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A Systematic Literature Review of the Design Thinking Approach for User Interface Design

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Abstract— The user interface is an influential element in software applications. A well-designed user interface will potentially increase the usability of software applications. Therefore, user interface designers should deliberate when considering which approach and method to implement for designing user interfaces. Design thinking is currently a widely followed approach in user interface design practices. Hence, this study aimed to explore research trends and current practices of design thinking approach for user interface design. This study employed a systematic literature review following the Kitchenham method. This study found 39 articles deemed relevant to the design thinking approach. In general, our study found five common stages broadly mentioned in the articles, i.e., empathize, define, ideate, prototype, and test. The most widely practiced method during those five stages is interview, user persona, brainstorming, user interface, and usability testing. However, there is no consensus on what kind of stage(s) and which method(s) should be employed when following the design thinking approach for user interface design. Therefore, it will depend on the designer's decision in choosing which stage(s) and their related method(s) will be employed.

Keywords— Design thinking approach; user interface; systematic literature review.

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I. INTRODUCTION

The actual problem for any application is creating an effective yet efficient interface, in which efficiency is defined as the ease of development, creation of an effective interface, maintenance, and working with the program [1]. Digital products and their user interfaces must be usable to everyone and accessible to any type of audience in an era of users with a rising diversity. As a result, designers must be familiar with complex and complicated issues in user requirements, context-oriented design, and adaptable and adaptive interactive behaviors [2]. The common method of designing user interfaces is based on heuristics and principles that various authors have systematized over time been systematized over time by various authors [3].

Research from Imaginovation (an American-based research institute) in 2017 states that 79% of users will leave the page if the content on the website needs to be properly optimized [4]. The term "user interface" describes how a system and a user communicate with one another in order to operate the system, enter data, and consume its contents [5]. This dramatically affects how important the role of the User Interface on a website display [6]. So, effective website

design becomes even more important when the internet becomes the main medium for delivering information [7].

One of a software project's most important components is the user interface. According to estimates, up to 48% of the project's labor goes into designing and implementing user interfaces [8]. User interface design needs to pay attention to user needs to customize the appearance of features and functions according to user characteristics. Numerous standard methodologies and recommendations can be used to create a user interface [9].

To accurately portray work practices in the system design specification, good interface design necessitates a thorough grasp of work practices in the context of the tasks the computer will support. Design thinking methodologies are just one of the many methodologies and techniques that may be used to assess end-user information processing activities in a certain job setting. More particularly, several literary works introduce cognitive engineering concepts [10]. To understand more about the design thinking approach, the researcher tried to understand multiple works of literature by conducting a literature review.

In this literature review, researchers understand several journals regarding the implementation of user interfaces with

a design thinking approach, and design thinking can be useful in helping in the way of thinking to get ideas, creativity, and innovation, which is done from a human-centered approach [11]. Design thinking is a user-centered approach to problem-solving that begins by analyzing the demands of the target audience before looking for creative answers to the problems that have been identified. The Design Thinking paradigm continues to develop in its journey; many new design paradigms are developing, including the 3I Model developed by Brown and Wyatt, the Human Centered Design (HCD) Model developed by the IDEO Design Agency, the Double Diamond model from the British Design Council, and several other design models [12].

This work aims to understand the approach to design thinking, such as the stages that have been used in previous research. More than that, it also aims to examine the steps that must be taken from each stage of design thinking based on methods and steps from several design thinking paradigms. This research is expected to contribute to helping researchers determine the right steps for each stage in the design thinking approach, with many methods in it.

II. MATERIAL AND METHOD

The approaches outlined by Kitchenham are referenced in the literature review's methodology. This method is a literature study method to identify and assess information that can be found in previously conducted research or can also be called a research question. There are three stages in conducting a systematic review: Planning, Conducting, and Reporting [13]. This study's steps are described in Fig 1.

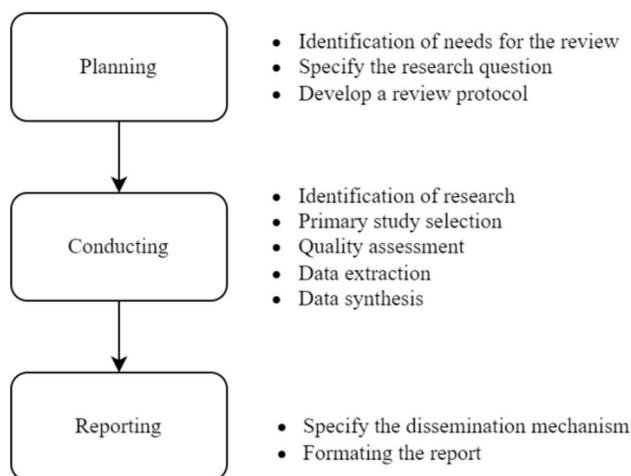


Fig. 1 Systematic Literature Review Process

Based on Fig 1, The process takes three phases to complete. Choosing the research question is the initial stage. The primary focus of this research's discussion will be these research questions. The next step is to choose a relevant article to address the questions under the research question. The specific actions are as follows.

