

UX/UI design for Memoa – a flashcard application

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<p>With the development of information technology, new advanced forms of learning are constantly appearing, typically learning applications. These applications provide users with new, more effective and enjoyable learning experiences. Therefore, many people have been interested and looking to learning applications to help them in their daily study. Based on those needs of users, the author and two other students have developed Memoa, a flashcard app for learning and memorization.</p> <p>Memoa was originally developed for Android. The app helps users study and remember new words, terms, formulas in an efficient and entertaining way. Implementation of spaced repetition in Memoa maximizes the productivity from learning by flashcards. Memoa also has gamification features, bringing fun and exciting study experiences to users.</p> <p>The author works as a UX/UI designer in Memoa development project. His tasks are researching, brainstorming and designing both functionality and visual interface of Memoa. In this thesis, the author reflects his learning and details of the project in UX/UI perspectives.</p> <p>The thesis is written in the traditional approach, in which the theoretical part was mentioned before the empirical part. The author explains terms, definitions, frameworks... relating to the project in the theory part. On the other hand, implementation part is divided into two chapters: UX design process and UI design. There are a total of five chapters in this thesis.</p>	
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1 Introduction

Learning has been an act connected with the development of people since the prehistoric era. Study has evolved into many different forms throughout history. With the development of information technology, new advanced forms of learning are constantly appearing, typically learning applications. These applications provide users with new, more effective and enjoyable learning experiences. Therefore, many people have been interested and looking to learning applications to help them in their daily study. Based on those needs of users, the author and two other students have developed Memoa, a flashcard app for learning and memorization.

Memoa is a mobile flashcard application developed initially for Android. People can learn not only new languages but also other subjects such as history, science with Memoa. The app helps users study and remember new words, terms, formulas in an efficient and entertaining way. Implementation of spaced repetition in Memoa maximizes the productivity from learning by flashcards. Memoa also has gamification features, bringing fun and exciting study experiences to users.

The author works as a user experience (UX) / user interface (UI) designer in this thesis project. While UX focuses on the meanings and functions of a product, UI directs to visual aspects of that product (Alan 2021). UX design and UI design are partly overlapped but still cannot interchangeable. With the responsibility of a UX/UI designer, the author has to self-cultivate his knowledge and skills in both two fields to serve Memoa development project.

This is a product-oriented thesis. Instead of having a specific commission party, Memoa will be released on Google Play store. A beta version was sent to Juha Hinkula, the thesis advisor, for his review. The content of this thesis is a report on author's progress as a designer of Memoa. In this thesis, the author reflects his learning and details of the project from UX/UI perspectives.

1.1 Objectives and deliverables

The thesis project serves two major purposes: theoretical research and application development. Firstly, the author should have a solid understanding of related terms such as Design Thinking, gamification, spaced repetition, Material Design... The application design process is an opportunity for the author to apply this knowledge into practice. Secondly, basic functions and features of the application are completed and the app is

ready for launch. The app should be highly relevant and practical, solving users' needs. The learning experience that the app offers is fun and productive. The interface of the app ensures aesthetics, complying with the Material Design guidelines.

1.2 Scope and out of scope

This thesis focuses mainly on UX and UI design for Memoa. Therefore, knowledge related to these fields will be presented and implemented throughout the application development process. The project started in September 2020 and will complete by April 2021. The author worked on his task as a designer and wrote this thesis at the same time. Most assets related to the design process are free and available for personal use.

As mentioned before, Memoa development project is a collaboration of three students, so there are three theses related to the app. In this thesis, the author only mentions what is related to his expertise. The other fields like programming, marketing are not focused on. On the other hand, post-release work is not discussed in detail but is only mentioned as future development.

1.3 Structure of the thesis

The thesis is written in the traditional approach, in which the theoretical part was mentioned before the implementation part. The author explains terms, definitions, frameworks relating to the project in the theory part. On the other hand, the implementation part is divided into two chapters: UX design and UI design. There are five chapters in this thesis in total.

The introduction consists of three subchapters: Objectives and deliverables, Scope and out of scope, Structure of the thesis. The introduction presents a general idea and defines the project. It also determines the problem which this project solved and other extends. The structure part helps readers understand the basic composition of the thesis.

The theoretical framework chapter thoughtfully presents the theoretical basis that would be applied in the UX design process. The terms and frameworks introduced in this chapter are: flashcard, spaced repetition, gamification, Design Thinking... The author conducted both quantitative and qualitative user research. They were thoroughly described in the research methods chapters. The Material Design theory at the end of this chapter serves for the UI design process.

Design Thinking is utilized for the design process. Therefore, the UX design progress chapter is divided into five subchapters, corresponding to five stages of the chosen framework: Empathize, Define, Ideate, Prototype, Test. The tasks and deliverables in each subchapter were listed and described fully. This chapter reports the UX design work completely, from problem to solution.

UI design is implemented at the same time as UX design. The UI design chapter expresses mainly visual aspects of the application: color scheme, font choices, illustrations... The link to the app on Google Play store is embedded at the end of this chapter. Readers can download the app to experience its functions and design its functions and design fully.

The conclusion chapter discusses the whole process of application development. In detail, the author reflects both achievements and frustrations of the thesis project in this chapter. The reference lists all books, websites and other materials relating to both app design and the thesis. Interview transcripts are attached in the Appendix.

2 Theoretical framework

This chapter introduces the theoretical basis that would be implemented in the UX design process. The terms and frameworks introduced in this chapter are: flashcard, spaced repetition, gamification, Design Thinking... The author conducted both quantitative and qualitative user research. They are thoroughly described in the research methods subchapter. The Material Design guidelines at the end of this chapter serve for UI design process.

2.1 Application definition

2.1.1 Flashcard and spaced repetition

A flashcard is a card with information on both sides, used for study and memorization. One side of a flashcard has a question and the other side shows a corresponding answer. Information on flashcards can be words, images, formulas... People use flashcards to learn new languages, scientific facts, historical dates...or anything in "question and answer" format. There are both paper flashcards and digital flashcards nowadays (Disprz blog 2021).

More specifically, this is a concrete example of a typical flashcard. The front of the flashcard shows the word, its phonetics and vocabulary types. The backside annotates the meaning with an illustrative example or image. Using flashcards to study will help people remember important knowledge and information easily and efficiently.

Flashcards bring many undeniable benefits to learners. Using flashcards is a very effective self-test method. University of Southern Maine (2021) pointed out that even the act of making flashcards is a method of processing information. It challenges people to brainstorm about the information recorded on one side and the relevant description on the other. Flashcards later can be used as a self-test method for learners who want to review their knowledge.

Paper flashcards with compact, concise form and do not take up too much space can help people take them anywhere. Therefore, learning vocabulary will become easier than ever and learners can practice anytime, anywhere. This way of learning will partly motivate individuals to learn more because learners do not need to stay focused on the traditional way of learning as before.

The effectiveness of flashcards is in their formation. No matter how simplified the vocabulary information on the flashcard, example sentences and illustrations are still important details that should be shown on the flashcard. The useful compression of flashcards is considered a remarkable advantage for learning vocabulary. Reviewing flashcards as a daily habit can make vocabulary learning more effective.

Spaced repetition is a very efficient learning approach in which lessons are re-executed at incremental intervals until knowledge is completely memorized in long-term memory (EdApp Microlearning Blog 2021). Spaced repetition is more practical than trying to cram knowledge in a short amount of time. This method also overcomes oblivousness after we have acquired a great volume of information. It also helps ones regain forgotten knowledge and quickly remember new information.

Effectiveness of flashcards collaborates vigorously with spaced repetition. Hence, the things people learn should be reviewed gradually over a period of time to guarantee that they are not overlooked. If individuals revisit the knowledge regularly (see them frequently), they can memorize it longer. Thanks to that, the amount of knowledge can increase quickly and not be forgotten easily.

A simple and active way to apply spaced repetition practice is using flashcards. People can make their own flashcard decks or download flashcard applications. For paper flashcards, if one has already memorized the word on the card, classify it in a group that requires less review (for example, three times a week). If he cannot remember the word on the card, put it in a column that needs to be reviewed more often (for example, daily). There is also a range of mobile applications utilizing flashcards and spaced repetition: Anki, Quizlet, Memrise... Figure 1 shows search results for the "flashcards" keyword on Google App Store.

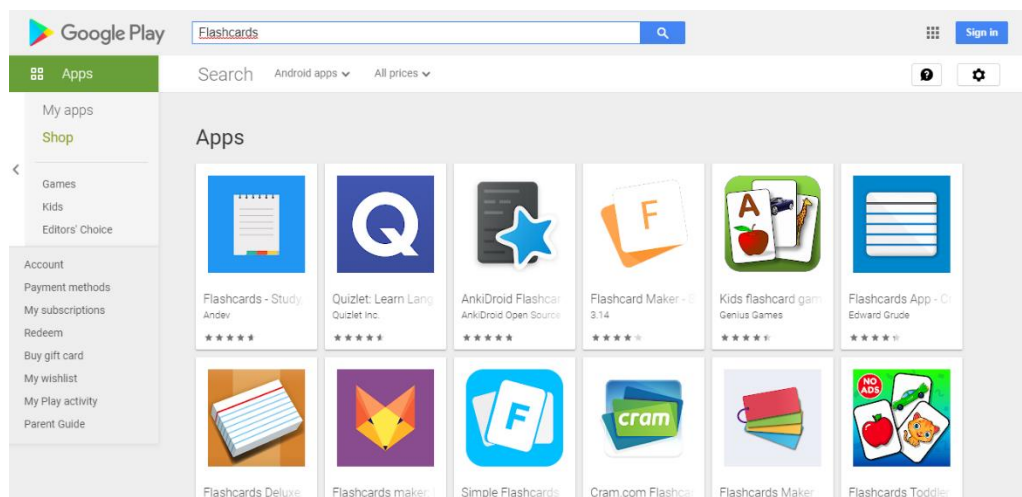


Figure 1. Flashcards applications on Google App Store.

2.1.2 Gamification

Gamification is the practice of creating enjoyable and engaging elements commonly found in games and applying them to several other fields (Yu-kai 2019). It utilizes mechanics in games to incorporate into product design, software development, marketing... with the purpose of motivating and encouraging users. The application of gamification in business will deliver one's customers impressive, interesting experiences. Another great effect of gamification is to motivate users to participate in more feedback and interaction activities.

Gamify (2021) listed three standard game elements applied in gamification: points, badges and leaderboards. Points or scores are identifiers for progress in sports, bonus cards and video games. Badges or medals are used as recognitions of player achievements. Finally, leaderboards in games display player rankings and competitiveness between players.

Gamification gives users an entertaining experience throughout their use and keeps a high level of interaction. On the other hand, businesses can get instant feedback so they have a clear picture of their products or services and what they need to improve. With all its benefits, gamification is constantly evolving to meet the ever-increasing demands of modern users. Using an appropriate gamification strategy makes using an application or a website a meaningful and memorable experience.

The core value of gamification is to make regular daily activities more enjoyable through amusing, creative and competitive gaming acts. Making good use of the above will increase the interactivity of users, establishing a strong connection between users and products. Measuring and analyzing tools should be integrated to be able to determine the effects when creating gamification, from which there can be the most appropriate changes. Feedbacks help the content of gamification become more and more complete.

Nowadays, the gamification method is used broadly in UX design because of its usefulness in problem-solving. Proper use of gamification and other game mechanics can turn into an invaluable tool for UX designers (Tubik blog 2021). In the Game industry, game mechanics are often calculated very complicatedly with many algorithms and formulas. Applying gamification to application design can stimulate users to experience and attach with the application for a long time.

It is important to keep gamification as a fun and engaging experience. The essential purpose of games is entertaining, so designers do not need to create extremely difficult games. Gamification factors should only have moderate difficulty to generate attraction and challenge for users. Designers should also create rewards to provide immediate encouragement and keep users motivated to learn more.

