

# E-PERPUS: Optimizing User Experience of Digital Library using Design Thinking Method

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## Abstract

The rapid growth of digital libraries in Indonesia highlights the need for applications that not only provide access to collections but also deliver an engaging and user-friendly experience. However, the E-Perpus application has received a relatively low user rating of 3.2/5 on the Play Store. This study addresses these challenges by applying the Design Thinking methodology to evaluate and improve the user experience of the application. The process involves five key stages: empathizing with users, defining core issues, generating ideas, developing prototypes, and conducting usability testing. In this study, we collected data through interviews, observations, and usability evaluation using the System Usability Scale (SUS). Twenty participants were involved in testing both the original and redesigned versions of the application. The redesigned prototype achieved an average SUS score of 81.875, categorized as “Excellent,” compared to baseline scores in prior studies (70.8, “Fair”). These results indicate significant improvements in navigation, interface clarity, and feature integration. Overall, this research demonstrates that the Design Thinking approach is effective in identifying user needs and providing practical solutions to enhance digital library user experiences.

## Keywords:

Digital Library, User Experience, Design Thinking, SUS

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## 1. Introduction

The rapid development of digital technology has significantly changed the way users access information, including the use of digital libraries. In Indonesia, the application of e-perpus platforms has grown widely, but many still face challenges in usability, interface design, and user engagement. Previous research shows that although digital library applications provide access to resources, users often experience difficulties navigating features and understanding workflows. For example, Amaliyah highlights that evaluations of E-Perpus applications indicate several shortcomings in UI/UX design, which reduce efficiency and user satisfaction. This demonstrates the need for redesign strategies that are user-centered and iterative to ensure that digital libraries can function optimally as learning and research tools [1].

To address these issues, the Design Thinking approach emerges as an effective methodology in designing interactive systems. Reynaldi and Setiyawati applied Design Thinking to educational platforms, demonstrating that its empathize–define–ideate–prototype–test cycle improves user experience by directly involving users in problem identification and solution development. Similarly, Fariyanto and Suaidah found that employing UX Design Thinking in village election applications increased accessibility and

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satisfaction among diverse users. These findings emphasize that user-centered methodologies can bridge the gap between system functions and user expectations, which is highly relevant to the optimization of digital library applications [2][3].

Despite the increasing application of digital libraries, their adoption by public institutions still encounters significant barriers, particularly regarding effectiveness and efficiency. Nurdi investigated the use of E-Perpus in Lampung Province and identified limited system adaptability, technical constraints, and weak personalization features as major obstacles. These findings align with Rivanka et al., who redesigned mobile library applications using Design Thinking, showing that inadequate attention to UI/UX design leads to poor user retention rates. Therefore, the digital library ecosystem requires not only technical development but also usability-driven redesign methods [4][5].

Further evaluations emphasize that improving UI/UX in digital libraries leads to measurable improvements in user satisfaction. Amaliyah and Dirgahayu analyzed existing E-Perpus applications and proposed redesign recommendations, showing that user experience scores improved significantly after implementing recommended changes. Similarly, Adiswara and Irianto highlighted that Human-Centered Design, which shares principles with Design Thinking, enhances usability in religion-based applications, making them more accessible and inclusive. These studies reinforce the urgency of continuous design evaluation as a key strategy for digital library development [6][7].

The importance of usability is also reflected in other application domains, such as delivery services and health monitoring systems. Bhakti and Ahmad demonstrated that Design Thinking-based approaches improved user experience in local delivery applications, while Yulianto et al. designed medicine reminder applications for elderly users, achieving high levels of satisfaction and task efficiency. These results highlight that digital systems across different sectors share common usability issues that can be effectively addressed through Design Thinking. Thus, applying similar principles to digital library systems holds promise for ensuring long-term sustainability and user adoption [8][9].

