

EVALUATION AND USER INTERFACE DESIGN IMPROVEMENT RECOMMENDATIONS OF THE IMMIGRATION SERVICE APPLICATION USING DESIGN THINKING

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ABSTRACT

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The M-Paspor application is an immigration service application. It is an application that is officially managed by the Directorate General of the Ministry of Law and Human Rights of the Republic of Indonesia. With this online service system, people who wish to apply for passports do not need to come to the office and stand in line to make passports; now, they only need to access the Directorate General of Immigration's website or this mobile-based application to submit an application. This study aims to evaluate and provide recommendations for user interface improvements that can be proposed to improve the user experience of the M-Paspor application. This research used the design thinking method. Design thinking itself consists of five stages, namely empathy, define, idea, prototype, and test. Some of the problems in the user experience of the M-Paspor application are the confusing flow and interface, the loading process taking too long, the information guide not being informative, and the display being boring and inconsistent. The user experience of the M-Paspor application has been tested with 15 respondents through five usability test task scenarios. The user experience of the M-Paspor application has been tested with 15 respondents through five usability test task scenarios. The test results shown that the average aspect of effectiveness is 100%, the average aspect of efficiency is 0.133 goals/second with a range of 0.197 goals/second, and the average aspect of user satisfaction is 5.1 with a range of 2.4 (from a scale of 1 to 7).



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1. INTRODUCTION

Mobile applications, commonly referred to as mobile apps, are designed for use on various mobile devices, including smartphones, smartwatches, tablets, and similar gadgets. Mobile applications have two main components, namely, user experience (UX) and user interface (UI). User experience or user experience is a feeling or experience after using the service or product in the application, while the user interface or user interface is a visual display seen by the user when interacting with the mobile application in order to serve as a communication tool between the application and the user to understand information and using the services provided by a product or service [1]. A mobile application is a software consisting of programs that run on the device and can perform certain tasks to help the user. Mobile applications are very easy, user-friendly, inexpensive, downloadable, and can be run on most smartphones [2]. A mobile application is considered as an additional program or software that is installed on a handheld device (phone or smartphone). Called a mobile application because it is installed or downloaded on a device that is easy to carry, so it can be accessed anytime and anywhere [3]. Mobile phones or smartphones have limitations such as mobile context, connections, small screens, different resolutions, limited power capabilities, and different data entry methods from other devices [4].

In 2022, the Director General of Immigration of the Republic of Indonesia introduced a new application to facilitate passport processing from anywhere without the need to queue. The new application is called M-Paspor. This application is much easier to access via a smartphone [5]. With this online service system, instead of coming to the office and queuing to apply for a passport, people who want to apply now only need to access the website of the Directorate General of Immigration or this application to apply [6]. With the emergence of the M-Paspor mobile application, its elements greatly affect the user experience, for example, the user interface, which is a communication tool between the user and the application [7].

The user interface is a reciprocal interaction between the system and its users through a series of techniques and commands that allow users to utilize, enter data, and use content in the system [8]. The User Interface (UI) is the interface on computer devices and software that focuses on the display style [9]. Users often don't judge a system's functionality but by its user interface. If the user interface design of a system is bad, then that is often the reason users don't use it anymore. In addition, the user interface design must be user-centered, which means that the user is very involved in the design process. Therefore, there is an evaluation process carried out by the user to assess how well the user interface design system [10]. Currently, UI is an important subject in product design because the ideal UI is determined by the placement, location, size, and shape of the elements [11]. To create efficient and useful human-computer interaction, UI should be designed with several things in mind, such as the ability of the user to operate the interface and the problems faced by one user that differ from one another and must be implemented across multiple UIs. Things like input, display, sound or audio, ergonomic components, removable parts, communication methods, and applications [12]. Currently, UI is used as a discussion medium to discuss the interaction between humans and computers on a product and the use of the product [13]. In general, UI software produced by software developers is designed uniformly, which causes problems because it is not fully in accordance with the real-life conditions and circumstances of everyone who uses it [14]. Therefore, UI design should not only examine the thinking model of software developers but also what users think [15].

User experience is centered on everyone's experience, which is related to preferences, perceptions, emotions, and even psychological and physical responses of users that occur before, during, and after product use. User experience relates to individual goals, which include personal motivation, including the need to acquire new knowledge and skills, communicate personal identity, and provide pleasurable memories. User experience also emphasizes how the experience changes with using repeated [16]. True user experience is more than just providing users with what they want, but to achieve a high-quality user experience, there must be an amalgamation of services from multiple disciplines, including engineering, marketing,

As an application that was created to solve the queue problem, this application is expected to solve the problem well, but after seeing reviews from the Google Play Store and App Store and asking several people to try using this application, this application still has problems so that it makes the application this does not work as expected by the user. Some of the problems submitted by users in reviews on the Google Play Store are that users cannot sign in or sign up, and the interface is considered not good. Then, some of the problems raised by users in reviews on the App Store, such as users finding it difficult to choose the immigration office because maps cannot be seen and the OTP code input field is not available at the time of registration.

These problems are related to usability aspects: effectiveness, efficiency [17], and error [18] that affect perceived satisfaction [18], learning ability for new users [18], and recall of existing users [18] who may try to optimize application usage. The small size of mobile devices has limited the way users interact with them. Small screen size, poor connectivity, and limited input modalities are problems that impact the usability of mobile applications [19].

Design thinking is one method that can evaluate user experience as well as design user interfaces. This method is considered to have a significant impact because it provides facilities for an in-depth understanding of user needs. Design thinking methods also provide a way to increase innovation towards creative and user-centric solutions [20]. Design thinking is known as a human-centered innovation approach, which is now becoming increasingly popular globally over the last decade [21]. The desire to adopt and apply this design practice in other fields has created a sudden demand for clear and definite knowledge of design thinking. This is quite a problem for the design research community, which is shy about simplifying its object of study and appreciates multiple perspectives and rich images [22]. Design thinking revolves around a deep interest in developing an understanding of the users of the product or service to be developed. Design thinking is often referred to as 'out of the box' thinking because design designers seek to develop new ways of thinking that do not adhere to dominant or more general problem-solving methods [23]. Design thinking is a process of observing how humans work and studying how humans live their lives with the aim of finding solutions to problems faced by activities carried out every day [24]. Design thinking is a discipline that uses a lot of a designer's sensibilities. This approach can match user needs with the technological feasibility of the designed object. Decision-makers in an organization incorporate design thinking into almost every stage of their business process to be able to innovate to gain a competitive advantage [25]. Design thinking techniques provide a way to promote collaboration, find new solutions, and reach agreement within groups [26].

Design thinking research is widely applied to redesign an application. The development of tools to improve patient care information during care transitions with a design thinking methodological approach was carried out by research [27]. Redesigning the dental clinic system with design thinking is done by research [8]. Based on the research that has been done, design thinking has succeeded in redesigning the UI according to the needs of each user. However, the design thinking is lacking in small and detailed technical aspects, as is known from user feedback. Therefore, in this study, user experience will be used in design thinking so that small and detailed technical aspects can be decomposed.

