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Designing an Adaptive UI/UX Application to Support Self-Directed

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abstract

In the digital era, the effectiveness of self-directed learning poses a challenge for many individuals, particularly in managing time optimally. This study aims to design a digital time-tracking application with a UI/UX design focused on enhancing the effectiveness of self-directed learning. The application is expected to help users allocate study time more systematically and improve their productivity. The research employs a User-Centered Design (UCD) approach, which involves user needs analysis, wireframe design, and application prototyping. The design process is carried out through literature reviews, potential user surveys, and UI/UX design analysis based on accessibility, convenience, and ease of use principles. The study results indicate that the application design features key functionalities such as study time tracking, learning habit analysis, and reminders tailored to users' needs. Based on prototype evaluation, the applied design is considered intuitive and effective in helping users manage their study time more efficiently. In conclusion, the design of this digital time-tracking application demonstrates potential in improving self-directed learning effectiveness through an optimized UI/UX approach. Although this study focuses only on the design stage without actual implementation, the results can serve as a foundation for further development in creating a fully functional application.

abstract

Di era digital, efektivitas pembelajaran mandiri menjadi tantangan bagi banyak individu, terutama dalam mengelola waktu secara optimal. Penelitian ini bertujuan untuk merancang aplikasi pelacakan waktu digital dengan desain UI/UX yang berfokus pada peningkatan efektivitas pembelajaran mandiri. Aplikasi ini diharapkan dapat membantu pengguna mengalokasikan waktu belajar secara lebih sistematis dan meningkatkan produktivitas mereka. Penelitian ini menggunakan pendekatan Desain Berpusat pada Pengguna (UCD), yang melibatkan analisis kebutuhan pengguna, desain wireframe, dan pembuatan prototipe aplikasi. Proses perancangan dilakukan melalui tinjauan pustaka, survei calon pengguna, dan analisis desain UI/UX berdasarkan prinsip aksesibilitas, kenyamanan, dan kemudahan penggunaan. Hasil penelitian menunjukkan bahwa desain aplikasi ini memiliki fungsi-fungsi utama seperti pelacakan waktu belajar, analisis kebiasaan belajar, dan pengingat yang disesuaikan dengan kebutuhan pengguna. Berdasarkan evaluasi prototipe, desain yang diterapkan dinilai intuitif dan efektif dalam membantu pengguna mengelola waktu belajar mereka secara lebih efisien. Kesimpulannya, desain aplikasi pelacakan waktu digital ini menunjukkan potensi dalam meningkatkan efektivitas pembelajaran mandiri melalui pendekatan UI/UX yang dioptimalkan. Meskipun penelitian ini hanya berfokus pada tahap desain tanpa implementasi aktual, hasilnya dapat menjadi dasar untuk pengembangan lebih lanjut dalam menciptakan aplikasi yang berfungsi penuh.

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ACM Computing Classification System (CCS)

EBSCOhost

Communication and Mass Media Complete (CMMC)

1. Introduction

Advancements in digital technology have transformed how individuals access and manage information, particularly in self-directed learning. Innovations such as REST API-based e-catalogs enhance access to relevant reference materials (Oktafameri *et al.*, 2023). Additionally, the emergence of e-learning and mobile learning platforms expands flexibility and access to educational resources (Yustian, 2021). However, these technological developments do not operate in isolation; the role of parents in fostering children's digital literacy significantly influences learning effectiveness (Radjagukguk, 2020). Integrating character education into technology use is essential to balance digital competence with ethical application (Nikmah, 2023). A collaborative approach involving schools, parents, and students is necessary to create an optimal and sustainable learning environment (Setyowati *et al.*, 2023).

Self-directed learning requires individuals to manage time and learning materials effectively. Digital technologies serve as facilitators, providing rapid access to diverse learning resources (Ayar *et al.*, 2021). The concept of self-directed learning indicates that learners who independently manage their learning processes tend to achieve higher academic performance and exhibit stronger motivation (Tekkol & Demirel, 2018). Such capabilities also support the development of digital literacy, particularly in skills related to searching, evaluating, and critically applying information (Nugroho *et al.*, 2024). Nevertheless, implementing self-directed learning faces challenges, including limited support from families and educational institutions (Armawi *et al.*, 2021). Collaboration between technology utilization and environmental support is critical to optimizing learning outcomes amid digital dynamics. Challenges in self-directed learning often stem from personal constraints, such as poor time management, low self-discipline, and inadequate support systems. Difficulties in scheduling study sessions can lead to procrastination, negatively impacting academic performance (Lemmetty & Collin, 2020). Low self-discipline further hinders the sustainability of learning processes, which require internal motivation and focus (Rashid & Asghar, 2016). Social support

plays a strategic role in enhancing student motivation and engagement, as individuals receiving emotional and instrumental support from their social environment are more likely to succeed in self-directed learning (Abeyrathne & Ekanayake, 2018). Therefore, an integrated strategy encompassing time management skill development, self-discipline cultivation, and provision of adequate support systems is essential to enhance the effectiveness of self-directed learning. Adaptive UI/UX design emerges as a vital element in creating a learning experience that fosters learner autonomy. An intuitive and functional interface enables users to manage study time and tasks more efficiently (Putri *et al.*, 2023). Well-designed UI/UX enhances user satisfaction while promoting motivation and engagement in the learning process (Putri *et al.*, 2023). Personalizing interfaces based on user preferences proves effective in organizing study time (Zhan *et al.*, 2024).

