



Redesigning the User Interface of a Language Translation App to Enhance User Experience Using Design Thinking

Jaka Septiadi¹, Rizki Hikmawan², Jihan Nurhaliza³, Azhar Nurulhaifa⁴, Azzahra Salsabilla⁵, Indy Hendiyani⁶,
Jasmine Nayla Hafiezh⁷, Afifah Nurfadilah⁸

^{1,2,3,4,5,6,7,8}Universitas Pendidikan Indonesia, Indonesia

Correspondence E-mail: jakaseptiadi@upi.edu

ABSTRACT

Language translation applications have become essential tools for supporting cross-language communication and are useful in daily and professional life. Naver Papago is a language translation mobile-based application that utilizes Artificial Intelligence technology. However, the application has a less intuitive interface, which limits users' ability to use its features effectively. The purpose of this study is to redesign the user interface of the Naver Papago mobile-based application to improve user experience. This study uses a Design Thinking approach that prioritizes user needs through five key stages: Empathize, Define, Ideate, Prototype, and Test. In the final stage, the prototype was evaluated by 13 respondents with a usability testing approach and using the Maze platform. Participants were asked to complete 10 representative tasks to assess the functionality and usability of the redesigned prototype. The Maze usability score reached 71%, placing it in the medium category.

ARTICLE INFO

Article History:

Submitted/Received 11 Jun 2025

First Revised 18 Jun 2025

Accepted 27 Jun 2025

First Available online 28 Jun 2025

Publication Date 1 Oct 2025

Keyword:

User Interface,

User Experience,

Redesign,

Design Thinking,

Artificial Intelligence.

1. INTRODUCTION

In the era of globalization, the use of smartphones has rapidly expanded and become an inseparable part of daily life. Smartphones are not only used as tools for communication but also for various activities such as work, learning, shopping, and accessing entertainment [1]. According to Badan Pusat Statistik (BPS), the smartphone usage rate in Indonesia reached 67.29% in 2023. This phenomenon indicates that smartphones are currently an essential aspect of daily life. The massive use of smartphones in Indonesia has a major impact on daily life. One of these applications is a language translation tool, which plays an important role in facilitating a range of activities, particularly in the context of education [2].

Language translation applications are utilized as tools to assist students in improving their understanding of foreign languages [3]. According to a study [4], the use of translation applications in classroom learning can enhance students' foreign language proficiency, indicating that such applications have a positive impact on the student learning experience. In the field of education, students' learning experience is directly related to the effectiveness of instruction and their motivation to learn. In the context of using language translation applications, an intuitive user interface enables students to access the required information more easily, conduct learning activities more effectively, and improve learning efficiency [5]. A well-designed interactive experience can strengthen learners' sense of involvement and engagement, while also increasing the enjoyment and appeal of the learning process [6].

The author conducted in-depth interviews with students who often use the Naver Papago mobile-based application in their daily lives, especially in supporting the learning process, both in class and outside the classroom. The aim was to analyze the effectiveness of using the application on students' learning motivation. Based on the interview results, most respondents stated that the Naver Papago application has shortcomings in terms of user interface. Some features that are not well understood in their use are rarely used, even though they are important to use. Respondents expressed frustration with the application's lack of user friendliness.

Given these insights, the redesign of Naver Papago's UI/UX is imperative. By applying the Design Thinking approach, this study aims to address user pain points and preferences [7]. This approach ensures that the redesigned interface not only resolves current usability issues but also aligns with user expectations [8]. This study uses the results of in-depth interviews with students to thoroughly understand the challenges of UI/UX in using the Naver Papago application, especially the impact of UI/UX on increasing student learning motivation in multiple languages. This study aims to increase user satisfaction in using this application.

The outcome of this redesign process is a prototype framework that includes several page structures, features, and contents, which provides a representation of the Naver Papago mobile-based application interface design. By emphasizing the importance of a user-centered approach and addressing the specific needs of users, this study aims to provide a comfortable and engaging foreign language learning experience, thereby increasing students' motivation in the foreign language learning process.

2. METHODS

The design thinking approach is an iterative process that focuses on understanding user perspectives, questioning assumptions, and reformulating to find innovative strategies and solutions that may not be obvious at first [9]. It combines a practical, solution-oriented mindset with a toolkit of interactive methods, offering both a way of thinking and working. Design thinking emphasizes gaining a thorough understanding of the end users for whom solutions are being crafted [10]. This approach encourages empathetic observation and insight into user needs and behaviors. It promotes a mindset of critical inquiry, challenging existing problems, assumptions, and potential outcomes [10][11]. Particularly effective for addressing complex or ambiguous issues, design thinking reframes challenges with a human-centered lens, encourages diverse idea generation through collaborative brainstorming, and embraces iterative development through prototyping and real-world testing. The process is inherently experimental, involving cycles of visualization, model-building, evaluation, and refinement of ideas.

According to the Interaction Design Foundation [9], the design thinking process consists of five stages (see **Figure 1**).