The significant contribution of this paper includes using design thinking based on user experience to evaluate the M-Paspor application and providing recommendations to improve the user interface of the M-Paspor application. In what follows, the research methods and details of the proposed approach are presented, followed by a description of the research results and discussion, which is then followed by the inferred conclusions.

2. RESEARCH METHODS

The research methods consist of nine parts, i.e., study of literature, application user research, test usability application, prototype design, prototype implementation, prototype user research, test usability prototype, evaluation, and drawing conclusions and suggestions. Each part is described in detail as follows.

2.1 Study of Literature

A literature study is a thorough and comprehensive review process of research that has been done previously in accordance with the research topic discussed. Literature studies have several purposes, including sharing the results of other studies related to current research [28].

2.2 Application User Research

User research aims to help place the user at the center of the design process and the product being made [29] in the process design thinking. The first process carried out is to empathize or empathize with users; here, user research will be conducted by conducting interviews with fifteen respondents. The number of 15 respondents was chosen because a minimum of fifteen people was needed to test the validity of the questionnaire. Because this research only requires a general understanding or brief description of a problem, fifteen respondents are enough to use. The criteria of respondents are 20-25 years old, domiciled in Surabaya,

and have used the M-Paspor application. In this stage, 10 interview questions have been prepared according to **Table 1**.

Table 1. Application User Research Interview Questions List

No	Question
1	Have you ever used the M-Paspor application?
2	Do you find it easier to apply for a passport by using this application?
3	Did you easily learn this application the first time you used it?
4	How long will it take you to learn this app?
5	Are there any difficulties while learning this app? If so, what difficulties did you face?
6	Does the information and guidance provided by this application make it easier for you to learn this application?
7	Do you think the design of this application makes it easy for you?
8	Can you easily use this app when you haven't used it for a long time?
9	Can you easily find the immigration office you are looking for?
10	What do you think needs improvement in the design of this app?

2.3. Test Usability Application

Usability is a quality attribute of the user interface, which includes whether the system is easy to learn, efficient to use, fun, and so on [30]. To test usability, it is enough to do it with five people because doing it with five people is enough to find almost all usability problems [18]. Based on [31], the evaluation of the e-marketplace mobile application using the usability model, the test was carried out by involving 5 people who were representatives of users of each application. Therefore, in this test, five respondents will be needed. The five at this stage are five of the fifteen respondents in the previous stage.

First, testing usability begins by inviting respondents to try running the M-Paspor application. Next, the researcher will run a test scenario for the respondents. In the final stage, respondents will fill out a Single Ease Question (SEQ) questionnaire in Google Forms. To measure effectiveness in completing a task, you can use the formula as shown in **Equation (1)**.

$$\text{Effectiveness} = \frac{\text{Number of tasks completed successfully}}{\text{Total number of tasks undertaken}} \times 100\% \quad (1)$$

Then, the efficiency component can be measured based on the time required by the respondent to complete a task using the formula as shown in **Equation (2)**.

$$\text{Time Based Efficiency} = \frac{\sum_{j=1}^R \sum_{i=1}^N \frac{n_{ij}}{t_{ij}}}{NR} \quad (2)$$

Information:

N : Number of tasks.

R : Number of respondents.

n_{ij} : Respondent has completed the task. If it succeeds it is given a value of 1 and it fails, it is given a value of 0.

t_{ij} : Respondent's time to complete the task. If the task cannot be completed, then the time will be counted until the respondent gives up on doing the task.

The selection of tasks for usability testing in this study is based on the functions contained in the main page of the M-Paspor application, as shown in **Table 2**.

Table 2. Application Usability Testing Task List

No	Task Name
1	Log in
2	Choosing the Tanjung Perak Surabaya Immigration Office
3	View history
4	Access general information details of Passport Requirements
5	Edit profile by filling in home address

2.4. Design Thinking

Design thinking is an iterative process that aims to understand users, challenge assumptions, and redefine the problem to identify strategies and solutions. Design thinking is often referred to as thinking 'out of the box' because designers are trying to develop new ways of thinking that do not adhere to one or more of the dominant problem-solving methods in general. The design process itself often involves several groups of people different in different departments. Therefore, developing, categorizing, and organizing problem ideas and solutions can be difficult. One way to keep a design project on track and organize the core ideas is to use a design thinking approach.

Design thinking starts with empathy and human factors to gain knowledge that can open new perspectives and actions to create situations that benefit both business and society. At the heart of design thinking is the desire to improve a product by analyzing and understanding how users interact with the product and studying the circumstances in which users use the product. Design thinking helps designers carry out proper research and prototyping and experiment with products and services to find new ways to improve products, services, or models [23]. The five steps of design thinking are as follows:

1. Empathize for the user. Design thinking cannot be started without a deeper understanding of the people who use the product or service. To gain empathy for people, designers often passively observe or interview people.
2. Define the needs and problems of users and designer information about the design. The purpose of this step is to find a problem to solve.
3. Ideate answers and provide solutions to user-defined problems. At this stage, design team members must take each other's ideas and build on them, finding ways to connect concepts, identify patterns, and translate ideas that seem impossible, then come up with new ideas.
4. Prototype as an application from the previous steps. During prototyping, the designer creates a simple experimental model of the offered product, so that he can check how well the model fulfils the user's wishes with the help of the feedback received.
5. Test the prototype produced and the proposed solution. Then, an analysis and evaluation are carried out to determine if there are still obstacles or other limitations in the tests.

2.5. Prototype Design

The initial design of the prototype will be done by paper prototyping. Paper prototyping is making a prototype by drawing an interface design on paper.

2.6. Prototype Implementation

The design that has been made previously on paper media is called a low-fidelity prototype. After that, the prototype design will continue with the manufacture of a high-fidelity prototype on the Figma software.

2.7. Prototype User Research

User research is done by conducting interviews again. Respondents were given 10 questions, which are described in **Table 3**.

Table 3. List of Prototype User Research Interview Questions

No	Question
1	Do you find it easier to apply for a passport by using this prototype?
2	Did you learn this prototype easily compared to the M-Paspor application?
3	Do you think the design that this prototype has is better than the M-Paspor app?
4	Were there any difficulties while studying this prototype? If so, what difficulties did you face?
5	Does the information and guide provided by this prototype make it easier for you to learn this application?
6	Do you think the design of this prototype makes it easy for you?
7	Do you think the user experience you get through this prototype is better than the M-Paspor app?

No	Question
8	Can you easily find the kanim you are looking for through this prototype?
9	Has this prototype solved your previous problem?
10	Is there anything else you think needs to be improved from this prototype?

2.8. Test Usability Prototype

Testing or testing is the last stage in design thinking. This test will be carried out by testing the usability aspect of the prototype that has been made. The usability testing method on this prototype is the same as the application usability testing method. Respondents at this stage are also the same as respondents at the application usability testing stage. Then, respondents will also fill out a SEQ questionnaire in the form of Google Forms, the same as the application usability testing stage, to re-measure the level of difficulty of the given task.