Design approaches such as Quality Function Deployment (QFD) and Design Thinking facilitate the development of features aligned with the needs of self-directed learning (Koswara & Alifin, 2024). Consequently, UI/UX serves as a strategic factor in shaping productive learning behaviors (Yu *et al.*, 2020). The development of digital applications to support self-directed learning must prioritize UI/UX optimization to deliver an intuitive and engaging experience. Integrating technology with self-directed learning principles enables students to develop self-management skills and enhances engagement through interactive features like reminders and study schedules (Li *et al.*, 2023). Adaptive interfaces adjust to individual learning styles, thereby strengthening active participation (Hietajärvi *et al.*, 2022). Applying heuristic usability principles further improves user comfort, satisfaction, and sustained application usage (Kaya *et al.*, 2021). Therefore, responsive, adaptive, and usability-focused UI/UX design is crucial for supporting effective digital self-directed learning. As a practical implementation, the development of a time-tracking application with adaptive UI/UX design aims to enhance the effectiveness of self-directed learning. The application offers features such as time tracking, task management, and productivity analysis, integrated within an intuitive and responsive interface (Olivencia *et al.*, 2021). A user-centered design (UCD)

approach enables feature customization, adaptive notifications, and accessibility for diverse user groups (Supriyadi *et al.*, 2022). Incorporating technologies like machine learning supports personalized study schedules, while gamification enhances user engagement through enjoyable learning experiences (Zainuddin *et al.*, 2020). Evaluation of the application's effectiveness emphasizes ease of access, cross-device compatibility, and iterative feedback utilization (Zhang, 2025). Consequently, the application's development is expected to support successful self-directed learning through a data-driven design continuously refined based on user needs (Supriyadi *et al.*, 2022).

2. Research Methodology

The study adopts the User-Centered Design (UCD) method to develop adaptive UI/UX for self-directed learning, prioritizing users as the central focus of the design process (Supardianto & Tampubolon, 2020). Data collection utilized questionnaires and UX observations to identify user needs and interactions with the prototype, facilitating iterative refinements based on feedback (Rahayu *et al.*, 2024). The analysis encompassed requirement identification, wireframe design, and usability testing to ensure an intuitive and effective interface (Ravelino & Susetyo, 2023), thereby enhancing user engagement and the effectiveness of self-directed learning (Susilo *et al.*, 2018).

User-Centered Design (UCD) is an iterative methodology that integrates user needs into the development of adaptive UI and UX for self-learning applications. The process involves user research through interviews and surveys to align the design with user expectations (Dananjaya *et al.*, 2024) and to understand their interactions with the application (Yang *et al.*, 2020). Ideation and prototyping stages are conducted iteratively, supported by continuous testing to enhance usability and minimize user frustration (Setiyawati *et al.*, 2022). Ongoing evaluation ensures the application remains user-focused, fostering greater engagement and satisfaction in self-directed learning (Kruzan *et al.*, 2021). The UCD stages applied in the study are outlined as follows:

- 1) **Understanding and Defining Application Use**
The initial stage of User-Centered Design focuses on understanding user needs and challenges in self-directed learning through methods such as surveys (Lettl *et al.*, 2006). Such understanding fosters innovation by actively involving users in product development (Martha *et al.*, 2023), considering technical, emotional, and interactional aspects to deliver a personalized and effective learning experience (Bergmann & McGregor, 2011). Thorough analysis of user needs establishes the foundation for developing an application that is functional and capable of enhancing motivation and effectiveness in self-directed learning (Herumurti *et al.*, 2023).
- 2) **Specifying User Requirements**
Developing a self-learning application necessitates defining functional and non-functional requirements aligned with user characteristics and usage scenarios. Functional needs analysis ensures the application operates as intended, while non-functional aspects—such as performance, security, UI, and UX adaptivity—play a pivotal role in enhancing the learning experience (Ishaq *et al.*, 2023). Standards like ISO/IEC 25010 and testing methods such as black box testing ensure the application meets specified requirements (Hakim *et al.*, 2019). A systematic approach to requirement analysis, specification, and testing equips the application to effectively address user needs (Yassir *et al.*, 2023).
- 3) **Designing Solutions**
Following the needs analysis, UI and UX designs are developed through wireframes, mockups, and prototypes to evaluate design possibilities and collect user feedback (Mota *et al.*, 2019). Adaptive design ensures the application adjusts to user preferences and various devices, enhancing the learning experience (Saleh & Mohamed, 2018). The design thinking approach facilitates understanding user needs alongside environmental and social interaction factors (Faiz & Kurniawan, 2023). Usability testing of the prototype ensures the application is functional, effective, and enjoyable to use (Grau & Rockett, 2022), while adaptive design principles ensure its relevance across diverse learning scenarios (Mehta & Magdalena, 2022).

- 4) Evaluating and Iterating Designs
 Prototype evaluation within the User-Centered Design process ensures the design meets user needs through usability testing, interviews, and surveys to assess effectiveness, efficiency, and user satisfaction (Aulia, 2020). The evaluation focuses not only on performance metrics but also on the overall user experience, with design iterations based on feedback to improve the application's usability and value (Nguyen *et al.*, 2019).

3. Results and Discussion

Results

Understanding and Defining Application Use

To identify user needs for designing adaptive UI and UX for self-directed learning applications, an analysis was conducted using a questionnaire. The questionnaire aimed to determine user preferences, challenges, and required features for independent learning. The findings from the analysis provided a foundation for developing an application aligned with user requirements. The survey results, illustrated in Figure 1 using a 5-point Likert scale, address the UI/UX design of the application, with a focus on navigation aspects. The analysis evaluated the degree to which users regard clear and user-friendly navigation as a critical factor in self-learning applications. These findings serve as a guide for creating a more intuitive interface that supports an effective learning experience.

