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The Role of Color in User Experience: A Systematic Literature Study of User Preferences for Dark and Light Mode

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Abstract

The increasing use of dark mode and light mode in user interfaces has prompted many studies to determine their effects on user experience. Findings in the literature show that research is still fragmented and does not provide a comprehensive understanding of the cognitive, emotional, and behavioral aspects of preferences for user interface themes. This study analyzed 25 selected scientific articles from 2020 to 2025. The identification topics were related to user preferences, performance, accessibility, and satisfaction with interface modes. The qualitative thematic analysis approach found 6 main themes, namely Readability and Accessibility, Cognitive and Emotional Responses, Usage Behavior and Preferences, Task Performance and Efficiency, Health and Environmental Impacts, and Interface Design and Satisfaction. The results showed that light mode was better in terms of readability and tasks that require high lighting, dark mode provides better visual comfort than light mode and reduces eye fatigue in low light conditions. User preferences were influenced by several things such as age, device type, environment, and emotional needs. This research emphasizes the development of an adaptive system that allows users to switch between dark and light modes according to their respective conditions is important. This research contributes to the field of Human Computer Interaction (HCI) by demonstrating an understanding of interface theme design as well as future research directions.

Keywords: Dark mode, light mode, user experience, user preference, HCI, accessibility

1. Introduction

The design of the user interface has recently experienced rapid transformations. User experience (UX) plays an important role in the design of digital products, because the visual factors significantly affect the feelings of users. Among these factors, color topics are noticeable importance, especially related to the choice between dark mode and light mode. Colors can significantly affect user comfort, readiness and the way users evaluate the quality of an application.

In recent years, dark and light mode have become standard features on mobile, offices and web platforms. Many users prefer darkness at night or in low light environments, while others are still in light mode because they find it easier to read and more professional. This change reflects a wider trend in interface design: Custom main and visual comfort as essential parts of user experience [1], [2].

Colors are always a powerful tool in design. It inspires emotions, establishes the brand's identity and affects awareness. The change in color design has raised new questions: Is dark mode more comfortable for users? Is the light mode still related, or is it gradually progressing in the direction of benefit for dark mode?

These questions go beyond aesthetic interests. The choice of color mode may have an impact on the comfort, mediocre and even the device's energy consumption. Dark mode, for

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example, is often preferred to be easier in the eyes, especially in the dark environment. However, some users point out that it makes the text more difficult to read in long -term periods or in good parameters [3]. Light mode tends to provide better contrast for reading and productivity tasks, making it default to many professional and educational applications [2].

Some studies show that the dark mode can reduce eye stress and improve comfort at night or in dark rooms [1]. On the other hand, the ability to read is often affected, especially by long reading or in light conditions. Light mode provides higher visual contrast between text and background, often more suitable for tasks that require concentration and brightness [2].

The user's preference is not heterogeneous; it is very context. Factors such as the type of application, the time users interact with it, their age, lighting conditions and even the culture can determine whether they choose the dark or light mode [4]. For example, users in creative areas may favor darkness for its elegance and modernity, while people with academic environment tend to be attractive to light mode because of its readability.

Another side of this topic is the increase of attention in personalization. More and more applications allow users to choose their favorite interface theme, note that developers are aware of the diversity of user needs and expectations. The academic understanding of what affects user preferences is still dispersed through isolated studies. Some results in even conflict with each other.

This situation emphasizes the need for structured understanding. A systematic mapping of the literature is necessary to identify common models and gaps in current research. A system of systematic documents (SLR) strictly to do so by analyzing a large set of studies in a structured and complete way [5]. With this method, researchers can explore trends, inconsistencies and forgotten fields that may not be seen in autonomous studies.

This study aims to conduct a systematic review of literature focusing on color topics in interface design, especially the use and users' awareness of the dark mode and light mode. The inspection will check the publications from 2020 to 2025 to ensure the relevance of current trends and technologies. The two main questions in this research are: (1) What factors affecting user preferences for dark mode and light mode? And (2) In which users tend to choose a mode compared to other modes?

This study aims to contribute both theoretically and practically. Theoretically, it enriched UX literature with a comprehensive vision of past results. In fact, it provides designers, developers and UX teams about how to make a wise decision on color topics based on user needs.

