

Double Diamond Approach to Design Web-based Library Clearance Management System for Graduation Requirements

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Abstract

The library clearance process is one of the main administrative requirements that students must complete before participating in the graduation process. In many higher education institutions, the library clearance process is still manual or fragmented across multiple information systems, resulting in inefficient verification, lengthy delays, and limited transparency for students and librarians. This study aims to design LibrePass, a library clearance management information system that digitizes and streamlines the submission and verification process for graduation requirements, including library clearance, submission of hard and soft copy final report documents, and other institutional requirements. This study adopts the Double Diamond approach, comprising four stages: Discover, Define, Develop, and Deliver. In the Discover stage, user needs and current business processes are identified through interviews, observations, and document analysis. Next, in the Define stage, the results of interviews and observations are synthesized to determine user experience, pain points, and user needs. Then, in the Develop stage, user flows and low- and high-fidelity wireframes are designed. The final stage is Deliver, usability testing is carried out on the prototype using the UEQ instrument with UEQ Data Analysis Tools. The test results show that all UEQ dimensions, namely attractiveness, perpicuity, efficiency, dependability, stimulation, and novelty, show excellent values, with an average score of 2,15. These results indicate that the double diamond approach is successful in designing a prototype that is acceptable and has met user needs.

Keywords: double diamond, library clearance, ueq, user experience, usability.

1 Introduction

The increasing demands for efficiency and quality of administrative services in higher education institutions have made the digitalization of academic processes an unavoidable necessity. The academic process encompasses the entire series of activities related to education, from planning and implementation to student learning [1]. As a work unit within a higher education institution, the Library supports the academic process by providing scientific information to the academic community [2]. In the current era, library services have extensively utilized information technology to provide literacy materials in both print and digital formats. Examples of the use of information technology in the library environment include the development of E-Libraries and book lending information systems that support reading access, browsing, and the borrowing and returning of collections.

In addition to these core services, university libraries also provide library clearance services that must be made available to meet student graduation requirements. Library clearance is a crucial service to verify that students have no outstanding book loans or other obligations at the library. This process is a fundamental administrative requirement for graduation processing. Each university has different policies regarding the list of library clearance requirements, such as user guidance activities, thesis

report similarity checks, free library book loans, library book donations, thesis report submissions, and so on. The series of requirements to meet these library clearance requirements involves more than just students and librarians; the more activities listed as library clearance requirements, the more staff are involved. Furthermore, managing library clearance requirements also requires integrating student data, loan data, library collection returns, and other administrative processes that students must complete.

However, in many universities, the library clearance process is still carried out manually or semi-digitally. This process has the potential to cause various problems, such as service delays, long queues, lack of status transparency, and the risk of administrative errors. This situation highlights the need for innovation in web-based application development to automate and integrate the library clearance process effectively and efficiently.

Web-based application development is considered more effective and efficient for several key reasons. The transition from traditional software development methodologies to the web development lifecycle has been recognized for its ability to better accommodate the unique characteristics of the web, such as global accessibility and ease of information sharing, which are critical for business applications [3]. In the education sector, web-based applications offer significant advantages in terms of flexibility, efficiency, and accessibility, enabling educational activities to be conducted anytime and anywhere.

In developing web-based library clearance applications, the user interface (UI) is crucial for effective information delivery, influencing user interaction, and overall system success [4]. The UI is the primary display that appears when the system is running, allowing users to interact through in-app commands [5]. The UI emphasizes the website or application's aesthetic appearance and focuses on direct user interaction [6]. The UI also includes buttons, menus, forms, and other elements necessary for user security [6]. The UI has been recognized as a critical element of information systems development projects, with an estimated 48% of system development effort devoted to UI design and implementation [5].

In addition to the UI, User Experience (UX) directly influences user satisfaction, engagement, and operational efficiency. UX is a person's response and perception of using a product, system, or service [6]; it refers to how users interact with the software [6]. A user-unfriendly UI/UX can lead to various obstacles, such as confusion, longer task completion times, and lower user satisfaction [7]. Some obstacles that can arise from poor UI/UX design include students having difficulty finding information regarding similarity test approval applications for their thesis reports due to difficult navigation. Librarians have difficulty learning various system settings due to excessive navigation and symbols, as well as a less concise system setup flow.

Research by [8] shows that UI elements such as color, typography, and layout significantly influence the success of a learning application, with a 44.3% impact on UX. Research by [9] also shows a positive relationship between UI and UX, with empirical evidence that good UI design contributes significantly to UX. [10] Also shows that UI improvements enhance user experience (UX) by improving user appeal and understanding.

By paying closer attention to UI/UX, the current system development focuses more on user needs (user-centered). This approach has experienced rapid growth because it produces innovative solutions that address user needs [11]. A popular approach to information system development that focuses on user needs is Design Thinking. Design Thinking is an approach to comprehensive thinking that seeks solutions, starting with observing user needs to drive innovation [11]. This is crucial because many systems fail or are difficult to adopt due to being too complex, unintuitive, and unresponsive to user needs. By involving users from start to finish, developers can build systems that provide an optimal UX [12][13].

The development of a library clearance application (LibrePass) based on a case study at XYZ University has a list of 13 administrative requirements that must be met by students, including the obligation to participate in literacy class, similarity checks for thesis reports, free central library book loans, free faculty library book loans, central library book donations, faculty library book donations, central library point donations, completing library service surveys, creating literacy content, uploading repositories, collecting hard copies of theses at the central library, collecting hard copies of theses at the faculty library, and collecting soft copies of thesis reports. This process involves many users, from students to institutional and faculty-level work units. Therefore, the development of this

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information system requires problem exploration at the institutional and faculty levels to structure the problem formulation and then determine the solution in the form of a LibrePass information system to be developed.

The appropriate system development method for this case study is Double Diamond, an approach that focuses on developing innovative solutions and utilizing design thinking. Double Diamond is a design thinking framework that assists in designing user UX processes [14]. This approach divides the design process into four main stages: Discover, Define, Develop, and Deliver. This method works by gathering as many ideas as possible and then narrowing them down to find the best idea or concepts [14].

UI and UX prototype development using Double Diamond is quite widely used, including by [15], [14], [16], and [17]. In research [15], the UI and UX of a Balinese cultural calendar application were developed for iOS. The output was a prototype application design that underwent usability testing, scoring 87, indicating user satisfaction and needs. [14] developed an Enterprise Resource Planning (ERP) system and successfully obtained the best business process flow based on various stakeholder input, resulting in a system prototype that was tested using usability testing with a satisfaction score of 95.2%. [17] Redesigned a final project management information system at a university because the business processes in the existing application were inadequate. Using the double diamond method, a UI design was produced and tested with the System Usability Scale (SUS), achieving a SUS score of 85.75, indicating user acceptance of the UI design and its potential for implementation as an information system.

Using the Design Thinking approach and the Double Diamond framework, it is possible to reformulate unsolvable problems from a human perspective by formulating ideas and creating digital solutions that are far more efficient than rigid conventional approaches [11][12][5]. This study aims to design a web-based UI for a library clearance application at XYZ University using the Double Diamond method. This ready-to-implement approach offers several benefits, including ease of access for students, accelerated verification processes, improved data accuracy, and real-time transparency into library clearance status. Furthermore, this system can be integrated with academic and library information systems, creating a more integrated digital service ecosystem.

From an academic perspective, the development of this application is crucial to improving the quality of information technology-based higher education services. The implementation of this system not only supports operational efficiency but also serves as a context-based learning tool for students to understand the application of technology to solve real problems in the campus environment.

