation Style Suitability, Layout Understandability, Content Understanding, Color Tone Suitability, Font Clarity, and Overall Website Interest. Participants rated each of these areas on a Likert scale (from 1 to 5) , according to [likert scale]. Providing measurable insights into their perceptions and experiences.

These are the rating questions: (Rating from 1 strongly disagree to 5 strongly agree)

- Content understandability.
    - The content and details of the website is easy to understand.
- Suitability of presentation style with content.
    - The presentation style is suitable for the type of content that it wants to present.
- Layout understandability.
    - The Layout of content is appropriate and easy to understand.
- Understanding of the MIT faculty program after visiting the website.
    - After going through the website, you clearly understand the curriculum and details of the faculty.
- Suitability and comfort of the color tone.
    - The Color and Tone of the website is suitable, clear to see, easy on the eye.
- Clarity and readability of the font.
    - The Font is easy to read and clear to see.
- Overall interest in the website.
    - You feel like the website is interesting.

These are open ended questions:

- Describe your first impression of the website
- If you can give one recommendation to make any change. What would you recommend?

Table 3: Questionnaire rating

	Original	Design A	Design B	Design C
Content in the website is easy to understand	4.52	4.76	4.64	4.47
The presentation style is suitable with the content	4.52	4.52	4.54	4.5
Layout of the website is easy to read and understand	4.3	4.59	4.5	4.47
After visit the website you understand more about the program	4.14	4.19	4.3	4.14
Color tone is easy to read	4.23	4.42	4.57	4.47
Font is clear and easy to read	3.76	4.8	4.59	4.57
The website is interesting	3.76	4.35	4.42	4.16
Content in the website is easy to understand	4.52	4.76	4.64	4.47
The presentation style is suitable with the content	4.52	4.52	4.54	4.5
Layout of the website is easy to read and understand	4.3	4.59	4.5	4.47
After visit the website you understand more about the program	4.14	4.19	4.3	4.14
You feel that the website improve your interest in the faculty	3.8	3.97	4.07	3.85
Total Average score	4.13	4.45	4.45	4.32

3.5 Participants

Our research involved two primary groups of participants, each sourced from distinct channels. The first group comprised university students who were invited to partake in the study at the faculty's on-site facilities. This group consisted of twenty-seven undergraduate students, aged between 18 and 21, all from TNI. The second participant group was formed through an online recruitment strategy, leveraging my personal social media network to invite individuals to participate using the realeye.io platform. These participants, a total of fifteen people and ranging in age from 18 to 59. In total, our study involved forty-two participants from diverse academic backgrounds, including but not limited to business and engineering. In addition to their engagement with the study, we also inquired about their interest in pursuing further higher education. This information was sought to gain a deeper understanding of their educational aspirations and potential influences on their interaction with the test material. This diversity in both background and educational interest was critical to enriching our understanding of user experiences across different demographics.

Figure 15: Testing Participants

3.6 Usability tasks

In our study, participants were not assigned any specific tasks but were instead instructed to explore the website as they would naturally encounter a landing page. This approach was chosen to emulate the typical user experience more authentically. After navigating through each prototype, participants were then asked to fill out a questionnaire.

3.7 Procedure

After giving their informed consent, participants initiated their involvement in the study by interacting with our prototype. The experiment commenced with a detailed calibration and validation of each participant's gaze, an essential step to guarantee the precision of the eye-tracking data. Initially, participants were asked to grant camera access, followed by a presentation of fundamental instructions. The calibration involved a detailed 40-point process [49], conducted against backgrounds of white, black, and gray to reduce any possible impact of the monitor's light intensity on the eye-tracking accuracy. The reliability of the calibration was then ascertained again through a nine-point validation system. This phase was pivotal, as it allowed only those participants whose gaze predictions were within a 300-pixel radius from the designated points to continue. This rigorous validation was critical for upholding the eye-tracking test's accuracy and integrity. Then participants were instructed to freely navigate the website, replicating a natural browsing experience. During this phase, the realeye.io system, along with the webcam, captured their eye movements, including fixations and saccades, as well as on-screen activities like clicks. After exploring each prototype, the participants were then asked to complete a questionnaire. This evaluative system was instrumental in assessing the impact of different design elements on user engagement and overall satisfaction with the website.

3.7.1 First Round

Our initial methodology involved the use of realeye.io, a web-based eye tracking platform. We selected its "Interactive mockup" feature to conduct tests on various prototypes, allowing us to highlight and segment interactive elements within each design. Participants were required to undergo an eye calibration process before sequentially engaging with each prototype. After completing one prototype, they would proceed to the next, ultimately evaluating all designs through a comprehensive questionnaire.

However, this approach faced a major obstacle when we discovered a malfunction in realeye.io's data recording capabilities. This flaw in eye tracking data recording was identified only after the participants had completed the tests.

3.7.2 Second Round

Consequently, we revised our experimental design, taking into account feedback from the initial participants and the limitations of realeye.io. We opted for a more streamlined "image" option, wherein screenshots of each prototype were combined into a single test. This change meant that participants only needed to complete the eye calibration once, significantly reducing the time required per participant. Additionally, we modified the questionnaire structure, placing it immediately after each Design Based on the feedback that participants found it challenging to recall details of earlier prototypes after engaging with multiple designs. This adjustment aimed to capture immediate, more accurate responses for each specific prototype.