In addition, Haryuda et al. showed that applying Design Thinking in corporate web applications facilitated better alignment between organizational goals and user needs, while Nurliana et al. confirmed that a user experience analysis of websites using this methodology improved navigation flow and interface aesthetics. Beyond library-specific platforms, Widayanti and Maknunah applied the SUS to academic websites and highlighted deficiencies in structure and interaction. These studies together highlight that usability testing and Design Thinking-based redesign are crucial in creating digital platforms that genuinely respond to user expectations [10][11][12].

More recent works further emphasize integrating advanced technologies with Design Thinking in digital library contexts. Susanto et al. proposed combining AI-based recommendation systems with user-centered design to enhance personalization in digital learning environments, while Li et al. applied Design Thinking to smart campus systems, demonstrating improvements in accessibility and engagement. In addition, Sari and Pratama introduced mobile-based Islamic digital libraries, showing that attention to UX design significantly improved student adoption rates. These contributions highlight that digital libraries must evolve toward personalization, inclusivity, and mobile accessibility to meet the needs of modern learners [13][14][15].

Lastly, Abdullah et al. explored augmented reality-based digital library services, showing that Design Thinking facilitated the integration of complex features into usable interfaces, while Chen and Zhang emphasized cross-platform consistency in digital libraries to reduce user frustration. These studies underscore that future development of digital libraries like E-Perpus must combine solid system architecture with user-centered methodologies such as Design Thinking [16][17].

## 2. Related Works

Amaliyah conducted a usability evaluation and redesign of the E-Perpus application using A/B testing and identified key weaknesses in interface navigation, layout consistency, and feature placement. The redesign process led to significant improvements in usability scores, confirming that iterative testing is essential in refining digital library platforms. This study shows that usability issues are not merely technical but also stem from poor design alignment with user expectations, reinforcing the need for structured design methods such as Design Thinking to produce sustainable improvements in user satisfaction [1].

Reynaldi and Setiyawati applied the Design Thinking methodology to an educational platform, focusing on the development of the "Mentor on Demand" feature. Their findings revealed that active user involvement in the design cycle increased feature adoption rates by more than 30%, while reducing reported usability complaints. These results highlight the effectiveness of empathy-driven approaches in digital system design, demonstrating clear potential for application in digital library platforms, which often suffer from low user engagement and feature underutilization [2].

Fariyanto and Suaidah designed a village election application using UX Design Thinking and reported that the prototype increased system accessibility, particularly among elderly users and those with limited technical knowledge. The results emphasize the role of iterative prototyping and feedback in ensuring inclusivity across user demographics. Similarly, Nurdi showed that applying E-Perpus technology at the provincial level still faced challenges in inclusivity and adaptability, indicating that lessons learned from user-centered design in other sectors can be directly applied to digital library optimization [3][4].

Rivanka, Purnamasari, and Prihandani redesigned a mobile-based library system using Design Thinking, showing significant improvements in user satisfaction as measured through surveys. The study emphasized that design iteration must not only focus on aesthetics but also on functional clarity, such as search optimization and categorization of resources. Their work underscores the direct relevance of Design Thinking for digital library applications, where both function and interface must work together to optimize learning experiences [5].

Amaliyah and Dirgahayu provided further evidence by combining evaluation with actionable recommendations for E-Perpus systems. Their approach improved the System Usability Scale (SUS) score by nearly 15%, confirming the impact of structured evaluation on system acceptance. In another domain, Adiswara and Irianto's application of Human-Centered Design to religious service applications improved task completion efficiency by 20%, reinforcing the broader potential of user-centered methods in diverse application areas, including library services that demand inclusivity and accessibility [6][7].

Bhakti and Ahmad worked on delivery service applications and demonstrated how Design Thinking improved user experience by reducing navigation errors and enhancing efficiency in completing transactions. Yulianto, Irianto, and Persada extended this finding in healthcare by designing a medicine reminder application for the elderly, showing that usability-driven design increased daily task adherence. These examples prove that when Design Thinking is applied, even critical sectors like health benefit significantly, suggesting that digital library applications can similarly enhance knowledge accessibility and reduce user effort through proper design [8][9].