2 Literature Review

2.1. Design Thinking

Design thinking is a user-centered approach to problem-solving that begins by analyzing the needs of the target audience before seeking creative solutions to identified problems. Methods or frameworks using the design thinking approach continue to evolve, with many new methods being developed, including the Stanford Design Thinking Method, IDEO Frameworks, the Design Council, and several other models [18]. Design thinking has core principles such as: 1) human-centered empathy; 2) problem reframing; 3) divergent and convergent thinking; 4) prototyping and testing; 5) iterative nature; 6) multidisciplinary collaboration [18].

Design thinking is highly relevant to software development, particularly for creating innovative, human-centered solutions [19]. This relevance is not limited to the initial phase of a project but extends throughout the development cycle and team culture. The relationship between design thinking and software development can be explained as follows [19], [20]:

- a) Facilitating a deep understanding of user needs, enabling developers to see user perspectives undetected through conventional methods by offering various techniques (such as personas, storyboards, and prototyping).
- b) Having a strong focus on users ensures that the solutions built truly address the real needs and problems faced by people.
- c) Design thinking facilitates cross-disciplinary collaboration, bringing diverse perspectives together to find better ways to communicate and collaborate.

- d) In software development, design thinking helps in-depth requirements engineering through interview and observation techniques.
- e) Through ideation and prototyping, design thinking helps development teams establish a clear product vision before the intensive coding process begins.

2.2. Double Diamond

The Double Diamond is a design thinking approach developed by the Design Council in 2005. It is a standard design process that prioritizes contextual factors to identify core problems and find solutions [21]. In software development, the Double Diamond is a widely used methodology in UI/UX design because it provides a more structured approach to uncovering user needs and creating optimal solutions [17]. The Double Diamond consists of four stages: Discover, Define, Develop, and Deliver. Terminologically, the Double Diamond is visualized as two diamonds, each with its own purpose and focus.

A visualization of the Double Diamond model is shown in Figure 1. The first diamond is a model for identifying and understanding user challenges and then exploring possible solutions. The first diamond represents the scope of the problem, which consists of two main stages: Discover and Define. The Discover stage prioritizes investigating users to gain insights into their needs, barriers, and experiences. Then, in the Define stage, the collected data is analyzed to clearly define the core problem and develop a strategy [22].

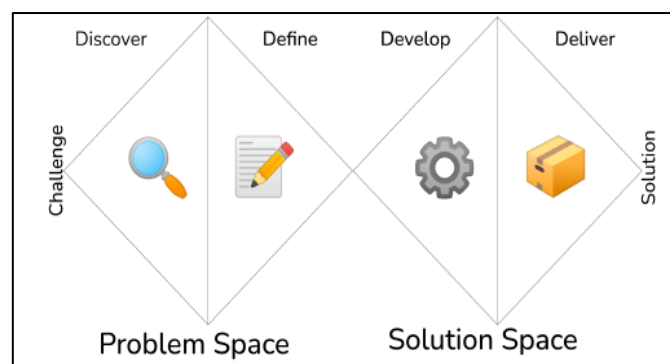


Figure 1 Double diamond model [22]

In contrast, the second diamond focuses on developing and implementing a concrete solution. This stage consists of Develop and Deliver. The Develop stage includes designing an interactive prototype with functionality tailored to user requirements. The Deliver stage involves testing the prototype with users, gathering feedback, and refining the design and functionality before release [22].

The Discover stage prioritizes gathering community knowledge and ideas through interviews with an emphasis on "divergent thinking," or thinking outside the box. The Define stage establishes a problem definition based on feedback from informants and systematically synthesizes the information. Next, the Develop stage formulates potential solutions for discussion and exploration, which can be conducted iteratively. The final stage, Deliver, refers to selecting one solution and evaluating it by fixing components that are not functioning as intended [21].

3 Research Method

This research uses a design thinking approach, guided by the Double Diamond framework, to design the UI for a library clearance application at XYZ University. The research stages are shown in Figure 2 below.

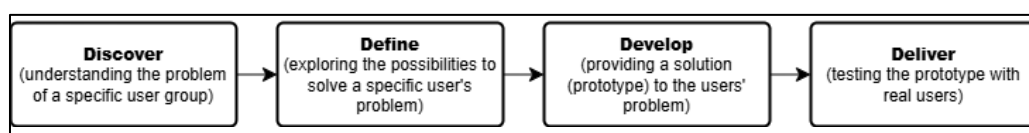


Figure 2 The four stages of the double diamond

The description of the activities for each stage carried out in this research, as shown in Figure 2, is as follows:

A. Discover

At this stage, data were collected on user experiences, needs, and obstacles in the library clearance process through interviews with students, library unit leaders, and librarians. The goal is to synthesize a list of key barriers or issues that need to be considered in product design [23]. Then the results will be represented in the form of a problem statement and empathy map. The list of interview questions for this stage is shown in Table 1.

Table 1 List of interview questions

Variable	Questions
User Experience	1. Can you explain the process or flow for managing library clearance? 2. What are the library clearance obligations imposed on students? 3. How long does it take to manage library clearance? 4. Is information about library clearance procedures or flow easily accessible and understandable? 5. Have you ever experienced data errors (e.g., still being recorded as having a loan even though it has been returned)?
Pain Points	1. Have you ever encountered any obstacles in meeting the library's clearance requirements? 2. Have you ever experienced delays in the verification process? 3. Have there been any access issues, such as having to come in person, queues, or limited time? 4. Have you had difficulty finding out your library's clearance status? 5. Do you feel this process is excessively time-consuming or labor-intensive?
User Needs	1. In your opinion, what would be the ideal library clearance application? 2. What features would you like to see available in a web-based library clearance application? 3. Would you like the library clearance application process to be completed online without having to visit in person? 4. How important is notification (e.g., via email/WhatsApp) in this process? 5. Is a history feature or a downloadable library clearance evidence needed?

B. Define

At this stage, the collected data will be analyzed by comparing user needs, obstacles, and experiences. Then, problems will be identified, and the most effective ideas will be formulated and summarized in user personas, including pain points and desires. The goal of this stage is to identify the specific problems to be addressed and propose effective design solutions [23].

C. Develop

At this stage, the idea is designed, and the user flow is described to identify the navigation flow. Next, a wireframe is designed from this user flow, which is then developed into an interactive prototype [23]. The wireframe design consists of a low-fidelity wireframe and a high-fidelity wireframe.

D. Deliver

This stage involves handing over the prototype design to users for usability testing [23]. Testing is conducted to ensure the prototype meets user needs. The testing tool used is the User Experience Questionnaire (UEQ). A user experience (UX) evaluation instrument developed by Martin Schrepp and his team to measure user perceptions of the quality of experience when interacting with a digital product, such as a website, mobile application, desktop software, or information system. The UEQ is designed to measure subjective user impressions quickly, simply, and reliably, not only in terms of ease of use (usability), but also in terms of emotional and attractive aspects (hedonic quality) that influence user satisfaction. The UEQ consists of 26 questions grouped into six dimensions:

attractiveness, perceptibility, efficiency, dependability, stimulation, and novelty. The UEQ questions are shown in Figure 3.