This chapter detailed the research methodology used to evaluate the impact of different design elements on user experience for a faculty website's landing page. A mixed-methods approach was adopted, combining qualitative data from user interviews and questionnaires with quantitative data from eye-tracking tests. This allowed for a comprehensive analysis of user interaction and cognitive load, focusing on both user preferences and actual behavior, highlighting how specific UX principles influenced user engagement and satisfaction. The results of this methodological approach are examined in the following chapter.

Chapter 4
Production and Results

In this chapter, the focus shifts to the presentation and analysis of the collected data, offering insights into user interactions with the three redesigned prototypes of the faculty landing page. Using both eye-tracking metrics and questionnaire feedback, this chapter aims to uncover which design choices were most effective in enhancing the user experience. The analysis will cover various aspects of user engagement, such as attention distribution, navigation patterns, and subjective feedback, drawing correlations between visual behavior and user perceptions. Through detailed examination and data-driven insights, this chapter seeks to identify the optimal design elements that contribute to a more intuitive and engaging website experience, providing valuable guidance for future design improvements.

4.1 Quantitative data from questionnaire

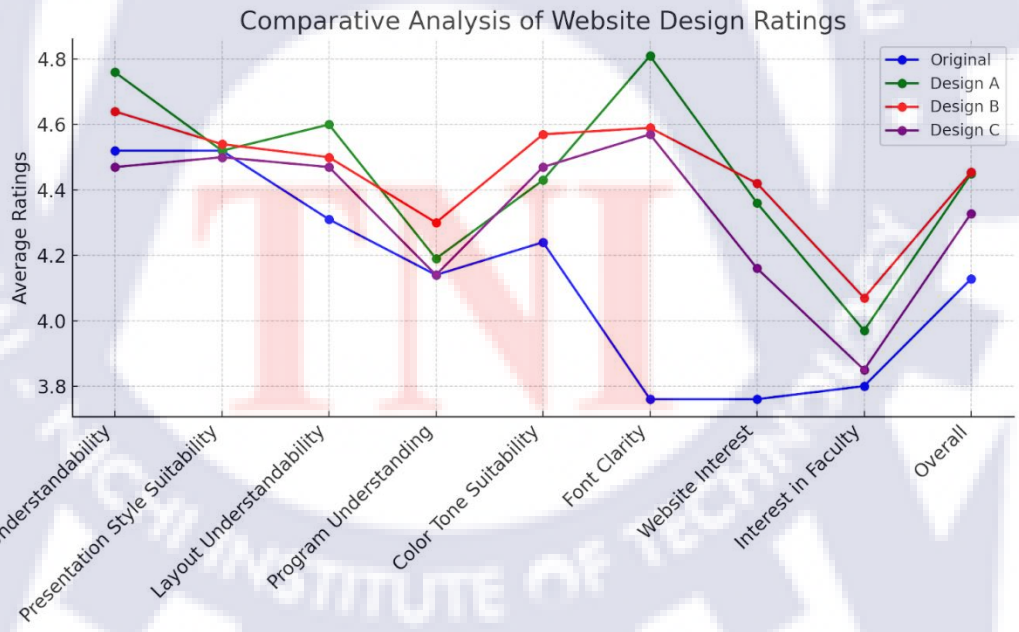

Figure 16: Questionnaire rating comparison

The line graph in the figure presents a comparative analysis of website design ratings for the original design and three new proposals: Design A, Design B, and Design C. Notable findings include the original design excelling in content understandability, while Design C lags behind. Design B stands out as the preferred choice for presentation style, with the original design being the least favored. All designs closely compete in layout understandability, with Design B slightly ahead. Program understandability sees Designs A, B, and C closely rated, with Design A having a slight advantage, while the original design falls significantly behind. Design A excels in color tone suitability, while the original design scores the lowest. In font clarity, Design A leads, and the original design ranks lowest. Design C captures user interest effectively, while the original design generates the least website interest. In terms of "Interest in Faculty," Design C leads slightly, with Designs A and B following closely behind, and the original design trailing. Overall, Design A receives the highest overall rating, followed closely by Design C, while the original design receives the lowest overall rating. In summary, Design A consistently performs well across various dimensions, Design C excels in generating interest despite lower content understandability, and the original design tends to rank lowest in most categories, indicating potential for improvement..