Haryuda, Asfi, and Fahrudin explored Design Thinking in corporate environments, showing that web-based systems designed with this methodology improved usability and alignment with organizational goals. Nurliana, Hanifati, and Ali reinforced these findings by analyzing user experience on academic websites, proving that Design Thinking improved both navigation flow and interface aesthetics. Their studies resonate strongly with digital library challenges, as E-Perpus systems often face similar issues of navigation complexity and misaligned feature prioritization [10][11].

More recently, Susanto et al. integrated AI-driven recommendation systems into learning platforms through Design Thinking, which resulted in higher personalization and user retention. Li et al. showed that Design Thinking enhanced smart campus systems by increasing engagement, while Sari and Pratama confirmed that UX-oriented Islamic digital libraries significantly boosted adoption rates among students. Furthermore, Abdullah et al. demonstrated that Design Thinking is effective in integrating advanced features such as augmented reality, and Chen and Zhang emphasized its importance for ensuring cross-platform consistency. Together, these works confirm that Design Thinking is a robust and flexible methodology that can be applied to optimize E-Perpus systems, making them more engaging, inclusive, and adaptable to modern user needs [13][14][15][16][17].

### 3. Proposed Method

This study is conducted through a series of stages that aim to achieve the main objective of integrating the Design Thinking methodology, which has been proven effective in solving user problems. The research process is divided into five stages, namely Empathize, Define, Ideate, Prototype, and Test. We express the usability of the E-Perpus digital library prototype as an optimization problem:

$$U(\theta) = \sum_{j=1}^n w_j M_j(\theta), \sum_{j=1}^n w_j = 1 \quad (1)$$

- $U(\theta)$  = overall usability score of the system design  $\theta$ .
- $M_j(\theta)$  = normalized usability metric (e.g., SUS score, efficiency, error rate, satisfaction).
- $w_j$  = weight representing the importance of each metric (all weights sum to 1).
- Constraints:

$$C(\theta) \leq B, T(\theta) \leq T_{\max}$$

where  $C(\theta)$  is the development cost,  $B$  is the budget,  $T(\theta)$  is development time, and  $T_{\max}$  is the maximum allowed time.

- Objective:

$$\theta^* = \arg \max_{\theta} U(\theta) \quad (2)$$

This formulation treats Design Thinking as a structured optimization process. At each stage (empathize, define, ideate, prototype, test), the design parameters  $\theta$  are updated to increase  $U(\theta)$ , the overall usability. The function  $U(\theta)$  balances multiple performance indicators: for instance, a design may achieve high SUS scores but be too complex or costly, so the weights  $w_j$  let researchers prioritize what matters most for library users (e.g., accessibility, efficiency, or satisfaction).

The constraints ensure realism: digital library projects often face budget and time limits, so a theoretically perfect design cannot be pursued if it exceeds resources. By formulating it as  $\theta^* = \arg \max_{\theta} U(\theta)$ , the method explicitly states that the goal is not absolute perfection but the best possible design under given constraints. This aligns with real-world software engineering, where trade-offs are unavoidable.

Additionally, the iterative loop of Design Thinking can be expressed as:

$$\theta^{(k+1)} = f(\theta^{(k)}, \Delta M(\theta^{(k)})) \quad (3)$$

where  $\Delta M(\theta^{(k)})$  represents feedback from usability testing at iteration  $k$ . This means each new prototype is a refinement of the previous one, guided by testing results, until the design converges near  $\theta^*$ .

## 4. Experimental Setup

This study employs the Design Thinking methodology to evaluate and enhance the user experience (UX) of the E-Perpus application. The main objective of this study is to identify usability issues faced by users and to propose design improvements that enhance the overall interaction between the user and the system. In the problem-solving process, the team strives to understand user needs and create the most effective solutions to meet those needs [8]. This methodological approach begins by generating as many ideas as possible, followed by filtering them to identify the most optimal ones [9].