Gamification features of Memoa are implemented through a point system and a virtual pet game. Users can take quiz daily and win certain points. Those points will be exchanged for food and toys for the virtual pet game. The growth of the virtual pet is recognition of the users' learning efforts.

2.2 Design Thinking

2.2.1 Definition of Design Thinking

Design Thinking is a human-centered approach for solving problems in creative and effective ways. This approach focuses on the needs of users of products or services (Christian 2020). It encourages people to define, analyze and resolve problems as designers would. Design Thinking can be applied to any area, from developing applications to creating a new business model.

Design Thinking considers the problem from the users' perspective, then identifies their problem. In this approach, designers try to understand their users' needs, identify critical issue ideas and conduct continuous tests to propose the optimal solution. During product development, designers should truly empathize with their users - ask themselves what users will experience and feel using their products. With that in mind, Design Thinking will help people build a product based on users and for the benefit of users.

Whether simple or complex problems, especially abstract ones that are difficult to anticipate in the future, Design Thinking can help people unravel by deep understanding human problems. This approach incorporates analysis and creativity, visual thinking techniques. It gives companies the flexibility to adapt to market fluctuations, constantly experiment and innovate.

According to Robert Stackowiak and Tracey Kelly (2021), Design Thinking was developed as a method of problem-solving in the 1950s in the industrial, science and technology communities. Although it originated more than 60 years ago, the ever-increasing use of computers and technology has kept Design Thinking in common use up to now. Design

Thinking can establish breakthrough creativity for complicated problems facing businesses today.

There are five main stages in the Design Thinking framework: Empathize, Define, Ideate, Prototype, and Test (Robert & Tracey 2021). This is a continually executed loop, not a linear process. In the process of applying Design Thinking, it is possible to go back to the previous stages. This framework helps designers consider the problem from many new perspectives, develop new methods in product development.

Design Thinking framework is based on two main principles: Empathy and Experiment. Empathy means that designers should walk in the users' shoes to understand their feelings, thoughts, and problems. Experiment means that based on user insights, designers continually test ideas with them and continually improve the solution based on user feedback until the optimal solution is found.

Design Thinking makes application development a more professional and efficient process. Therefore, the author utilizes Design Thinking and its framework as a core methodology in this thesis project. Design Thinking not only solves many types of problems in the development process but also helps members have the same perspectives and common directions about the project.

2.2.2 Design Thinking framework

The 5-phases Design Thinking framework was first introduced by the Institute of Design at Stanford University (Robert & Tracey 2021). The main stages are: Empathize, Define, Ideate, Prototype, Test. They are illustrated in Figure 2. These stages are not always in linear order and can be repeated during the development process (Interaction Design Foundation 2021). All stages contribute to the accomplishment of a project.

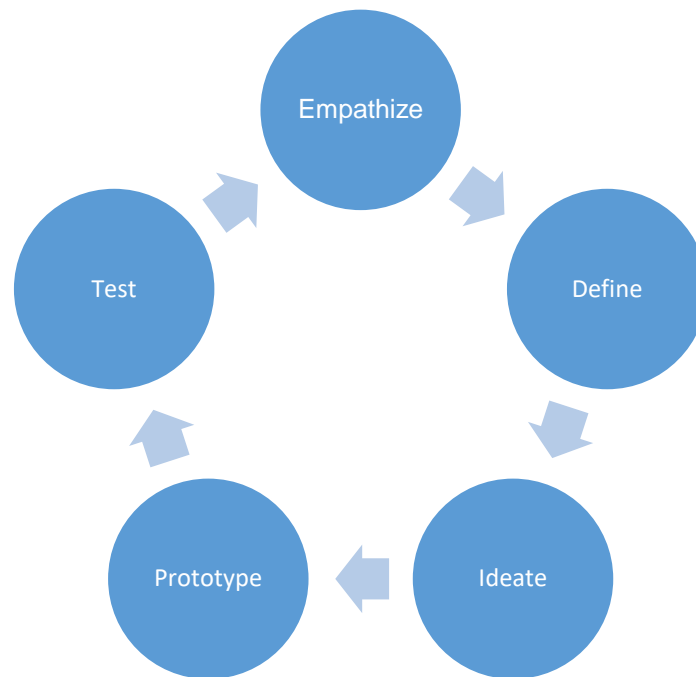


Figure 2. Design Thinking framework

Empathize

Empathize is a significant stage in a human-centric approach like Design Thinking. In this stage, designers need to interview, observe, integrate, and sympathize with users to understand their experiences and motivations. Interaction Design Foundation (2021) emphasizes that designers should adopt a beginner's mindset to be able to perceive and analyze users' problems objectively. Empathize helps designers understand users and their needs better, thereby developing a more suitable application.

The main task in Empathize phase is conducting user research. In this thesis project, user research involved online surveys (quantitative) and user interviews (qualitative). These two methods were conducted before any steps in the design process, ensuring that the application becomes meaningful to users. Insights gained from user research are crucial for the next steps of the design process.

Define

During the Define stage, designers focus on understanding users' motivation, goals, decisions, challenges, and pain points (Robert & Tracey 2021). It is still important that users are concentrated and problem-solving meets users' needs. Designers should sketch out the whole picture; from that, they can brainstorm all possible solutions. This phase will

help designers gather many ideas to build features, functions, and more to solve the problem.

The author created user personas in Define to analyze users' behaviors, challenges, goals... Building persona is the premise for designers to determine the direction of development in the future. On the other hand, user stories were also developed to give the author basic yet intuitive information. Both personas and user stories help designers fully comprehend users' needs in a natural, clear and effective way.

Ideate

The robust knowledge base gathered from the first two stages is applied to generate new ideas in the Ideate stage (Interaction Design Foundation 2021). It is important during the early period of Ideate to come up with as many ideas and solutions as possible. Designers should "think outside the box" and do not confine themselves to unproven assumptions. Not only designers but all other team members are encouraged to collaborate in order to give out fresh ideas.

The deliverables in this phase are user flows and wireframes. User flows and wireframes focus on the feature, function, as well as structure of the application. They should be logical and straightforward, clearly demonstrating steps users need to follow when the app is put into use. Designers can get an objective perspective about navigations, workflows, logic... of the app by creating user flows and wireframes.

Prototype

Prototype is a stage when ideas are visualized and verified. Designers should build the prototype to match the type of desired feedback from users (Christian 2020). At the end of this stage, designers will understand better product limitations and existing issues. Moreover, they can have a more specific view of how users will react, think, and feel when interacting with the end product.

Prototypes can be designed in many ways: paper, low fidelity or high fidelity. The author utilized Adobe XD to design prototypes for this thesis project. The high fidelity (hi-fi) prototype shows visual, contents, interactions... which are closest to the final application. A range of tests is conducted with users to evaluate prototypes.

Test

Test is the final stage but designers can repeat the above stages of Design Thinking framework. In reality, designers tend to use the Test phase results to identify further problems (Interaction Design Foundation 2021). Testing will quickly highlight any design flaws that need to be addressed. In the Test phase, gathering user feedback and reviews is essential and focused.

The author conducted usability tests in the Test phase. Planning is one of the most important tasks in usability tests. Designers need to identify and record exactly what they want to do, how they will do it, the number of users needed for the test and what criteria of the test are. From 10 to 15 minutes before or after the test are also added to ask more questions for future development.

2.3 Research methods

Quantitative and qualitative research methods were applied mainly in the Empathize and Test stages of the thesis project. More specifically, those mentioned methods were utilized for conducting user research. User research is the process of understanding how individuals interpret and use products or services. It is implemented in a wide range of different fields: website development, electronics, banking, and more. There are also many methods to carry out user research: interviews, surveys, usability testing... (Elizabeth, Mike & Andrea 2012).

User research is the foundation task of the whole UX design process. It helps designers comprehend their users, their users' problems as well as the discomfort when using the current solution. The user research conducted in the early periods of a stage often brings immense value in the later development cycles of that stage. In user-centered design process, the user has become an integral part of product development.

The purpose of user research is to discover insights: getting important information and opinions from users for product development purposes. User research is the backbone of the project. The things designers discover and learn during this task will be the foundation for the development of the whole project. The principles drawn from research methods are fundamentally similar. Two of the most common research methods are interviews and questionnaires.

Nielsen Norman Group (2021) defines user interview as a methodology of user research in which designers question users about topics of interest with the purpose of learning about those topics. These questions help designers understand who their users are and

what their users' habits are. According to David (2019, 151), there are many styles of interviews, ranging from structured interviews to general conversation. Designers should prepare questions properly in the structured interviews before the meeting.

Questionnaires are an approach of streamlining the user research process if designers need to survey a great quantity of users while resources are limited to interview them one by one (David 2019, 151). Questionnaires and other quantitative research methods are highly presentative and reliable in decision-making. The results of questionnaires are mainly numbers or sometimes short replies. Designers will collect and analyze these results to have deeper knowledge for later of the UX design process.

User interviews and questionnaires are the typical example of quantitative research and qualitative research, respectively. In many projects, both quantitative and qualitative research methods are implemented. Quantitative research can verify insights discovered in qualitative research. In other cases, qualitative research helps further explain the numbers obtained from quantitative research. The application of many research methods provides valuable perspectives and answers for what, what, how questions.

2.4 Material Design

Material Design is a design system developed by Google, supporting designers to create intriguing, intuitive user experiences on many digital platforms, including Android, iOS, Flutter... (Material Design 2021). This design system is simple with the application of bold and vivid colors to make the main elements stand out more. Besides the color choice, Material Design also aims to natural motion effects with distinctive buttons displayed on the screen. This can deliver users more authentic and lively feelings.

Material Design is inspired by papers and ink in the real-world (Ian 2015). It can be imagined as different sheets of overlapping paper with many colors and sizes. The overlapping effect is reimagined as shadows in Material Design. Simplicity and compacity are also fully utilized in this design approach. It helps minimize the confusion of complicated buttons, especially when running on small devices.

The most apparent advantage of Material Design lies in its minimalism. The extra details are omitted. Instead of that, the color use combined with effects such as shadows, animations... emphasize the content and direct users to the features of the application. Material Design is presented clear and easy to understand. Therefore, it helps users get used to the system quickly, creating a familiar feeling in just a few first uses.

Material Design is operated by print design methods, which are typography, colors, images, grid... All together deliver hierarchy, meaning, and focus with the purpose of engaging users in the visual experience (Material Design 2021). Applying those visual methods helps users differentiate what the primary information is, what is the secondary information. From there, they can easily interact and experience the application.

Another emphasized feature of Material Design is the application of motion. Motion plays an irreplaceable role in supporting user actions and providing needed feedback. The movement of a component is based on real-world features that help the user understand the nature of the component itself. Smooth and dynamic motion effects are also improved, making the user experience on mobile devices even better.

With Material Design, users will have an intuitive and natural feel when interacting with everything presented in the digital interface (Alan 2021). Designers should use a visible color scheme and choose a primary color. Material Design is not monotonous but also unnecessarily complex in color tone. Material icons are usually flat, simple, and conceptual. The design of icons is abstract but easy to understand, express the meaning of the action properly.

It is undeniable that if there is an app developed primarily on the Android platform, then using Material Design is an ideal choice. Figure 3 shows an example of using Material Design in UI design. Material Design is created to allow expressing individual identity and creativity. Based on the basic principles, designers can customize their design according to the requirements of the application.