	1	2	3	4	5	6	7		
annoying	☐	☐	☐	☐	☐	☐	☐	enjoyable	1
not understandable	☐	☐	☐	☐	☐	☐	☐	understandable	2
creative	☐	☐	☐	☐	☐	☐	☐	dull	3
easy to learn	☐	☐	☐	☐	☐	☐	☐	difficult to learn	4
valuable	☐	☐	☐	☐	☐	☐	☐	inferior	5
boring	☐	☐	☐	☐	☐	☐	☐	exciting	6
not interesting	☐	☐	☐	☐	☐	☐	☐	interesting	7
unpredictable	☐	☐	☐	☐	☐	☐	☐	predictable	8
fast	☐	☐	☐	☐	☐	☐	☐	slow	9
inventive	☐	☐	☐	☐	☐	☐	☐	conventional	10
obstructive	☐	☐	☐	☐	☐	☐	☐	supportive	11
good	☐	☐	☐	☐	☐	☐	☐	bad	12
complicated	☐	☐	☐	☐	☐	☐	☐	easy	13
unlikable	☐	☐	☐	☐	☐	☐	☐	pleasing	14
usual	☐	☐	☐	☐	☐	☐	☐	leading edge	15
unpleasant	☐	☐	☐	☐	☐	☐	☐	pleasant	16
secure	☐	☐	☐	☐	☐	☐	☐	not secure	17
motivating	☐	☐	☐	☐	☐	☐	☐	demotivating	18
meets expectations	☐	☐	☐	☐	☐	☐	☐	does not meet expectations	19
inefficient	☐	☐	☐	☐	☐	☐	☐	efficient	20
clear	☐	☐	☐	☐	☐	☐	☐	confusing	21
impractical	☐	☐	☐	☐	☐	☐	☐	practical	22
organized	☐	☐	☐	☐	☐	☐	☐	cluttered	23
attractive	☐	☐	☐	☐	☐	☐	☐	unattractive	24
friendly	☐	☐	☐	☐	☐	☐	☐	unfriendly	25
conservative	☐	☐	☐	☐	☐	☐	☐	innovative	26

Figure 3 User experience questionnaire (UEQ)

The test was conducted using stratified sampling, a probability sampling technique. Sampling is conducted by dividing the population into strata based on characteristics relevant to the research objectives. In this study, there were two populations: 1,206 final-year students (final semester) and 53 library staff handling library clearance requirements.

After dividing the population into strata, the sample size was determined using the Cochran formula. The Cochran approach was chosen because it can be used with large populations and adapted Confidence Level and Z Value in Cochran's Formula stratified sampling, because each member of the population has a known chance of being included in the sample. In this study, the sample was determined using the Cochran formula for limited populations as follows [24]:

$$n_0 = \frac{Z^2 pq}{e^2} \quad (1)$$

n_0 = initial sample size

Z = Z value based on confidence level

p = proportion of success or characteristic being studied

$q = 1 - p$

e = margin of error (tolerable level of error)

The Z-value is obtained from a standard normal distribution, with the confidence level chosen by the researcher based on the research objectives and the desired level of accuracy. There are three commonly used Z-values, as shown in Table 2. If no previous research has estimated the proportion (p) value, $p=0.5$ and $q=0.5$ are used. The commonly used margin of error (e) for academic research is 0.05.

Table 2 Confidence level and Z value in cochran's formula

Confidence Level	Significance Level (α)	Z Value
90%	0,10	1,645
95%	0,05	1,96
99%	0,01	1,576

In the Cochran formula, if the population is known and not too large, then the calculation results need to be adjusted using the following formula:

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}} \quad (2)$$

n = sample size after correction

n_0 = sample size using Cochran's formula

N = population size

The samples were then allocated to each stratum, using the following formula:

$$n_h = \frac{N_h}{N} \times n \quad (3)$$

n_h = number of samples in the h- stratum

N_h = number of population in the h- stratum

N = total population

n = number of samples

The determination of the research sample is based on the Cochran formula in equation (1) using a 95% confidence level, obtaining a sample size of 384.16. The results were then corrected using the formula in equation (2), and the sample size was 294.52, which was rounded up to 294. Furthermore, the sample allocation for each stratum using the formula in equation (3) resulted in 282 students and 12 librarians. So the total sample in this study was 294 people.

4 Result and Analysis

A. Discover

At this stage, interviews were conducted with 5 students, 1 librarian, and the library head to determine user experiences, obstacles, and user needs. Interviews were conducted using the interview instrument previously compiled in Table 1, and then an empathy map was compiled as shown in Tables 3, 4, and 5. The empathy map is used to gain a comprehensive understanding of users' core problems, including what they say, think, do, and feel.

Tabel 3 Student empathy map

No	Says	Thinks	Does	Feels
1.	"The paperwork required to sign the library clearance obligation list is easily damaged if not stored properly."	This is less than ideal, as many services can be delivered digitally to ensure data availability.	The obligation fulfillment sheet should be kept in a folder to prevent damage or loss.	This is inefficient and impractical, considering the numerous activities involved in completing a thesis and graduating.
2.	"I lost my library-free obligation checklist, so I have to process proof of fulfillment from the earliest list."	There should be an information system that can automatically record these on a digital platform.	I have to manually recap and request a new library clearance obligation checklist and verification from the librarian.	This is time-consuming and ineffective.
3.	"I have to wait in line for 15-60 minutes to get a signature from a librarian."	The verification process should be able to be done more quickly and at any time for most of the library clearance obligation list through digital	Queuing should be done at relatively quiet times.	This is a hassle during the thesis revision process, where you also have to wait for examiners and supervisors to queue for guidance.

		platforms.		
4.	"The process of fulfilling my thesis's library clearance obligations can only be monitored through the list of obligations. If it's lost, I have to request verification through a signature from a librarian."	This is impractical and not well documented from the student's perspective.	Maintaining the fulfillment obligation sheet to prevent loss or damage ensures easy access at any time if needed.	This is impractical and requires opening files to view the list of obligations to fulfill the library clearance obligations.
5.	"In addition to queuing, we have to walk from the faculty library building to the central library building to complete library clearance requirements for book donations and free loans."	This could be done more conveniently through a digital platform, such as Google Forms, so there's no need to wait in long lines to register donations.	Queuing and fulfilling the library clearance requirements at both buildings.	This process is impractical and time-consuming.
6.	"We must pay attention to the library staff's initial briefing before starting to fulfill and verify the list of library clearance obligations. If we forget, we ask a colleague who remembers the details of the briefing."	There should be a list of information shared or accessible to remind us of the completeness and procedures for fulfilling the library clearance requirements.	Take notes during the initial briefing, and ask a colleague who remembers, or ask the library staff again if there is any information we missed or forgot.	We want a reliable source of information that can be accessed at any time to simplify the requirements preparation process.

Table 4 Library officer empathy map

No	Says	Thinks	Does	Feels
1.	"The process is entirely face-to-face; all administration and implementation of the library clearance process is done on-site, requiring students to come directly to the library."	The process for obtaining a Library Clearance Certificate should be done online without the need for physical meetings, except for the submission of books/physical theses.	Exhausting Physical Verification: Lining up donated books and checking each thesis CD individually; often the CDs jam or become unreadable by the CPU.	Overwhelmed by Queues and naturally feeling burdened by the long queues of students, especially when verification time is very limited.
2.	"Lack of student awareness and indifference to the responsibility of completing library research due to the lack of binding consequences and regulations."	With binding regulations in place, the availability of applications should be an effective control tool.	Manually pursuing students by pulling transaction reports and then announcing and posting a list of outstanding balances on every bulletin board on campus.	Disappointment due to "Missed" Data and feelings of regret if one or two students manage to escape without completing their obligations due to scattered or lost physical documentation.
3.	"The quality of	The application must	Manual	Plagiarism concerns

	scientific papers is uncontrolled because librarians only receive physical copies (CDs/hardcopies) without the authority to revise the content or check for plagiarism using Turnitin."	use a single data integration or a proper database to ensure valid data.	synchronization efforts using Excel, Google Drive, or Spreadsheets to connect data from three different teams for checking (borrowings, donations, and theses).	arise when uploading scientific papers without a plagiarism filter, especially following degree revocations at other universities.
4.	"Arrears are out of control because some students borrow books and then leave them, resulting in mounting fines."	The borrowing process must be properly recorded by student name with a valid student ID number.	The Stamp and Type System uses control paper that must be manually stamped by staff and then retyped into the computer during the borrowing and administration process. The Library also has a fine waiver policy.	Anxiety about Audits: Feeling afraid and worried if uncollected fines are questioned by the financial auditor.