### 1. Empathize

According to Michael Shanks from Stanford University, the empathy stage involves a deep understanding of users' needs and experiences, which serves as the foundation for creating relevant and effective solutions [11]. In the Empathize stage, user needs and problems encountered while using the application are explored. This involves conducting observations with users to gather direct feedback, as well as interviews to gain deeper insights into their experiences, difficulties faced, and desired features. Empathy is a fundamental aspect of human-centered design processes [11]. According to Michael Shanks of Stanford University, gaining a deep understanding of users' needs and experiences is a crucial initial step in designing effective and meaningful solutions [11]. The Empathize stage is crucial, as a strong foundational understanding of the users will guide the entire design and development process.

Table 1. Interview Question

NO	Daftar Pertanyaan
1.	How was your experience in searching for or finding books within the E-Perpus application?
2.	Did you encounter any difficulties or obstacles while using the application? If yes, what kind of issues did you face?
3.	What is your opinion about the book categories available in the application?
4.	If you could add one useful feature to the application, what feature would you suggest?
5.	Which feature do you like the most and which one do you like the least? Please explain why.
6.	Have you ever preferred to use another application instead of E-Perpus? If so, why?
7.	How satisfied are you with using the E-Perpus application? Please rate on a scale of 1 to 5, where 1 means very dissatisfied and 5 means very satisfied.

After conducting the interviews, the next step was to develop an empathy map. The empathy map helps researchers organize information collected from interviews, surveys, or observations, enabling a deeper understanding of users' needs, expectations, and challenges. It consists of four key components: Says, Thinks, Does, and Feels, each representing a distinct perspective of the user's experience. By using this tool, researchers can gain clearer insights into user behavior and emotions, which serve as a foundation for formulating more effective design solutions.

# Empathy Map

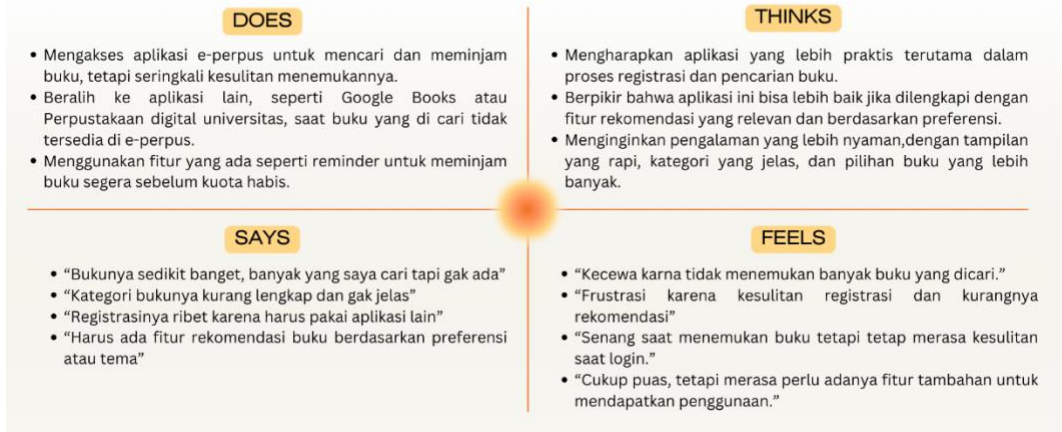


Fig. 1 Empathy Map

## 2. Define

The Define stage is where the data gathered from user interviews is analyzed and synthesized. The main goal of this phase is to formulate a clear problem statement that will become the central focus of the study. Based on the developed personas, several classifications of problems experienced by E-Perpus application users were identified. These issues are summarized in the table below.