4.2 Qualitative data from questionnaire

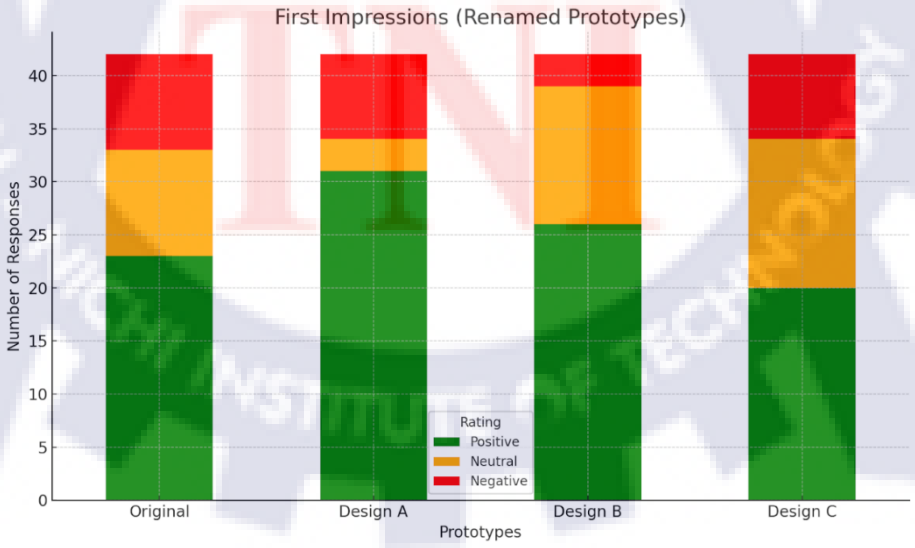

Figure 17: First impression

In the questionnaire we have a fill in the blank section where participants need to fill in the first impression of the website and any additional feedback that they have for each prototype. The image provided showcases a stacked bar chart detailing the distribution of responses across three categories: Positive, Neutral, and Negative. The Original prototype exhibits a balanced distribution of opinions, with a slightly higher count of positive responses in comparison to neutral and negative ones. It stands out with the lowest number of negative responses when compared to the other prototypes. Design A shines with a majority of positive responses, recording the highest count among all the prototypes. Notably, it also boasts an equal number of neutral and negative responses, both of which are the lowest when compared to the other prototypes. This suggests that the Design A was exceptionally well-received during initial impressions. In contrast, Design B registers a higher number of negative responses when compared to the original and Design A. The count of positive responses is notably lower than that of the Design A but surpasses the original. Design C records the highest number of negative responses among all the prototypes. While the count of positive responses falls short of the Design A, it surpasses the original and Design B. When considering first impressions, the Design A emerges as the best-received option, boasting the highest number of positive responses and the lowest counts of both neutral and negative feedback. Conversely, Design C appears to make the least favorable initial impression, garnering the highest number of negative responses. The original design, while not receiving as overwhelmingly positive feedback as the Design A, benefits from having the least negative feedback, which could be advantageous if the goal is to minimize strongly negative reactions.

4.3 Combining Qualitative and Quantitative data from questionnaire

Starting with the Original Design, as depicted in the line graph, it consistently received lower ratings across various dimensions of website design, signaling areas that require improvement. Interestingly, when we turn to the first impressions chart, it presents a more balanced view, with a slightly higher positive response and the lowest negative response among all designs. This suggests that while the original design may not excel in specific metrics, it manages to avoid evoking strong negative reactions. Design A, emerges as a standout performer in the line graph. It achieves high ratings across the board, particularly excelling in font clarity and color tone suitability, ultimately securing the

highest overall rating. This positive sentiment is further reflected in the stacked bar chart, which predominantly conveys approval, with minimal neutral and negative responses. These findings collectively indicate a strong initial approval from users, making Design A a successful redesign that enhances the original design.

Turning our attention to Design B, the line graph reveals that it closely aligns with Design A in terms of layout and program understandability but falls slightly behind in content understandability. The first impression scores, as portrayed in the stacked bar chart, offer a mixed reception. While it receives fewer negative responses than the fourth Design But more than the second prototype, positive responses do not reach the same level as those for Design A. This mixed reception suggests that while Design B has its strengths, it may possess aspects that could be polarizing or require refinement. Lastly, Design C, exhibits a strong performance in generating website interest and achieves a robust overall rating, closely trailing Design A in the line graph. However, the initial impressions derived from the stacked bar chart indicate that it received the highest number of negative responses among all designs. This discrepancy between detailed design aspects and immediate user reactions suggests that while Design C contains elements that are well-rated upon closer examination, its initial impact on users may not be as favorable. In summary, Design A emerges as the top-performing redesign, garnering positive initial impressions and excelling in more detailed aspects of website design. The Original Design, while not standing out in detailed metrics, maintains a safe level of reception without strong negative reactions, which may be crucial depending on the risk tolerance for the redesign. Design B exhibits potential but receives mixed feedback, indicating that certain design elements may require adjustments. Design C, while intriguing upon detailed review, may need to address elements causing negative first impressions to enhance its initial user reception.

4.4 Qualitative data from eye tracker

Keywords:

- No. of fixation - how many fixations were registered within this area.
- Average TTFF (time to first fixation) - how long it took the participants on average to first look at this area in seconds (when the first fixation sample was taken).

- Average time spent - total time spent by viewers (on average) looking at this area.
- Ratio - how many of all the viewers saw this area (based on fixations).
- Average revisits - how many times (on average) participants looked back at this area (looked at it, looked away and then looked back again); AOI visit is detected if there's a fixation within the AOI (or many fixations "one after another").
- Average FFD (first fixation duration) - how long, on average, lasted the first fixation.