2.9. Evaluation

After getting the results of the usability testing of the prototype, an evaluation will be carried out by comparing the results of user research and usability testing of the prototype with the results of user research on usability testing of the M-Paspor application. This process will be iterated if the results of the usability testing of the prototype and the questionnaire obtained have not increased compared to the value of the usability test results of the M-Paspor application.

2.10. Drawing Conclusions and Suggestions

The last stage is drawing conclusions and suggestions. Drawing conclusions here, is intended as one step in finding the overall meaning of what was obtained during the research and the results obtained. In addition to the conclusions, suggestions will be explained so that the next research can be even better and get more optimal results.

3. RESULTS AND DISCUSSION

In this section, we discuss the results discussion. The results consist of study of literature, application user research, test usability application, prototype design, prototype implementation, prototype user research, test usability prototype, evaluation, and drawing conclusions and suggestions.

3.1 Study of Literature

Based on the literature study that has been carried out, some of the results of the literature study that have been obtained include user experience or user experience centered on the experience of everyone related to preferences, perceptions and emotions even the psychological and physical responses of users that occur before, during and after product use. User experience can be measured by how much the user interacts with the product through the user interface design. A good user interface should unify user interactions.

The M-Paspor application, which is a mobile application managed by the Directorate General of the Ministry of Law and Human Rights, was created for the purpose of assisting the public in managing passports. With this application, people now only need to access the application to apply without the need to come to the office and queue to apply for a passport.

The design thinking method is one method that can evaluate user experience and design user interfaces. This method is considered to have a significant impact because it provides facilities for an in-depth understanding of user needs.

3.2 Application User Research

From the interview results, it was found that twelve respondents felt it was quite easy to learn this application when they first used it, while three respondents found it difficult when using this application for the first time, two out of fifteen respondents felt that the information and guidance possessed by the M-

application Passports do not make it easier for respondents to study the application because it is less interactive, respondents find it difficult to choose an immigration office because *user interface* which is confusing at this step, and there are varied responses regarding things that need to be improved from the M-Paspor application design, including the following:

1. Banners on the uninformative and unclickable home page
2. Confusing immigration office search page
3. Unattractive display of general information
4. Inconsistent font size
5. Use of non-standard Indonesian
6. No back button on the profile edits page
7. There is no search feature on the Information page.

3.3 Test Usability Application

After testing the five scenarios according to **Table 2** to five respondents, the test results for each usability aspect (effectiveness, efficiency, and user satisfaction) were obtained. The test results from the effectiveness aspect are shown in **Table 4**. The test results from the efficiency aspect are shown in **Table 5**. The Test results from the user satisfaction aspect are shown in **Table 6**.

Table 4. Application Effectiveness Aspect Test Results

	T1	T2	T3	T4	T5
R1	1	1	1	1	1
R2	1	1	1	1	1
R3	1	1	1	1	1
R4	1	1	1	1	1
R5	1	1	1	1	1

Information:

R : Respondent

T : Tasks given to respondents in accordance with Table 2 (worth 1 if successfully completed, 0 if failed)

Table 4 shows that all respondents successfully completed all the tasks given from the first task to the fifth task. Furthermore, the aspect studied is efficiency, which is assessed based on the time used to complete each given task. The results of testing aspects of application efficiency based on time are shown in **Table 5**.

Table 5. Application Efficiency Aspect Test Results (seconds)

	T1	T2	T3	T4	T5
R1	14.4	130.2	9.39	5.99	61.8
R2	13	66	2.73	4.13	42.52
R3	27.8	132.6	9.74	3.59	56.06
R4	19.6	73.2	5.99	12.28	44.23
R5	11.93	37.4	3.21	6.13	67.81

Furthermore, testing the aspects of user satisfaction is carried out. This is done by giving the SEQ questionnaire to 5 respondents. SEQ questionnaire consists of a scale of 1 (very difficult) to 7 (very easy). The results of Application User Satisfaction are shown in **Table 6**.

Table 6. Application User Satisfaction Results

	T1	T2	T3	T4	T5
R1	5	2	7	6	6
R2	3	5	7	6	6
R3	3	2	6	4	4
R4	5	3	7	7	6
R5	5	2	7	7	6

After conducting the test, the results of each usability aspect were measured for each task described in **Table 7**, **Table 8**, and **Table 9**. **Table 7** shows that the results of measuring the effectiveness aspect get 100% results for the five tasks that have been given. This indicates that the functions of the M-Paspor application can be operated by respondents.

Table 7. Aspects of Application Effectiveness Measurement Results

No	Task	Effectiveness
1	T1	100%
2	T2	100%
3	T3	100%
4	T4	100%
5	T5	100%

Table 8 shows that the results of measuring the efficiency aspect of the M-Paspor application; the results range from 0.014 to 0.211 goals/sec. The task that has the highest efficiency value is Task 3.

Table 8. Application Efficiency Aspect Measurement Results

No	Task	Efficiency
1	T1	0.063 goals/sec
2	T2	0.014 goals/sec
3	T3	0.211 goals/sec
4	T4	0.186 goals/sec
5	T5	0.019 goals/sec

Table 9 shows task 1 got a value of 4.2, which means that the task was easy enough for the user to do. Task 2 got a value of 2.8, which means that the task was difficult for the user to do. Task 3 got a value of 6.8, which means that the task was easy for the user to do. Task 4 got an average score of 6 which means the task was easy to do. Task 5 gets an average score of 5.6, which means that the task was quite easy for the user to do. The task that gets a low score is task 2, so it can be concluded that the usability of the M-Paspor application for the aspect of user satisfaction is quite good, but there is still a need for improvement, especially in the user interface.

Table 9. Application User Satisfaction Aspects Measurement Results

No	Task	Average Score of Questionnaire Results
1	T1	4.2
2	T2	2.8
3	T3	6.8
4	T4	6
5	T5	5.6

3.4 Prototype Design

After completing the empathize and define stages, the next ideate process will be carried out which aims to generate ideas as solutions in answering the problems faced by users. Some ideas that will be implemented at a later stage. Here are some ideas that will be used to improve the user interface of the M-Paspor application:

1. Making changes to the selection of the immigration office by distinguishing and explaining between the user's location selection and the selection of the immigration office location to be searched for.
2. Improve the consistency of the use of margins, font size, sentences and grammar. Make sure they are good and correct.
3. Provide icons for buttons that need them and remove symbols or icons for buttons that don't need them.
4. Added search features in Information, FAQ and Help Center to make it easier for users to find the information they want to find.
5. Added a login feature using another account such as Google, so that users can more easily log into the application.

6. Improving the appearance of the banner so that it is more informative and works well by making the banner clickable and the information in it can be conveyed properly.
7. Added confirmation dialogs when the user makes changes and leaves the edit page.