A. Planning

At this stage, we tried to identify some literature related to thinking design. The search was carried out based on keywords and traced several research records. Besides, researchers tried to make a Systematic Literature Review

protocol to facilitate data extraction and synthesis. The protocol can be seen in Table 1.

TABLE I
SYSTEMATIC LITERATURE REVIEW PROTOCOL

SLR Protocol	Description
Research Question	<ul style="list-style-type: none"> • RQ1. What are some design thinking models commonly used in recent research? • RQ2. What kind of methods are employed at every stage in design thinking?
Sources Searched	Google Scholar, Scopus, IEEE, ACM Library, and JMIR
Search Terms	"Design User Interface" AND "Design Thinking" AND "Design Thinking Approach" AND "Design Thinking Method" <ul style="list-style-type: none"> • The literature contains discussions about implementing user interfaces using a design thinking approach.
Inclusion	<ul style="list-style-type: none"> • The literature selected was scientific publications published from 2018 to 2022. • Journals or conference papers make up the majority of the literature under discussion. • This journal is taken from journals indexed by Scopus and Google Scholar. • The literature does not discuss the implementation of user interfaces using a design thinking approach. • Literature was other than journals and conferences with the publication year before 2018.
Exclusion	<ul style="list-style-type: none"> • Discussed in the form of journals or conference papers. • This journal does not take journals outside the Scopus index and Google Scholar. • Clarity of research objectives • Contains literature review, background, and research context
Quality Assessment Criteria	<ul style="list-style-type: none"> • Describe the Design Thinking Method used • Contains related work from previous research • Shows relevant conclusions
Data Extraction Synergy	Researchers mapped the research based on the methods and variables used. In addition, each variable will be assessed in the data collection process and research.
Data Synthesis Strategy	The data synthesis uses a data-driven approach, which is based on the results of the paper extraction. In this data-driven approach, a comparison list for each paper is made to answer the research question.

B. Conducting

Following the systematic literature review, researchers tried to collect journals based on the inclusion and exclusion that had been applied in the research methodology. Based on the search, researchers found journals that fit the criteria described in Figure 2.

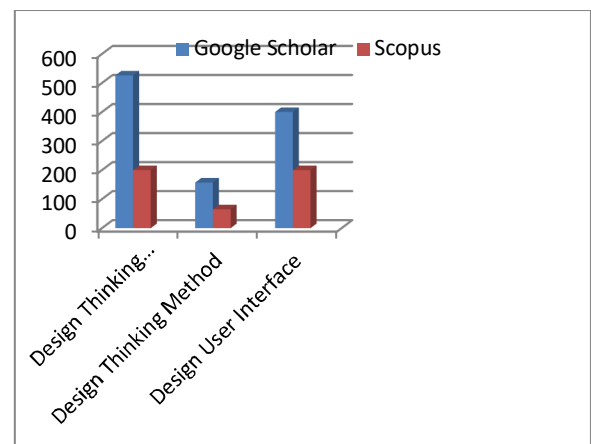


Fig. 2 Number of literature searched from journal database

Based on the data displayed, several journals have been obtained from search results indexed by Google Scholar and Scopus. Journal searches use the Publish or Perish application by classifying by year, keywords, and journal libraries from Google Scholar, Scopus, IEEE, ACM Library, and JMIR. By searching using these criteria, 1,548 journals were obtained.