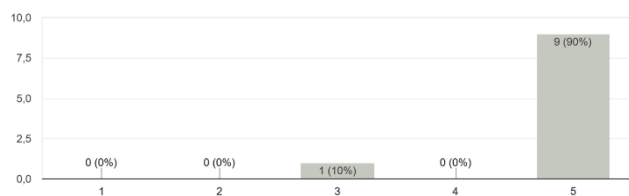


Figure 1. A self-directed learning application must have clear and easy-to-use navigation

The survey findings, illustrated in Figure 1 using a 5-point Likert scale, indicate that 90% of respondents strongly agreed that clear and user-friendly navigation is a critical factor in self-learning applications. Intuitive navigation in UI/UX design improves efficiency, reduces cognitive load, and

fosters focused learning (Mumtazuddin & Ahmad, 2023). The User-Centered Design (UCD) approach ensures that the interface aligns with user needs, enhancing the effectiveness of self-directed learning (A. S. Nugroho & Ariyanto, 2024). Furthermore, seamless access within the application supports successful self-directed learning outcomes (Lutfi & Latipah, 2023). Therefore, the adoption of intuitive and adaptive UI/UX design is essential for creating an effective learning experience. The survey results, shown in Figure 2 using a 5-point Likert scale, focus on UI/UX design elements such as color, icons, and layout. The analysis aimed to evaluate the degree to which these elements affect user comfort during the self-learning process. These findings provide a foundation for developing adaptive UI/UX that aligns with user preferences.

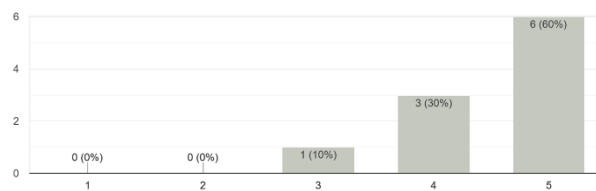


Figure 2. The colors, icons, and layout used in the application affect my comfort while learning

The survey findings, illustrated in Figure 2 using a 5-point Likert scale, reveal that 60% of respondents strongly agreed and 30% agreed that color, icons, and layout influence learning comfort. The absence of low ratings underscores the significance of UI/UX elements in enhancing the learning experience. Well-crafted visuals improve focus, navigation, and learning effectiveness by reducing cognitive load and fostering greater engagement and information retention (Pateman & Pramudia, 2024). The adoption of human-centered design in educational applications further enhances user comfort and satisfaction (Soedewi, 2022). Therefore, adaptive UI/UX design is essential for facilitating effective and engaging self-directed learning. The survey results, shown in Figure 3 using a 5-point Likert scale, address the adaptability aspect of the application. The analysis evaluated the degree to which users prefer applications capable of adjusting their interface and features to align with individual learning habits. These findings provide a basis for developing a personalized system that enhances the effectiveness and comfort of self-directed learning.

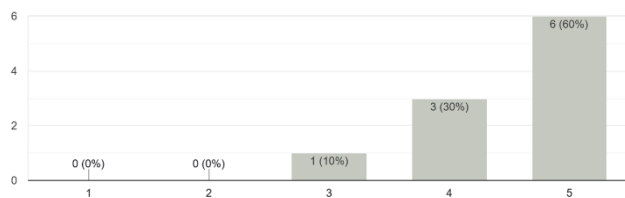


Figure 3. I prefer an application that can adjust its interface and features based on my learning habits

The survey findings, illustrated in Figure 3 using a 5-point Likert scale, reveal that 60% of respondents strongly favored, and 30% agreed with, applications that adapt their interface and features to individual learning behaviors. Only 10% of respondents remained neutral, with no disagreement expressed. Personalization in UI/UX design enhances motivation, engagement, and learning effectiveness (Froiland & Worrell, 2016). Adaptive features and gamification create a more interactive and appealing learning process (Puspitasari & Arifin, 2023). Therefore, UI/UX design should prioritize personalization and active engagement to optimize the self-directed learning experience (Naeghel *et al.*, 2012). The survey results, shown in Figure 4 using a 5-point Likert scale, focus on the adaptability of the application, specifically regarding recommendation systems tailored to learning progress. These findings reflect user perceptions of the value such features offer in improving understanding during the learning process.

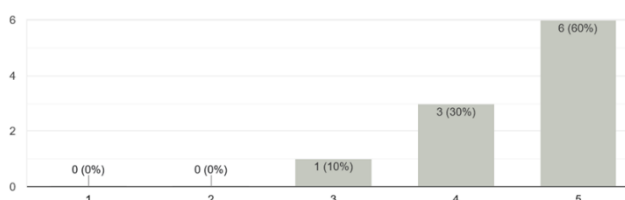


Figure 4. A recommendation system based on my learning progress would help enhance my understanding

The survey findings, illustrated in Figure 4 using a 5-point Likert scale, indicate that 60% of respondents strongly agreed and 30% agreed that a recommendation system tailored to learning progress enhances understanding. Only 10% of respondents remained neutral, with no disagreement expressed, reflecting significant user interest in the feature. Adaptive learning systems based on recommendations improve learning effectiveness by

customizing content to align with user preferences and needs, thereby fostering greater motivation and engagement (Drachsler *et al.*, 2015). Incorporating such features into self-learning applications facilitates a more personalized, efficient, and collaborative learning experience (Nakić *et al.*, 2015). The survey results, shown in Figure 5 using a 5-point Likert scale, focus on the adaptability of the application, specifically regarding the automatic feedback feature for learning outcomes. The questionnaire evaluated the degree to which respondents considered the feature beneficial in supporting the self-directed learning process.