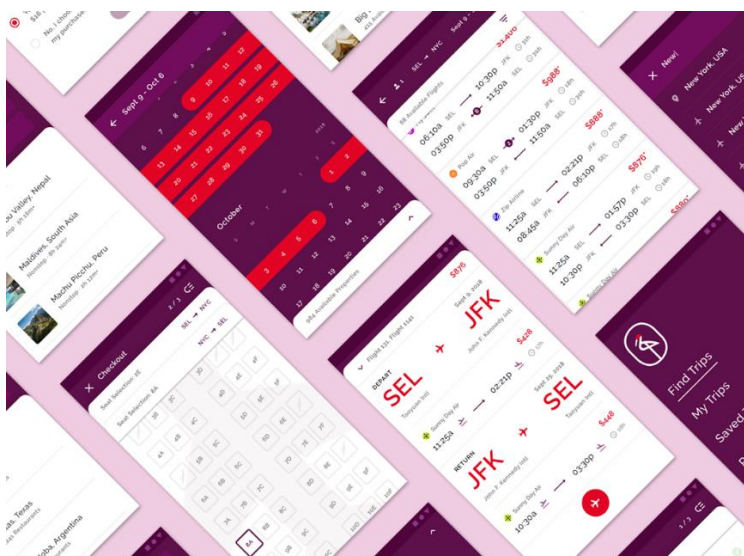


Figure 3. An application applying Material Design (Material Design 2021)

3 UX Design Progress

Design Thinking is utilized for the design process. Therefore, this UX design progress chapter is divided into five subchapters, corresponding to five stages of the chosen framework: Empathize, Define, Ideate, Prototype, Test. The tasks and deliverables in each subchapter were listed and described fully. This chapter reports the UX design work completely, from problem to solution.

3.1 Empathize

In this project, the author carried out quantitative and qualitative research methods to learn more about user's experiences and motivations when using flashcard apps. The quantitative method includes an online questionnaire created on Google Form, and the qualitative one focuses on user interviews. The interview questions can be found in the Appendix.

3.1.1 Online questionnaire (quantitative)

The author was responsible for sending the survey to potential users. The responses were collected between 9 September 2020 and 16 September 2020. There were 75 respondents sending their answers after seven days of the survey being published. The basic information of the respondents is demonstrated as below.

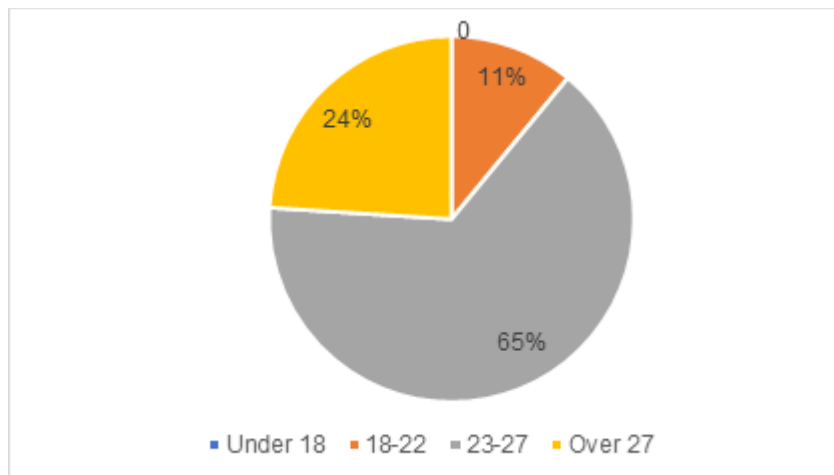


Figure 4. Respondents' age range

The majority of respondents belong to the age range of 23 and 27, followed by the group of people over 27 years old. The age group between 18 and 22 comes as the third position. There was no respondent under 18 years old taking part in the survey.

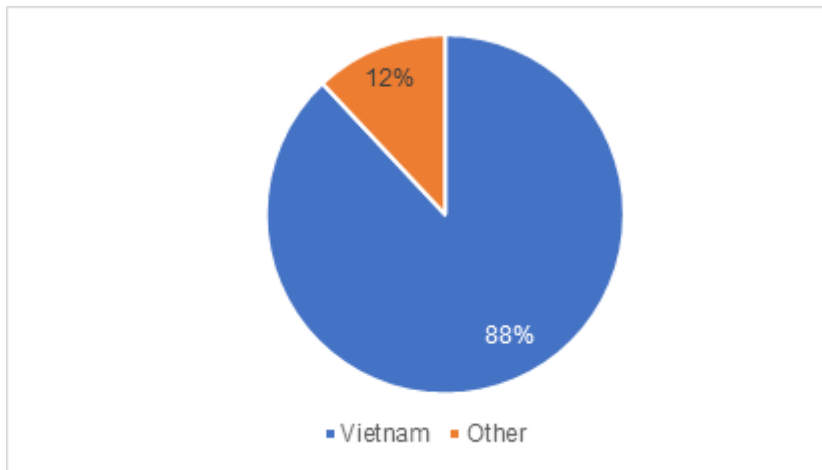


Figure 5. Respondents' nationalities

This survey reached respondents with six nationalities – Vietnamese, Finnish, Spanish, Taiwanese, Chinese, and American. Most of the respondents are Vietnamese (88%). The number of other nationalities counts for a smaller part of the total responses (12%).

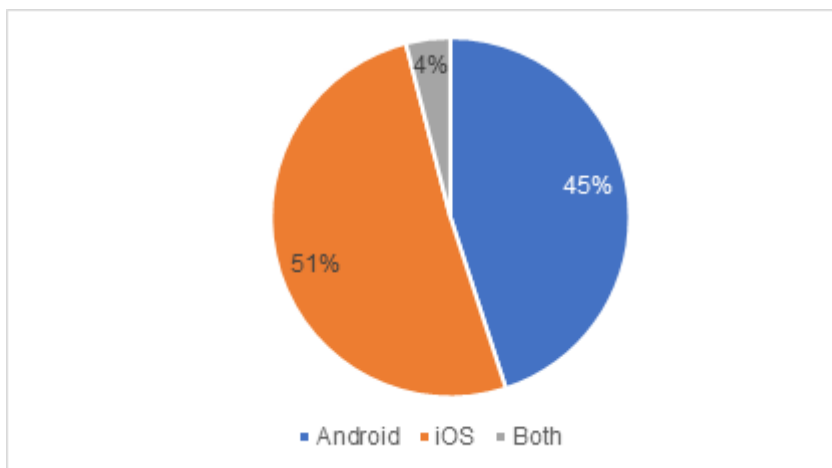


Figure 6. Respondents' mobile devices

More than a half of respondents are using iPhone (iOS operating system). Android users made it to the second position with 45% of people being in favor of this system. Only a small fraction (4%) of respondents have both iOS and Android devices. This information is crucial as the app will be first released on Google Play Store, a platform that supports Android apps.

Android users act as the foundation of the further analysis. The author uses Excel to filter out respondents who own an iPhone. The answer “both” is counted as Android as the

respondents have Android mobile devices besides Apple products. After applying the filter, 37 responses are left to be proceeded further.

Next, the author discards respondents who chose “I have heard of it but don’t use it” and “I have never used flashcards”. The purpose of omitting these responses is to focus on those who are familiar with flashcards to understand their experiences. There are 24 respondents left after the second filter is applied, which makes up 32% of the total respondents.

Online questionnaire results

The final result involves paper flashcard users and digital flashcard users. Like the initial analysis, the number of respondents ranging from 23 to 27 years old takes up most of the list (84%). The age group of 18 to 22 and over 27 share the same size – 12.5%.

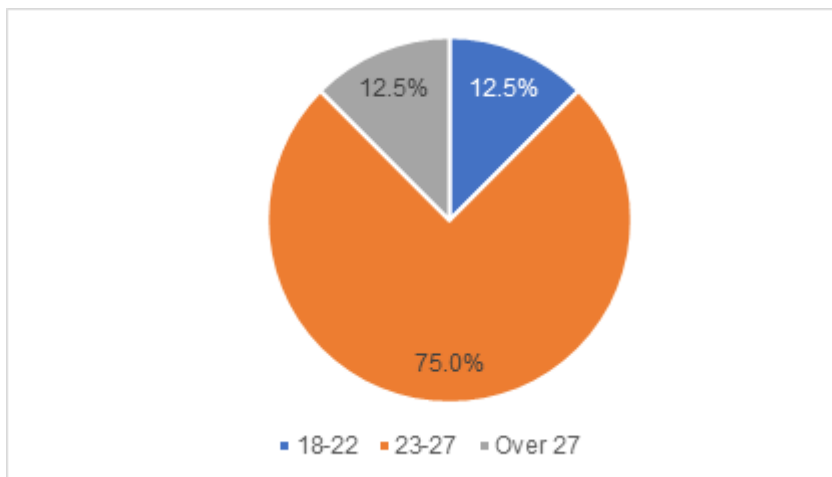


Figure 7. Filtered respondents' age range

Two-thirds of the filtered respondents are female (66.7%), while this figure of males is 33.3%. This data is essential to develop the design style that suits each gender (Figure xx).

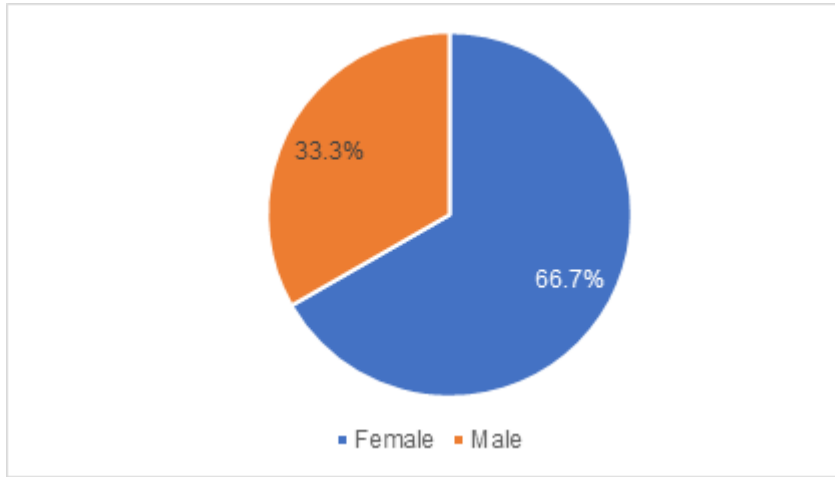


Figure 8. Filtered respondents' gender

On average, most respondents spend less than an hour a day on educational apps. Two-thirds of respondents (66.6%) over 27 years old prefer a less-than-30-minute study session, while this figure is 50% in the largest group (aged 22 to 27). A third of the age group of 18 to 22 also reports that they spend no more than half an hour on an education app.

The statistics have some changes in the answer “30 minutes to an hour”. Two-third of respondents over 27 years old use apps for study purposes for 30 to 60 minutes. The figure is relatively different for the younger age (23 to 27) as only a third of them spend this much time. No respondent between 18 and 22 years old study during this period.

When it comes to sessions over than an hour, the data witnesses a significant change. Only a third or less of the respondents from each age group spend more than 60 minutes every day on an educational app (Figure 9).

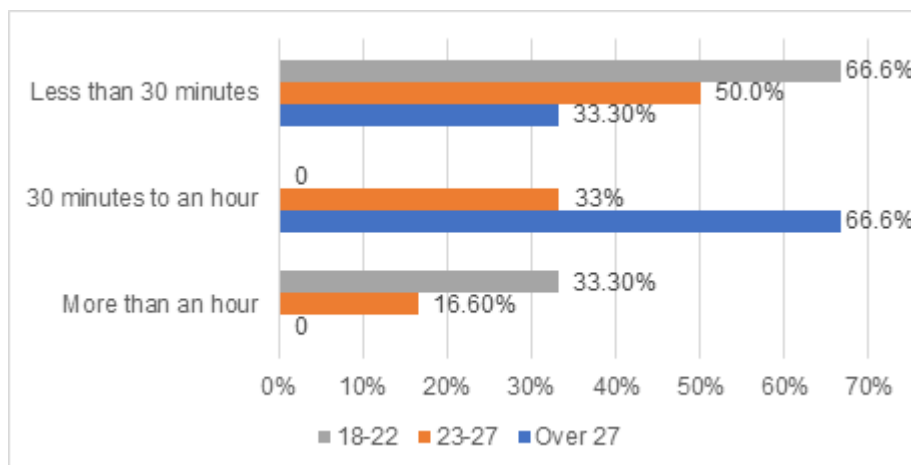


Figure 9. Daily average time spent on educational app of three age groups

The main purpose of using flashcards is to learn foreign languages (91%). Studying school subjects is reported to be the second reason to use flashcards (29.9%). Teaching and personal interests are not as substantial (16.7% for each), yet they are still worth considering while designing the app (Figure 10).