Table 4: Fixation

	Original	**Design A**	**Design B**	**Design C**
Header	586	712	166	78
Introduction	1778	706	659	583
What do you get	365	910	1250	640
USP	536	654	580	487
Admin details	402	535	645	417

Table 5: Avg.TTFF (s)

	Original	**Design A**	**Design B**	**Design C**
Header	2.1	0.81	3.28	4.83
Introduction	1	2.25	1.08	0.98
What do you get	13.41	11.29	5.07	6.55
USP	10.72	20.33	12.15	10.29
Admin details	23.26	15.31	16.87	4.62

Table 6: Avg.Time Spent (s)

	Original	**Design A**	**Design B**	**Design C**
Header	3.57	4.08	1.17	0.85
Introduction	10.85	4.39	3.69	3.24
What do you get	3.19	6.16	8.02	3.99
USP	4.37	6.1	4.3	3.28
Admin details	3.49	4.66	4.35	2.64

Table 7: Ratio (%) (Fixation)

	Original	**Design A**	**Design B**	**Design C**
Header	41/42 (98)	42/42(100%)	33/42(79%)	21/42(50%)
Introduction	42/42 (100%)	42/42(100%)	42/42(100%)	42/42(100%)
What do you get	30/42 (71%)	38/42(90%)	41/42(98%)	38/42(90%)
USP	33/42 (79%)	28/42(67%)	37/42(88%)	36/42(86%)
Admin details	30/42 (71%)	32/42(76%)	38/42(90%)	40/42(95%)

Table 8: Avg.Revisits

	Original	**Design A**	**Design B**	**Design C**
Header	4.83	4.9	1.19	0.83
Introduction	9.29	5.14	2.88	2.98
What do you get	3.78	2.8	3.78	3.34
USP	4.93	3.27	2.83	3.05
Admin details	2.46	2.66	3.88	2.46

Table 9: Avg.FFD (s)

	Original	**Design A**	**Design B**	**Design C**
Header	0.22	0.24	0.21	0.24
Introduction	0.24	0.23	0.21	0.22
What do you get	0.21	0.26	0.23	0.22
USP	0.24	0.24	0.25	0.24
Admin details	0.24	0.26	0.24	0.25

In conducting a comprehensive analysis of the qualitative data from the eye tracker across various designs—Original, Design A, Design B, and Design C—we observed a nuanced landscape of viewer engagement and attention distribution. Design A emerges as notably effective in drawing and maintaining attention on crucial content areas, such as "What do you get," evidenced by its superior gaze and fixation metrics. This design's ability to quickly attract viewer attention, particularly towards the header, as indicated by the lowest average time to first gaze (Avg.TTFG) and time to first fixation (Avg.TTFF), underscores its layout's efficacy.

Design B, while presenting a balanced engagement profile, reveals slight delays in attracting attention to key elements. This suggests a potential for improvement in its ability to direct viewer focus towards critical information swiftly. On the other hand, Design C often registers the lowest engagement metrics, particularly in visibility and interest metrics for the "Header" area, hinting at less effectiveness in capturing and holding viewer interest.

Moreover, the average time spent across different areas suggests Designs A and B foster deeper engagement or require more time for viewers to process the information, which could reflect on the designs' complexity or the compelling nature of their content. Interestingly, the average revisits and the average first fixation duration (Avg.FFD) metrics across all designs point to a consistent initial impact level and a varying ability to recapture attention, highlighting areas for potential refinement in re-engaging viewers.

The ratio metrics illuminate high visibility for most areas across all designs, with certain exceptions indicating areas where visibility or interest might be improved,

especially in Design C's "Header." This analysis reveals that Design A's strategic layout and content presentation are particularly adept at not only attracting but also retaining viewer attention on key elements. However, the ultimate effectiveness of these designs should be evaluated against specific objectives, such as conversion rates or information retention, complemented by qualitative user feedback for a rounded assessment.

4.5 Heatmap from eye tracker

In the Original design, the webpage's upper section, particularly around the title and navigation elements, shows a significant concentration of heat, indicating that users are initially attracted to the site's identity and menu options upon landing on the page. As the focus moves to the main content area, the heat becomes more dispersed but with distinct hotspots, possibly corresponding to headings, key phrases, or images, emphasizing the need to align these areas with critical information or user actions. The left side of the page also receives notable attention, following the typical F-shaped scanning pattern of web users. The middle section, with images and multimedia, shows warmer colors, suggesting that these visual elements effectively draw user interest, beneficial for engaging users with various aspects of the program. The footer area also has a hotspot, implying that users are scrolling to the end, potentially in search of additional details like contact information or social media links, a positive indication of user engagement.

Design A maintains the significant attention on the header, with a focused concentration on the right side, possibly due to new design elements such as a call to action or a striking logo. Images of people, particularly in the header, show clear hotspots, indicating strong user engagement and the effectiveness of human elements in capturing attention. The central content area displays a band of heat across interactive elements or headings, suggesting active user engagement with the main content. The navigation elements and calls to action are distinct hotspots, indicating effective user attraction and potential for high interaction rates. The lower third of the page, featuring several information blocks, shows multiple hotspots, suggesting effective content organization. The footer, like in the Original design, draws user attention, highlighting its importance for additional information or actions. The side margins are less focused, aligning with good design practices of centering main content.