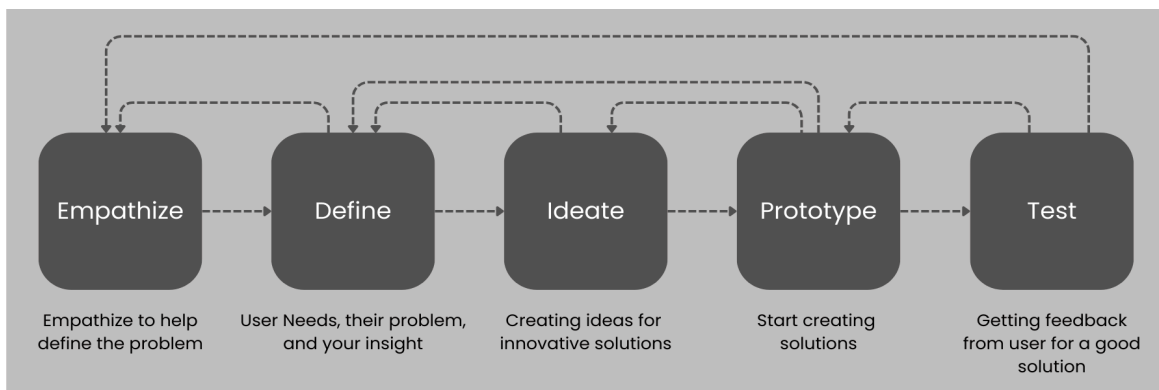


Figure 1. The Design Thinking Process Consists of Five Stages

In the first stage, Empathize is focused on emphasizing ethnographic methods to gain a deep understanding of the user's experiences, needs, and challenges [12]. This stage involves interview and observation methods. The interviews were conducted as direct interactions between the interviewer and the respondents. The interviews were carried out with thirteen college students who frequently use the Naver Papago mobile-based application. The primary goals are to gain a deep, personal understanding of the user's needs, emotions, and experiences. Furthermore, interviews help the author to identify the challenges and frustrations users face, revealing gaps or problems in their current experiences. Observation was conducted by examining how users interact with the application, including their behavior, challenges, reactions, and areas where users may experience confusion or frustration that may not be immediately obvious through verbal communication. In this stage, the author has defined the criteria for respondents, which are as follows:

- College students.
- Aged between 17 and 21 years.
- Users of the Naver Papago application.

- The respondents are individuals who are proficient in using laptops, smartphones, and technology.

The second stage is Define, where the insights gathered during the empathize stage are analyzed and synthesized to define the core problem that needs to be solved. The objective is to uncover patterns, themes, and key insights that help understand the needs, pain points, and desires of the users. The Define process can be done by using several tools and techniques to help synthesize insights [13], such as affinity diagram [14][15], empathy map [15][16], user persona [14][15][16], how might we [17], and user journey map [18]. In this study, the empathy results are represented through user persona, empathy map, affinity diagram, and storyboard.

The third stage is the Ideate process. The focus in this stage is on generating a wide range of ideas and potential solutions to address the problem defined in the Define stage [13]. Creativity is encouraged during this stage, with an emphasis on thinking beyond conventional boundaries and considering numerous possibilities before refining and selecting the most effective solution [18].

The fourth stage is the Prototype process. The prototyping stage is principally on converting ideas into tangible or digital representations that can be tested and explored [18]. In this stage, the sketches created in the previous stage are converted into low-fidelity wireframes. The design system technique is utilized as a framework for component guidelines to create a high-fidelity wireframe.

The final stage is the Testing process, where the prototype developed in the previous stage is prepared to be evaluated through usability testing. The objective is to verify that the design aligns with user needs and preferences, ultimately enhancing the overall user experience. The usability testing was conducted with 13 participants, who were users of the Naver Papago application.

3. RESULTS AND DISCUSSION

3.1. Empathize

In the process of redesigning the Naver Papago user interface, the empathize stage was carried out to gain a comprehensive understanding of the users' perspectives and experiences, explore the needs, motivations, and challenges or problems of the user. And minimize subjective bias by directly understanding the user's experience. The data collection method at this stage uses the interview and observation method with the user. The questions asked in the interview aim to collect data on the habits, needs, and problems of users in using the Naver Papago application. While observations were conducted to see directly how users behave and react in using the application by monitoring all activities.

After conducting interviews and observations, the author processes all the findings that have been obtained into the form of an empathy map and user persona as a representation of the user's needs. The empathy map generated from the findings is presented in **Figure 2**. In addition, the author uses personas to represent the characteristics of users that reflect their goals, needs, and challenges faced in using the application. This user persona includes

information such as background, demographics, goals, challenges, and user expectations. The representation of user personas can be seen in **Figure 3**.