Table 5 Emphaty map of the head of the library

No	Says	Thinks	Does	Feels
1.	"Business processes already exist, but they are still manual, with initial requirements only including free book loans at the central and faculty libraries."	Applications must be based on real needs, not just the desire for technology, to truly help simplify work.	Using Excel and spreadsheets as temporary control tools allows staff to enter their own data, despite the risk of data deletion or input errors.	Extreme overwhelm and fatigue, especially when having to summarize thousands of data items in a short time (such as during Eid al-Fitr holidays or before graduation).
2.	"Physical verification is very difficult, especially for theses on CDs, which are often unreadable on library computers. Checking them is a pain."	Automating existing business processes so that application requirements analysis is based on previously established manual workflows.	Creating manual checklists to verify Turnitin, repositories, and other requirements one by one.	Worrying about data loss, because if the physical sheet is lost, the control record is also lost, and students must start the process from the beginning.
3.	"Data recapitulation is a major obstacle because it must be done manually for thousands of students and dozens of classes."	Data transparency and integration, where the final results (resume) can be viewed directly by the faculty or other relevant units through the provided account.	Going directly into the field to conduct outreach and provide guidance to students because an online system is not yet available.	Concern about human error, such as checking the wrong name or entering incorrect data due to drowsiness while working late at night.
4.	"Low completion rates, where students were previously unable to 100% complete their library	Independent data management, such as the ability to import student data or perform updates	Conducting massive physical recapitulation, such as aligning data from 60 classes to be manually	Burdened by piles of physical files, the stacks of folders per class once reached almost the ceiling of

	clearance obligations by graduation time."	independently by the library's internal team.	reviewed one by one every morning and evening.	the old library building.
5.	"Data isn't real-time, making it difficult to know exactly who has or hasn't completed their obligations at any given time."	Ease of reporting to management, so that when a superior (such as the Vice Chancellor) requests data, reports can be available instantly or "right now."	A wet-signature and stamp system, where every letter of permission must be initialed by an officer and manually signed by the Unit Head, is very tedious.	Feels ineffective because, even though the requirements were fewer than they are now, manual processing time is much longer, and the results are not guaranteed to be 100% complete.

B. Define

Based on the empathy map results, the definition stage continues by analyzing what features will be provided in the application service. One of the references in designing this feature is based on data and interview results from the Discover stage [14]. One technique used for definition is user persona, which can interpret user needs and preferences. The results of the user persona in this study are shown in Tables 5, 6, and 7.

Table 5 Student's user persona

Demographics	Behaviors
Name : Abi Age : 23 Status : college student in final semester	- Diligent and active - Uses a laptop for studying - Uses an LMS to access materials and submit assignments - Tech-savvy (adaptive and intuitive in using technology)
	Goals - Complete thesis revision based on the results of the comprehensive examination - Complete the requirements for bibliography release - Immediately participate in the final exam and graduation ceremony
	Pains - The free library obligation checklist was damaged and then lost, requiring a replacement and the need to start over with the library staff. - The queue for verifying free library requirements was quite long and took a considerable amount of time. - Information regarding missing free library requirements was obtained by asking the library staff.

Table 6 Library staff user persona

Demographics	Behaviors
Name : Devi Age : 25 Status : Librarian	- Performing numerous administrative tasks at the XYZ College central library - Working as a librarian - Using laptops and computers in daily work
	Goals - Able to complete work effectively and efficiently - Able to provide good service to students and management
	Pains Managing library clearance data through spreadsheets requires

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thoroughness and accuracy, as it is prone to errors.

- Generating a report on student library clearance compliance requires data processing, which can be time-consuming.
- At certain times, the queue for library clearance verification can be very long and is considered ineffective.

Table 7 User persona of the library unit head

Demographics	Behaviors
Name : Arif Age : 40 Status : Head of Library Unit	• Visionary and passionate about innovation • Has many work programs for the library • Attentive to ongoing programs and activities in the library
	Goals • Digitization of various library services • Providing ideal library services • All library programs are well-monitored
	Pains • In library services that are not yet digital, it is difficult to get reports quickly with the expected visualization. At certain times, the queue for library clearance verification is very long and perceived as ineffective.

Based on interviews, empathy map analysis, and user personas, the desires of stakeholders students, librarians, and library unit heads were identified. These desires stemmed from ineffective, inefficient processes that were cumbersome, even though most could be automated through digitization using an information system. The identified list of user experiences, barriers, and needs is shown in Table 8.

Table 8 Identification of user experience, pain points, and user needs

Variable	Description
User Experience	1. Managing library access is still manual, with records made using sheets of paper containing a list of 10 obligations that must be met as a graduation requirement, all signed by a librarian. 2. The list of requirements includes: 1) similarity check for thesis reports, 2) checking for free borrowing of books from the central library, 3) checking for free borrowing of books from the faculty library, 4) donating books from the faculty library, 5) donating points from the central library, 6) completing a library service survey, 7) uploading a thesis summary repository, 8) submitting a hard copy of the thesis to the library, 9) submitting a hard copy of the thesis to the faculty library, and 10) submitting a soft copy of the thesis report. 3. Completing all requirements takes approximately two weeks, with each item on the list taking approximately 15-60 minutes to complete. 4. The library provides guidance to students in fulfilling library access obligations. 5. There are no errors in the data on other library access loan and deposit documents. 6. Library officers summarize data on the fulfillment of all students' free

<http://sistemasi.ftik.unisi.ac.id>

	library obligations via spreadsheet.
Pain Points	1. The paper list of obligations required for library clearance is prone to damage and loss. If lost, it takes time to re-complete the required documentation. 2. If there are long queues, it takes a long time to obtain proof signed by a librarian. 3. The length of the queue cannot be determined; when arriving during a long queue, students must wait. 4. Library clearance status can be tracked by using the paper containing the list of obligations each student brings. 5. Information regarding library clearance requirements is only provided during the initial briefing by the librarian. If you forget or miss something, you should ask a colleague who remembers or the librarian. 6. There are two buildings for handling thesis clearance requirements, which are located far from each lecture hall. 7. The verification data for library clearance obligations is very large, making it possible for data entry errors to occur. 8. Difficulty monitoring and reporting student compliance with the library clearance process.
User Needs	1. Evidence of fulfillment of library clearance obligations is stored in an information system that can be accessed at any time. 2. It can be completed independently online and verified online. 3. A printable report is provided on the results of fulfilling library clearance obligations. 4. Email and WhatsApp notifications are provided regarding the progress of fulfilling library clearance obligations. 5. An access history feature is available. 6. Information on the types of library clearance obligations, information system usage guidelines, and a helpdesk is available. 7. Library staff can verify these requirements via the information system. 8. The information system administrator can manage user data, library clearance obligations data, usage guide information, and generate reports. 9. Library leaders/unit heads can view and download reports on fulfillment of library-clearance obligations.

C. Develop

The main outputs of this stage are low-fidelity and high-fidelity wireframes. However, before designing the wireframes, a user flow is first designed to understand the processes or activities users engage in when using the application. The user flow of a library clearance information system is shown in Figure 4. Generally, user flows are depicted using basic flowchart symbols, such as circles or ovals to represent entry and exit points, rectangles to represent user actions or specific process steps, rhombuses to symbolize decision points, parallelograms to indicate data input or output processes, and arrows to indicate navigation paths or sequences of user operations.