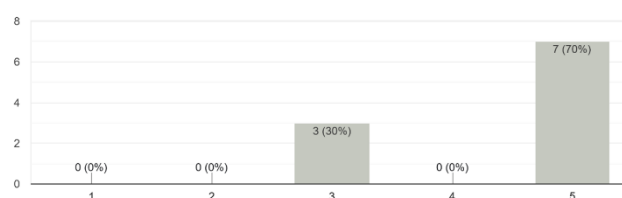


Figure 5. An application that provides automatic feedback on my learning outcomes would be very beneficial

The survey findings, illustrated in Figure 5 using a 5-point Likert scale, reveal that 70% of respondents strongly agreed and 30% agreed that automatic feedback features are highly beneficial. The absence of disagreement underscores the perceived importance of the feature in supporting self-directed learning. Adaptive feedback enhances understanding, motivation, and learning effectiveness by tailoring responses to students' developmental levels (Kornegay *et al.*, 2017). In educational technology, automated feedback fosters personalized learning experiences (Vasilyeva *et al.*, 2007), making it an essential component for self-learning applications (Waheed *et al.*, 2021). The survey results, shown in Figure 6 using a 5-point Likert scale, focus on interaction and accessibility, specifically regarding user preferences for applications that support multiple devices (PCs, tablets, and smartphones). These findings reflect the need for access flexibility to facilitate more efficient learning experiences.

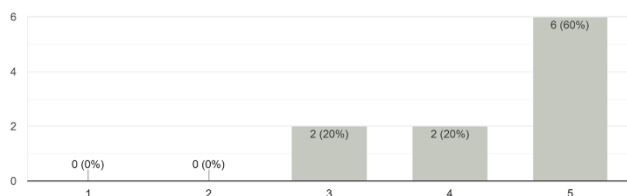


Figure 6. I prefer applications that support multiple devices (PC, tablet, and smartphone)

The survey findings, illustrated in Figure 6 using a 5-point Likert scale, indicate that 60% of respondents strongly favored applications supporting multiple devices, with the remaining 40% also expressing positive responses. These results affirm user preference for adaptive UI/UX designs that ensure consistent experiences across platforms. Responsive design enhances accessibility, effectiveness, and the overall learning experience by adapting the application's display to various devices (Siyam & Abdallah, 2021). Therefore, incorporating adaptive design is recommended to facilitate inclusive and effective self-directed learning (Chatterjee *et al.*, 2021). The survey results, shown in Figure 7 using a 5-point Likert scale, focus on user preferences for dark mode and adjustable text size in self-directed learning applications. The questionnaire evaluated the significance of these features in enhancing user comfort and improving the learning experience.

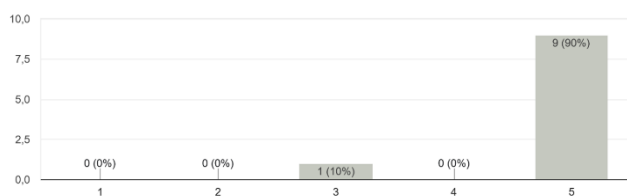


Figure 7. Self-learning applications should have dark mode and text size adjustment features for user comfort

The survey findings, illustrated in Figure 7 using a 5-point Likert scale, reveal that 90% of respondents strongly agreed that dark mode and adjustable text size are essential for comfort in self-directed learning. Interface personalization enhances comfort, readability, and user engagement in self-directed learning (Nix & Wyllie, 2009). Dark mode mitigates eye strain and supports learning effectiveness (Rowe & Wood, 2009), while carefully designed elements such as color contrast and font size improve focus and material comprehension (Gupta *et al.*, 2021).

Incorporating these adaptive features fosters both comfort and sustained learning effectiveness (Gan *et al.*, 2023). The survey results, shown in Figure 8 using a 5-point Likert scale, focus on the need for quick search features in self-directed learning applications. The questionnaire evaluated the degree to which users consider search functionality essential for accessing learning materials efficiently.

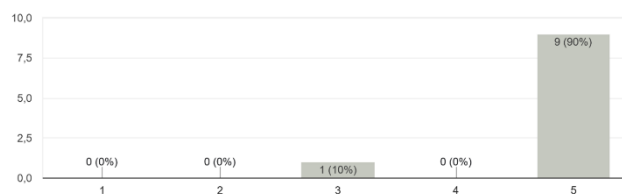


Figure 8. I need a quick search feature to find the materials I need

The survey findings, illustrated in Figure 8 using a 5-point Likert scale, reveal that 90% of respondents strongly agreed that integrating learning resources such as PDFs, videos, and discussion forums supports the learning process, with the remaining 10% expressing positive responses. These results align with multimedia theory, which emphasizes the value of combining diverse media to enhance understanding and information retention (Peddibhotla & Jani, 2019). Discussion forums further strengthen conceptual understanding and engagement through dynamic interaction (Brodoehl *et al.*, 2015). The integration of multimedia and discussion forums fosters an interactive learning environment that enhances the effectiveness of self-directed learning and promotes students' collaborative skills (Ouyang & Chang, 2018).