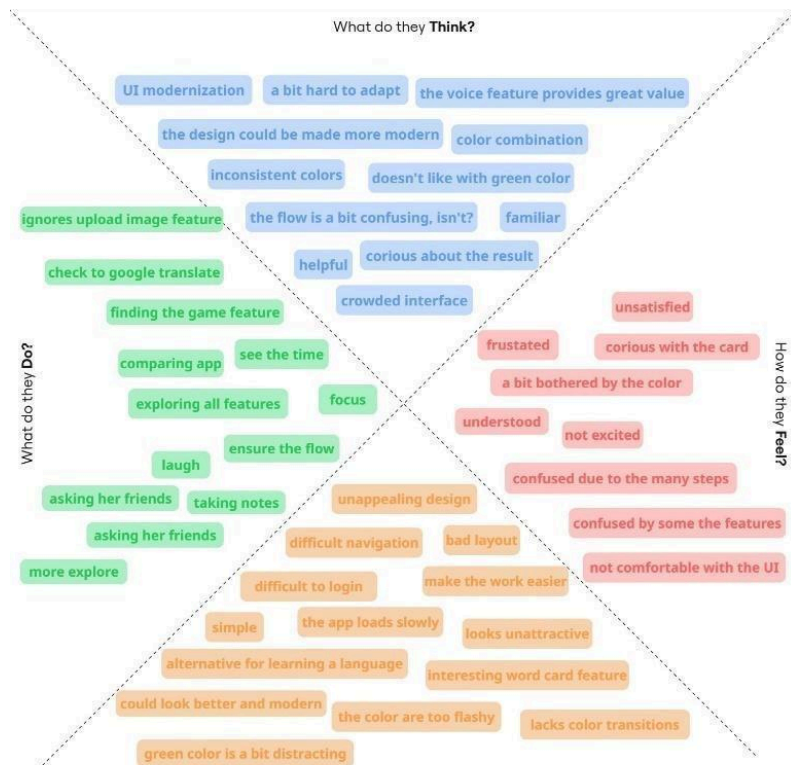


Figure 2. The Empathy Map Generated


<p>Alya Riska Maghfira</p> 		<p>PROFILE</p> <p>Alya Riska Maghfira is a 19-year-old undergraduate student currently in her third semester of the Information Systems and Technology Education program at UPI Purwakarta Campus. With a deep interest and passion for data analysis, Alya aspires to develop her skills and knowledge in analyzing data to generate meaningful insights. Driven by a strong enthusiasm for learning, she focuses on understanding data analysis methodologies and tools, as well as applying theoretical concepts gained through her academic studies to solve data-driven problems.</p>	
<p>AGE 19</p> <p>GENDER Female</p> <p>STATUS Student</p> <p>LOCATION Purwakarta, Jawa Barat, Indonesia</p>	<p>GOALS</p> <ul style="list-style-type: none"> • Complete tasks quickly and efficiently • Easily find the information or features they need • Have a smooth and intuitive user experience • Feel in control while using the product • Enjoy using a visually appealing and modern interface 	<p>FRUSTATION</p> <ul style="list-style-type: none"> • Confusing navigation or too many clicks to get things done • Slow loading times or poor performance • Too much information or cluttered layout • Unresponsive or broken features 	
<p>PERSONALITY</p> <ul style="list-style-type: none"> • Goal oriented • Detail focused • Curious • Tech Savvy • Impatient • Creative • Social 		<p>INTEREST</p> <ul style="list-style-type: none"> • Enjoys discovering new tools and updates • Interested in tools that help them navigate new environments • Values clean, modern, visually appealing UI • Frequently shops or browses online • Uses apps or platforms to acquire new skills • Active on social platforms and enjoys sharing • Uses digital tools to stay structured • Interested in translation, learning languages, or cross-cultural interaction 	

Figure 3. The Representation of User Personas

3.2. Define

In this stage, the results in the empathize stage will be defined more clearly and will be more focused on the core of the problem. This process analyzes user problems in terms of application usage and determines the desired feature. Pain points were taken based on the interview and observation results that have been mapped into an empathy map. Pain points can be seen in **Figure 4**.



Figure 4. Pain points

Based on Figure 4, two primary aspects are the main focus in the use of the application. The first pertains to user interface concerns, including bad layout, difficult navigation, color, crowded interface, and unattractive design. The second aspect is related to the quality and features regarding duration, facilities, and system specifications. Based on the results of the pain point mapping analysis, this study uses the How Might We (HMW) method, which refers to both aspects of pain points. The HMW results are shown in **Table 1**.

Table 1. How Might We Formula.

How Might We		
Pain Point	How	Possible Solutions (Might)
Difficult Navigation	How could we simplify the navigation structure?	Redesign the menu with a more logical structure and intuitive icons.
Bad Layout	How could we redesign the layout?	Rearrange UI elements based on priority and ease of access.
Unattractive Design	How could we enhance the visual design?	Apply modern design principles, attractive illustrations, and consistent typography.
Color Combination	How could we apply more harmonious color schemes?	Use a visually pleasing and accessible color palette.
Crowded Interface	How could we remove visual clutter?	Eliminate unnecessary elements and add sufficient white space.