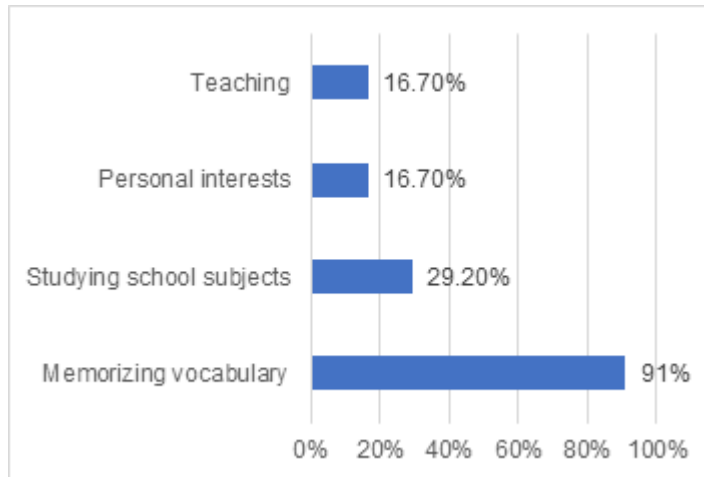


Figure 10. Filtered respondents' purposes of using flashcards (both paper and digital)

Both self-made flashcards and ready-made flashcards are supported by the respondents. Each method makes up 45.8% of the total responses. There is a small number of respondents (8.4%) make flashcards from scratch and use flashcards that are prepared by other people (Figure 11).

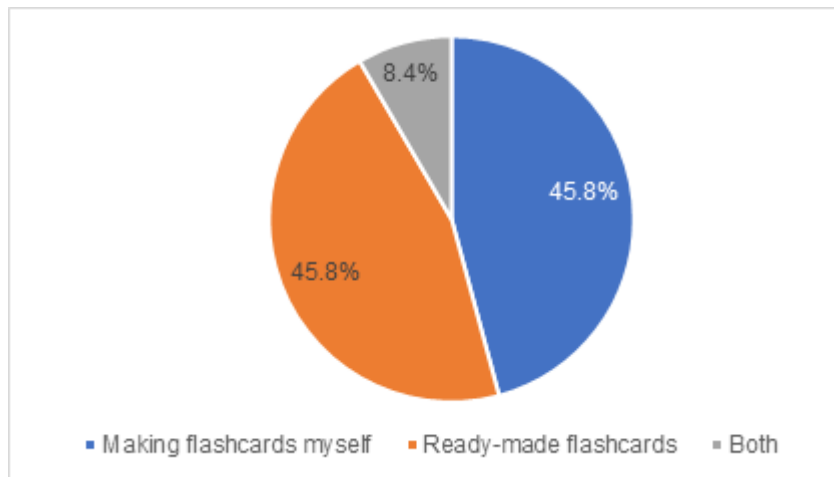


Figure 11. Filtered respondents' preference of self-made flashcards and ready-made flashcards

Two-thirds of the respondents acknowledge the effectiveness of flashcards as they choose “I think flashcards works well for me”. Another third does not have specific attitude towards flashcards as they choose “I think the flashcards is neither good nor bad” (Figure 12).

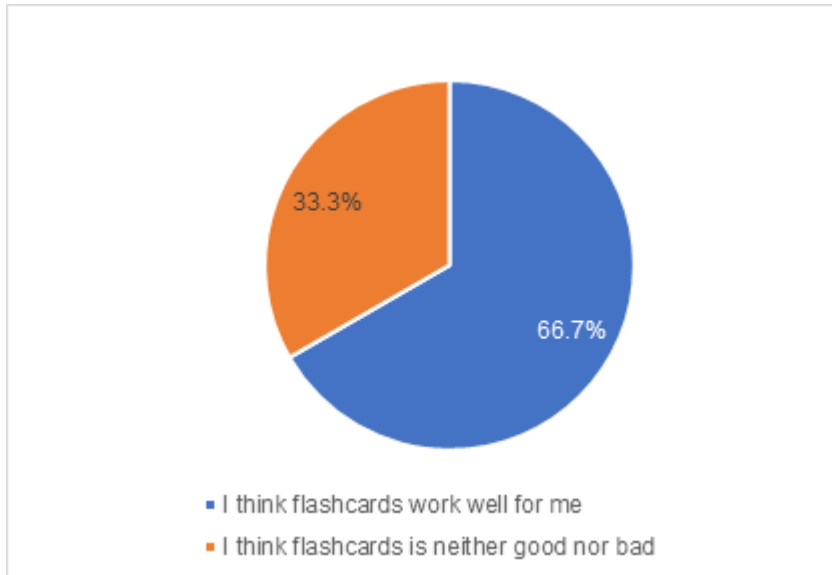


Figure 12. Filtered respondents' attitude towards flashcards

3.1.2 User interviews (qualitative)

The interview was conducted with a focus group of two users (referred to as A and B) in two separate interview environments. Both interviews followed the same questions as well as the data collecting method. The two user interviews were carried out at the end of September 2020. As allowed by the interviewees, the author uses a smartphone to record the interview. Following that, the recording was transcribed, and an analysis procedure was applied. Table 1 below divides the interview questions into three categories to answer two questions – What (basic information, behavior) and How (experience) - as follows.

Table 1. Categories of interview questions for interviewees

	Interview question	Category
1	What languages/ subjects are you studying at the moment?	Basic information
2	How often do you learn that language at home? And for how long?	User behaviors
3	How do you usually learn new words/ concepts?	

4	What difficulties do you face when learning by that way?	User experience
5	Have you used any app, website to learn that language/ information? If yes, what is your experience with the app?	
6	Have you used flashcard before? Why, Why not?	

The categories above define two investigative questions (referred to as IQ) for later qualitative research analysis:

IQ 1: What do learners do when learning a subject?

IQ 2: How are learners' experiences with their learning?

The transcripts of the interviews have been reviewed and organized to the defined category above (Table 2). As the interviewees went through the same pre-determined questions, the answers have similar patterns that can be easily recognized. Table2 compares the differences between interviewees A and B in terms of user behaviors and previous experience.

Table 2. Analysis of interviewees' responses

Category	Interviewee A	Interviewee B
Basic information	- Learn Finnish	- Learn business English
User behaviors	- Learn on weekdays - Spend 2-3 hours a day - Use a Finnish learning app, write everything down, listen to the pronunciation, repeat the word	- Learn when have time or in the mood - Spend under 1 hour each time - Use paper notes, learn when having the note
Previous experience	- Likely to forget new words - Think about using paper flashcards - Satisfied with the app Worddive - Think flashcards are helpful but time-consuming	- Irregular study time - Forget to bring paper notes with her - Satisfied with Google Translate - Think flashcards are helpful

Results in user interviews

IQ 1: What do learners do when learning a subject?

Regarding the basic information, language learning is the common activity between the two interviewees. Although the language level was not specified, their primary purpose is to improve the capability of using the language. The frequency of language learning is different between interviewees A and B. While A has a structured study time and a pre-determined plan for Finnish, B does not have a clear schedule to study business English.

The two interviewees also have contrasting priorities for the activity. While A usually spends two to three hours a day learning, B is more willing to have a less-than-one-hour study session. According to B, "time management is not an easy task," so it takes more time for her to get back to study. Both interviewees use the traditional study approach, which is passive learning (from videos) and paper notetaking.

IQ 2: How are learners' experiences with their learning?

The two interviewees have different experiences with their language learning journey. Although A is relatively satisfied with the app, she wants to remember the new words longer as she "may forget 20% to 30% of the vocabulary after few weeks." Interviewee B has some difficulties planning her study time, and she tends to leave the notes at home. Both interviewees call for the need to have the vocabulary list at hand to get access to at any time.

Flashcards are a familiar concept to both interviewees A and B. They consider flashcards a useful tool to facilitate the learning experience. Interviewee A used paper flashcards before, but she is not using them now because it is time-consuming. In contrast, interviewee B has been using paper flashcards frequently as she can "review the knowledge twice when making flashcards."

3.2 Define

3.2.1 User personas

Personas are fictional characters made up by designers based on user research to represent different types of users who might use the service, product or brand (Interaction Design Foundation 2021). The factors related to persona usually are the user's needs, goals, and attitudes toward the app. In addition, demographic information such as age,

gender, occupation, ... is also noted when creating personas. Designers do not need to focus on every trivial aspect of users, but only on the elements related to the applications.

Before the creation of user personas, thorough user research was essential to make sure the personas are based on actual users, not just on designers' assumptions. This is the appropriate way to gain a precise understanding of users will interact with apps. The personas help designers create user-centered applications, ensure to deliver users unique products. In this thesis project, accurate statistics were carried out to ensure the personas are built on reliable facts and numbers.

There are many different formats of persona including different information. However, most persona formats consist of essential elements like biographies of users, their targets, and issues... For this project, there are five main elements in persona: basic profile, bio, goals, problems, and other information. The basic profile of each persona shows age, occupation, place of living, the language he or she learns. The bio describes the persona's current situation. Goals and problems are two crucial elements of each persona, connecting closely with the app's insight. Other information reveals the type of mobile device that the persona uses, his or her preference, his or her knowledge about flashcards.

It is advised that designers create just about one or two personas for a project (Playbook UX 2021). The author created two personas in correspondence with two groups of target users. This helps author have clear vision of application requirements. These personas are unique in many aspects but still share some similarities.

Figure 13 is a profile of a persona named Jenny. She is a young business student living in Vietnam. She is using a Oneplus smartphone. Jenny wants to have enjoyable experiences when she learns English. Her problems are that she can get bored easily and she has a bad memory. She tried using flashcard apps like Anki before but did not satisfy with them.