For the future, this topic will only become more important. While users interact with devices in increasingly diverse lighting conditions, shiny offices with dark rooms, the design of the interface must become more adaptable and reactive. Colors, in this context, are not just a decorative option, but also an essential part of creating effective, effective and satisfactory user experience.

This study positions itself within that broader shift. Through an SLR approach, it is aimed at exploring coherent models, notable differences and potential orientation for future research. In the end, the more we understand the user's interests, the more we can design the user interface that is inclusive, meaningful, and user centered.

2. Related Research

The color design of the user interface (IU) plays a key role in forming user experience, not only affects the aesthetics but also usability, readability, and cognitive load. Among the different colors, the dark mode and light mode are becoming more and more important. Their widespread application between operating systems, websites and mobile applications has caused researchers and students to check the

meaning of each mode from some angles, such as user preferences, reading, fatigue and accessibility.

Some studies have discovered the physiological and psychological effects of color design. Research that compares reading speed and understanding in the dark mode and light mode [6]. The result shows that light mode improves the reading ability of text in vivid lighting conditions, while the minimum mode is more effective in reducing the screen to the screen during the use of low light. Similarly, research used eye monitoring techniques to evaluate visual fatigue and see that the dark mode leads to less eye deformation after prolonged use, especially on the OLED screen [7].

The emotional aspects and the awareness of the preference color have also been studied. The awareness of color changes significantly according to cultures, age groups and tasks [8]. Their cultural research emphasizes the complexity of the "universal" color interface design, emphasizing that personalization may be a more effective approach.

Another study has evaluated the satisfaction and commitment of users with the dark mode in mobile applications [9]. They discovered that users prefer the dark mode mainly for aesthetic reasons and comfort in the bright environment, although this preference did not always translate to higher usability scores.

The functional significance of the palettes has also been studied. The contrast ratio and their impact on accessibility [10]. The bad implementation of the dark mode can cause usability problems, especially for users of visual disabilities. These results emphasize that the dark mode is not inherently superior or inferior, but must be designed with attention to contrast, font style and context of use.

Another important research has studied how to use the prolonged dark mode affecting user productivity in web applications [11]. Their results show that if the dark mode can improve visual comfort, it does not necessarily need to improve productivity in high-intensity tasks such as data entry or text editing.

There was an impact of environmental light on user preferences on the themes of the user interface [12]. It shows that users often change between dark and light modes depending on the time of the day and the surrounding light, emphasizing the importance of adaptive interfaces that can change flexibly.

Ergonomics also plays a important role. A recent study Show that the choice of the font weight and the distance of the lines significantly affects the ability to read in the dark mode, especially for users with mild visual deficiency [13]. This shows that the design in the dark mode that requires more is just color inversion, it involves rethinking layout and typography.

From a developmental and technical perspective, heuristic evaluation of popular mobile applications with dark mode features concluded that many developments still lack color consistency, leading to usability problems, especially in multitasking environment or for users with vision problems [14].

Lastly, there was research that explored user experience with dark mode on educational platforms during remote learning [15]. Their research has shown that students tend to prefer light mode in daytime lessons for clarity, while the dark mode is more appreciated during night sessions. The trend of this behavior offers an overview of temporary options and supports the need to customize the themes based on user context.

Although these studies provide valuable information, they also reveal a fragmented research landscape. Many people focus on isolated aspects, such as fatigue, easy to read or satisfied, without integrating these dimensions into the comprehensive understanding of the user's interests. The methods used also change significantly, from controlled experiments to self-highlighting surveys, resulting in inconsistent conclusions. In addition, most studies tend to apply short -term lens, evaluating

the user reaction in a session instead of longitudinal usage.

Another important difference lies in the lack of synthesis of these results. There is a limited work, how the map has different variables, such as the context of use, age, type of device or complexity of tasks - interacting with the interests of the topic. This gap makes it difficult for designers to make decisions based on evidence when choosing default color palette or theme conversion functions.

Recent literature began to realize the need for such synthesis. However, comprehensive reviews are still rare, especially those that apply systematic literary evaluation methods (SLR). A SLR approach will allow more structured analysis than current studies, identifying models, conflicts and areas that require more in exploration [16]. When doing so, it can contribute to both theory and practice, by providing a grounded framework on the user's preference and by notifying interface design guidelines.