Difficult to Login	How could we simplify the login process?	Add quick login options like biometrics or social media login.n
Loading Slowly	How could we optimize performance?	Optimize code and images, and implement caching strategies.
Too Many Steps in Word Cards	How could we reduce unnecessary steps?	Streamline word card interactions to one or two essential steps.
Inconsistent Colors	How could we unify the color system?	Create and follow a consistent color style guide.
Unappealing Design	How could we improve design elements?	Redesign icons, buttons, and visual components to be more engaging.
Difficult to Adapt	How could we make the app more intuitive?	Add interactive onboarding tutorials and simplify the interface.
Lacks Color Transitions	How could we introduce smooth color transitions?	Implement soft transition effects between screens.
No Facility to Translate Documents	How might we add a feature that allows users to translate documents directly within the app?	Implement a document upload feature that supports translation for formats like PDF, DOCX, or TXT.
The Colors are too Flashy.	How might we adjust the color scheme to be more visually comfortable and user-friendly?	Redesign the interface using softer, neutral tones or provide a dark mode/light mode toggle for user preference.

3.3. Ideate

Following the define stage, the process continues with the ideate stage. At this stage, the focus is on generating solution ideas for the issues identified earlier. Ideas can be gathered by assessing various existing or accomplished concepts, which will lead to the creation of a user flow and sitemap, crucial elements that serve as a foundation for the subsequent development stages [18]. Before proceeding to the user flow, it is essential to design the Information Architecture (IA). Information Architecture plays a vital role in organizing the content of the application, ensuring that users can navigate and access information efficiently. The construction of the IA not only enhances usability but also acts as a basis for information in user flow design. The IA can be seen in **Figure 5**.

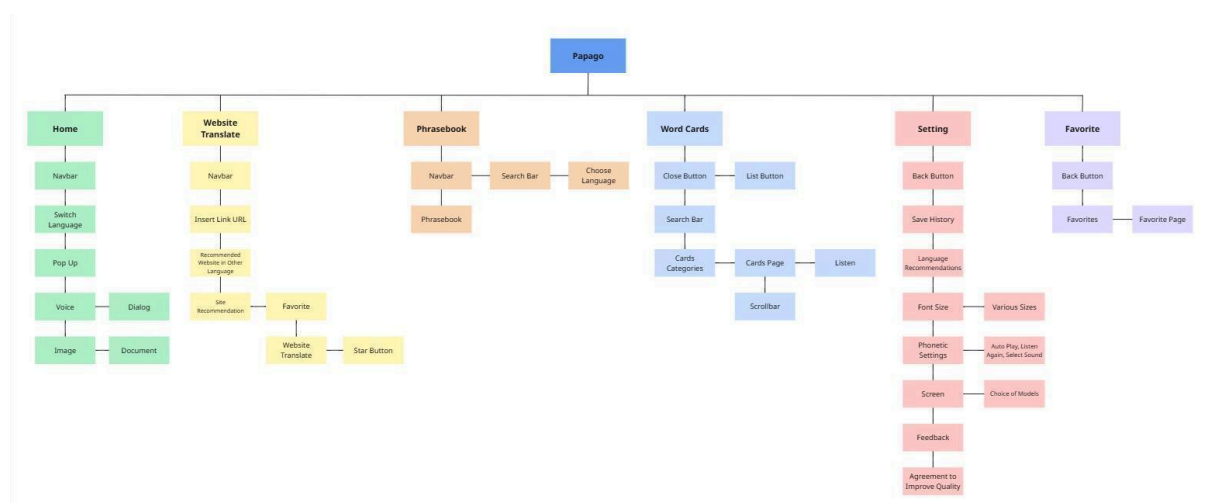


Figure 5. The construction of the IA

After designing the Information Architecture, the next step is to design the user flow. The user flow is designed to represent the steps taken by the user to complete the main tasks in using the application, thus ensuring that the navigation created is in accordance with the IA structure. The user flow is designed hierarchically; this user flow consists of the main page (parent) and subordinate pages (child). The user flow can be seen in **Figure 6**.