Specifying User Requirements

Defining user requirements is a pivotal step in designing adaptive UI/UX applications to support self-directed learning. The following outlines user needs to ensure the development of an intuitive, interactive, and responsive learning experience that accommodates diverse learning styles. Functional requirements for adaptive UI/UX applications encompass interface design, adaptivity, interaction, and ease of access. The UI/UX design must be visually appealing, simple, and functional to facilitate ease of use for various user types while maintaining focus on learning. Clear navigation, combined with carefully selected colors, icons, and layouts, is essential for optimizing the learning experience. Application

adaptivity is achieved through personalized interfaces and features tailored to user learning habits, content recommendation systems, and automated reminders and feedback to enhance understanding. Accessibility is reinforced by support for multiple devices, dark mode, adjustable text sizes, quick search functionality, and integration with diverse learning resources to enrich learning methods. Non-functional requirements include performance, security, availability, maintainability, and accessibility. For performance, the application must remain responsive and capable of supporting multiple users without performance degradation. Security and privacy are ensured through data encryption and robust authentication protocols. The system must maintain high availability to provide uninterrupted access, even during maintenance periods. For ease of development, a modular application architecture, supported by thorough technical documentation, is necessary. Additionally, the application must adhere to accessibility standards, including support for users with special needs and clear, user-friendly language in the interface. The Empathy Map serves as a tool to capture user experiences by mapping what users think, feel, say, do, and hear during self-directed learning. Understanding user needs, motivations, and challenges is essential for designing adaptive UI/UX applications that support independent learning. Such an approach ensures alignment with user preferences and addresses barriers, thereby enhancing the effectiveness and comfort of the self-directed learning process.

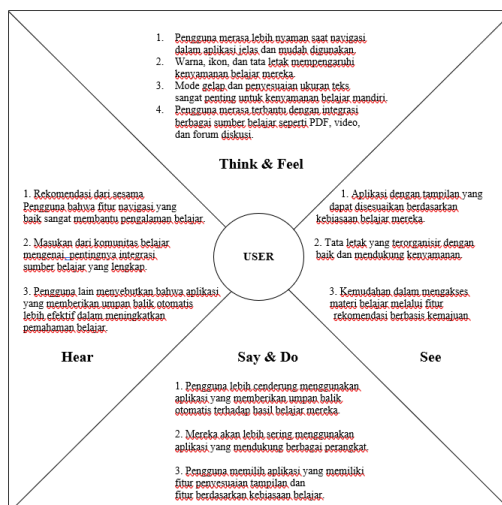


Figure 9. Empathy Map

The Empathy Map, shown in Figure 9, indicates that users experience greater comfort with applications featuring attractive and functional designs (Think & Feel). Respondents emphasized the importance of clear and user-friendly navigation (Says) and expressed a preference for applications with simple and intuitive interfaces (Does). Additionally, users rely on recommendations from others regarding applications with effective UI/UX design (Hears). These findings provide a foundation for developing applications that align closely with user needs, thereby enhancing the effectiveness of self-directed learning. The mind map, illustrated in Figure 10, visualizes solution ideas derived from questionnaire analysis, focusing on the design of adaptive UI/UX applications. These solutions aim to support self-directed learning by addressing various user needs identified through the questionnaire. The mind map offers a clear representation of how UI/UX elements can be tailored to enhance individual learning experiences.

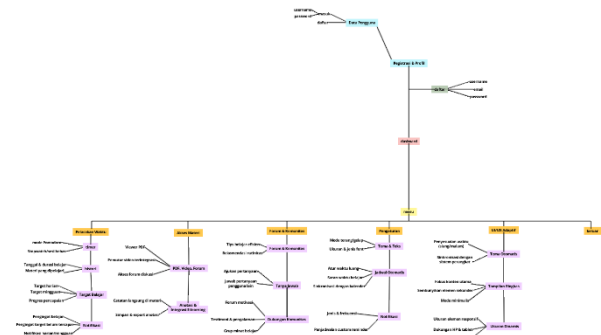


Figure 10. Mind Mapping of Adaptive UI/UX Design Solutions

Design Solutions

The mind map, shown in Figure 10, illustrates the solution design for an adaptive UI/UX application tailored for self-directed learning. It integrates user needs, UI/UX principles, and key features to support a personalized and flexible learning experience. The diagram outlines essential components, including registration, time tracking, content access, community forums, settings, and adaptive UI. These components are designed to enhance learning effectiveness, consistency, and comfort through a responsive, personalized, and accessible interface. The following elaborates on the design solutions derived from user requirement analysis and relevant design principles.

The approach aims to develop effective, efficient, and adaptive solutions to support the research objectives. The user flow, depicted in Figure 11, illustrates the design of an application to support self-directed learning through adaptive UI/UX. The flow outlines interaction stages, beginning with the splash screen and authentication, followed by navigation to key features such as time tracking, content access, community forums, settings, and interface customization. The design is structured to ensure an efficient, responsive, and personalized learning experience.

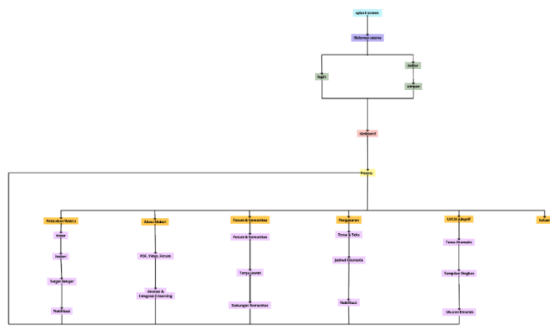


Figure 11. User Flow

The user flow, depicted in Figure 11, demonstrates that an application with adaptive UI/UX effectively supports self-directed learning. Features such as time tracking, content access, community forums, and personalization settings enhance user comfort and learning efficiency. The adaptive design allows the interface to adjust to individual preferences, including theme, font size, and layout, thereby improving the user experience. Additionally, the integration of forums and notifications fosters engagement and sustains learning consistency. Overall, the approach offers a relevant solution for flexible and sustainable learning needs. The flowchart, shown in Figure 12, systematically illustrates the program's logic flow. It serves as a visual representation of system processes, encompassing data initialization, iterative processes, decision-making (branching), and the final stage. Each element in the flowchart is arranged according to the logical execution sequence, reflecting the relationships between processes and the conditions required for program execution. The visualization aids in understanding the algorithm-controlled process flow and evaluating the effectiveness and efficiency of the system design.