Next, design a prototype by drawing a prototype on paper. Login Page Prototype Design as shown in **Figure 1**. Homepage Prototype Design as shown in **Figure 2**. The Immigration Office Selection Page Prototype Design is shown in **Figure 3**. The information on the Page Prototype Design is shown in **Figure 4**. Profile Page Prototype Design as shown in **Figure 5**.



Figure 1. Login Page Prototype Design

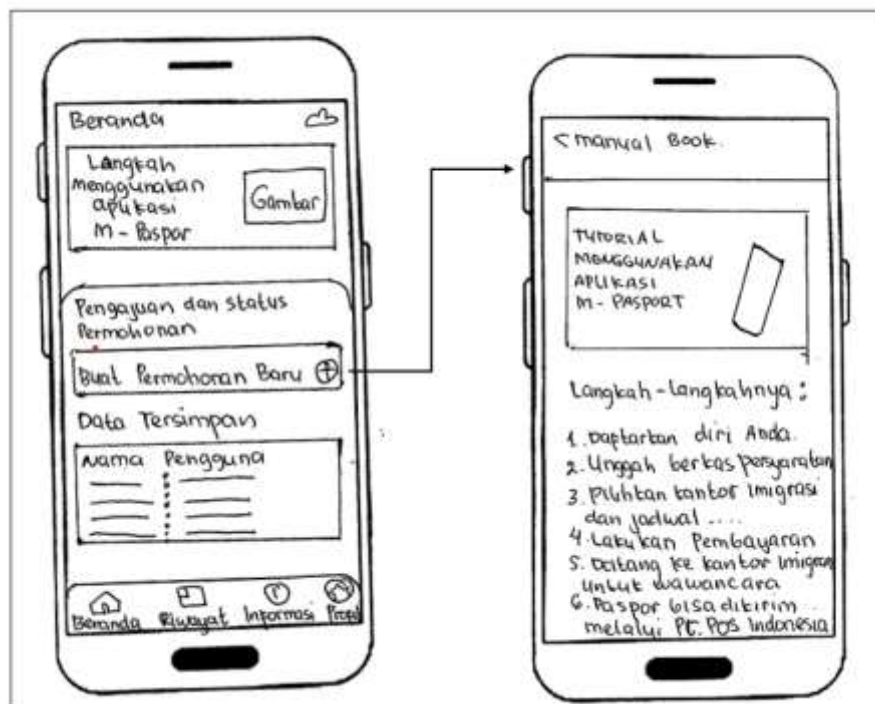


Figure 2. Homepage Prototype Design

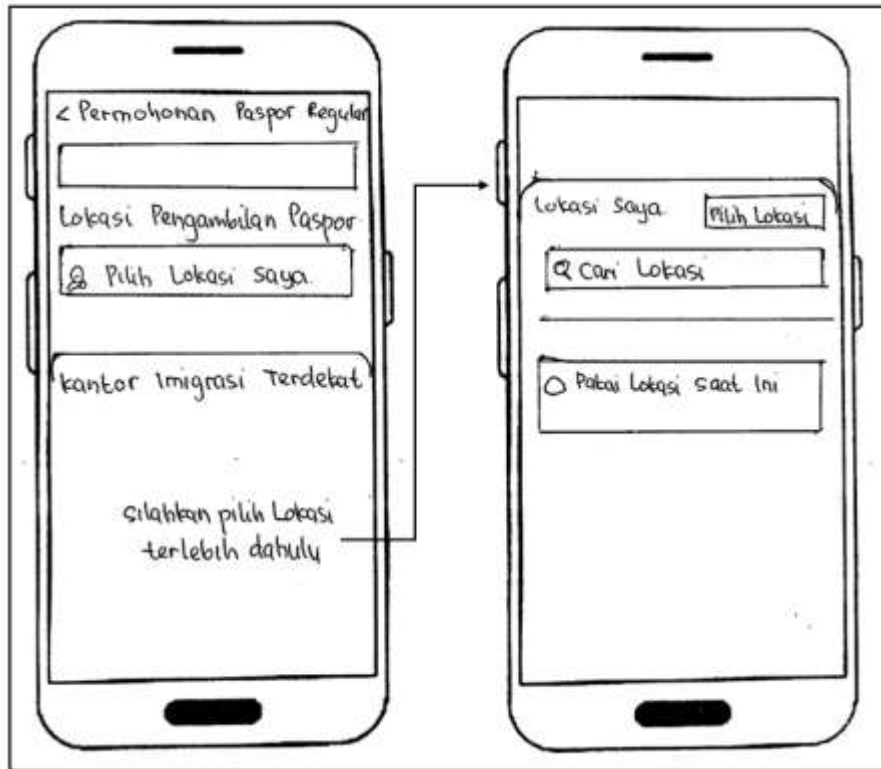


Figure 3. The Immigration Office Selection Page Prototype Design

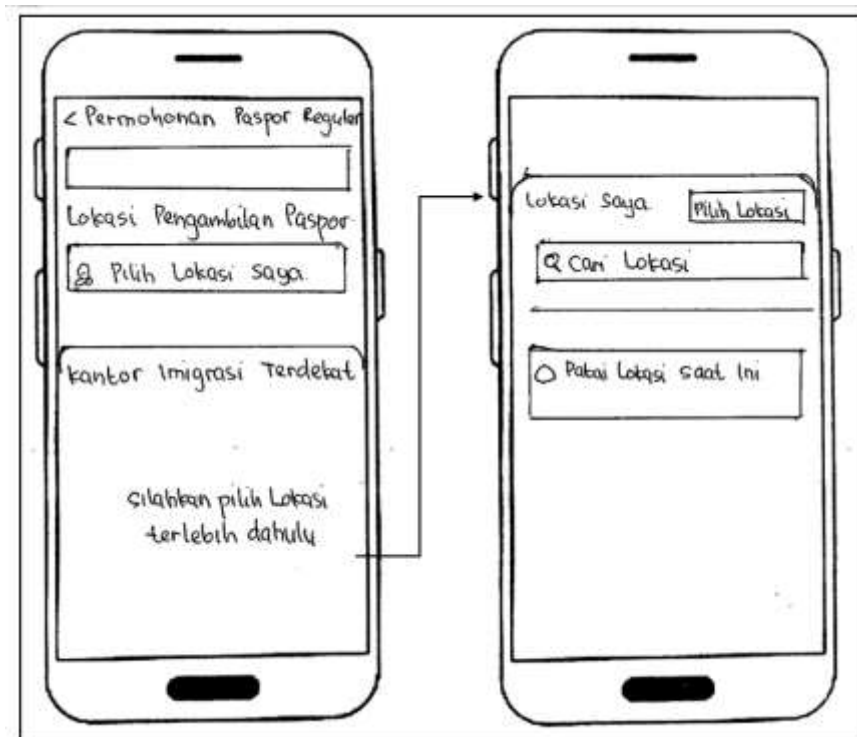


Figure 4. Information Page Prototype Design

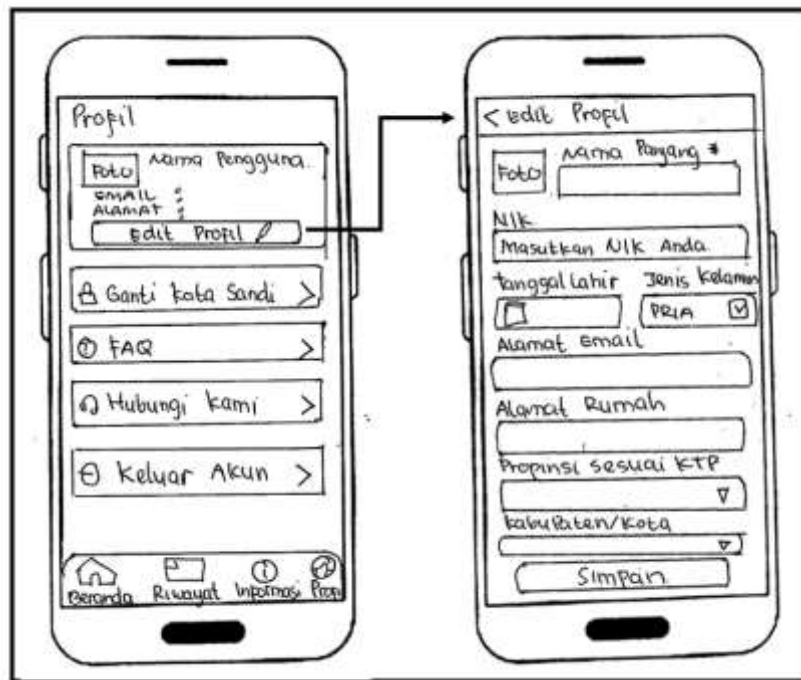


Figure 5. Profile Page Prototype Design

3.5 Prototype Implementation

The Prototype Implementation consists of five parts, i.e., Page Repair Log in, Home Page Repair, Immigration Office Selection Page Improvement, Information Page Repair, and Profile Page Repair. Each section is described in detail as follows:

1. Repair Log in Page

In accordance with the design that has been made, in the implementation of the prototype log in page, what is added is the Log in button with a Google account under the Log in button. In addition, the log in button will be disabled if the user has not filled in the email address and password correctly and vice versa, as shown in **Figure 6**.