Design B's header, particularly the search bar and menu area, shows strong engagement, indicating effective placement and user recognition of these as interactive tools. The central area, with prominent images, attracts considerable attention, suggesting effective placement if linked to key information or actions. The even heat distribution across content blocks in the middle section implies that users are thoroughly examining each section, indicating engaging presentation or a layout that facilitates easy reading. The lower page, likely with additional information or secondary actions, captures attention, showing overall engagement. The navigation elements and footer display clear hotspots, pointing to user interest in finding additional navigation options or contact information.

In Design C, the header, and specifically the search bar area, stands out as a key engagement point, mirroring the pattern seen in Design B. This consistency highlights the effectiveness of a prominent search feature in capturing user attention. Additionally, the image of a person in the header is a focal point, reinforcing the trend observed in Designs A and B that human images effectively attract attention. The main content blocks in the middle section, presumably detailing key program offerings, show varying levels of engagement. Unlike Design B's even heat distribution, Design C displays a more diverse engagement pattern, suggesting certain elements or information within these blocks are more attention-grabbing. A notable hotspot around a call to action button indicates strong user engagement and interest in interacting with this element. The lower part of the page in Design C, similar to other designs, also captures user attention but with more defined areas of focus around specific content and images, possibly indicating strategic information placement. The footer area, consistent with other designs, shows significant engagement, highlighting its role in further user navigation or action facilitation.

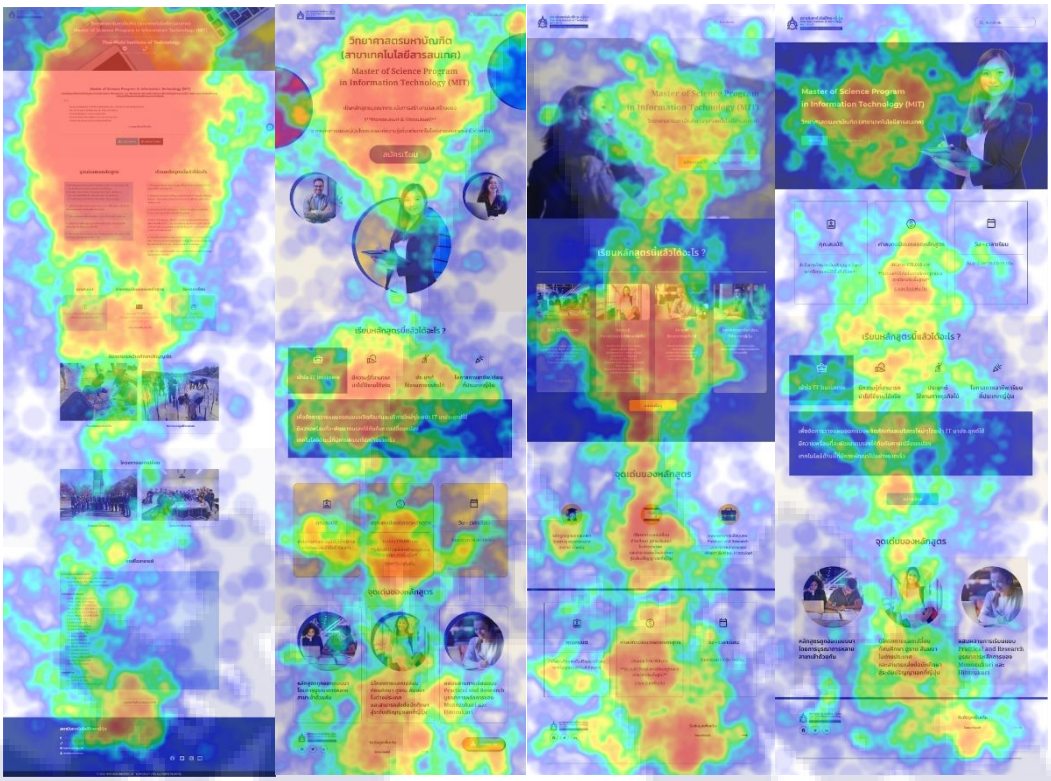

Figure 18: Heatmap across 4 prototypes

4.6 Combining All eye tracker data

Integrating insights from both the qualitative eye-tracking data and heatmap analysis offers a nuanced view of how users interact with and respond to the Original design and Designs A, B, and C. The analysis illuminates key areas of user engagement, interaction patterns, and the strategic placement of design elements to optimize user experience.

The Original design captures immediate attention in the upper section, particularly around the title and navigation elements, as evidenced by the significant heat and gaze metrics. This suggests a successful initial draw to the site's identity and menu options. As users navigate to the main content, the heatmap shows dispersed engagement with specific hotspots, likely aligning with critical information or actions, complementing the eye-tracking data. The prominence of the footer in both datasets underscores its role in user engagement, suggesting users often seek additional information here.

Design A stands out for its focused attention on the header, driven by new elements such as calls to action or dynamic logos. The heatmap further reveals that images of people, especially in the header, significantly engage users, a finding supported by the eye-tracking data. The heatmap's indication of a band of heat across interactive elements or headings in the central content area aligns with active user engagement observed in the eye-tracking metrics. This suggests Design A's content is not only strategically organized but also effectively engages users, a sentiment echoed in the lower page's multiple hotspots which indicate a well-structured approach to information dissemination.