This study aims to fill these gaps by making SLRs focused on the dark mode and light mode in user interface design, with a specific highlight of the dimension of the user experience. By consolidating the literature before, the study is aimed at providing an overview of the field. The goal is to understand not only what users like, but why they like it, under what conditions and how this knowledge can make better design decisions.

3. Method

This study uses a Systematic Literature Review (SLR) approach to understand and summarize user options for dark mode and light mode in the context of user interface design (IU). This approach provides a structured and planned way to review the results of the previous research, identify patterns of findings, group thematic categories, and at the same time find research gaps that have not been widely explored. The selection of the SLR method is not only because of its analytical power, but also because of its suitability in developing an evidence-based understanding framework. The literature search was conducted with an explicit protocol for replication, following standard practices in SLR as proposed by Kitchenham [17].

3.1. Research Questions

This study is based on a systematic discovery on the user interface (UI) preferences, especially the dichotomy between the dark mode and the light mode. To ensure focused inquiry and consistent filtering of literature, the following research questions (RQ) have been built:

RQ1: What are the main factors influencing user preference for dark mode or light mode in digital interfaces?

RQ2: Which design implications can be derived from current research to inform better theme implementation in UI/UX design?

These questions are derived from an initial gap analysis in the document, where previous studies often treated dark mode as a stylistic trend instead of choosing a design that focuses on usage. Through this SLR, we aim to go beyond subjective preference and examine empirical evidence regarding human-computer interaction (HCI) elements affected by the theme choice. In addition, these questions allow summarizing different studies in areas such as mobile applications, web platforms and education systems. This focus ensures that the review will create practical relevant information for designers, developers, and HCI researchers seeking to implement more adaptive and user-centered UI themes.

3.2. Search Strategy

The literature research was conducted systematically by using some reliable academic databases: IEEE Xplore, ACM Digital Library, ScienceDirect, SpringerLink, and Google Scholar. These platforms were chosen due to their high-quality research scope in HCI, UX design, and cognitive ergonomics. To make sure consistency

and comprehensiveness during retrieval process, a series of Boolean search string has been produced:

("dark mode" OR "light mode" OR "theme preference") AND ("user experience" OR "usability" OR "interface design") AND ("2020" OR "2021" OR "2022" OR "2023" OR "2024" OR "2025")

The use of multiple synonyms and contextual terms allowed us to capture a wide range of relevant studies across UI/UX topics. The search started in March until April 2025, including literature published from January 2020 to February 2025. Total, 312 initial records were retrieved.

Manual screening of the bibliographies of selected studies has also been conducted to identify additional related works not indexed in the initial database search. This backward snowballing approach helped uncover niche or domain-specific studies that might be missed.

3.3. Selection Process

The selection process uses PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines for conducting and reporting literature reviews. The process consists of four phases: identification, screening, eligibility assessment, and final inclusion.

In the identification phase, a total of 312 records were retrieved from five academic databases using the predefined search string. In this phase, 36 duplicate articles were found, then these articles were discarded, and 276 articles remained.

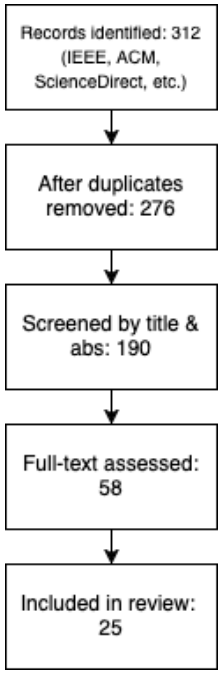
During the screening phase, each title and abstract were reviewed to assess relevance to the research questions. Papers that clearly did not focus on UI theme preferences or failed to discuss user experience were discarded. 86 articles were found to be inappropriate, then these articles were discarded, and 190 articles remained.

In the eligibility phase, full-text reviews were conducted and then remained 58 papers. Articles were excluded if they lacked empirical data, failed quality assessment benchmarks, or focused solely on visual aesthetics without engaging user feedback.