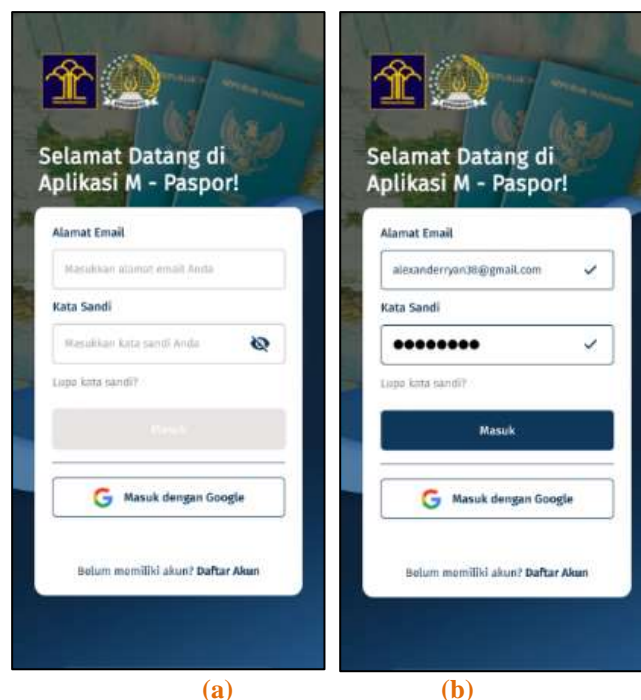


Figure 6. Improvements to the Login Page (a). Blank login page (b). Filled login page.

2. Home Page Repair

The first fix on the home page is to equalize the font size on the page title. Then, fix the banner to display only the title or headline and make the banner clickable, which will take you to a new page when the user clicks on it. Then, make the Create New Request button as long as the stored data looks aligned, which makes it easier for users to click on it.

Next, separate and give the title "Saved Data" to the stored data so as not to confuse the user; besides that, a delete button is given so that the user does not need to click on the data to delete the data they want to delete as shown in **Figure 7**.

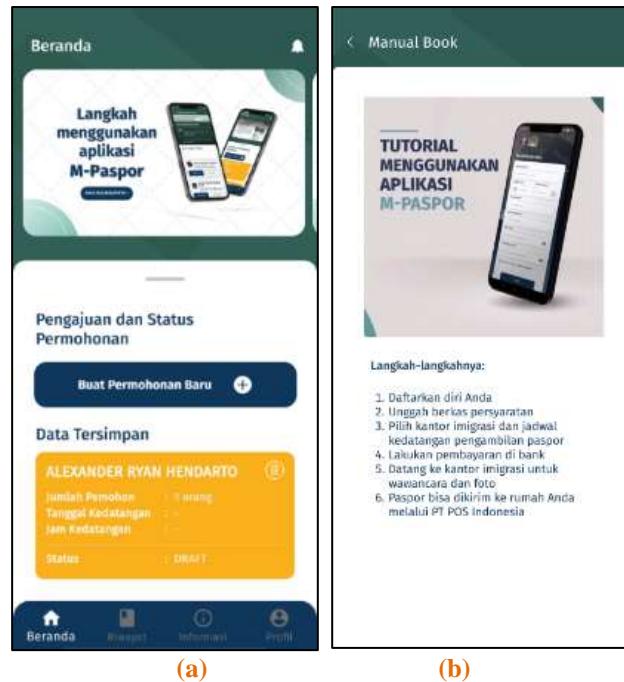


Figure 7. Home Page Repair (a). Home page (b). Manual Book

3. Immigration Office Selection Page Improvement

Prototyping according to the design made, the flow that is changed is that when you first enter the Step 6 page, the user's location will be automatically filled, and the nearest immigration office will immediately appear. The user can change the user's location by clicking on the location and then looking for it in the search box, as shown in **Figure 8**.