Design B is characterized by strong engagement in the header, with the search bar and menu area highlighted as particularly effective, an observation that complements the eye-tracking data. The central content area's even heat distribution suggests that users are giving thorough attention to each section, indicative of an engaging presentation or layout that facilitates easy consumption. This design maintains user interest down to the lower page areas, capturing attention across various content blocks and indicating a cohesive and engaging user journey throughout the page.

Design C, similar to B, demonstrates the effectiveness of a prominently placed search feature, with the heatmap and eye-tracking data both highlighting this area as a key engagement point. The main content blocks show a varied engagement pattern, suggesting that specific elements within these blocks are particularly attention-grabbing. A notable hotspot around call-to-action buttons underscores strong user interaction, aligning with the eye-tracking data to suggest areas of heightened interest and engagement.

In summary, when considering both the heatmap and eye-tracking data, Design A emerges as highly effective in engaging users through well-placed header elements and interactive content. The Original design, while capturing initial attention effectively, adheres to more traditional engagement patterns. Design B’s layout encourages a comprehensive examination of content, suggesting a balance between engagement and navigational ease. Design C reveals that certain content elements distinctively attract user attention, indicating potential areas for refinement to enhance initial engagement. This comprehensive analysis underscores the critical importance of thoughtful design element placement, especially in headers and interactive sections, and highlights the strategic value of human elements and clear calls to action to maximize user engagement and experience.

4.7 Correlation Analysis

To gain deeper insights into how user behavior (captured through eye-tracking) relates to subjective user satisfaction (measured through questionnaires), we conducted a series of correlation analyses, visualizations, and comparisons. These analyses provided a more comprehensive view of how different design elements and sections of the website impacted user experience.

4.7.1 Correlation Analysis

We calculated correlations between key eye-tracking metrics (fixation, time to first fixation, total time spent, revisits, etc.) and questionnaire ratings for each design (Original, Design A, Design B, and Design C). The following heatmap visualization (Figure X) represents the correlation matrix, which highlights the strength and direction of relationships between the metrics.

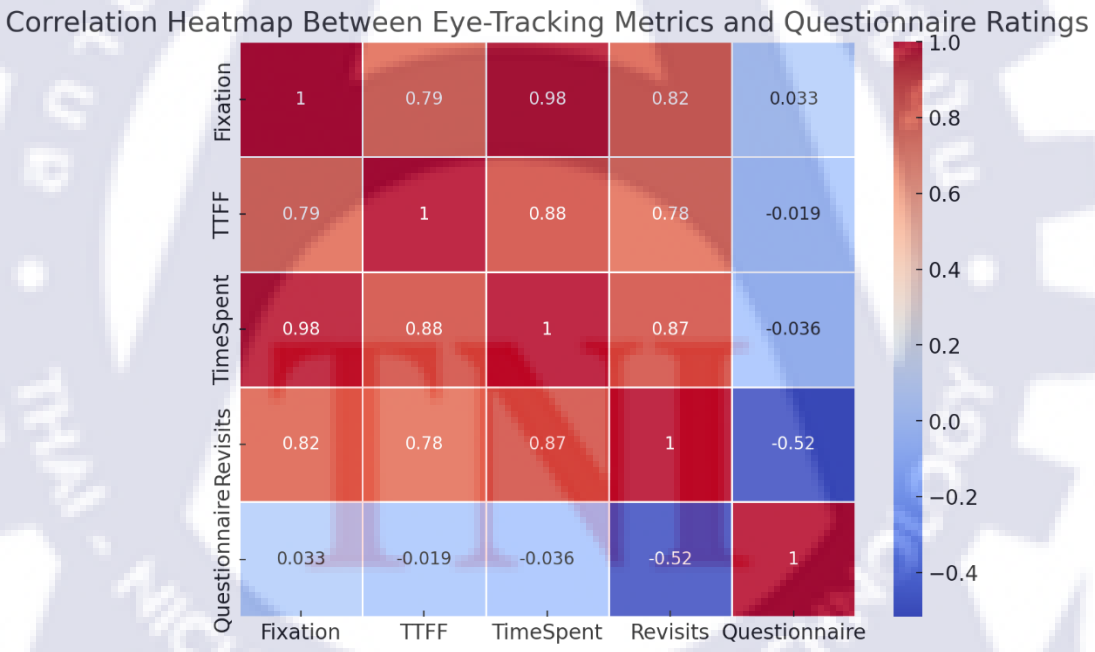

Figure 19: Correlation Heatmap

Key findings from the correlation analysis:

Weak Negative Correlations: Eye-tracking metrics such as Fixation, Time to First Fixation (TTFF), and Time Spent showed weak negative correlations with questionnaire

ratings. This implies that higher engagement with these sections did not necessarily lead to better satisfaction scores, indicating that users might not have found the sections clearer or more engaging despite spending more time on them.

Moderate Negative Correlation with Revisits: Revisits had a moderate negative correlation with questionnaire ratings, particularly in Design C. This suggests that sections that required users to revisit multiple times were associated with lower satisfaction.