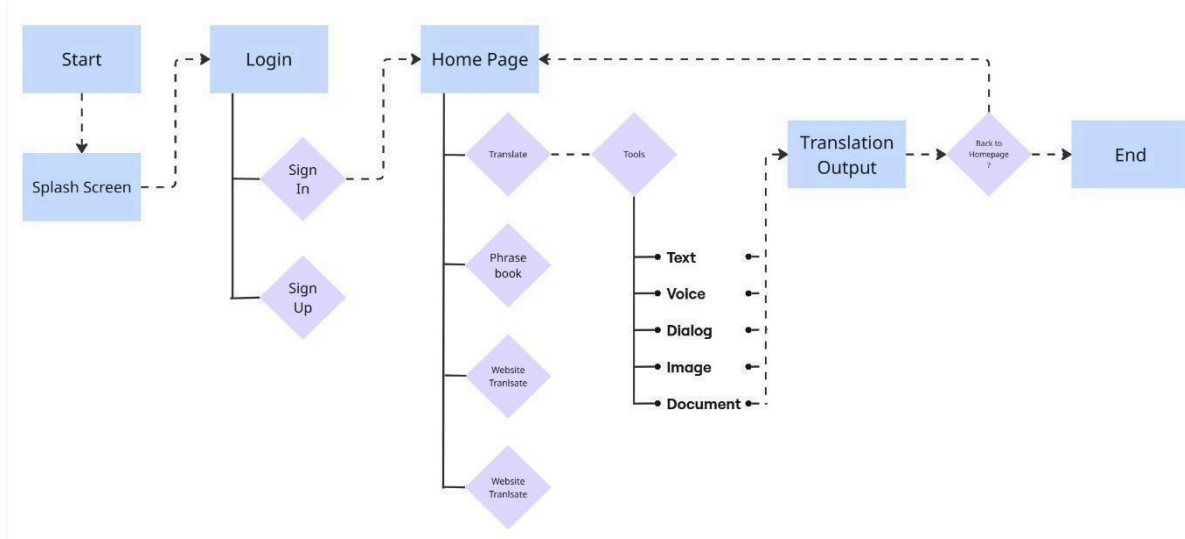


Figure 6. User Flow

3.4. Prototype

In this stage, the potential solution concepts that have been created in the previous stage are further refined into an interactive model. A prototype is a representation of a solution that has been defined in the previous stage and serves as a visual and functional representation of the user interface. This study utilizes Figma as the design tool due to its flexibility in creating prototypes. The prototyping process begins with creating a low-fidelity wireframe that places more emphasis on content layout and information structure. Low-fidelity wireframe can be seen in **Figure 7**.



Figure 7. Low-Fidelity Wireframe

After completing the low-fidelity prototype and validating the basic structure and functionality, the design process progressed to the design system. A design system was established to ensure visual consistency and interface scalability. The design system includes a set of standardized UI components such as buttons, input fields, icons, color palettes, typography styles, and spacing rules. These elements were carefully defined based on usability principles and brand identity, allowing for a more efficient design workflow and a cohesive look across all screens.

As can be seen in **Figure 8**, in this study, the Papago brand was changed to Mamago as an effort to maintain the credibility and integrity of the original brand, as well as avoid potential violations of intellectual property rights.

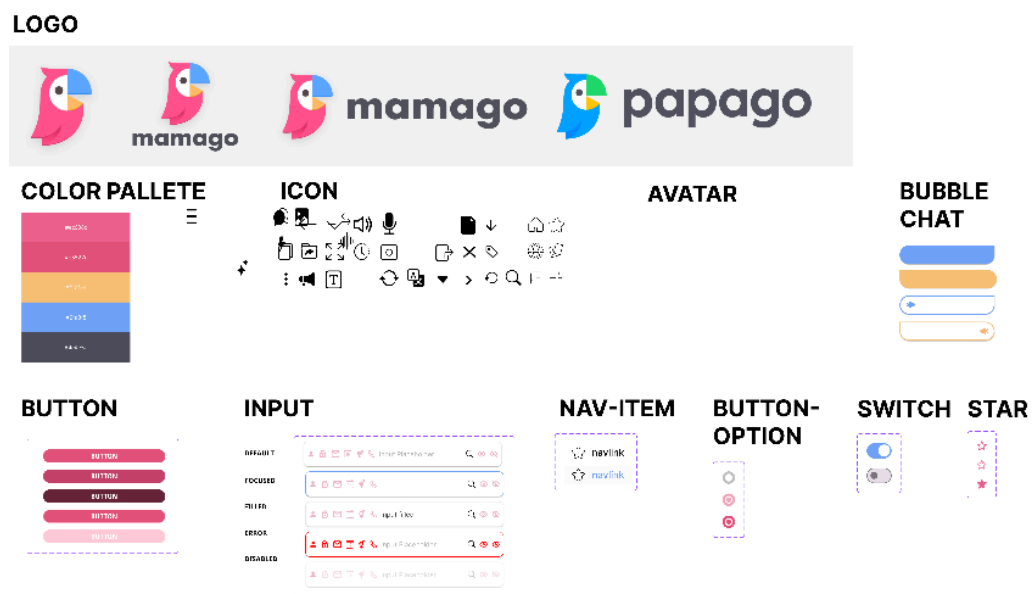


Figure 8. Papago Brand

After completing the low-fidelity prototype and design system, the design process progressed to the development of the high-fidelity prototype. The high-fidelity prototype provides a more realistic representation of the final product, allowing users to better visualize the overall experience. High fidelity wireframe can be seen in **Figure 9**.