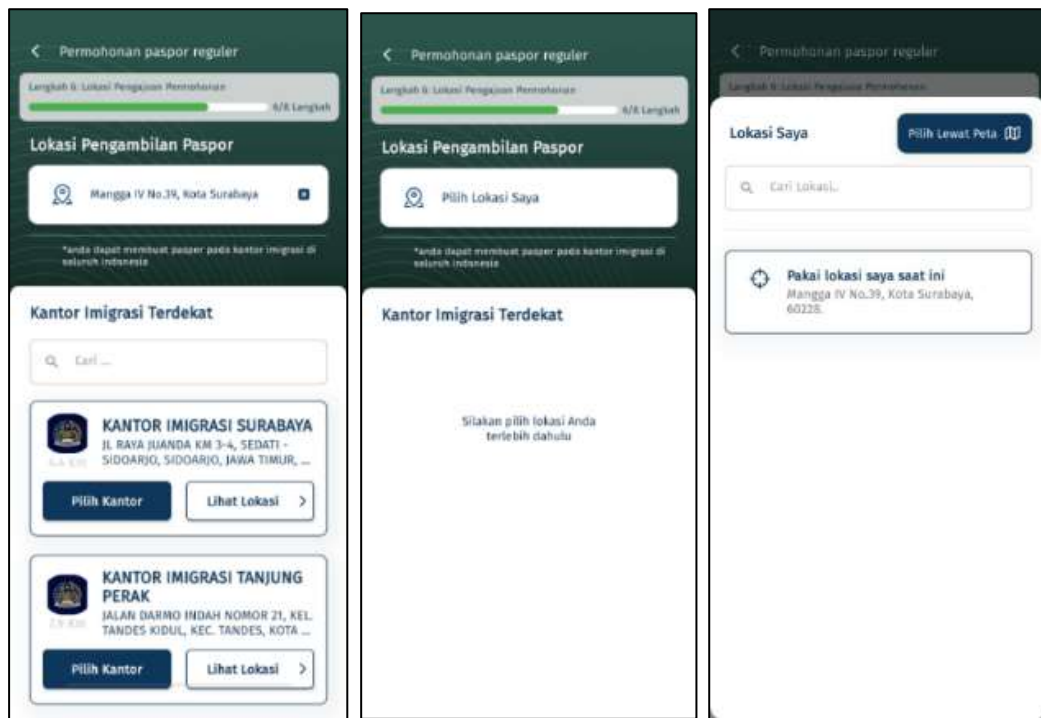


Figure 8. Improvements to the Immigration Office Selection Page (a). Details of Immigration Office (b). Immigration Office to be selected (c). Selected Immigration Office

4. Information Page Repair

Improvements made to the Information page, namely the first is to add a search box to make it easier for users to find the information they want to find, then for detailed information, an accordion menu is made for each section so that the full text does not appear and makes it easier for users to read which information section is as shown in **Figure 9**.

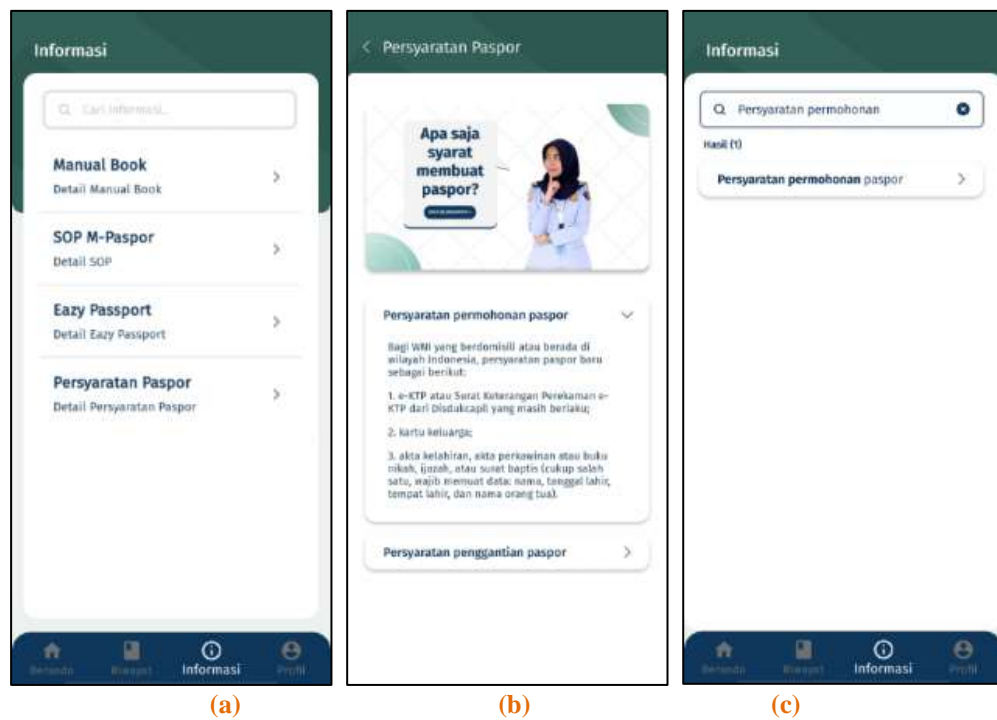


Figure 9. Information Page Repair (a). Information Page (b). Details of Application Requirements Page (c). Information of Application Requirements Page

5. Profile Page Repair

On the Profile page, the improvement made is to make the edit profile button bigger and in the middle. Then, on the edit profile page, the save button is always in the bottom center position, which means the user no longer needs to scroll down to find the save button. Additionally, added a back button, which is on the top left. Improvements have also been made, namely adding FAQ and Contact Us features. The FAQ feature aims to help users find information about common or frequently asked questions. Because the M-Paspor application is still in the development stage and users often encounter errors when using it, the Contact Us feature aims to help users convey problems that they encounter when using this application. In addition, provide an icon for each button on the Profile page and create a red account exit button indicating that the action taken by a malicious user is logging out of the account, as shown in **Figure 10**.

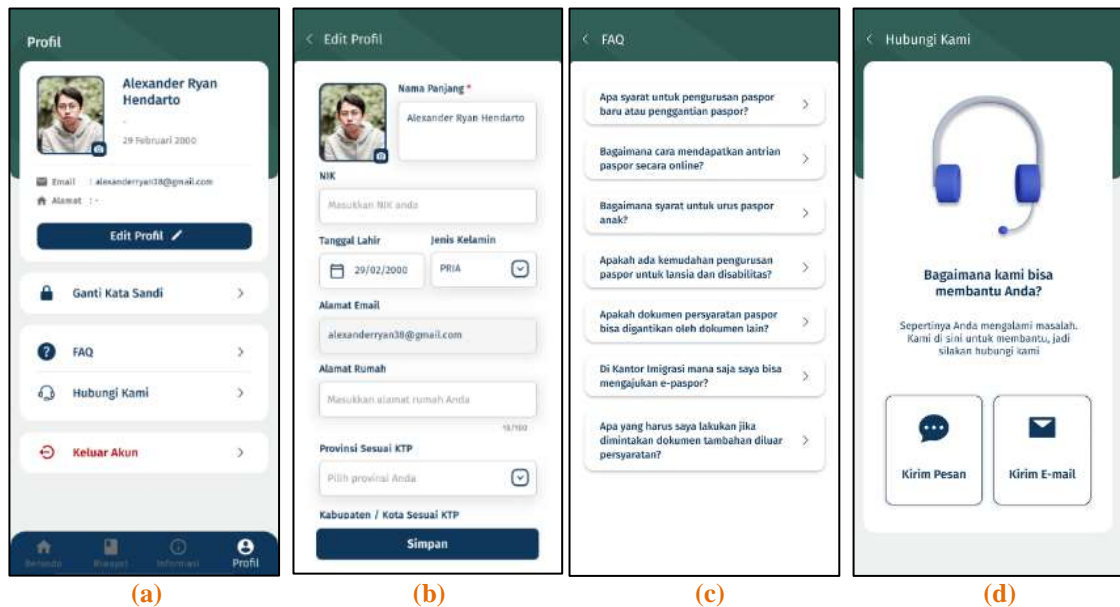


Figure 10. Improvements Profile Page (a). Profile Page (b). Edit Profile Page (c). FAQ Page (d). Contact Page

3.6 Prototype User Research

From the results of interviews that have been carried out again, some of the results are almost all respondents found it easier to learn this prototype than the M-Paspor application, while two respondents found it quite easy. Then, all respondents felt that the design of this prototype was better than the M-Paspor application, all respondents felt that the user experience they received through this prototype was better than the M-Paspor application, and all respondents felt that there was nothing that needed to be improved of this prototype.