Finally, in the inclusion phase, 25 articles met all criteria and were selected for complete analysis. These included a mix of controlled experiments, surveys, case studies, and heuristic evaluations. The entire process was documented and stored in a shared repository, ensuring auditability and reproducibility.

PRISMA diagram has been built to visually show this filtering process. The structured selection method minimized bias and ensured only high-quality and relevant studies were included, as shown in Figure 1.

Figure 1.
PRISMA Diagram



3.4. Data Extraction and Synthesis

Information about metadata, research methodology, main UX metrics, key findings and reported limitations was compiled and subjected to thematic coding. Thematic analysis allows identifying models and concepts between studies, such as preferences under specific

lighting conditions, psychological comfort, age-related differences, and accessibility implications.

This process was facilitated using NVivo software, allowing effective organization and comparing codes between articles. This synthesis allows not only summarizing the results of personal research but also identification of overarching narratives and gaps in the literature. The result is a coherent picture of current knowledge and practical implications related to dark mode and light mode UI design.

3.5. Quality Assessment

To maintain accuracy in the review process, each included study was subjected to a quality assessment using a modified version of Kitchenham's checklist [17]. The following four questions were used to evaluate each paper:

a. Is the research aim clearly defined and justified?
b. Is the methodology appropriate and well described?
c. Are the results supported by evidence and analysis?
d. Are limitations acknowledged and discussed?

Each question gives a score from scale 0 (not addressed) to 2 (fully addressed), so the total score for each paper will be between 0 and 8. Only articles that have scored at least five were included for the final synthesis. This threshold was chosen to balance inclusiveness and quality assurance. Quality scores were used not only as a filter but also as a weight during the synthesis stage. Interpretation will prioritize articles with high scores and articles with low scores will become support for triangulation.

3.6. Limitations of the Method

Some limitations of this study include: First, only articles written in English were considered, potentially excluding studies published in other languages. Second, the subjectivity of literature quality assessment and thematic analysis. Although efforts were made to reduce bias through the assessment rubric and software, it was still conducted by human judges. Then, the date from year 2020 until year 2025 may have ignored previous studies before this. But using recent period ensures that research has relevance with the technologies. Finally, the diversity of platforms and user contexts in the included studies introduced heterogeneity, which made direct comparisons difficult. These challenges were addressed by categorizing themes based on specific contexts (e.g., mobile apps vs. web platforms).

4. Result and Analysis

NVivo software used to analysis 25 articles to help in systematic coding, theme generation, and visual synthesis. These articles can be seen in Appendix.

4.1. Overview of Selected Articles

The review included 25 articles between 2020 and 2025. The distribution of articles by year shows a consistent concern in the topic of dark and light themes. As illustrated in Table 1, there is a noticeable increase in publications after 2021, with the peak **happening** in 2024. This pattern may reflect a growing concern for user interface customization and accessibility in digital platforms, especially following increased technology use during the global COVID-19 pandemic.

Table 1.
The distribution of articles by year

Year	Number of Publications
2020	0
2021	2
2022	5
2023	4
2024	10
2025	4

4.2. Methodological Trends

The results of the 25 selected studies show a variety of methodologies used to investigate user experiences in dark and light themes. The results in Table 2 demonstrate the importance of

combining empirical research and user-centered understanding when designing and evaluating UI/UX. The details can be seen in Table 2.

Table 2.
The methodological approach in selected articles

Methodological Approach	Number of Studies	%
Experimental	17	68%
Survey-based	3	12%
Qualitative (interview/observation)	2	8%
Mixed-Methods	3	12%

4.3. Research Topic Classification

To structure the body of literature and understand the focus of previous research, 25 of these study groups selected papers based on their main research emphasis, as shown in Table 3.