Table 2. Problem Classification

No	Problem	Description	Solution
1	Limited Book Availability and Incomplete Collection Categories	Some books searched by users are not available in the application. The existing book categories are perceived as incomplete or irrelevant. Users also report confusion due to unclear category labels, such as "Info BCA".	<ul style="list-style-type: none"> <li>Add more complete and relevant book collections based on user needs.</li> <li>Improve category naming to be more intuitive and accurate.</li> </ul>
2	Lack of In-App Registration Feature	Users complain that the registration process requires using a third-party app (Gramedia Digital), which is considered inconvenient. Some users also face difficulties logging in due to the unintuitive process.	Provide direct registration and login features within the E-Perpus app without requiring external applications.
3	Poor Book Categorization	Book categories are considered too broad or random, making it difficult for users to find books relevant to their needs. The absence of specific subcategories leads to confusion.	Introduce subcategories within main categories to help users find books based on their specific interests..

4	Lack of Recommendation and Review Features	The app does not offer book recommendations based on user preferences or reading history, which makes it harder for users to discover relevant content.	Add an automatic recommendation system based on users' preferred genres or reading history.
5	Unattractive User Interface	The application's interface is considered visually unappealing. The homepage lacks meaningful grouping of content, causing user confusion.	Redesign the homepage with more visually engaging layouts and relevant book groupings.
6	Limited Reading Preferences	Users expect features such as bookmarking pages or saving reading history for easier access in the future.	Provide bookmarking and reading history features to help users track their reading progress.

### 3. Ideate

In the Ideate stage, the researcher focuses on generating a wide range of creative solutions to address the problems and user needs identified during the Define phase. This process involves freely exploring ideas without limitations to encourage innovation. The primary goal of this stage is to develop various innovative concepts that can be applied to enhance the E-Perpus application. As a result of this phase, a collection of ideas is produced, which will then be selected and refined further. These ideas are translated into initial design structures through the creation of a site map, user flow, and wireframe, which serve as foundational components for building the prototype in the next phase.

### 4. Prototype

Once the wireframes were completed, the next step was to develop the prototype of the E-Perpus application. This prototype transformed the static wireframes into an interactive design that simulates the actual user interface and experience. It allowed users to navigate through the application, interact with its core features, and provide feedback before the final implementation. The prototype served as a critical tool for usability testing and further refinement based on real user interactions.

### 5. Testing

After completing the development of the E-Perpus application prototype, the next phase of this research was to conduct a usability evaluation of the design. The testing involved 20 participants and utilized the System Usability Scale (SUS), a widely adopted quantitative method for assessing the usability of digital applications such as E-Perpus. The SUS method was selected due to its simplicity, speed, and efficiency, even when implemented with a relatively small sample size. The SUS questionnaire comprises 10 statements rated on a 5-point Likert scale, ranging from "strongly disagree" to "strongly agree." Each statement is designed to assess key usability dimensions, including ease of use, interface consistency, feature integration, and user confidence during interaction. Table 3 presents the list of SUS statements used in the evaluation.

Table 3: The list of SUS evaluation statements of this study

1	I think that I would use this application frequently.
2	I found the application unnecessarily complex.
3	I thought the application was easy to use.
4	I think that I would need the support of a technical person to be able to use this application.
5	I found the various functions in this application were well integrated.
6	I thought there was too much inconsistency in this application.
7	I would imagine that most people would learn to use this application very quickly.
8	I found the application very cumbersome to use.
9	I felt very confident using the application.
10	I needed to learn a lot of things before I could get going with this application.

To determine the evaluation category based on SUS scores, the classification of results is generally conducted by referring to the SUS percentile ranking. Table 4 presents the score percentile of several categories.

Table 4. SUS score percentile

Predicate	Information
Excellent	>80,3
Good	68 -80,3
Fair	68
Poor	51 – 68
Very Poor	< 51

After collecting data from respondents, the next step involves analyzing the individual scores obtained from each participant. The scoring procedure is applied consistently across all respondents to ensure accuracy and comparability. Each participant's SUS score is first calculated, after which the scores are aggregated and divided by the total number of respondents to generate the overall average. The calculation of the System Usability Scale (SUS) score follows the formula 4.

$$\bar{x} = \frac{\sum x}{n} \tag{4}$$

where  $\bar{x}$  represents the average SUS score,  $\sum x$  is the sum of all respondents' SUS scores, and  $n$  denotes the total number of respondents.