3.7 Test Usability Prototype

The testing phase used a smartphone with the Android operating system, 4 GB of RAM, and the Figma Mirror application. The five respondents in this prototype usability test were the same as the respondents in the previous application usability test and were given the same five task scenarios, according to **Table 2**. **Table 10** explains that all respondents successfully completed all the tasks given from the first task to the fifth task. The test results from the Prototype effectiveness aspect are shown in **Table 10**.

Table 10. Prototype Effectiveness Aspect Test Results

	T1	T2	T3	T4	T5
R1	1	1	1	1	1
R2	1	1	1	1	1
R3	1	1	1	1	1
R4	1	1	1	1	1
R5	1	1	1	1	1

Furthermore, the aspect of efficiency is based on the time to complete each given task. **Table 11** shows the diversity of test results for each task assigned. Task 1 shows 2 - 4 seconds, task 2 shows 7 - 11 seconds,

task 3 shows 0 - 1 seconds, task 4 shows 3 - 5 seconds, and task 5 shows 7 - 11 seconds. The test results are shown in **Table 11**.

Table 11. Prototype Efficiency Aspect Test Results (seconds)

	T1	T2	T3	T4	T5
R1	2.63	10.68	1.59	5.42	11.31
R2	4.62	11.34	1.31	3.87	13.49
R3	4.62	8.14	1.49	3.17	7,10
R4	4.94	9.22	1.39	5.8	7.12
R5	4.65	7.94	0.71	5.68	13.65

The third aspect of usability testing is the user satisfaction aspect, which is conducted by providing a Single Ease Question (SEQ) questionnaire with a scale ranging from 1 (very difficult) to 7 (very easy). The results of testing aspects of user satisfaction are shown in **Table 12**. Tasks 1 to 5 obtain a scale of 6 and 7, meaning that these tasks were very easy to carry out and work on.

Table 12. Prototype User Satisfaction Aspect Test Results (Seconds)

	T1	T2	T3	T4	T5
R1	7	6	7	6	7
R2	7	7	7	6	7
R3	7	6	7	6	6
R4	7	7	7	7	7
R5	7	7	7	7	7

3.8 Evaluation

This stage was carried out to compare the aspects of effectiveness, efficiency, and user satisfaction from the application and improvement prototype. Comparison of Application and Prototype Effectiveness Aspects Results as shown in **Table 13**. Comparison of Application and Prototype Efficiency Aspects Results as shown in **Table 14**. Comparison of Application and Prototype User Satisfaction Aspects Results are shown in **Table 15**.

Table 13. Application and Prototype Effectiveness Aspects Results

No	Task	App Effectiveness	Prototype Effectiveness
1	T1	100%	100%
2	T2	100%	100%
3	T3	100%	100%
4	T4	100%	100%
5	T5	100%	100%

Table 14. Application and Prototype Efficiency Aspects Results

No	Task	Application Efficiency	Prototype Efficiency
1	T1	0.063 goals/sec	0.246 goals/sec
2	T2	0.014 goals/sec	0.110 goals/sec
3	T3	0.211 goals/sec	0.838 goals/sec
4	T4	0.186 goals/sec	0.221 goals/sec
5	T5	0.019 goals/sec	0.103 goals/sec

Table 15. Application and Prototype User Satisfaction Aspects Results

No	Task	Application User Satisfaction	Prototype User Satisfaction
1	T1	4.2	7
2	T2	2.8	6.6
3	T3	6.8	7
4	T4	6	6.4
5	T5	5.6	6.8

From the results of the measurement of the effectiveness of both, it can be seen that both from the application and the prototype, the respondent successfully completed all tasks, or in other words, the functions possessed by both can be used and operated by the respondent.

Next, from the comparison of the efficiency aspect of the application and the prototype, for task 1, there was an increase of 290.5% with an efficiency value of 0.246 goals/sec. Then, task 2 increased by 685.7% with an efficiency value of 0.110 goals/sec, task 3 increased by 297.2% with an efficiency value of 0.838, task 4 increased by 18.8% with an efficiency value of 0.221 goals/sec., and task 5 increased by 442.1% with an efficiency value of 0.103 goals/sec. From the comparison results, it can be seen that all tasks have increased.

Finally, the results of the comparison of the user satisfaction aspects of the M-Paspor application and the improved prototype can be seen that task 1 has increased by 66.7%, task 2 has increased by 135.7%, task 3 has increased by 2.9%, task 4 increased by 6.7% and task 5 increased by 21.4%. From the comparison results of the user satisfaction aspect of the M-Paspor application and the improved prototype, it can be seen that all tasks experienced an increase, and the largest increase was in task 2.

4. CONCLUSIONS

User experience (user experience) of the M-Paspor application has been successfully tested through five test task scenario usability with the average result of 100% effectiveness aspect, the average efficiency aspect is 0.133 goals/sec with range 0.197goals/sec, and the average aspect of user satisfaction is 5.1 with range 2.4 (on a scale of 1 to 7).

There were seven main ideas that were used to improve the user interface of the M-Paspor application, namely improving the appearance of the immigration office selection, improving the consistency of the use of margins, font sizes, sentences, and grammar that were good and correct, providing icons for buttons that were needed, added a search feature in Information, FAQ and Help Center features, added a login feature with a Google account, made the banner on the Home page informative and clickable, and added confirmation dialogs.