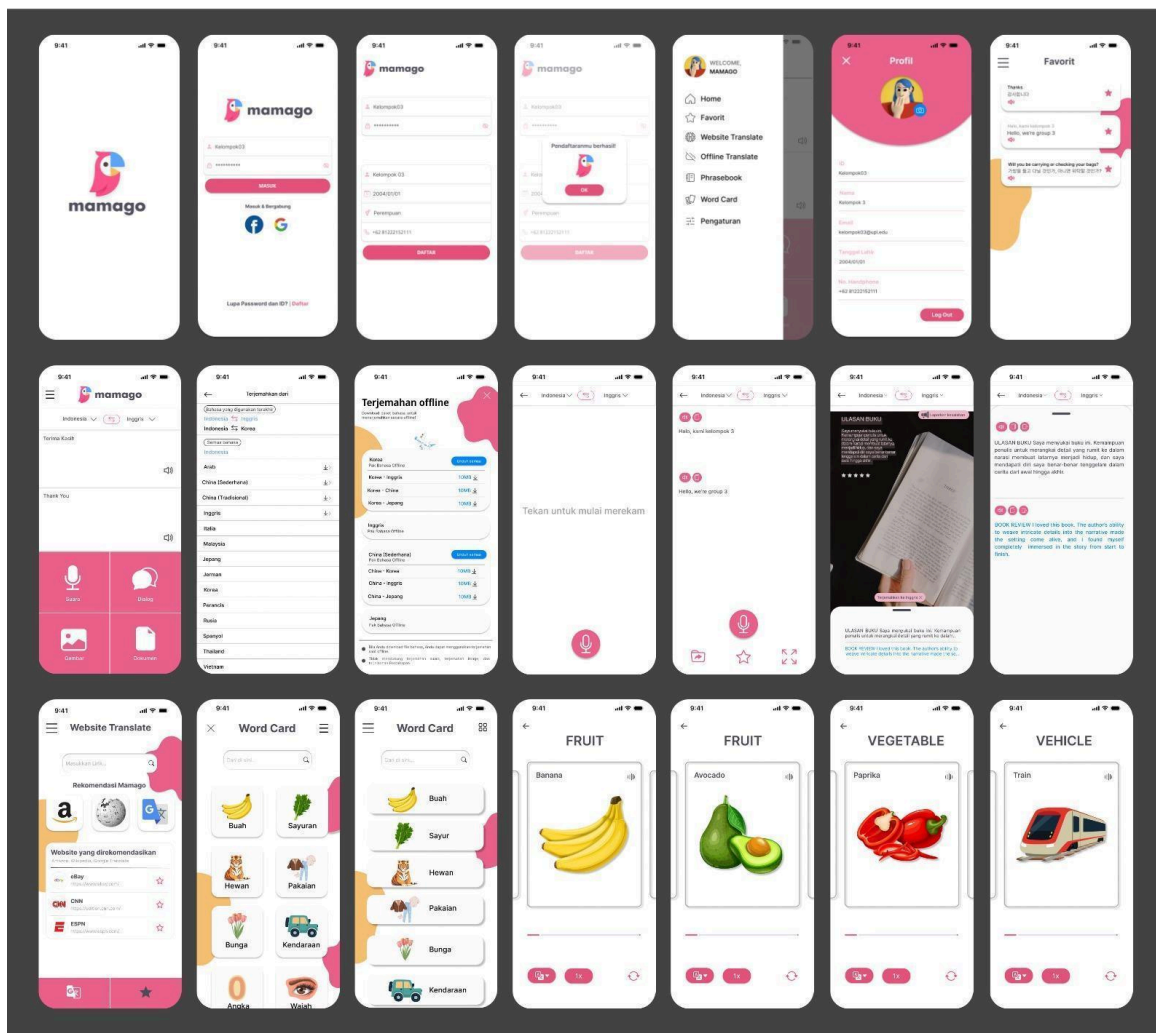


Figure 9. Papago Brand

3.5. Test

The final stage of the design thinking process is Test, which aims to evaluate the usability and effectiveness of the high-fidelity prototype. In this study, usability testing was conducted with 13 student respondents as participants, representing the target user group. In this evaluation, task scenarios were assigned during usability testing to examine the extent to which participants can perform assigned tasks while using the application in their daily lives.

To facilitate the testing process and collect both quantitative and qualitative feedback, the prototype was uploaded to the Maze platform. Maze enabled remote testing by allowing users to interact with the prototype and complete a set of predefined tasks [19]. During the evaluation, each respondent was asked to complete 10 specific tasks that reflect key user goals within the application. The functions included; 1) Registering and logging in to Papago; 2) Translating an image; 3) Translating voice input; 4) Using the conversation (dialog) feature; 5) Editing the user profile; 6) Marking a translation website as favorite; 7) Searching for a phrasebook; 8) Viewing favorite translations; 9) Searching for a word card and; 10) adjusting voice settings. The task scenario and Usability Testing Results Using Maze can be seen in **Table 2 and Table 3**.

Table 2. Task Scenario

Task	Instruction
Registering and logging in to Papago	Register your account first before you log in.
Translating an image	Take a picture of the object you want to translate, then select all the translation results and click to view the full translation results.
Translating voice input	Record a voice to translate the language and add it to the favorites for the result.
Using the conversation (dialog) feature	Engage in a conversational dialogue to facilitate language translation, and subsequently review the recorded history of the interactions that have occurred.
Editing the user profile	Navigate to your user profile and make edits to any information you choose.
Marking a translation website as a favorite	Add the recommended website to your favorites.
Searching for a phrasebook	Search for a phrasebook in the language of your choice.
Viewing favorite translations	Locate and view your list of favorite translations.
Search for a word card	Search for word cards in the Fruit category.
Adjusting voice settings	Locate and modify the voice settings.