Table 3.
Research Topic Classification

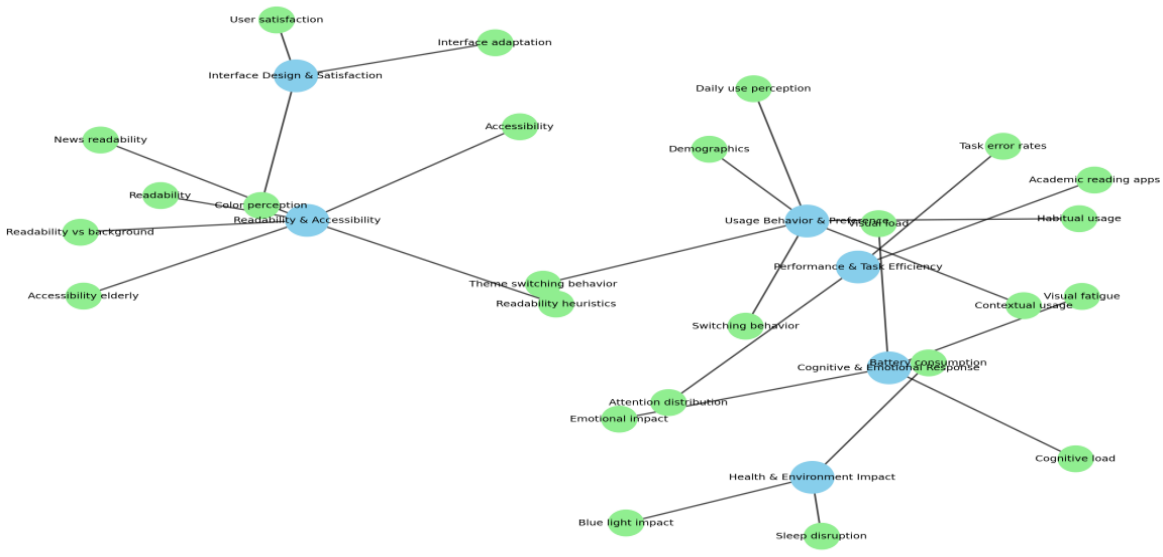
Research Topic	Number of Studies
Readability and Accessibility	6
Cognitive and Emotional Response	4
Usage Behavior and Preference	2
Performance and Task Efficiency	3
Health and Environmental Impact	7
Interface Design and Satisfaction	3

4.4. NVivo Coding and Theme Generation

To deepen the analysis beyond surface-level categorization, a thematic synthesis approach was applied using NVivo. Open coding was performed across all selected articles. The model was structured into six main themes, corresponding to the six research topics.

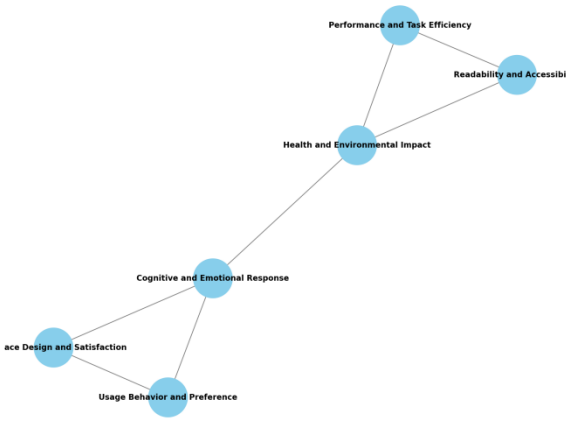
This approach provides a strong link between the stated research objectives and the thematic patterns identified across the studies, as shown in Figure 2. The information taken from the software was that dark mode associated with "eye relief" and "night usage", Light mode is consistently tied to "clarity", "task performance", and "usability", Preference is deeply influenced by contextual factors such as "time of day", "age group", and "screen environment", as shown in Figure 2.

Figure 2.
Thematic mapping diagram of the relationship between the main theme and research subtopics



In the relationship between the main research topics, the topics of Readability, Performance, and Health often intersect, as do Emotional Response with Preference and Interface Design, as shown in Figure 3.

Figure 3.
Theme mapping chart between main topics



5. Discussion

This research has identified six main topics from a qualitative synthesis of 25 studies published from 2020 until 2025 regarding user preferences and experiences with dark mode and light mode in user interface. These topics are Readability and Accessibility, Cognitive and Emotional Response, Usage Behavior and Preference, Performance and Task Efficiency, Health and Environmental Impact, and Interface Design and Satisfaction.

5.1 Readability and Accessibility

Readability is one of the most regular topics in literature, especially related to interface clarity, user comprehension, and inclusive access. Most of studies confirm that light mode provides superior legibility for extended reading and detail-oriented tasks due to higher contrast and visual sharpness in well-lit environments [1], [18], [19], [20], [21].