4.7.2 Section-Wise Correlation Comparison

We also analyzed correlations across different sections of the webpage (Header, Introduction, What do you get, USP, Admin details) to observe how user engagement varied by section. The bar chart below (Figure Y) compares the correlation coefficients across each section for different eye-tracking metrics, showing the impact of each section on user satisfaction.

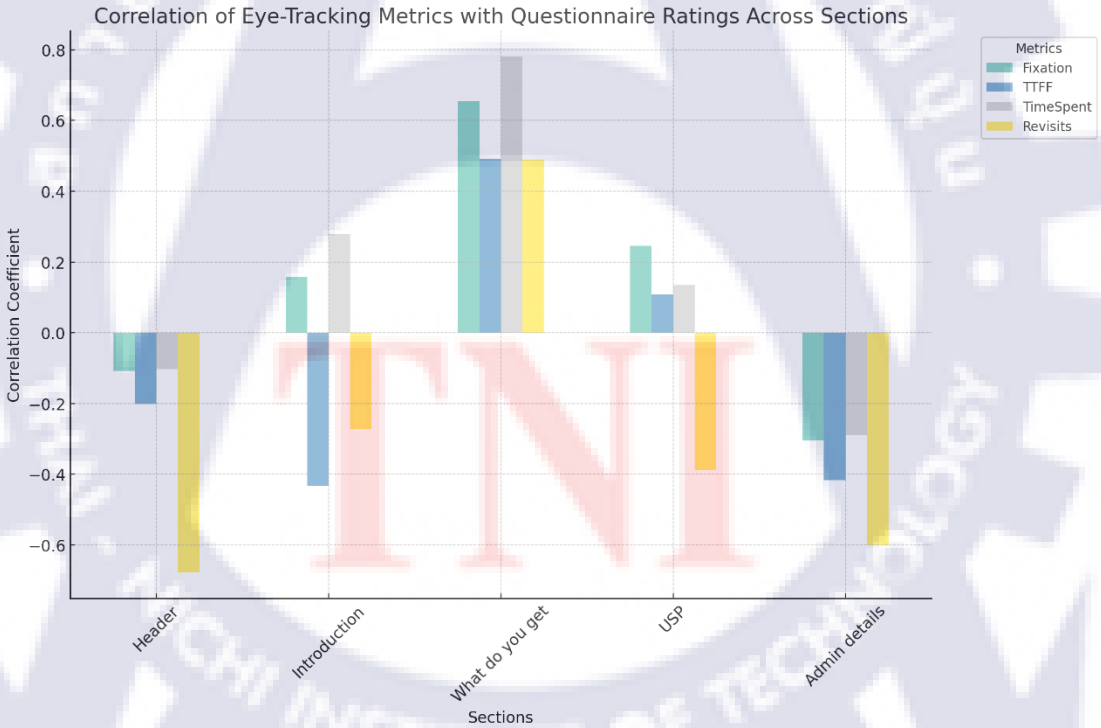

Figure 20: Bar Chart Comparing Correlations Across Sections

Key section-wise insights:

Introduction Section: In Design A and Design B, Fixation correlated more strongly with user satisfaction, suggesting that users who spent more time on this section felt more engaged with the content and rated it higher for clarity.

What Do You Get Section: A strong correlation between Time Spent and questionnaire ratings was observed in Design B, indicating that users who engaged with this section for longer durations found it informative and rated it highly.