Figure 12. Basic Flowchart

The flowchart, depicted in Figure 12, outlines the process flow of a self-directed learning application with adaptive UI/UX. The process begins with user login and advances to menu selection based on user roles, such as student or admin. For students, the system grants access to learning materials, quizzes, and evaluations. Each learning stage is followed by an automated assessment. If the score meets the established standard, users proceed to the next material; otherwise, the system recommends reviewing prior material. The flowchart illustrates a design responsive to user needs, supporting a structured and progressive learning process. It reflects a systematic and adaptive system logic aligned with the application's objective of enhancing self-directed learning effectiveness. The flowchart, shown in Figure 13, details the user authentication process for the self-directed learning application with adaptive UI/UX. It outlines the registration and login procedures users must complete to access the application's main features.

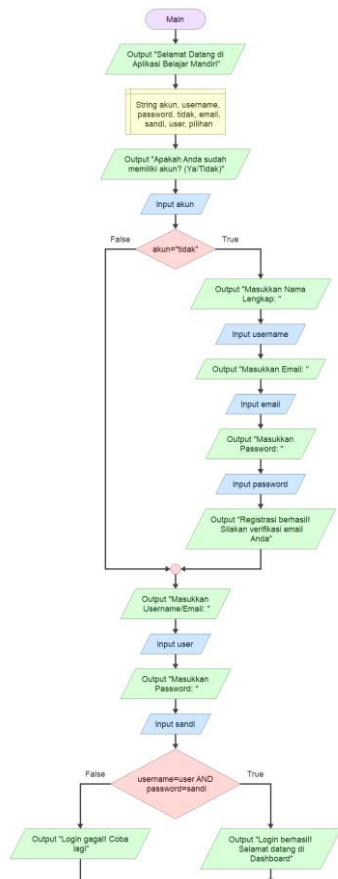


Figure 13. Registration Flowchart

The flowchart, depicted in Figure 13, outlines the user authentication process for the self-directed learning application. The process begins by verifying whether the user has an existing account. If no account exists, the system directs the user to register by entering their name, email, and password. Upon successful registration, the user is prompted to log in using the registered credentials. The system verifies the login data, directing the user to the dashboard if valid or displaying an error message if invalid. The flowchart ensures secure access and aligns with adaptive UI/UX principles to provide a user-friendly experience. The flowchart, shown in Figure 14, illustrates the process flow following successful user login. From the dashboard, the user can select various menus, including the time tracking feature. Upon selecting the time tracking menu, the system prompts the user to confirm the start of the timer, recording the study duration until the stop button is pressed. The flow supports self-monitoring of learning activities, enhancing user engagement in self-directed learning.

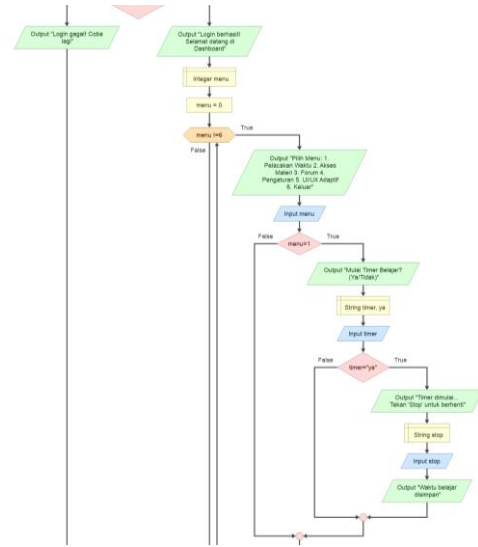


Figure 14. Flowchart – Menu 1: Time Tracking

The flowchart, depicted in Figure 14, details user interaction with the system after login, focusing on the time tracking menu. Upon selecting the menu, the system prompts the user to confirm the start of the timer. If confirmed, the timer begins, recording the study duration until the stop button is pressed, after which the system stores the data. The process supports measurable and independent time management, a critical element of the adaptive learning approach implemented in the application. The flowchart, shown in Figure 15, illustrates the process of selecting and accessing learning materials within the digital system. Users choose the type of content (e.g., PDFs, videos, or forums) and are offered the option to add notes. If notes are added, the system saves them and displays a confirmation. The flowchart reflects a straightforward yet functional interaction that enhances the self-directed learning process.

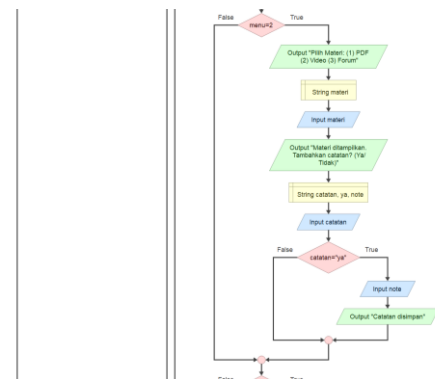


Figure 15. Flowchart – Menu 2: Content Access

The flowchart in Figure 15 shows the system flow when users select the menu to access learning materials. After choosing the type of material (PDF, video, or forum), users are given the option to add personal notes. If selected, the system prompts for note input and saves the information. This flow reflects an interactive feature that supports active user engagement in the learning process while allowing for personal documentation of important information. Figure 16 presents a flowchart illustrating the process flow of user interaction within the discussion forum feature in the digital learning system. This diagram demonstrates how users are provided with the option to initiate a new discussion after selecting the forum menu. This flow supports the creation of a collaborative space among users, which plays a crucial role in enhancing interaction and information exchange during the learning process.