User flows describe the sequence of steps a person takes when interacting with an application and are usually represented as a diagram connecting the entry point (the application's home page) to the final destination [25][26]. In this study, three user flows were compiled that describe the sequence of interaction steps in a library clearance application, namely by students, librarians, and library unit leaders. Based on these user flows, a set of wireframes can be compiled that represent the application pages users access. The low-fidelity wireframes for student accounts are shown in Figures 5, 6, and 7.

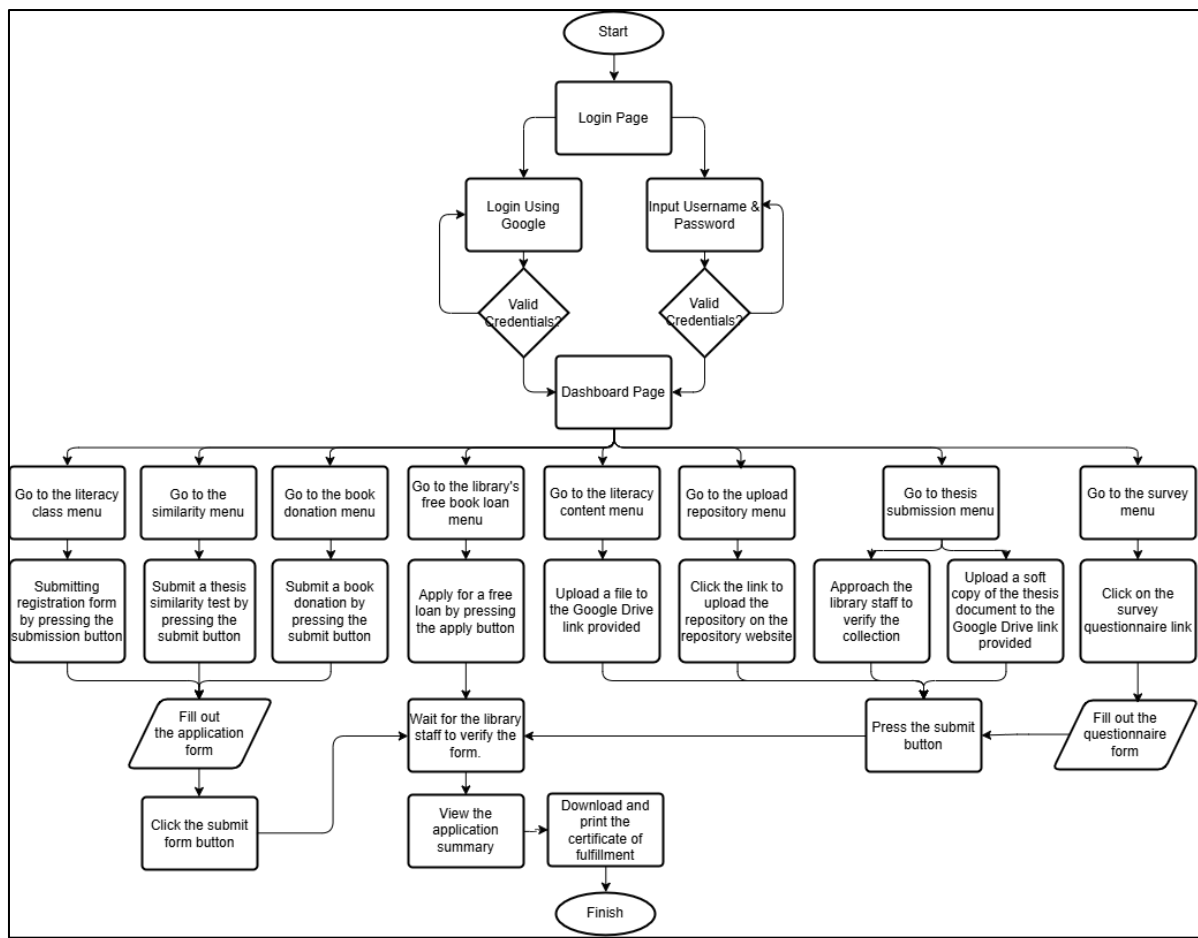


Figure 4 User flows

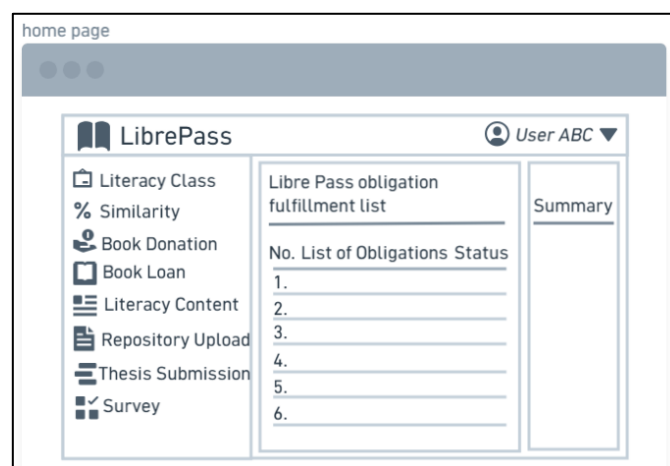


Figure 5 Low-fidelity wireframe of student account homepage

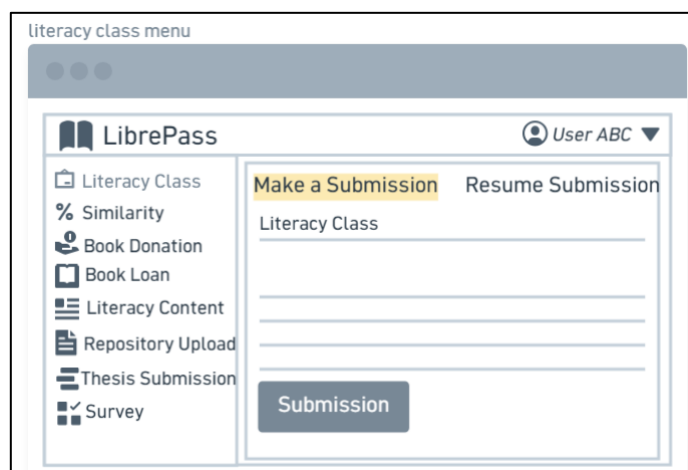


Figure 6 Low-Fidelity wireframe of literacy class page in the submission page

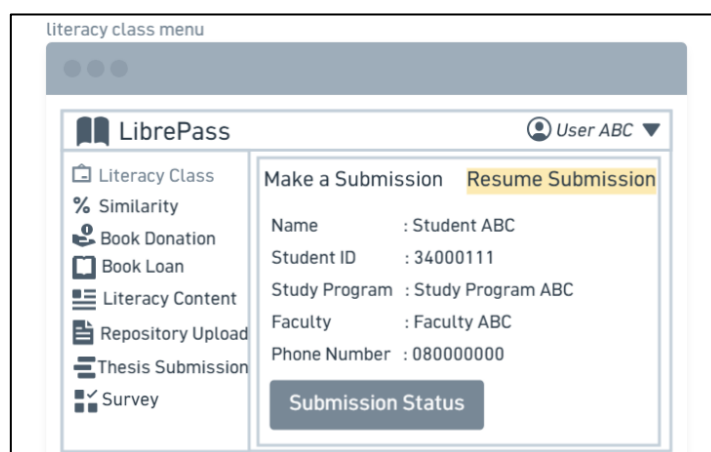


Figure 7 Low-Fidelity wireframe of literacy class page in the resume submission page

User flows for library staff are much simpler than for students, as roles and access rights related to library access are specifically assigned, such as checking similarity and collecting soft copies of thesis documents, borrowing collections and surveys, uploading documents to repositories, providing literacy content, and so on. The total number of librarians involved in the library clearance process is 53. The user flows for librarians are shown in Figure 8.