Dark mode superior in low-light conditions, where it minimizes glare and visual discomfort. This is good for users with visual sensitivities, such as photophobia or dyslexia [1], [22], [23]. However, older adults and users with visual impairments often face readability issues in dark mode when the contrast levels are insufficient [24], [25].

Accessibility prioritizes light mode, which leads to a design equity issue for dark mode users. Future guidelines should evolve to prioritize adaptive contrast and user-controlled themes, which enable inclusive readability across user demographics. [10], [26], [27].

5.2 Cognitive and Emotional Response

User perception of UI themes is related to functional and emotional. Thematic coding reveals that dark mode is often associated with minimalist aesthetics, emotional calm, and modernity. On the other hand, light mode conveys a sense of professionalism, cleanliness, and familiarity, especially in work-related settings[11], [15], [18], [21].

Empirical evidence from cognitive assessments and user satisfaction test showed that dark mode can reduce mental fatigue during nighttime use or in dim settings [22], [23], [28]. However, light mode gave more consistent visual and emotional engagement across lighting conditions, although it may cause eye strain if used extensively in dark environments [20], [29].

The emotional comfort derived from either theme is heavily influenced by context and task type, reinforcing the importance of giving users an agency in customizing their interfaces [30], [31].

5.3 Usage Behavior and Preference

Usage behavior depends on conditions. Data shows that users will switch between dark and light modes based on the type of task, time of day, and device usage habits. Dark mode is preferred for casual use, browsing, and nighttime activities, while light mode is preferred for productivity tasks, reading, and communication [11], [19], [22], [24], [30].

Age and digital fluency influence theme preferences. Younger users often choose dark mode because it is commonly used in gaming and social media environments, while older users tend to choose light mode because it is more familiar and clear [21], [29], [32]. Customization features

such as theme switching significantly increase user satisfaction. This supports the importance of UI personalization as a foundation in UX design [27], [33], [34], [35].

5.4 Performance and Task Efficiency

Studies on user performance with different UI themes show the results of nuances. Light mode supports faster reading, lower error rates, and improved comprehension during extended tasks, especially in high ambient lighting conditions [19], [21], [24], [29]. Dark mode does not directly reduce performance but is less effective for text-heavy or form-based tasks in bright condition. Dark mode works better in short interactions, especially in dim lighting [25], [28], [36]. Users' performance differences reduced when allowed to choose their favorite mode. Comfort and familiarity can reduce functional gaps across themes [20], [22], [31].

5.5 Health and Environmental Impact

The health implications of dark and light mode use have received more attention. Research shows that exposure to bright screens in dark environments, typical of light mode usage, can cause eye strain, circadian rhythm disruption, and sleep disturbances [29], [32], [34], [37].

Dark mode provides visual relief, reduces blue light emission, contributing to better sleep quality and longer visual comfort [22], [23], [35][. Dark mode extending battery life by minimizing pixel light, so energy use on OLED displays more efficient [21], [31], [38]. Prolonged use of dark mode in high lighting settings can cause eye fatigue and decrease visibility, especially in designs that do not adhere to proper contrast ratios [21], [33].

5.6 Interface Design and Satisfaction

User satisfaction with UI theming is deeply linked both with visual appeal and control over visual settings. Dark mode with well designed (balanced contrast, typographic clarity, and aesthetic cohesion) comparable or even superior in satisfaction levels compared to light modes in certain contexts [21], [28], [39].

Poorly implemented dark mode creates confusion, usability, and negative sentiment issues due to poor visibility, inconsistent branding, and illegible elements [10], [20], [22].

The most consistently appreciated design features are responsive interfaces, customizable themes, and visual customization. These are the expectations for the development of user centered and responsive UI design [31], [34], [36].

User preferences for dark or light mode are influenced by contextual, behavioral, and demographic factors. Several studies have emphasized that users choose modes based on task type, environmental lighting, and personal habits [18], [23], [30], [31]. Light mode is preferred for activities that require high concentration or prolonged reading, especially in bright environments, due to its sharp clarity and contrast [20], [21], [24]. Dark mode preferred during night hours or in low light settings due to its visual comfort and reduces glare [22], [32], [35].