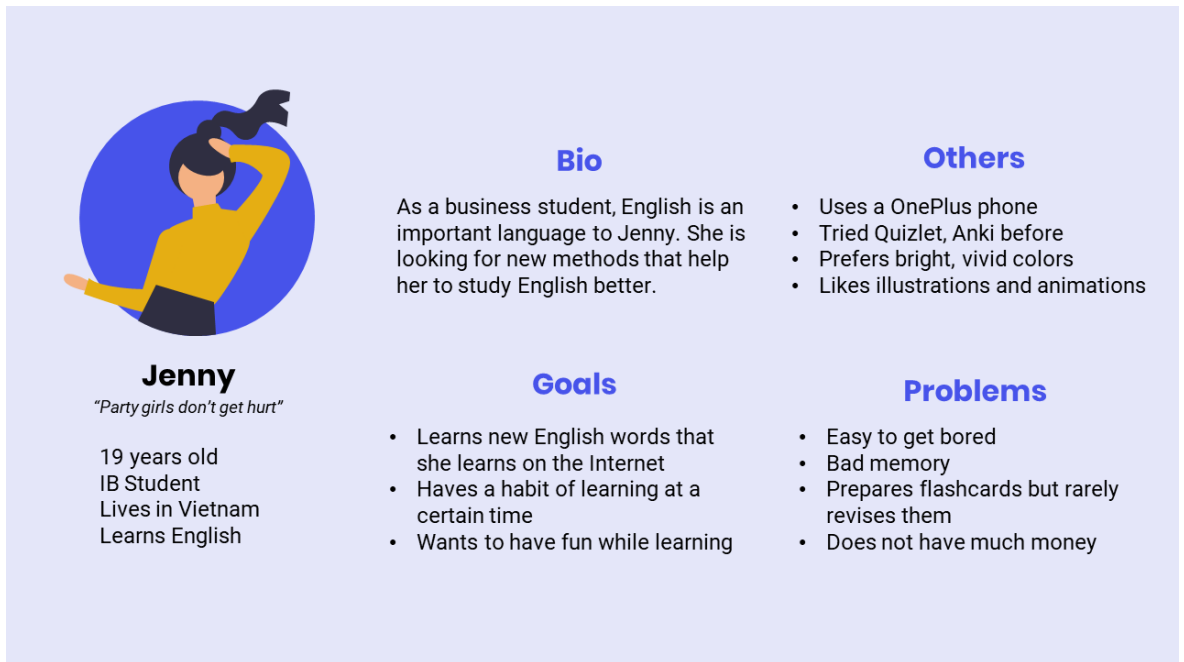


Figure 13. Persona 1

Figure 14 shows a persona called Tony. He is a developer working for an international IT company so he wants to improve his English. He is using Samsung Galaxy S21. His goal is to expand his IT English vocabulary in effective ways. He already knew about flashcards but had not used any flashcard app. He wants a simple and productive app to help him learn English.

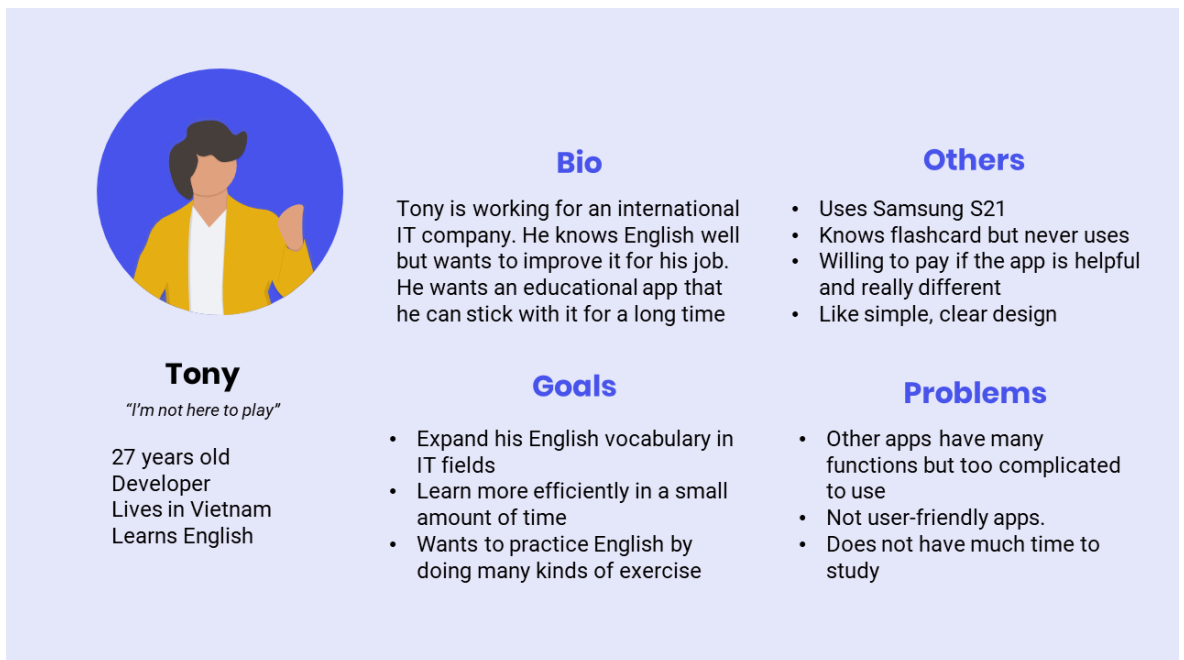


Figure 14. Persona 2

3.2.2 User scenarios

According to David Benyon (2019), a user scenario is a story about people performing a series of actions in context using an application or a website. User scenarios should be practical, simple, and easy to understand for everyone. A proper scenario can cover enough requirements for a development project. By using scenarios, designers have genuine perspectives of user experience from the very beginning.

User scenarios usually answer who, what, how questions. The first element included in scenarios is the background of users: who they are and what their skills are. Next are the goals of users – what they want to accomplish. Users' tasks to complete their goals are also mentioned in scenarios (Interaction Design Foundation 2021). Finally, the context is an essential part of user scenarios. Below is a scenario of Jenny using Memoa app.

Jenny is a Vietnamese business student. English is an important subject in her university and can help her in the future. Jenny usually sees new English words and has to use dictionary to look them up. She sometimes notes new vocabularies down but rarely reviews them. She also has a bad memory so learning English words by heart is a difficult task for her. She tried some apps and websites to learn English, but she gave up in just a few weeks. She gets bored easily with those plain apps.

Jenny knew about flashcards and tried to make them to learn English. She wrote new words down and put them everywhere. The problem with this method is she has to carry a bunch of flashcards and usually loses them along the way. She then tried a well-known flashcard application. It is pretty complicated and causes many confusions for a new user like her. She also does not like the plain and outdated interface of that app.

Jenny later found out Memoa – a flashcard app with gamification features, bringing fun and engaging learning experiences to users. She just needs a few steps to log in to the app and start building her own digital flashcards. With each deck of flashcards created, she firstly learns new words by flipping two sides of flashcards. Next, she can choose a variety of quizzes to test words she learned. If she cannot remember words, the app will notify those words in the next few days. She can also set the time of notifications so that she has a habit of learning English at a certain point of time during the day.

Another exciting feature of Memoa is Meow, the virtual cat that accompanies users on their study journeys. Jenny enjoys raising Meow while learning in this app. Points she collected when taking quizzes can be exchanged for food and toys for Meow. The more

she feeds and plays with Meow, the bigger Meow becomes. Meow can also play new tricks when it grows bigger. This gamification feature makes Jenny's learning experiences more entertaining but still compelling.

3.3 Ideate

3.3.1 User flows

User flow is a graph that shows the process of users interacting with an application or a website to complete a task (Justinmind 2021). Lines and paths on user flows can represent user actions and clearly represent opportunities for improving user experience. The most important thing when creating user flows is to empathize with users and understand users' needs. It helps designers know what problems their users have and how they can solve issues.

A good user flow should precisely define the purpose of the process. Even the process is simple; designers have to take an eye on details of the user flow: the number of steps, possible directions, description of each step... There are various tools for sketching user flows. The simplest way is using pen and paper. Designers can draw user flows on paper and take photos to share with other team members. On the other hand, there are a range of digital tools for user flows: Microsoft Visio, Lucidchart, Sketch...

In this thesis project, the author used Microsoft PowerPoint to draw user flows for Memoa app. This tool is not specified for user flows but it is available on many devices and has basic yet efficient features to draw lines, shapes for flows. Different user types interact differently with the app. Therefore, two user flows are created in the Define stage: one the new users and the other for frequent users.

Figure 15 demonstrates the user flow for new users. First, they need to login or sign up. This only applies for their first time using the app. Then, they create a new deck and multiple flashcards in the deck. On the main screen, users can navigate between Profile and Meow – the virtual pet.

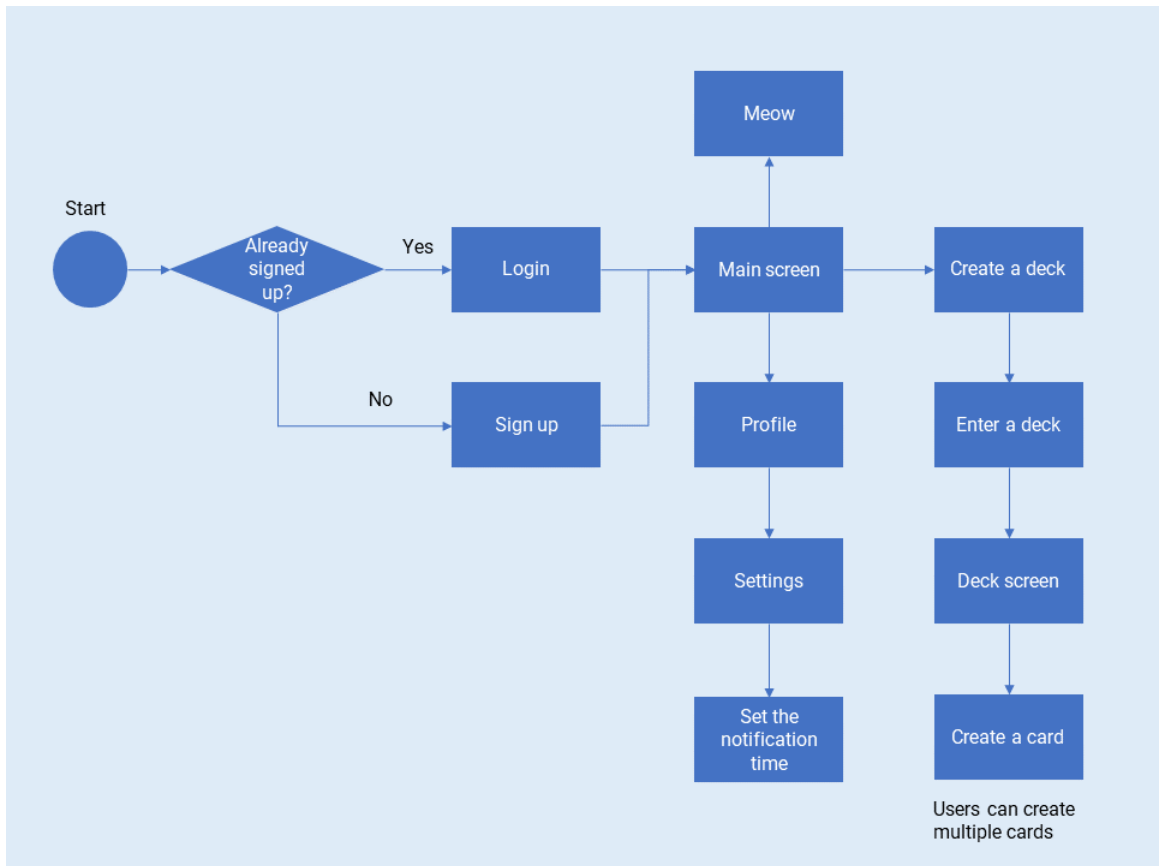


Figure 15. User flow of new users

Figure 16 presents the user flow for users utilizing the app regularly. They can start by learning words they created before. They, they can take quizzes to test their memories and earn points. The points then can be exchanged to foods and toys to raise Meow.