In Figure 8, the user flow for library staff is depicted in general, with menu names not specifically mentioned, because the division of tasks related to library clearance varies among staff members, ranging from 1 to 3 types of tasks from the 8 requirements for fulfilling library clearance. Based on this user flow, a low-fidelity wireframe is compiled, some of which are shown in Figures 9 and 10.

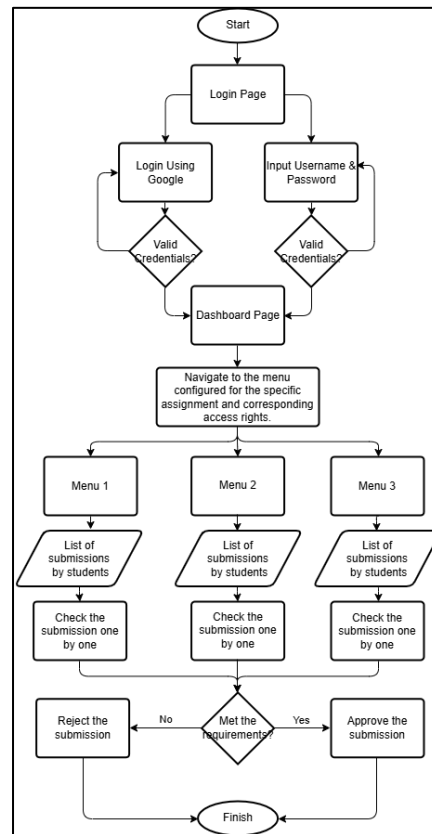


Figure 8 Library staff user flow

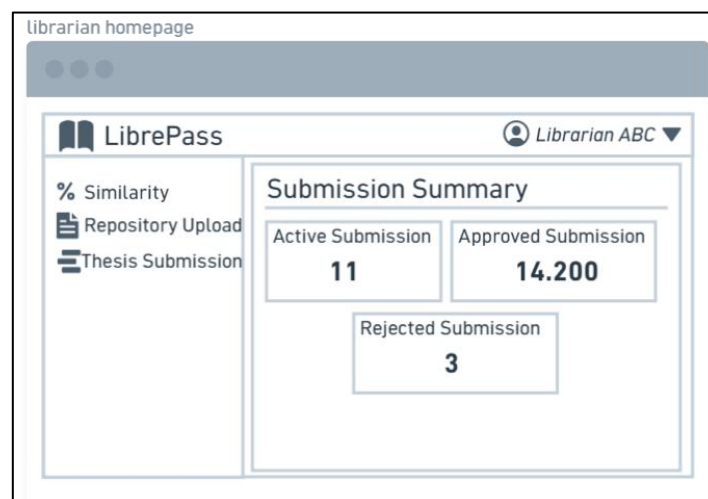


Figure 9 Low-Fidelity wireframe of the library staff homepage

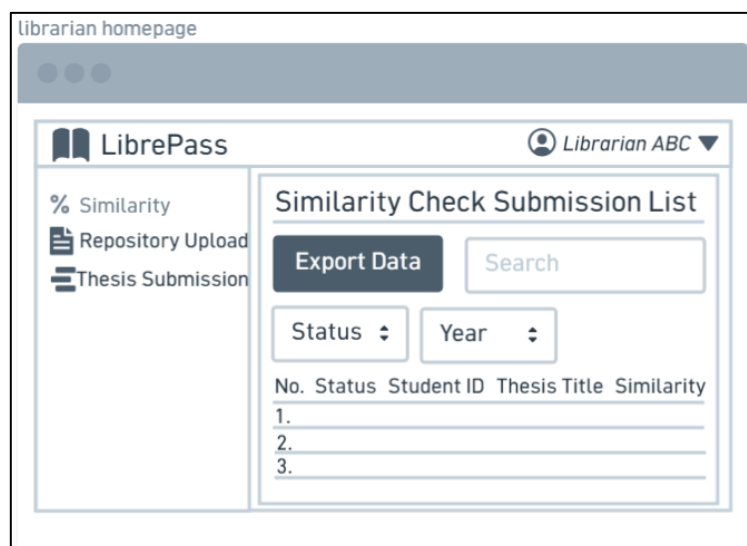


Figure 10 Low-fidelity wireframe of the library staff similarity check menu page

High-fidelity wireframes based on the designs in Figures 5, 6, 7, 9, and 10 are shown in Figures 11, 12, 13, 14, and 15. These designs are dynamic web-based prototypes that librarians and students can use.