Age and digital fluency play a big role because younger users prefer dark mode as gaming and social media platforms adopt dark mode [26], [40]. While older people and users with visual impairments prefer light mode because it is easier to read and more familiar with it [25], [31]. Studies consistently show that personalization and control in choosing themes increases user satisfaction, suggesting that preferences are situational and flexible [21], [27], [34].

Dark mode does not generally improve UX, and light mode does not work well for all conditions. Both modes have advantages and limitations, depending on the user's physical, cognitive, and emotional state. Therefore, the optimal user experience arises from the system's ability to adapt to the user's needs. These findings affirm the development of responsive, contextual, and inclusive UI/UX design, and pave the way for future research on ergonomic design and behavioral personalization.

6. Conclusion

This research has explored user's experiences and preferences between dark mode and light mode. By applying qualitative synthesis and thematic analysis using NVivo six topics have been identified, these topics are Readability and Accessibility, Cognitive and Emotional Response, Usage Behavior and Preference, Performance and Task Efficiency, Health and Environmental Impact, and Interface Design and Satisfaction.

None of the modes outperformed the others. User experience depends on the context, such as task type, lighting, device usage, demographics, age, emotional state, and visual state. Light mode is more effective for prolonged reading in bright environments, while dark mode excels at reducing glare and eye fatigue in low-light conditions. Additionally, the ability for users to switch modes based on the context of use significantly increases satisfaction. Most research lack diversity about demographic in terms of age, culture, and user disabilities. Research exploring the role of emotion, psychological comfort, and long-term cognitive impacts of UI themes is also lacking.

7. Author Contribution

Conceptualization: M. Rifqi Atsani; **Data curation**: Iif Alfiatul Mukaromah, M. Haikal Citra Anugerah; **Formal Analysis**: Iif Alfiatul Mukaromah; **Software**: M. Rifqi Atsani; **Writing-original draft**: M. Rifqi Atsani; **Writing-review & editing**: Iif Alfiatul Mukaromah, M. Haikal Citra Anugerah.

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9. Appendix

Articles reviewed synthesis on dark and light mode preferences.

No	Authors (Year)	Method	Sample	Focus Area	Key Findings	UX Metrics Used
1	Q. Fan, J. Xie, Y. Wang, and Z. Dong (2024) [29]	Experimental	28 participants in lab settings	Visual fatigue under negative polarity (dark mode) and different lighting conditions	Negative polarity (dark mode) combined with certain ambient illumination reduced visual fatigue, especially when using high-contrast text	Visual Fatigue Score, Blink Rate, Subjective Comfort Rating
2	T. Gazit, T. Tager-Shafrir, H.-X. Zhong, P. C. K. Hung, and V. Cheung (2025) [18]	Experimental	120 participants performing cognitive tasks	Impact of interface background (light vs. dark) on cognitive performance	Light mode led to slightly better cognitive task performance, but dark mode improved visual comfort	Task Completion Time, Accuracy Rate, NASA-TLX (Cognitive Load)
3	N. Muhamad and N. Mokhtar (2024) [41]	Experimental	90 young adults (age 18–25)	Reading speed and error rates under different display polarities	Dark mode (negative polarity) slightly decreased reading speed but reduced error rate for prolonged reading	Reading Speed (WPM), Error Rate, Eye Strain Survey
4	Đ. Damnjanović, D. Stojić, D. Vujičić, and M. Milošević (2024) [40]	Survey-based	210 users of productivity apps	Dark mode adoption in minimalist interface design	Dark mode is preferred for aesthetic and ergonomic reasons, particularly in minimalist UI environments	SUS (System Usability Scale), User Preference Ranking, Satisfaction Likert Scale