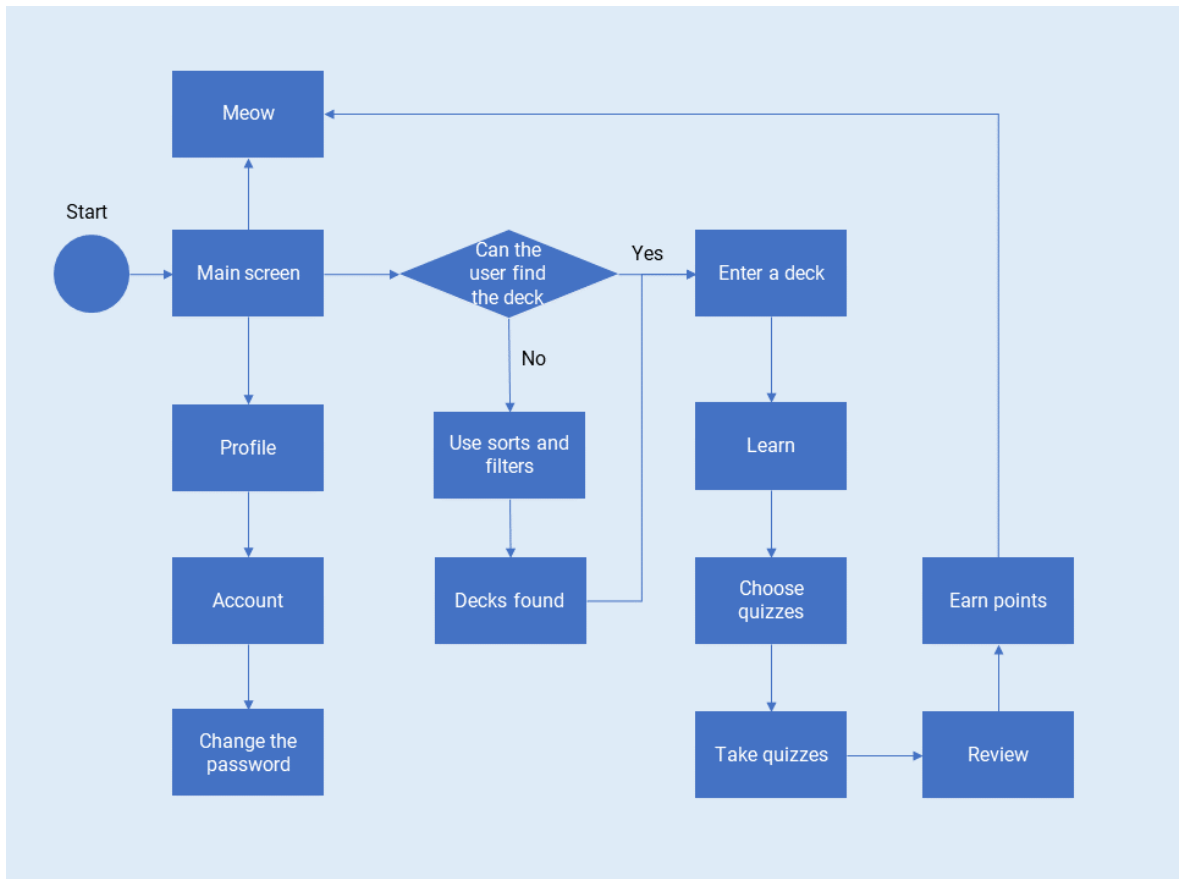


Figure 16. User flow of frequent users

3.3.2 Wireframe

A wireframe is a low-fidelity design layout to showcase the composition of an application or a website and other elements in that app or website (Invision 2021). Wireframe easily conveys ideas and information not only between team members but also between the team and users. Designers can design interface elements such as buttons, texts, inputs...based on completed wireframes. On the other hand, developers can use wireframes to program functionalities for the apps.

Wireframing is an essential step in the UX design process. With the advantage of being easy to create and saving time, it is the simplest guide for the project team to understand the product concept, description, and function. The clear, easy-to-understand wireframe is a good start to the later development process. Designers can use wireframes to conduct some usability tests even before the Prototype phase. In this thesis project, the author performed some tests with users using wireframes to determine errors in the early stages.

The author utilized Adobe XD to design the wireframe for the Memoa app. The wireframe has a simple and minimal design. There are just a few basic interface elements on the wireframe, but they still demonstrate the essential functions and features of the app. The main shades of the wireframe are black, grey, and white so that the author can focus more on the navigation and structure of the app. The fonts and images are also not a big concern at this stage. Figure 17 showcases the wireframe for the Memoa app.

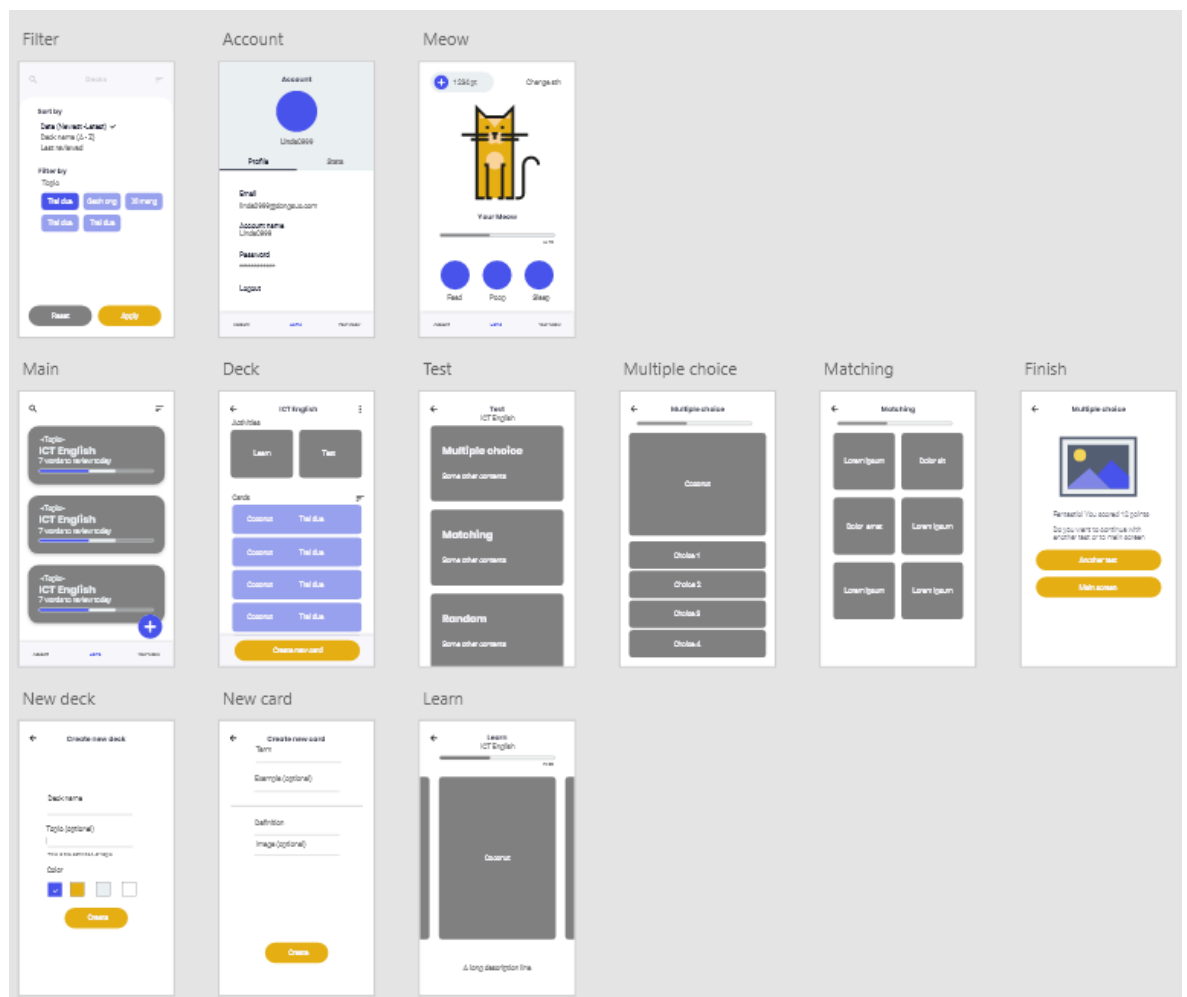


Figure 17. The wireframe for Memoa

3.4 Prototype

Prototype is a draft version of a product or an application which enables the development team to delve into their ideas and demonstrate features or design concept to users. Prototyping can be done by many methods ranging from low fidelity to high fidelity. Low fidelity (lo-fi) prototypes can be made from pen and paper, which is fast and easy to create. High fidelity (hi-fi) prototypes, on the other hand, deliver users the most similar possible presentation of actual user interfaces, so hi-fi prototypes can take more time and effort to complete (Usability 2021).

Prototype illustrates the product in more detail than the wireframe. Hi-fi prototypes have the interactive element, allowing users to experience content and interact directly on the user interface, just like when they use real products. UI design plays an undeniable role in Prototype stage. The specialties of designers such as interaction design, visual design... or even copywriting are highly needed for prototyping.

Adobe XD is the main software for prototyping in this thesis project. Adobe (2021) describes XD as a dynamic and easy-to-use vector-based experience design software. Designers can utilize Adobe XD in many stages of the UX design process: wireframing, prototyping, interaction design... Another strength of XD is the collaborative features, allowing the teams keep tracks of every design activities. Adobe XD is also free for personal use and available on both Windows and Mac.

Memoa was initially designed for Android so the author set dimensions of each screen 640 : 360. The square grid was applied throughout the whole prototyping process to guarantee the layouts are rigid and unified. At the beginning of Prototype phase, the author determined the main color scheme, the fonts system for the whole app and the style of each component. Then, those elements were arranged and combined into each screen according to the previous wireframe. The details of interface design will be discussed more properly in the UI design chapter.

Figure 18 presents prototypes for login and register screens. These screens only appear for the first-time users downloading Memoa. Users can choose between their emails, Facebook accounts, or Google accounts to login. These login or register forms are simple and straightforward, allowing users to get into the app quickly.

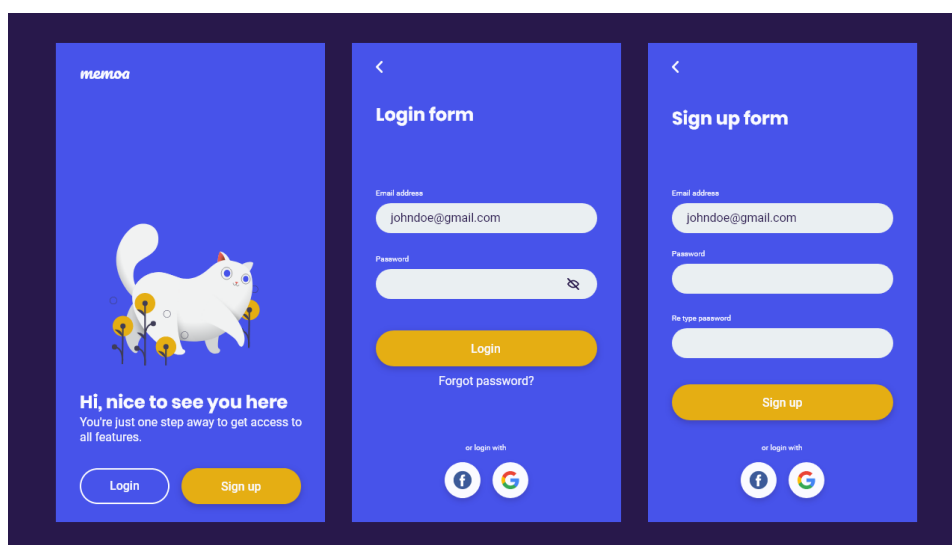


Figure 18. Login and register screens

The main screen displays decks of flashcards. Users can create new decks or browse them easily by scrolling up and down. The sort and filter function helps long time users find their needed decks effortlessly. The kinds of information on each deck are: the name of the deck, decks topic, progress of users, the number of cards to review on a day. These screens are presented in Figure 19.