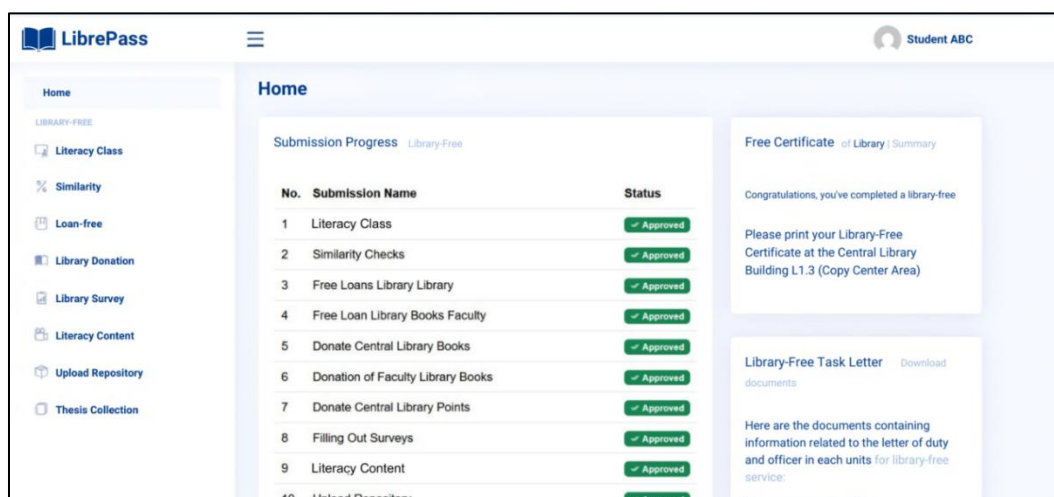


Figure 12 High-fidelity wireframe of the student homepage

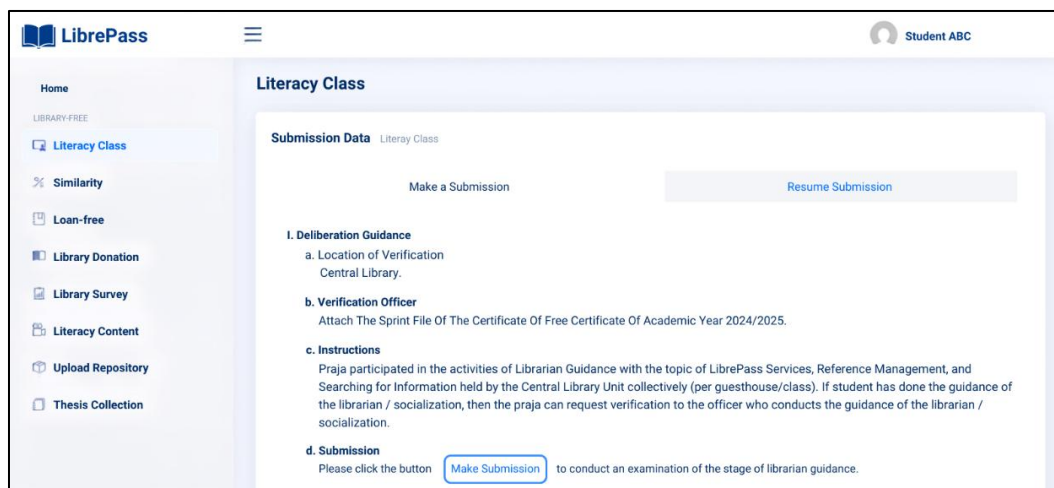


Figure 12 High-fidelity wireframe of literacy class, on the submission page

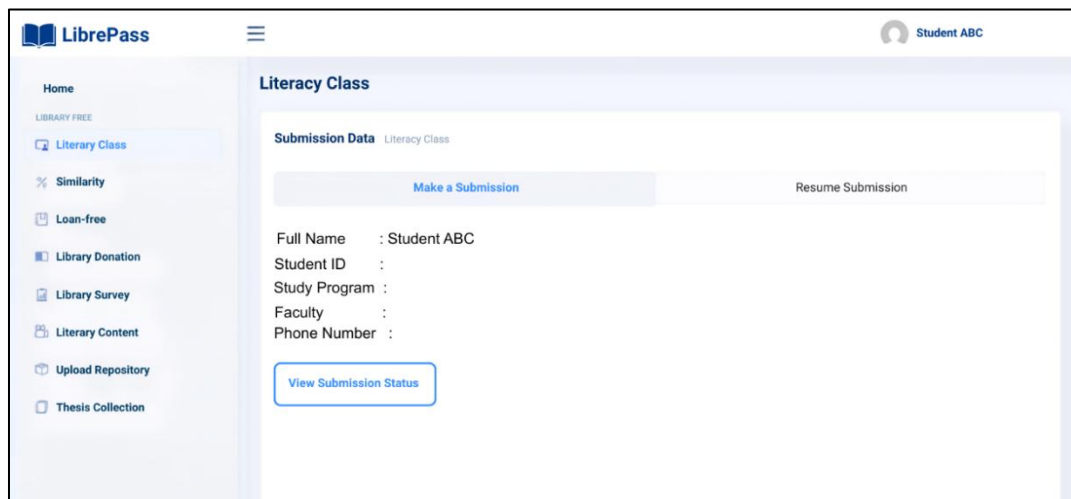


Figure 13 High-fidelity wireframe of literacy class on the resume submission page

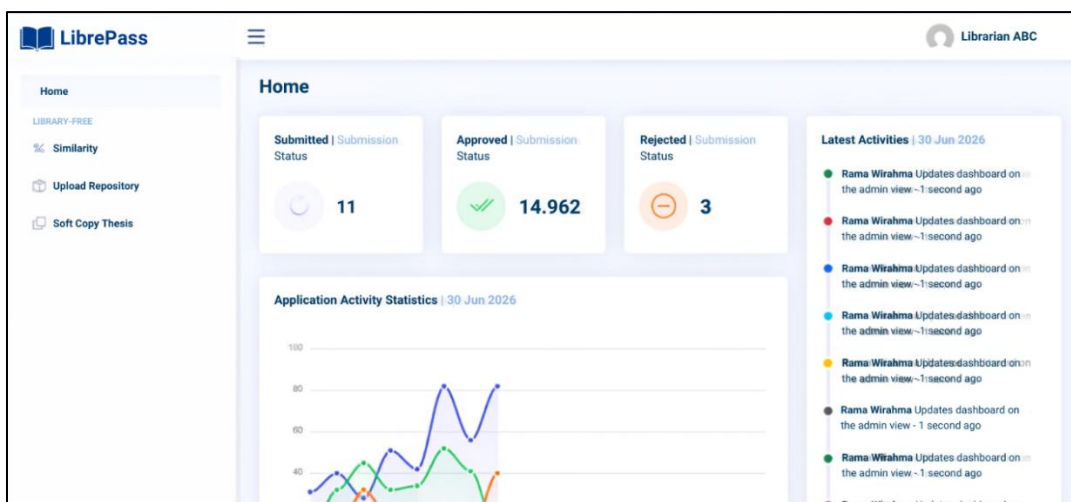


Figure 14 High-fidelity wireframe of the librarian's homepage

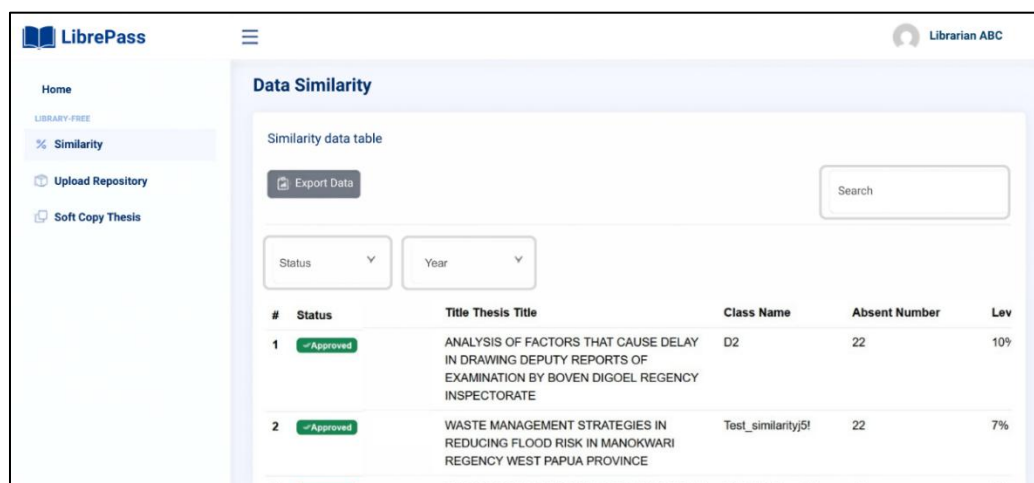


Figure 15 High-fidelity wireframe of the similarity check page

D. Deliver

This stage is the final stage of the double diamond method. At this stage, the prototype development results are presented to users for usability testing using the UEQ. The results of the UEQ questionnaire analysis are shown in Figure 16 using UEQ Data Analysis Tools, indicating that the developed prototype met general expectations for user experience.

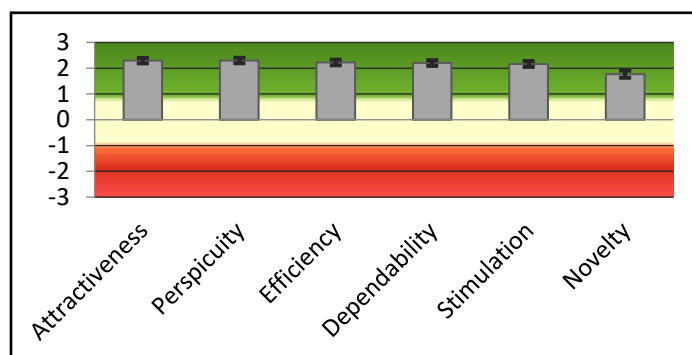


Figure 16. Graph of UEQ scale results for the librepass application

The UEQ analysis results show that all scales showed positive evaluations. Of the six UEQ measurement scales—attractiveness, clarity, efficiency, accuracy, stimulation, and novelty—all received scores above 0.8, indicating positive evaluations. Of the UEQ scales, five scored above 2.0: attractiveness (2.293), clarity (2.298), efficiency (2.223), accuracy (2.201), and stimulation (2.163). Meanwhile, the novelty scale score was 1.766, which also falls into the positive evaluation category. The results of this scale calculation are summarized in Figure 17.

UEQ Scales (Mean and Variance)		
Attractiveness	2,293	0,84
Perspicuity	2,298	0,86
Efficiency	2,223	0,92
Dependability	2,201	0,94
Stimulation	2,163	0,99
Novelty	1,766	1,46

Figure 17 Table of UEQ scale calculation results

Usability testing using UEQ also yielded benchmark calculations and assessment graphs, as shown in Figures 18 and 19. These benchmark scores are the result of comparing the average calculated scores for each scale with UEQ's benchmark dataset. Comparing the evaluated prototype results with the benchmark data in UEQ allows conclusions about the prototype's quality relative to other products.