REFERENCES

- [1] A. E. Budi and E. F. Jasjfi, "Kajian Peranan Desain Ux (Pengalaman Pengguna) - Ui (Antar Muka Pengguna) Mobile Application Kategori Transportasi Online Terhadap Gaya Hidup Bertransportasi Masyarakat Urban," *J. Seni dan Reka Ranc.*, vol. 1, no. 1, pp. 181–207, 2018.
- [2] W. Chmielarz, M. Zborowski, M. Atasever, and A. Fandrejewska, "Smartphone and Mobile Applications Usage . Comparison Poland- Smartphone and Mobile Applications Turkey Usage . Comparison Poland-," *Procedia Comput. Sci.*, vol. 192, pp. 1369–1384, 2021, doi: 10.1016/j.procs.2021.08.140.
- [3] M. Strenitzerova and K. Stalmachova, "Customer requirements for urban public transport mobile application," *Transp. Res. Procedia*, vol. 55, no. 2019, pp. 95–102, 2021, doi: 10.1016/j.trpro.2021.06.010.
- [4] D. Zhang, "Challenges , Methodologies , and Issues in the Usability Testing of Mobile Applications," *Int. J. Hum. Comput. Interact.*, vol. 18, no. 3, pp. 293–308, 2005.
- [5] D. Imigrasi, *Buku Panduan Aplikasi Layanan Paspor Online*. 2021.
- [6] Rayadi, "Sistem informasi pelayanan paspor republik indonesia," *Integr. J.*, vol. 5, pp. 13–20, 2015.
- [7] O. Al-shamaileh and A. Sutcliffe, "Why people choose Apps : An evaluation of the ecology and user experience of mobile applications," *Int. J. Hum. - Comput. Stud.*, vol. 170, no. March 2022, p. 102965, 2023, doi: 10.1016/j.ijhcs.2022.102965.
- [8] I. Engineering, U. Indonesia, and A. Suzianti, "User Interface Redesign of Dental Clinic ERP System using Design Thinking : A Case Study," pp. 193–197, 2019.
- [9] H. W. Alomari, V. Ramasamy, J. D. Kiper, and G. Potvin, "A User Interface (UI) and User eXperience (UX) evaluation framework for cyberlearning environments in computer science and software engineering education," *Heliyon*, vol. 6, no. November 2019, p. e03917, 2020, doi: 10.1016/j.heliyon.2020.e03917.
- [10] L. A. M. Zaina, R. P. M. Fortes, V. Casadei, L. Seiji, D. Maria, and B. Paiva, "Preventing accessibility barriers : Guidelines for using user interface design patterns in mobile applications ☆," *J. Syst. Softw.*, vol. 186, p. 111213, 2022, doi: 10.1016/j.jss.2021.111213.
- [11] S. Hsiao, C. Lee, M. Yang, and R. Chen, "User interface based on natural interaction design for seniors," *Comput. Human Behav.*, vol. 75, pp. 147–159, 2017, doi: 10.1016/j.chb.2017.05.011.
- [12] F. Calisir, E. Cevikcan, H. C. Akdag, and I. A. Areas, *Industrial Engineering in the Big Data Era*. 2018.
- [13] B. H. Mass, E. Horizon, T. Collaboration, and K. Akiyama, "Analysis of User Interface and User Experience on Comrades

- Application Analysis of User Interface and User Experience on Comrades Application,” in *Material Science and Engineering*, 2018. doi: 10.1088/1757-899X/407/1/012127.
- [14] H. Ji, Y. Yun, S. Lee, K. Kim, and H. Lim, “An adaptable UI / UX considering user ’ s cognitive and behavior information in distributed environment,” *Cluster Comput.*, vol. 21, no. 1, pp. 1045–1058, 2018, doi: 10.1007/s10586-017-0999-9.
- [15] P. Liu, Z. Jiang, T. Li, G. Wang, R. Wang, and Z. Xu, “User experience and usability when the automated driving system fails : Findings from a field experiment,” *Accid. Anal. Prev.*, vol. 161, no. July, p. 106383, 2021, doi: 10.1016/j.aap.2021.106383.
- [16] N. Bevan, J. Carter, J. Earthy, T. Geis, and S. Harker, “What are user requirements ? Developing an ISO standard”.
- [17] K. Vincent, M. Daly, C. Scannell, and B. Leathes, “What can climate services learn from theory and practice of co-production ?,” *Clim. Serv.*, vol. 12, no. July, pp. 48–58, 2018, doi: 10.1016/j.cliser.2018.11.001.
- [18] B. A. Kumar, “Usability heuristics for mobile learning applications,” pp. 1819–1833, 2019.
- [19] B. A. Kumar, “Usability of mobile learning applications : a systematic literature review,” *J. Comput. Educ.*, vol. 5, no. 1, pp. 1–17, 2018, doi: 10.1007/s40692-017-0093-6.
- [20] D. De Paula, “Design Thinking in Practice : Understanding Manifestations of Design Thinking in Software Engineering,” pp. 1059–1069, 2019.
- [21] H. Traifeh, R. Bin Tareaf, R. A. Refaie, and C. Meinel, “How Did Design Thinking Develop in the Arab World ? Finding from Twitter Analysis,” vol. 19, no. April, 2022, doi: 10.22059/JDT.2022.312803.1063.
- [22] R. Article and S. Panke, “Design Thinking in Education : Perspectives , Opportunities and Challenges,” no. 2018, pp. 281–306, 2019.
- [23] B. R. Dam and T. Siang, “What is Design Thinking and Why Is It So Popular?,” 2018, [Online]. Tersedia: <https://www.interaction-design.org/literature/article/what-is-design-thinking-and-why-is-it-so-popular> [Diakses: Diakses pada 1 Februari 2022].
- [24] T. Brown, *Design Thinking*. 2008, [Online]. Tersedia: <https://hbr.org/2008/06/design-thinking> [Diakses: 25 Maret 2022].
- [25] V. Braun and V. Clarke, “Conceptual and design thinking for thematic analysis Virginia Braun and Victoria Clarke Qualitative Psychology,” pp. 1–67.
- [26] A. Hulme, N. A. Stanton, G. H. Walker, P. Waterson, and P. M. Salmon, “What do applications of systems thinking accident analysis methods tell us about accident causation ? A systematic review of applications between 1990 and 2018,” *Saf. Sci.*, vol. 117, no. March, pp. 164–183, 2019, doi: 10.1016/j.ssci.2019.04.016.
- [27] S. Hahn-goldberg *et al.*, “Tool development to improve medication information transfer to patients during transitions of care : A participatory action research and design thinking methodology approach,” *Res. Soc. Adm. Pharm.*, vol. 18, no. 1, pp. 2170–2177, 2022, doi: 10.1016/j.sapharm.2021.04.002.
- [28] A. S. Denney and R. Tewksbury, “How to Write a Literature Review,” 2013.
- [29] E. Goodman and M. Kuniavsky, *Observing the User Experience: A Practitioner’s Guide to User Research (Second Edition)*, vol. 56, no. 3. IEEE, 2013. doi: 10.1109/TPC.2013.2274110.
- [30] C. Lallemand, G. Gronier, and V. Koenig, “User experience : A concept without consensus ? Exploring practitioners ’ perspectives through an international survey,” *Comput. Human Behav.*, vol. 43, pp. 35–48, 2015, doi: 10.1016/j.chb.2014.10.048.
- [31] H. M. Az-zahra, “Evaluating E-marketplace Mobile Application Based on People At the Center of Mobile Application Development (PACMAD) Usability Model,” pp. 72–77, 2019.