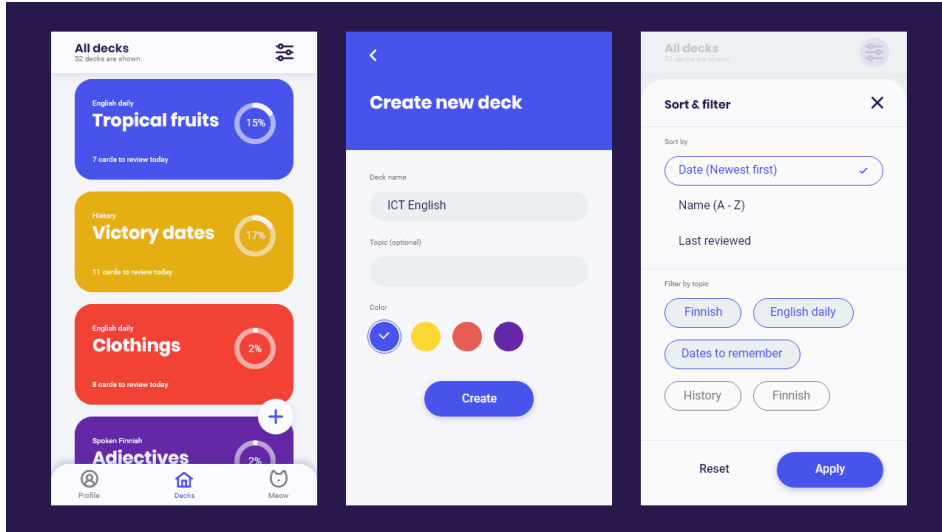


Figure 19. Deck screens

Figure 20 showcases the inside content of each deck. Users can create new flashcards in a deck. The flashcards are in the lower part of the screen and can be sorted by date, alphabet order or by last review time. Users later can review and take quizzes with created flashcards.

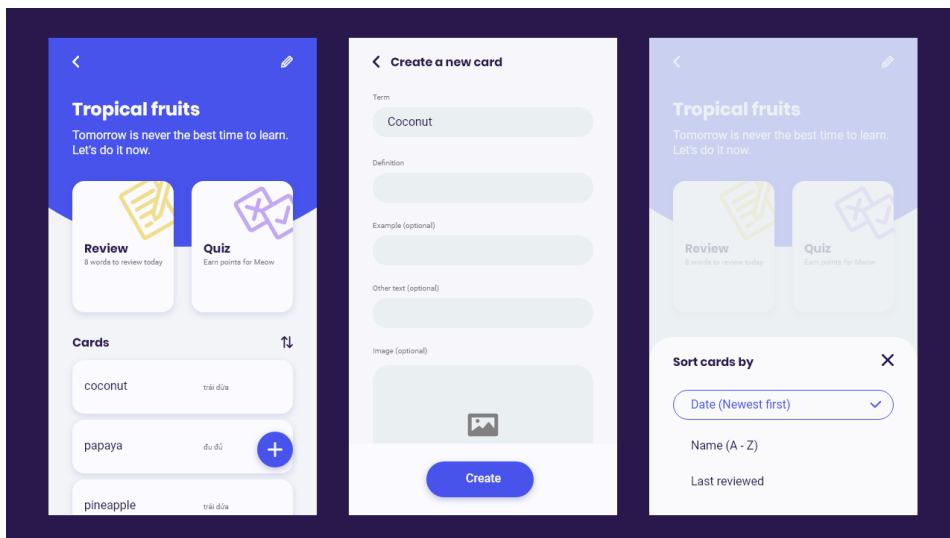


Figure 20. Inside deck screens

There are two types of quiz currently: Multiple choices and Matching. They are displayed in Figure 21. For multiple choice quizzes, users choose one correct answer between four options. In matching quizzes, users choose a correct pair of term and definition among other ones. There will be more kinds of quiz in the future development.

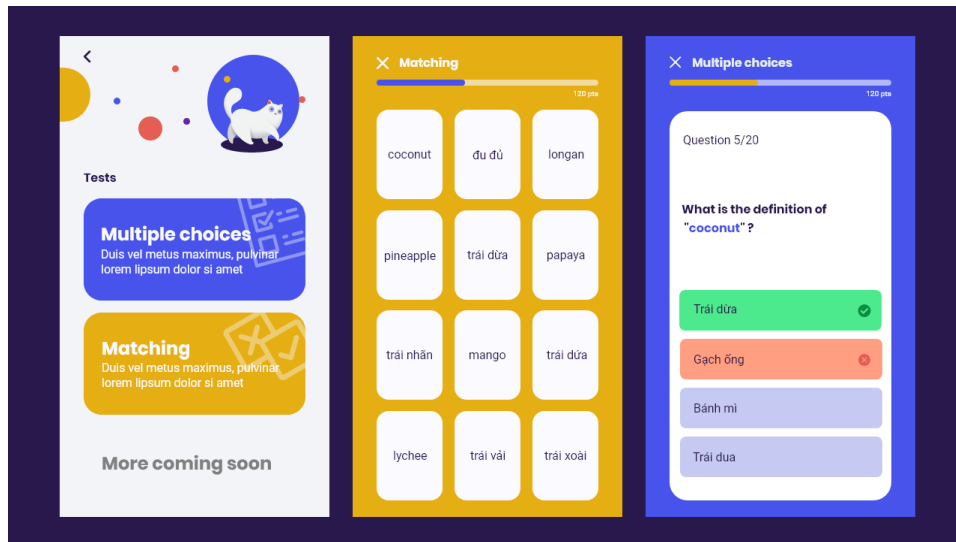


Figure 21. Quizzes screens

Flashcard details are displayed in Figure 22. The front side of each flashcard has only a word/ question/ term. Users can press the hint icon on the top left corner of the flashcard to reveal an example or an image of that word. The full information is presented on the back side of each flashcard. Flashcard can be flipped by tapping, the flip icon on the top right corners of both sides is the complimentary to that.

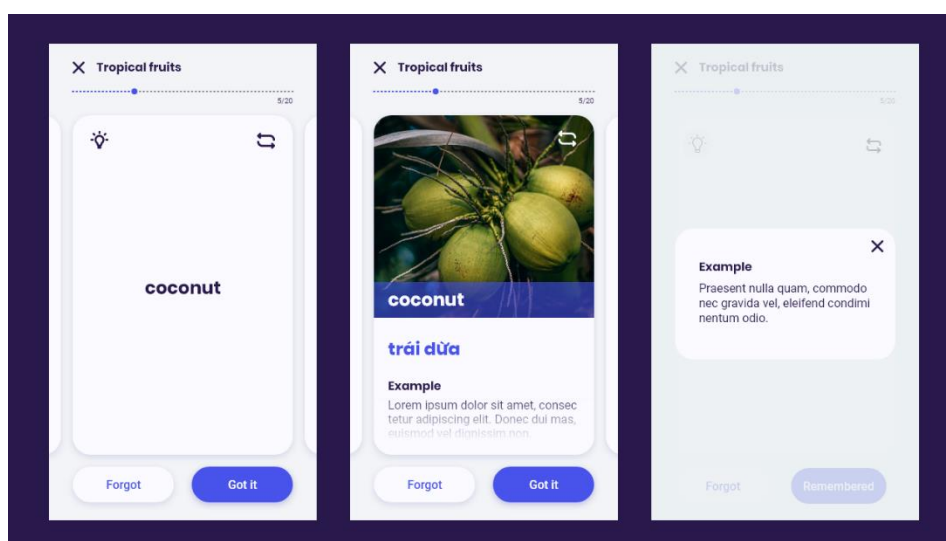


Figure 22. Flashcard screens

3.5 Test

Conducting the usability test is the main task in Test phase. Hotjar (2021) defines usability test as a technique of testing the functionality of a website or an application by monitoring users while they try to perform tasks on it. Designers should observe and note down the whole process of testing. The purpose of usability tests is to detect errors or confusion in using digital products and discover opportunities to enhance the overall user experience.

The usability test can be used to test a new feature or a specific function of an application. It is also used to test a complete application, website, or even a mock-up application to measure users' needs. Designers should be clear about what criteria they want to evaluate from the very beginning. In Memoa development project, a usability test was carried out to assess the hi-fi prototype and explore which features should be improved in the future.

There was a detailed plan for the usability test. The plan included the number of users, goals, criteria, methods, tasks and time of the test. The author conducted the usability test on five users. This number of users was suggested by Jack Nielsen (2021) from Nielsen Norman Group – a trusted UX source. Because of the Covid-19 situation, all users participated in the test by video calls. The author sent them the link to the hi-fi prototype beforehand and observed their acts through their share screens.

The team prepared five tasks for the usability test: creating a new deck, creating a new flashcard, displaying decks on the same topic, reviewing flashcards, taking multiple choice quiz. The difficulty of tasks was increasing. The first tasks only required users one or two steps to complete, while the latter ones had the more complicated process. 20 minutes were reserved for each user. The author's responsibility was monitoring and taking notes during the usability test. Table 3 shows the result of the test.

Table 3. Usability test result

	creating a new deck	displaying decks in a same topic	creating a new flashcard	reviewing flashcards	taking multiple choice quiz
User 1	performed well	performed with small troubles	performed well	performed well	performed well

User 2	performed well	performed well	performed well	performed well	performed well
User 3	performed well	performed with small troubles	performed well	performed with small troubles	performed well
User 4	performed well	couldn't performed	performed with small troubles	performed with small troubles	performed well
User 5	performed well	performed well	performed well	performed with small troubles	performed with small troubles

The result pointed out errors and confusion to be surmounted in the real app. The prototype was edited to solve those problems. After each test section, the author spent about 10 more minutes asking for feedback and review from users. They are valuable and constructive for Memoa development project in the future.

4 UI Design

This chapter discusses mainly the visual perspective of Memoa app. UI elements such as typography, colors, components... are presented thoroughly, giving readers a comprehensive view of the whole UI design process. The meanings and reasons behind the design are also explained in this chapter. There are two subchapters: the first one addresses colors and typography, while the second subchapter mentions UI components.

4.1 Colors and typography

Colors were taken into consideration even before the UI design process because they can represent the characteristics of Memoa. Blueish purple (#4753EA) is the primary color of the app. Lighter shades of purple bring a positive and energetic atmosphere (Nick 2021). Shades of blue mixed in the primary color make it more suitable for users of any gender or age. The secondary colors were chosen to create harmony and complementary to the primary ones. Figure x shows the complete color scheme for Memoa app.

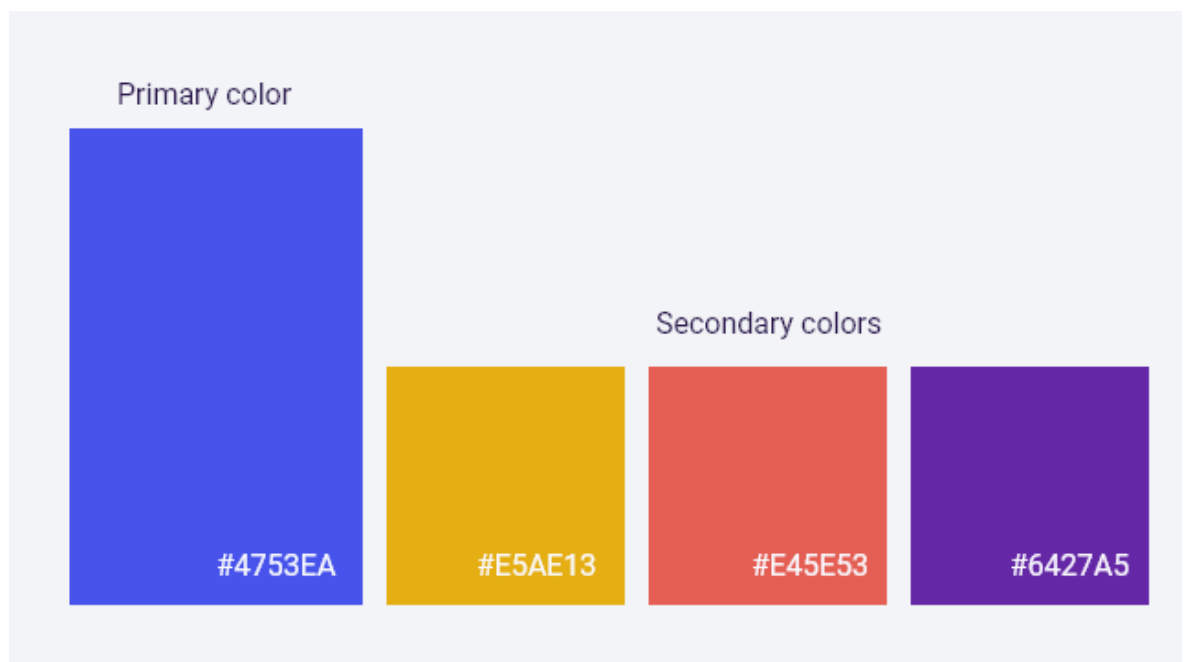


Figure 23. Color scheme for Memoa

Poppins and Roboto font families are utilized in Memoa app. They are both free and available on Google Fonts (2021). The main headers and sub headers are in Poppins bold size 24 and size 16, respectively. Roboto regular is used for body text at size 16 and

for small notes at size 10. These two fonts are distinctive but can combine properly for an easy-to-read app. Figure 24 shows the typography system for Memoa app.