No	Authors (Year)	Method	Sample	Focus Area	Key Findings	UX Metrics Used
5	S. Andrew et al. (2024) [30]	Mixed-Methods	25 interviews + 20 UI comparisons	Light vs. dark mode on iOS & Android apps	Designers prefer flexibility in theming; dark mode praised for battery and eye comfort	Interview themes, Preference Ranking
6	Z. While & A. Sarvghad (2024) [24]	Experimental	60 participants (diverse age groups)	Impact of contrast polarity on data visualization	Younger users perform better in dark mode; older users favor light mode	Task Accuracy, Completion Time
7	Y. Choi & Y. S. Kim (2022) [33]	Experimental	40 MR users	Adaptive UI & satisfaction prediction in Mixed Reality	Dark/light mode adaptation improves satisfaction in immersive tasks	Satisfaction Score, Prediction Model Accuracy
8	P. Sengsoon & R. Intaruk (2025) [22]	Experimental	88 tablet users	Immediate visual fatigue under dark/light mode	Dark mode reduces fatigue in low-light conditions	Blink Rate, Visual Fatigue Survey
9	F. J. Pathari et al. (2024) [28]	Experimental	100 smartphone users	Eye fatigue in dark vs. light mode	Dark mode reduces fatigue in prolonged use	Eye Strain Index, Subjective Feedback
10	H. Palmén et al. (2023) [19]	Experimental	35 participants	Font grade readability in both polarities	Bolder fonts improve readability in dark mode	Readability Scores, Font Perception Survey
11	J. Schiewe (2024) [32]	Experimental	32 map users	Color perception in dark mode maps	Users showed stronger “dark-is-more” bias in choropleth maps	Perception Accuracy, Visual Bias Measure
12	X. Xie et al. (2021) [26]	Experimental	52 users	Color mode & luminance contrast on fatigue	Higher luminance contrast in dark mode decreases fatigue	Eye Tracking, EEG, Subjective Ratings
13	L. Qiao & M. Wu (2023) [36]	Experimental	44 users	Public web maps in dark/light mode	Dark mode less preferred for map reading due to clarity issues	Eye-tracking Fixation, Preference Survey
14	A. Yang et al. (2024) [31]	Systematic Review	38 studies	UX impacts of dark mode	Dark mode linked to personalization and emotional engagement	S-O-R Framework Coding, Thematic Grouping
15	P. Choudhary & S. Kumar (2023) [37]	Qualitative	Literature-based	Broader impacts of light pollution	Dark environments improve cognitive recovery and sleep	Conceptual Framework (Environmental UX)
16	P. Tian et al. (2022)	Experimental	60 users	Brightness and color paradigm in night use	Moderate brightness in dark mode leads to least fatigue	Eye Tracker, EEG Fatigue Signal

No	Authors (Year)	Method	Sample	Focus Area	Key Findings	UX Metrics Used
	[23]					
17	M. Chatrangsan (2023) [20]	Survey-based	85 elderly tablet users	Dark mode on usability for elderly	Elderly prefer light mode for readability, dark mode for comfort	SUS, Likert-scale Readability
18	T. Sethi & M. Ziat (2022) [25]	Experimental	70 participants	Benefits of dark mode for general users	Dark mode showed benefit only in certain visual comfort tasks	NASA-TLX, PSSUQ, Task Errors
19	L. Lambillotte et al. (2022) [34]	Survey-based	120 e-commerce users	Personalization in UI (includes theming)	Theme control improves playful engagement	Engagement Rating, Customization Feedback
20	Y. Liu et al. (2024) [35]	Experimental	98 mobile users	Personalized theming for engagement	Adaptive color themes boost satisfaction and retention	Time on Task, Satisfaction Score
21	H. Hristov et al. (2022) [10]	Experimental	50 participants with vision deficiency	Accessible color contrast models	Adaptive themes increase readability in color blindness	WCAG Contrast Ratio, Readability Score
22	N. Muhamad & N. Mokhtar (2024) [21]	Experimental	90 young adults	Display polarity on reading	Light mode faster; dark mode fewer errors	Reading Speed, Error Rate
23	T. Cai et al. (2024) [27]	Mixed-Methods	24 UI iterations + participant feedback	Iterative readability in dark/light UI	Readability depends more on content layout than mode	Iteration Feedback Themes, Eye-tracking
24	B. Fialkowski & D. Schofield (2024) [39]	Qualitative	Expert-based	Psychological theory on digital color use	Theme choice affects trust, attention, and action	Expert Evaluation, Color Psychology Coding
25	P. Dash & Y. C. Hu (2021) [42]	Experimental	Device-level test on smartphones	Battery usage by dark mode	Dark mode significantly saves power on OLED screens	Battery Drain Rate, Display Energy Profiling