Table 3. Usability Testing Results Using Maze

Task Num.	Usability Score (%)	Success Rate (%)	Misclick Rate (%)	Average Duration (seconds)
T1	71	93.8	35.3	16s
T2	64	100	48.1	31.7s
T3	70	100	29.9	24.1s
T4	68	100	33.4	17.3s
T5	75	100	20	23.5s
T6	60	100	35.1	17.5s
T7	56	85.7	64.3	36.7s
T8	77	92.3	39.1	19.8s
T9	83	100	32.3	13s
T10	86	100	15.8	19.1s
Average	71	97	35.3	21.8

The results of usability testing using Maze are presented in Table 3. Scenario testing is measured based on three parameters: (1) task completed; (2) time per completed task; and (3) number of clicks [20]. Task completion time is the time required by a participant to complete a specific task while testing the application. Completed tasks refer to the level of success that includes [21][22]: (1) the task can be completed successfully, and the number of errors in the processing steps is less than or equal to the number of predetermined processing steps; (2) the task can be completed but has more errors in the work steps than the number of predetermined steps; and (3) the task cannot be completed correctly. Misclick evaluates how often participants click incorrectly while completing a task. Average

duration refers to the time per completed task, which is the duration of participant task engagement is measured from the moment they begin the evaluation until the point at which they cease working on it.

Based on the usability testing results shown in Table 3, the average task completion rate across 10 tasks was 97%, with the overall Maze usability score was 71.71%. This gap suggests that although nearly all participants were able to complete the tasks, the experience was not fully intuitive for many of them. Maze usability score threshold is categorized as high (80-100), medium (50-80), and low (0-50). With a Maze Usability Score of 71%, the results of this evaluation fall into the medium category. The evaluation also recorded a misclick rate of 35.5% and an average task duration of 21.8 seconds. The relatively high misclick rate suggests that users may have encountered confusion or uncertainty when navigating the interface, leading them to click on unintended elements. Meanwhile, the average duration indicates that participants generally completed tasks within a reasonable time, although some hesitation or inefficiencies in the user journey may still be present.

4. CONCLUSION

This study successfully applied the Design Thinking approach to redesign the user interface of the Naver Papago application. Through five iterative stages- Empathize, Define, Ideate, Prototype, and Test—the research focused on understanding user needs, identifying pain points, and proposing solutions that address real usability issues.

The results of the usability test show that although the success rate of task completion is very high (97%), the user experience still needs to be improved, as reflected in the Maze usability score of 71%, which is in the medium category. The high misclick rate of 35.5% indicates that some interface elements are not fully intuitive, causing user confusion. The average task completion time of 21.8 seconds indicates that the completion time is reasonable, although there is still room to simplify the interaction flow and improve the overall efficiency of the application.

5. ACKNOWLEDGMENT

The author would like to express sincere gratitude to all participants who were involved in the user interviews and usability testing, particularly the students who provided valuable feedback throughout the design process. Special thanks are also extended to the academic advisors and stakeholders who offered guidance and support during the research. This project would not have been possible without their contributions.

6. AUTHORS' NOTE

The authors declare that there are no conflicts of interest regarding the publication of this article.