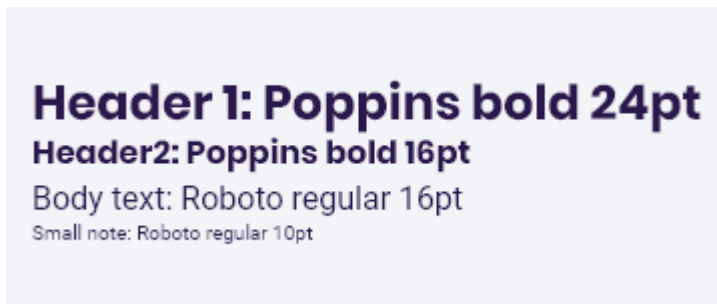


Figure 24. Typography system for Memoa app

4.2 Components

Buttons are one of the basic components in each mobile app. Buttons in Memoa are designed in line with Material Design guidelines (2021). Most of the buttons are rounded, giving not only the aesthetic look but also friendliness to users' eyes. The primary buttons can be recognized easily with blueish purple background color and shadow, while the secondary ones are more subdued with only plain text. The visual of buttons are presented in Figure 25

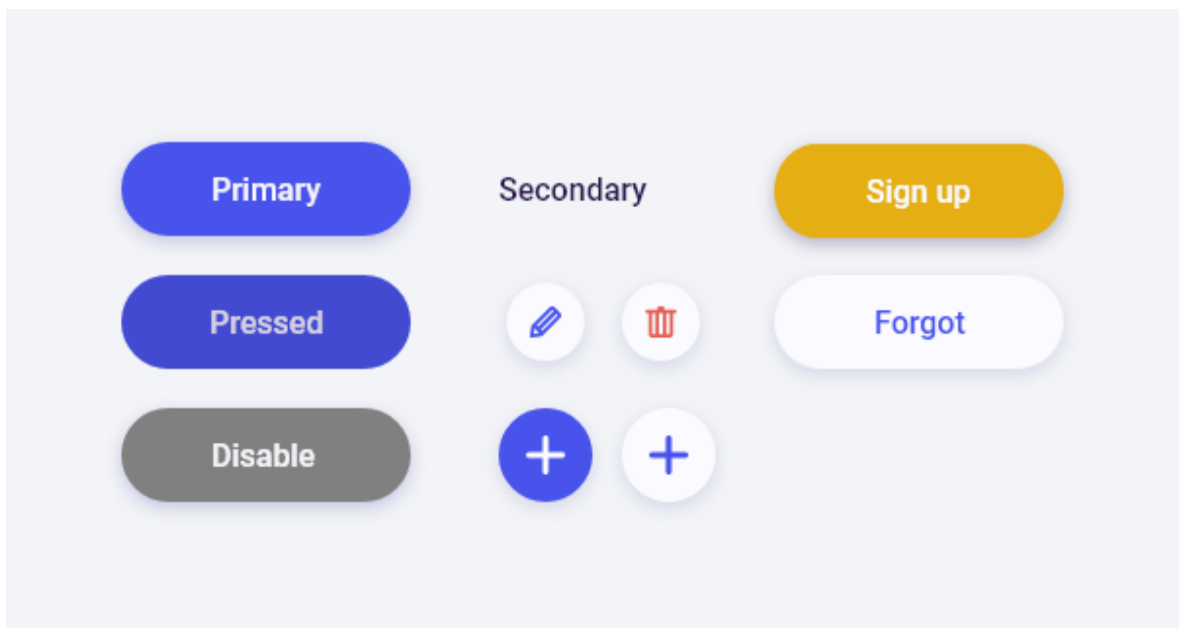


Figure 24. Buttons

Material Design guidelines (2021) is also applied for other components such as: text field, bottom navigation, cards... Components with shadows indicate that they are on top of other ones. Their states change according to users' interaction. Figure 25 and 26 show the details of these components.

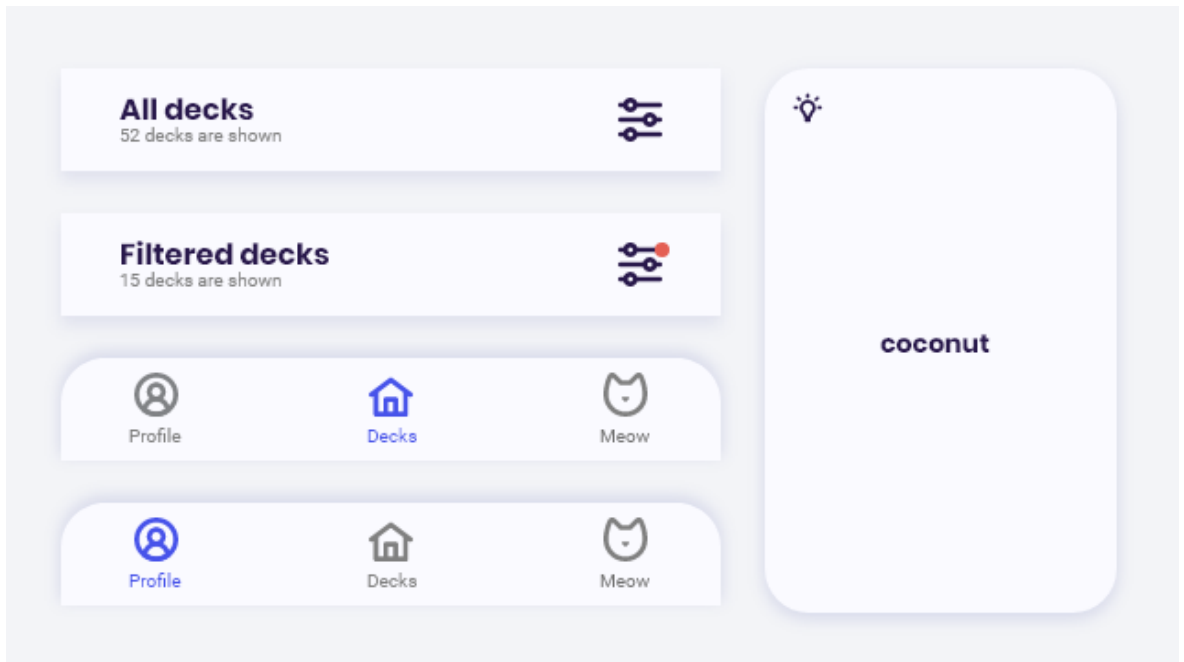


Figure 25. Nav bars and cards

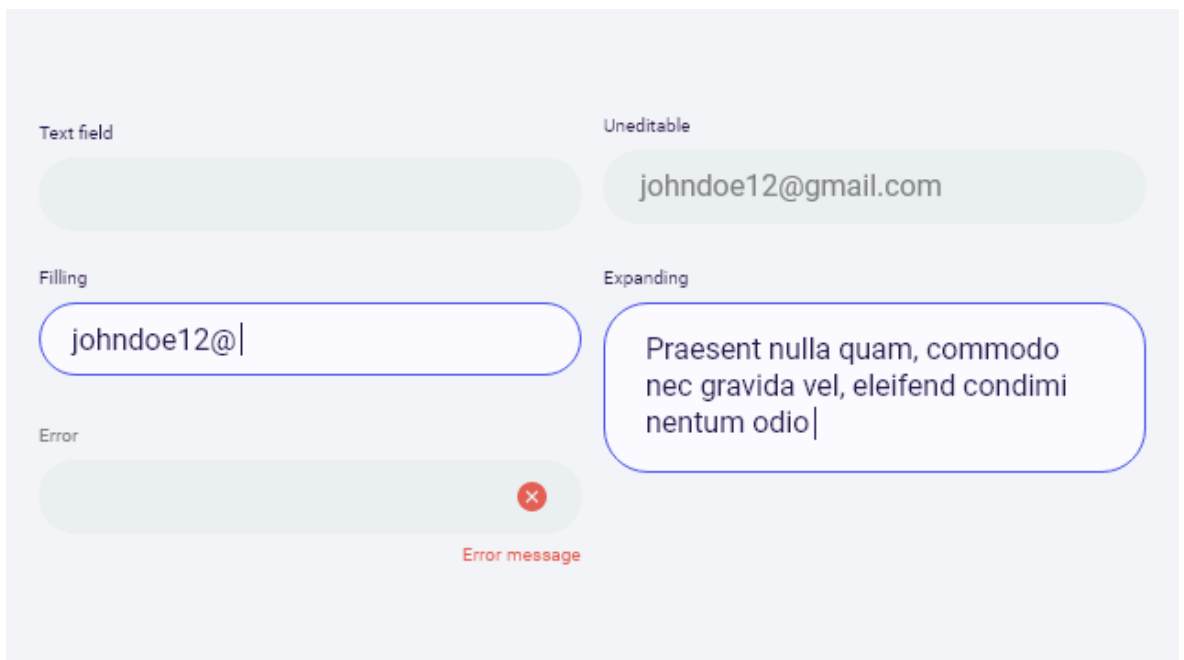


Figure 26. Text fields

5 Conclusion

The functions and features of Memoa have partly solved users' problems in studying and memorizing. Memoa has been developed and designed throughout the full and complete Design Thinking Process. The interface of Memoa is easy to use, convenient and flexible for users. Most UI elements of the real app are similar to the final prototype. The application is ready to launch on Google Store by the end of the thesis project.

The author has made progress in both academic knowledge, theoretical research, and skill enhancement during the thesis project. More specifically, the author applied what has been learned in the implementation of the UX design process, thereby grasping the theory, serving the design and development of Memoa. Besides professional understandings and skills, the author also practices project management, self-study as well as soft communication skills.

Because development time is limited and the practical experience of each team member is insufficient, Memoa still has some unfinished functions. There can be several minor errors in the actual use of the application. Time management is the major problem of Memoa team, causing many delays in the delivery of the app. Another problem is that flashcards are still unfamiliar to some people, so marketing is needed after the launch.

Submitting the thesis and releasing the app are just the beginning for Memoa team. With the purpose of putting Memoa in practical use, the author will hone his knowledge and skills in UX and UI to complete the app. Meow, a virtual pet in Memoa, will be introduced in future updates. Feedbacks and reviews from users are highly welcomed to make the app more user-friendly and relevant to users' needs. Memoa team hopes the app becomes a reliable study companion for many learners around the world.

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Appendices

Appendix 1. The interview questions

1. What languages or subjects are you studying at the moment?
2. How often do you learn languages or subjects at home? And how long you learn ?
3. How do you usually learn new words/concepts?
4. What difficulties do you face when learning by that way?
5. Have you use any app, website to learn languages or subjects?
6. If yes, what your experience with learning apps and websites?
7. If no, do you know any app, website to learn those languages or subjects?
8. Have you use flashcard before? Why, why not?
9. Your experience with flashcard, app or paper?