## 5. Result and Analysis

In this work, we evaluate the E-Perpus application using the System Usability Scale (SUS) with a total of 20 participants in testing both the original version of E-Perpus and the redesigned prototype. The first step was to adjust the score of each questionnaire item based on the type of statement number. For odd-numbered statements (items 1, 3, 5, 7, and 9), the score was calculated using the formula (response value). Meanwhile, for even-numbered statements (items 2, 4, 6, 8, and 10), the score was calculated using the formula (5–response value). After the adjusted scores for all 10 statements were obtained, they were summed for each respondent. The total score was then multiplied by 2.5, resulting in an individual SUS score ranging from 0 to 100. Table 5 describes the representation scores of the system's usability level based on user perception.

Table 5. SUS Score Results of the Original E-Perpus Application

Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total
R1	3	4	2	4	3	4	2	4	3	2	15
R2	5	1	5	1	5	1	5	1	5	5	40
R3	2	3	3	2	3	4	4	3	2	2	20
R4	3	2	3	4	3	4	4	3	4	4	20
R5	3	2	2	3	2	2	3	3	4	2	23
R6	3	2	2	4	3	4	2	3	3	3	17
R7	3	3	4	3	2	5	3	5	4	5	15
R8	2	4	2	3	2	4	2	4	3	5	12
R9	3	2	3	4	3	5	3	5	4	5	15
R10	2	3	3	2	2	4	3	4	2	3	16



The average SUS score obtained from the usability testing of the final design of the E-Perpus Digital Application was 81.875. Based on the SUS percentile ranking, a score of 81.875 falls into the “Excellent” category. Compared to the original version of the application, the final design achieved a substantially higher average SUS score, indicating a clear improvement in usability [18][19][20]. These results demonstrate that the redesign process successfully enhanced both usability and user experience. This finding is supported by positive feedback from respondents, who considered the new interface to be more intuitive and comfortable to use than the previous version. Improvements in navigation, layout, and visual interface were assessed as being more effective in meeting user needs. These findings are further reinforced by the significant increase in the SUS score, which reflects substantial progress in the overall quality of the user experience.

## 6. Conclusion

This study systematically evaluates the E-Perpus Digital Application using the Design Thinking approach and reveals that user comfort and satisfaction remain below optimal levels, necessitating targeted improvements. Observations and interviews highlight several usability challenges, including a non-intuitive interface, a complex registration process, and the absence of essential features such as book reviews, wishlists, and borrowing history. Although the SUS evaluation yielded an average score of 81.875, categorized as “Excellent,” the score does not fully capture weaknesses in navigation and visualization. By applying the iterative stages of Design Thinking that empathize, define, ideate, prototype, and test. This study successfully identifies the root causes of usability issues and develops design solutions that align more closely with user expectations and established UI/UX principles. The resulting prototype demonstrates a more responsive and user-centered design, thereby enhancing the overall experience of interacting with the digital library.

To address the identified challenges, the study proposes several strategies for improving the application’s UI/UX. These include implementing a direct registration feature without relying on third-party platforms to streamline account creation, refining the interface to achieve greater intuitiveness and consistency in navigation and visual hierarchy, and integrating additional functions such as book reviews, wishlists, borrowing history, and a personalized recommendation system. The redesigned interface yields measurable improvements in usability, with users reporting higher effectiveness and efficiency in completing tasks with minimal obstacles.

Overall, the findings confirm that the integration of Design Thinking provides a robust framework for optimizing the usability of digital library applications. By embedding user perspectives into the redesign process, E-Perpus achieves a stronger alignment with user needs and operational goals. Future work should extend this evaluation to a larger and more diverse user base, integrate advanced features such as adaptive recommendation algorithms and AI-driven personalization, and conduct longitudinal studies to assess long-term impacts on user engagement and learning outcomes.

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