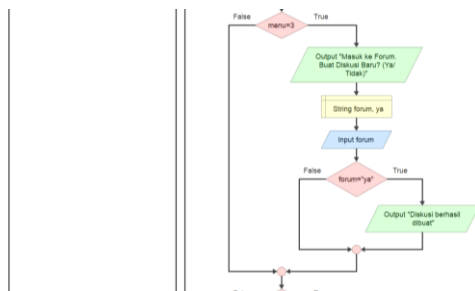


Figure 16. Forum Menu Flowchart

The flowchart in Figure 16 illustrates the process by which users access the forum in the digital learning system. After selecting the forum menu, users are offered the option to create a new discussion. If they choose “yes,” the system confirms that the discussion has been successfully created. This flow demonstrates the system’s support for collaborative learning through discussion features that promote user interaction. Figure 17 displays a flowchart representing the display settings process in the digital learning system. This diagram shows how users can access the settings menu to modify the theme or text appearance. The system then offers a confirmation option for the changes and saves them if the user agrees. This flow reflects the system’s effort to provide a personalized learning experience tailored to individual user preferences.

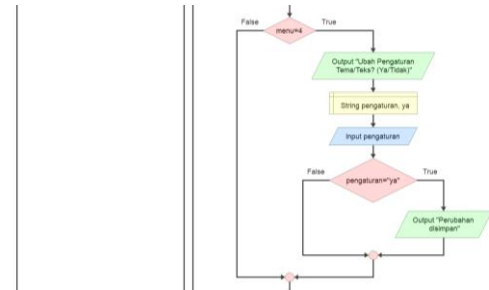


Figure 17. Settings Menu Flowchart

The flowchart in Figure 1.7 depicts the display settings process within the digital learning system, particularly in modifying the theme or text appearance. After accessing the settings menu, users are given options to change the interface. If the user selects “yes,” the system saves the changes and displays a notification. This flow indicates that the system is designed to support personalization, which is essential for ensuring user comfort and accessibility during the learning process. Figure 18 illustrates a flowchart of the interface theme selection process in the application. Users are provided with three theme options: light mode, dark mode, and contrast. Based on the user’s input, the system displays the selected theme. This flowchart demonstrates the decision-making logic for application display settings.



Figure 19. Adaptive UI/UX Menu Flowchart

The flowchart in Figure 18 illustrates the theme selection process in the application system. Based on testing, the system successfully displays the selected theme—whether light mode, dark mode, or contrast—according to user input. Conditional

statements have been correctly applied so that the system accurately responds to user preferences. These results demonstrate that the flowchart design supports a flexible and user-friendly interface functionality. Moreover, the use of flowcharts has proven helpful in mapping out program logic prior to implementation. Figure 19 presents a flowchart of the exit process from the application. When users select the menu option with a value of 6, the system displays a closing message and terminates the program. This flow ensures a clear and structured exit process.

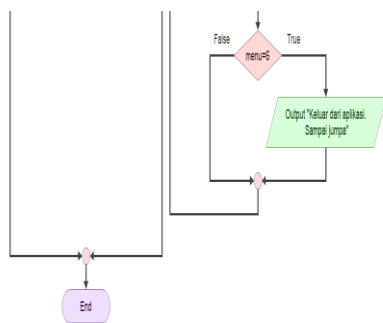


Figure 19. Exit Menu Flowchart

The flowchart in *Figure 19* illustrates the process of exiting the application when users select the menu option labeled with the value 6. The system successfully displays a closing message and terminates the program as intended. This confirms that the decision-making logic for exiting the application functions as designed and supports a clear and structured user interaction. The wireframe functions as a non-functional visual representation that outlines the arrangement of key elements in the application, including the landing page, user authentication processes (login and registration), profile settings, and other main feature displays. The purpose of the wireframe is to systematically map the user interaction flow and ensure that the application design adheres to principles of usability, efficiency, and supports the self-directed learning goals central to the application's development. This phase is a critical component of the UI/UX design process, providing an early visual reference before proceeding to visual design and functional implementation. Figure 20 illustrates the wireframe of the initial user interface design.

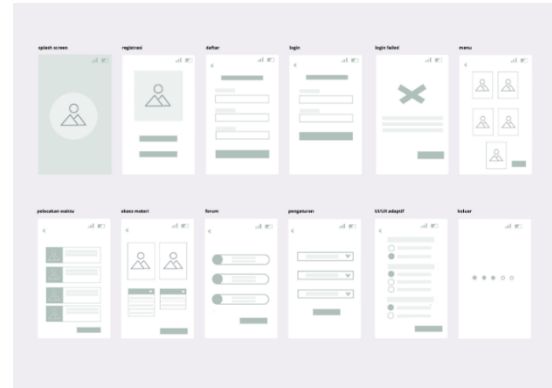


Figure 20. Wireframe

Figure 20 presents the wireframe as an initial representation of the interface design in the study on Designing Adaptive UI/UX Applications to Support Self-Directed Learning. The wireframe serves as a visual framework outlining the structure, layout, and main navigation of the application. This approach ensures that the UI/UX design is developed systematically to provide an intuitive, adaptive, and learning-oriented user experience.

Figure 21 presents the user interface flow design for a self-paced learning application based on adaptive UI/UX. This diagram illustrates the relationships between screens, from the initial process (splash screen), registration, login, to various key features such as time tracking, material access, discussion forums, settings, and adaptive interface management. Each interaction path is indicated by a line that illustrates a logical transition between pages based on user actions. This design aims to ensure an intuitive, efficient, and individualized user experience in the context of self-paced learning.