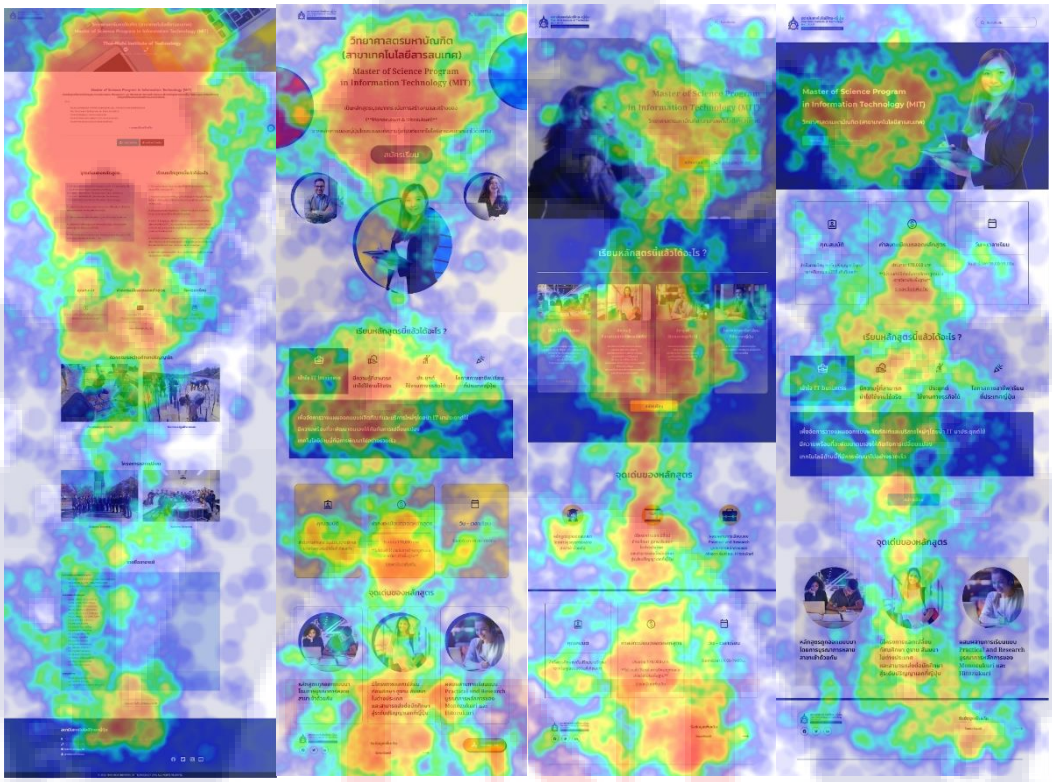

Figure 21: Heatmap across 4 prototypes

Key engagement insights:

Design A: This design showed concentrated user attention on important sections, such as the header and the call-to-action buttons. Users spent more time engaging with these elements, which aligns with the higher satisfaction ratings this design received in the questionnaire.

Design B: Though user engagement was high in sections like “What do you get,” there was a slight delay in fixating on key elements. This indicates room for improvement in capturing users’ attention earlier in the interaction.

Design C: The heatmap revealed less engagement in critical areas such as the header and main navigation elements, contributing to the lower questionnaire ratings observed for this design.

4.7.3 Comparative Analysis of Correlations Across Designs

The comparison of correlations across the designs is visualized in the heatmap and bar chart (Figures X and Y). Design A demonstrated better alignment between user behavior and satisfaction:

Fixation and Time Spent in Design A correlated more strongly with positive user feedback, particularly in sections where information clarity and engagement were essential, such as the introduction and “What do you get” areas.

Design C showed the lowest correlation between eye-tracking metrics and satisfaction, indicating that users were not as engaged or satisfied with this layout, despite its professional aesthetic.

4.7.4 Overall Summary of Findings

Design A emerged as the most user-friendly and engaging, with strong correlations between fixation and time spent metrics and user satisfaction in key content areas. Design B performed well in some sections but took longer to capture user attention in critical areas. Design C, while having a more professional layout, was less effective at engaging users and correlating with higher satisfaction, as seen in both the correlation analysis and the heatmap results.

Revisits tended to negatively correlate with satisfaction, suggesting that designs that led to frequent revisits were less effective at delivering a clear and intuitive user experience.

Chapter 5
Conclusion and Future Research

This study sought to understand the relationship between user behavior, as captured through eye-tracking metrics, and user satisfaction, as measured by a traditional questionnaire. The research evaluated four website designs (Original, Design A, Design B, Design C), focusing on how design elements impacted user interaction and perception of usability, readability, and interest. Through the use of eye-tracking technology and questionnaire data, this study employed a mixed-method approach to gain insights into user engagement, behavior patterns, and satisfaction.

5.1 Summary of Findings

From the correlation analysis between eye-tracking metrics and questionnaire ratings, several important trends emerged:

- Weak Correlations Between Fixation and Satisfaction: The analysis showed weak correlations between fixation counts and user satisfaction. This suggests that while users may focus on certain areas, the number of fixations alone does not determine how positively they rate the design.
- Moderate Negative Correlation with Revisits: Revisits were found to have a moderate negative correlation with questionnaire ratings, especially in Design C. This suggests that revisiting content multiple times may lead to confusion or dissatisfaction, as users struggle to understand certain sections.
- Design A's Success: Among all the designs, Design A consistently received the highest ratings in both the eye-tracking data and questionnaire results. It captured user attention efficiently and maintained engagement, as indicated by both heatmap data and positive questionnaire feedback.
- Room for Improvement in Design C: Design C demonstrated some strong points in capturing initial interest, but also faced challenges in conveying content clarity. The moderate correlation between time spent and revisits suggests areas of content complexity that may have confused users, despite initial engagement.

5.2 Implications for Design

The findings provide several implications for future web design:

- Engaging Content Presentation: Design A effectively used visual elements, such as color tone and clear font, to keep users engaged, as shown by the positive correlation between fixation counts and user ratings of readability.
- Improving Content Clarity: Design C, despite being visually attractive, resulted in lower user satisfaction due to the complexity of its content. Future designs should aim to simplify content, particularly in administrative sections, to prevent multiple revisits and confusion.
- Reducing Cognitive Load: The negative correlation between revisits and user satisfaction suggests that designs should focus on reducing cognitive load by organizing content in a clear and intuitive way. Sections that cause multiple revisits can lead to frustration, reducing overall satisfaction.

5.3 Future Research

This research opens the door for further exploration in several areas:

- Longitudinal Studies: Future studies could investigate user engagement and satisfaction over time to understand how repeated interactions with a website affect behavior and perceptions.
- Targeted User Segments: Analyzing how different user demographics (e.g., age, education level) interact with specific design elements could help tailor designs for target audiences.
- New Metrics: Further studies could incorporate additional metrics, such as emotional response and task completion rates, to provide a more holistic understanding of user experience.

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