7. REFERENCES

- [1] Aisyah, K., Sunardi, S., & Nur, A. D. (2024). Opportunities for Using Smartphone in the Digital Age Literacy to Facilitate Students in Learning English Language at Junior High School. *Advances in Social Science, Education and Humanities Research*. doi:10.2991/978-2-38476-301-6_2.
- [2] Groves, M., & Mundt, K. (2021). A ghost in the machine? Staff and student perspectives on the use of machine translation in a UK university. *International Journal of Educational Technology in Higher Education*, 18(1), 58. doi: <https://doi.org/10.1186/s41239-021-00293-6>
- [3] Milda, N.S., Muhammad, B., & Andi, Muliati. (2023). The Effect of Google Translate Application on English Vocabulary Mastery of High School Students. *Journal of English Education and Literature*. doi:<https://doi.org/10.26858/performance.v2i2%20May.46294>.
- [4] Hind, A., & Dania, S. (2023). The Impact of Translation Apps on Translation Student's Performance. *Journal of Education and Information Technologies*, 10709-10729. doi: <https://doi.org/10.1007/s10639-023-11578-y>.
- [5] Yan, Q., & Rui, X. (2024). Research on User Interface Design and Interaction Experience: A Case Study from "Duolingo" Platform. *EAI Endorsed Transactions on Scalable Information System*, 11(5). doi: <https://doi.org/10.4108/eetsis.5461>.
- [6] Shah, A., & Nasnodkar, S. (2021). The Impacts of User Experience Metrics on Click-Through Rate (CTR) in Digital Advertising: A Machine Learning Approach. *Sage Science Review of Applied Machine Learning*, 4(1), 27–44.
- [7] N. Aulia, S. Andryana, and A. Gunaryati. (2021). Perancangan User Experience Aplikasi Mobile Charity Menggunakan Metode Design Thinking User Experience Design Of Mobile Charity Application Using Design Thinking Method. *J. Sisfotenika*, vol. 11, no. 1, pp. 26–36, 2021.
- [8] G. Karnawan. (2021). Implementasi User Experience Menggunakan Metode Design Thinking pada Prototype Aplikasi Cleanstic. *Jurnal Teknoinfo*, vol. 15, no. 1, p. 61, Jan. 2021, doi: 10.33365/jti.v15i1.540.
- [9] Interaction Design Foundation. *The Basics of User Experience Design*.
- [10] Juniantari, M., Ulfa, S., & Praherdhiono, H. (2023). Design Thinking Approach in the Development of Cirgeo's World Media. *Jurnal Nasional Pendidikan Teknik Informatika: JANAPATI*, 12(1), 42-55. <https://doi.org/10.23887/janapati.v12i1.55203>.
- [11] Schweitzer, J., Groeger, L., & Sobel, L. (2015). The Design Thinking Mindset: An Assessment of What We Know and See In Practice. *Journal of Design, Business & Society*, Forthcoming, Available at SSRN: <https://ssrn.com/abstract=2647299>.
- [12] Leem, S., & Lee, S.W. (2024). Fostering Collaboration and Interactions: Unveiling the Design Thinking Process in Interdisciplinary Education. *Thinking Skills and Creativity*. <https://doi.org/10.1016/j.tsc.2024.101520>.
- [13] Zamakhsyari, F., & Fatwanto, A. (2023). A Systematic Literature Review of the Design Thinking Approach for User Interface Design. *International Journal on Informatics Visualization*. doi: <http://dx.doi.org/10.62527/joiv.7.4.1615>.
- [14] Ilham, H., Wijayanto, B., & Rahayu, S.P. (2021). Analysis and Design of User Interface/User Experience with the Design Thinking Method in the Academic

- Information System of Jenderal Soedirman University. *Jurnal Teknik Informatika (Jutif)*, vol. 2, no.1 pp. 17-26, Jan. 2021, doi: <https://doi.org/10.20884/1.jutif.2021.2.1.30>.
- [15] Subarjah, V.A., & Wahyu, A.P. (2022). Analysis and Design of User Interface and User Experience of Regional Tax Enterprise Resources Planning System with Design Thinking Method. *Inform: Jurnal Ilmiah Bidang Teknologi Informasi dan Komunikasi*, vol. 7, no.2, pp 96-106, Jul. 2022, doi: <https://doi.org/10.25139/inform.v7i2.4729>.
- [16] Suratno, B., & Shafira, J. (2022). Development of User Interface. User Experience using Design Thinking Approach for GMS Service Company. *Journal of Information Systems and Informatics*, vol. 4, no. 2, pp 469-494, 2022, doi: <https://doi.org/10.51519/journalisi.v4i2.344>.
- [17] Saputra, D., & Kania, R. (2022). Designing User Interface of a Mobile Learning Application by Using a Design Thinking Approach: A Case Study on UNI Course. *Journal of Marketing Innovation (JMI)*, 2(2). <https://doi.org/10.35313/jmi.v2i2.36>.
- [18] Darmawan, I., Anwar, M.S., Rahmatulloh, A., & Sulastri, H. (2022). Design Thinking Approach for User Interface Design and User Experience on Campus Academic Information Systems. *JOIV: International Journal on Informatics Visualization*, vol. 6, no. 2, p. 327, Jun 2022, doi: <https://doi.org/10.30630/joiv.6.2.997>.
- [19] Rinawiyanti, E., Surjani, R., Hartono, M., Permatasari, E., & Chrisma, A. (2024). Mixed Method Usability Testing for User Experience and User Interface of AI-Based Supermarket Applications. *Journal of Applied Data Sciences*, 6(1), 483-495. doi:<https://doi.org/10.47738/jads.v6i1.453>.
- [20] J. R. Lewis, and J. Sauro. (2021). Usability and User Experience: Design and Evaluation, In *Handbook of Human Factors and Ergonomics* (eds G. Salvendy and W. Karwowski), NJ, USA: Wiley, 2021, <https://doi.org/10.1002/9781119636113.ch38>.
- [21] Liu, C., Song, X., & Hansen, P. (2023). Characterising users' task completion process in learning-related tasks: A search pace model. *Journal of Information Science*, 49(6), 1462-1480. doi: <https://doi.org/10.1177/01655515211060527>.
- [22] P. Weichbroth. (2024). Usability of Mobile Applications: A Consolidated Model, *IEEE Access*, vol. 12, no. April, pp. 62378–62391, 2024. doi: <https://ieeexplore.ieee.org/document/10510383>.