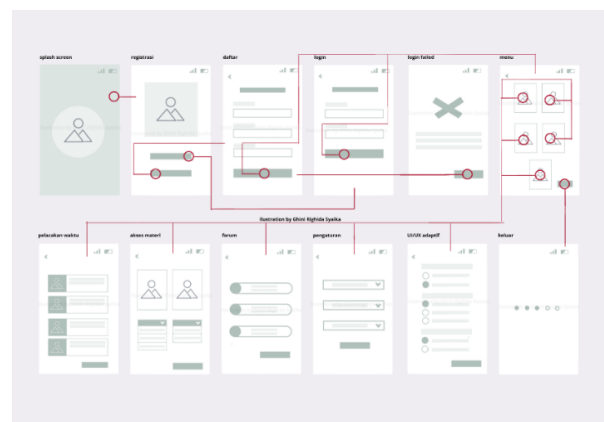


Figure 21. Prototype

The user interface flow design in Figure 21 is a structured visualization of navigation within a self-paced learning application that adopts adaptive UI/UX principles. The process begins with a splash screen that serves as the initial introduction to the application before users are directed to the registration or login page. The login flow includes the possibility of authentication failure, indicated by a "login failed" display, as part of system security validation. After successfully logging in, users are directed to the main menu page, which presents several key features, including time tracking, material access, discussion forums, account settings, and adaptive UI/UX features. Each feature has its own navigation path designed to facilitate users in accessing learning content according to their individual needs and preferences. The time tracking feature allows users to monitor their learning duration, thus supporting more effective time management. The material access feature provides a visual interface for selecting and accessing various learning content. The discussion forum serves as a collaborative tool between users to support social interaction in the context of self-paced learning. Furthermore, the settings menu provides users with flexibility in managing application preferences, including personalization settings relevant to the learning experience. Adaptive UI/UX features are a central aspect of this application, providing a customized interface and interaction flow based on user needs, such as learning style or level of understanding. Finally, a logout option is available to ensure user account privacy and security. The overall design reflects the principles of user-centered design, with a systematic approach to creating a user-friendly, efficient, and adaptive interface for different learning contexts.

Discussion

Self-directed learning in the digital era presents several challenges, particularly in effectively managing time. Although technology has facilitated access to various learning resources, significant challenges remain, such as the lack of social support and time management skills among individuals engaging in self-directed learning (Rashid & Asghar, 2016). This research designs a digital time-tracking application with a focus on UI/UX design to enhance the effectiveness of self-directed learning.

By adopting a User-Centered Design (UCD) approach, this study results in an application that enables users to better organize their study time, improve productivity, and reduce procrastination (Ayar *et al.*, 2021; Aulia, 2020). One important finding in this study is the significance of an intuitive interface design. According to the survey results, users highly value easy-to-use navigation because it reduces cognitive load and makes it easier to use the application for self-directed learning (Mumtazuddin & Ahmad, 2023). Clear and simple navigation supports users in maintaining focus on the learning process without confusion that could disrupt their learning flow (Faiz & Kurniawan, 2023). Visual design, such as the selection of colors, icons, and layout, also plays a key role in learning comfort, which in turn boosts learning motivation and user satisfaction (Pateman & Pramudia, 2024). Additionally, the study's findings indicate that personalizing the application according to users' learning habits is a highly appreciated feature. Features like theme customization, font size adjustments, and personalized reminders enhance engagement and motivation in the learning process (Drachslar *et al.*, 2015). This personalization offers a more relevant experience for each individual, supports them in managing their study time effectively, and helps them stay focused on their learning goals (Li *et al.*, 2023). These adaptive features not only improve comfort but also encourage achieving optimal learning outcomes (Froiland & Worrell, 2016).

Another feature that received significant attention from users is the recommendation system based on learning progress. This system can suggest learning materials tailored to the user's understanding level, thereby improving efficiency and motivation (Drachslar *et al.*, 2015). Users who receive feedback personalized to their progress feel more motivated and engaged in the learning process, ultimately enhancing the effectiveness of self-directed learning (Kornegay *et al.*, 2017; Vasilyeva *et al.*, 2007). Overall, responsive and user-centered UI/UX design plays a crucial role in enhancing the effectiveness of self-directed learning. This study emphasizes the importance of integrating technology with a user-centered approach in designing learning applications, with the hope that the resulting application can

support more productive, flexible, and enjoyable learning experiences for users (Chatterjee *et al.*, 2021; Setiyawati *et al.*, 2022). Therefore, the development of a UCD-based application that is responsive to users' needs will greatly support the achievement of educational goals, especially in the context of self-directed learning in the digital era.

4. Conclusion

The survey results indicate that adaptive UI/UX design plays a crucial role in supporting an optimal self-directed learning experience. Intuitive navigation, comfortable layout, and visuals that enhance focus have been proven to improve learning effectiveness. Furthermore, personalization features such as dark mode, customizable display settings, and content recommendation systems contribute significantly to increased user engagement and learning motivation. Support for multiple devices and multimedia integration further enrich the user experience, ensuring both accessibility and flexibility in learning. Therefore, the design of responsive, adaptive, and user-centered UI/UX is strongly recommended to enhance the effectiveness of self-directed learning. For future research, it is recommended to develop the application through to the implementation and direct testing phases. In addition, integrating technologies such as machine learning may be considered to further optimize personalization. Collaboration with educational experts may also add value to the development of this application.

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