Scale	Mean	Comparisson to benchmark
Attractiveness	2,29	Excellent
Perspicuity	2,30	Excellent
Efficiency	2,22	Excellent
Dependability	2,20	Excellent
Stimulation	2,16	Excellent
Novelty	1,77	Excellent

Figure 18 Table results of the librepass application benchmark

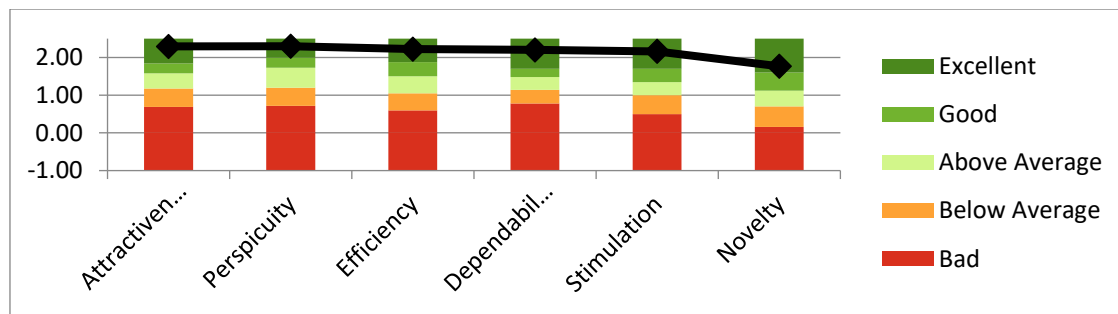


Figure 19 LibrePass application benchmark results graph

The benchmark graph from the UEQ tool shows the UX quality of the evaluated library clearance application prototype. UEQ benchmark results are divided into five categories on a scale from excellent to poor. The benchmark result with the highest score is "Excellent," meaning the tested product falls within the top 10% of benchmark results. The second-ranked benchmark result is "Good," meaning 10% of the benchmark data performs better than the tested product, but still better than 75% of the overall benchmark data. The third-ranked benchmark result is "Above Average," meaning that 25% of the benchmark data performs better than the tested product, but that better than 50% of the benchmark data does. The lowest-ranked benchmark score is "Below Average," meaning 50% of the benchmark data performs significantly better than the tested product. The lowest-ranked benchmark result is "Bad," indicating that the tested product falls within the bottom 25% of benchmark results.

Based on the benchmark evaluation results, the LibrePass application received an Excellent category on each scale. This indicates that the LibrePass application is within the top 10% of benchmark results. The attractiveness scale assessment showed that users had a positive impression of the LibrePass application prototype developed. Then, on the clarity scale, users assessed that the LibrePass application was easy to learn and that they became familiar with its existing features quickly. Furthermore, on the efficiency scale assessment, users agreed that the LibrePass application developed was very helpful in completing tasks related to the LibrePass process more easily and with less effort. Regarding the accuracy scale, users also reported that the LibrePass application allows them to easily control it. This also ultimately affects the stimulation scale value, where users found the application interesting and were motivated to complete their responsibilities in managing Library Clearance. Finally, the novelty scale had the lowest score among the other scales because it was assessed based on product innovation, which several other campuses have implemented in similar ways. However, the assessment here remains high and positive because this application is truly designed to meet the agency's business processes.

In the Discover stage, the empathy map revealed students' needs regarding the library clearance process. These included documentation of the requirements and stages, available at any time; comprehensive information on the requirements for library clearance, including procedures and locations; and the creation of an online platform. These student expectations and needs were identified in the Define stage, including experiences, barriers, and user needs. The identified needs were then used as the basis for designing wireframes in the Develop stage. The implementation of these low- and high-fidelity wireframes included the design of two "make submission" and "resume submission" pages for each library clearance requirement menu, complete with detailed information on the requirements and a summary of the stages that can be viewed at any time, as shown in Figures 12 and 13. The list of requirements can also be monitored and summarized on the homepage, as shown in Figure 11.

For the librarian role, the identified needs included ease of checking requirements through a single platform, data availability, and operational conveniences such as an easy student search. This has been addressed through low- and high-fidelity wireframes, as shown in Figure 15. The wireframes have also been adapted to the library unit's business processes, which divide librarian assignments among specific faculties and study programs. This allows librarians conducting checks to search for students' names within their assigned study programs. Librarians can also make corrections to LibrePass requirements submitted online through the website. Students can also view application

status through the "resume submission" menu. Similarly, library unit heads can monitor the application process in real time and receive progress reports on LibrePass requirements whenever needed. Data summaries of requirements from thousands of students can be easily compiled.

The translation of user needs into relevant wireframes is supported by excellent UEQ testing results. These results demonstrate the highest level of user satisfaction, particularly among students, of whom the majority (282) responded. In addition to meeting needs through menus and features, the user interface (UI) meets student expectations, as demonstrated by the attractiveness and clarity criteria, which achieved excellent benchmark results.

The test results are also in line with the application development using the double diamond approach conducted by [15], which obtained a usability score of 87/100, [14] with a usability score of 95.2%, [10] with a usability score of 92.5%, and [17] with a usability score of 85.75. The research shows that all prototypes developed are acceptable to users and meet the needs identified in the Discover stage.

However, the development of this library clearance information system (LibrePass) still requires refinement of several features, such as the addition of automatic notifications via email and WhatsApp regarding notification of the library clearance application process, whether it is accepted or rejected, and other information notifications. Furthermore, the user management feature in the administrator account cannot yet regulate the detailed assignment of librarians who serve as verifiers of library clearance requirements. The organization is still organized by the library unit's assignment letter, with assignments distributed among different staff. For example, staff A is responsible for checking the similarity of thesis reports, collecting soft copies of thesis reports, and verifying the upload of thesis summaries to the library repository. Staff B is responsible for verifying the collection of hard copies of thesis reports. Staff C is responsible for verifying library book loan data and student library surveys. Furthermore, the student application list needs to be more organized and dynamic.

The limitations in the development of this library clearance information system stem from the fact that development prioritizes users' primary needs, ensuring immediate implementation and use. Furthermore, the development team has limited time, as the information system is needed immediately. This presents an opportunity for further development and research related to the features and business processes of the LibrePass.

5 Conclusion

This research successfully provided a solution to a problem that stemmed from complaints of the academic community, particularly students and librarians. A design thinking approach using the double diamond framework enabled the creation of a LibrePass prototype library clearance information system that met user needs and desires. Began with the Discover stage by identifying user experiences, needs, and barriers through interviews, to generated an empathy map of students, librarians, and library unit heads. Thus, the Define stage yielding a definitive identification of user experiences, barriers, and needs. These identification results were used to model a low-fidelity wireframe, which was refined into a high-fidelity wireframe, and a dynamic prototype in the form of a website page that users can access directly in a browser. To ensure that the prototype met user needs and desires, usability testing using UEQ was conducted during the Deliver stage. The test results showed that attractiveness, clarity, efficiency, accuracy, stimulation, and novelty achieved an "excellent" benchmark score in average of 2,15 which means that the prototype is well-received by users and met their needs. These results also demonstrate that the double diamond stage successfully explored user needs and that the development process aligned with those needs. Future research should focus on advancing the LibrePass prototype into a fully integrated system by implementing automated email and WhatsApp notifications, as well as embedding a service survey module directly into the platform. Additionally, subsequent studies should pursue API-based data integration with both the library's book lending system and the Academic Information System to facilitate automated verification.

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