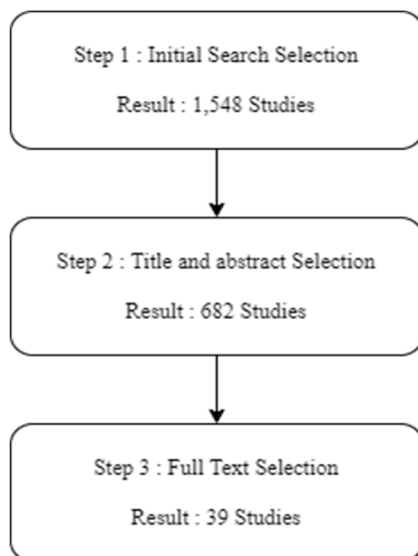


Fig. 3 Primary Studies Selection Process

Based on Fig. 3, we found 1,548 studies based on searching through five journal databases, 682 studies from the title and abstract selection, and, finally, 39 studies from the full-text selection. After collecting the journals, researchers tried extracting data to gather reliable and consistent data. Identification, Author Name, Publication Year, Source, Reference, Data Collection Methodology, Data Analysis, and Concept are the literary criteria used in this data extraction. The selected research is mapped based on the sources obtained and presented in Table 2.

TABLE II
PRIMARY STUDIES AFTER QUALITY ASSESSMENT

Source	Articles	Total
Google Scholar	[6], [9], [15], [16], [17], [18], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [29], [30], [31],	19
Scopus	[8], [32], [33], [34], [35], [36], [37], [38], [39], [40]	10
IEEE	[41], [42], [43]	3
ACM		
Digital Library	[44], [45], [46], [47]	4
JMIR	[10], [48], [49]	3
Total		39

After conducting a quality assessment based on the plan established during the planning stage, data extraction and synthesis were carried out on 39 articles as primary studies. Based on Table 1, we reviewed 39 publications as primary studies published between 2018 and 2022, with distribution increasing from the former year to the latter, as depicted in Fig. 4.

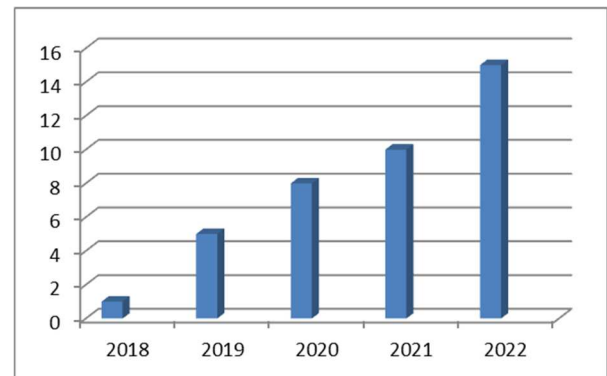


Fig. 4 Year journal published.

Fig 4 analysis found that most journals collected were published in 2022, followed by 2021. With this data, the journals reviewed are still relevant to be studied based on their novelty.

C. Reporting

Reporting is the last stage of the Systematic Literature Review. The process is to carefully read and analyze the information in the literature to answer the research question previously determined at the planning stage. The results of the analysis are reported in the Results and Discussion section [50].

III. RESULTS AND DISCUSSIONS

A. RQ1. What are some design thinking models commonly used in recent research?

Design Thinking's human-centered approach, which manifests itself in the collaborative manner in which designers work and in participatory co-creation techniques, is one of its fundamental characteristics. An attitude changes from designing "for users" to designing "with users" occurs. Design Thinking, which expresses the transfer of design culture and its methods into domains like corporate innovation, is now recognized as a sophisticated thinking approach for conceptualizing new realities [12].

The Design Thinking paradigm continues to develop in its journey; many new design paradigms are developing, including the 3 I model developed by IDEO Design Agency, the Human Centered Design (HCD) Model developed by the IDEO Design Agency, the Double Diamond model by the British Design Council, and several other design models.

TABLE III
DIFFERENCES IN DESIGN THINKING MODELS

Model	Process	Scope
Design Thinking	Empathize, Define, Ideate, Prototype, and Test	Design Creativity
3I model	Inspiration, Ideation, and Implementation	Social Innovation
Human Centered Design (HCD)	Hear, Create and Deliver	NGO,s and Social Enterprise
Double Diamond	Discover, Define, Develop, and Deliver	Design Creativity
Kees Dorst	Formulating, Representation, Moves, Evaluation, and Managing	Business Design

The concept of design thinking is prevalent and is often used by several researchers or designers. This concept carries five stages: empathize, define, ideate, prototype, and test. This concept is easy to understand and clearly explains the process and stages of design thinking. Most studies use this research model in the literature that researchers collect. The research includes; [6], [8], [9], [10], [15], [16], [17], [19], [20], [22], [23], [24], [25], [26], [27], [28], [29], [30], [31], [32], [34], [35], [36], [37], [38], [40], [41], [42], [43], [44], [45], [47], [48], and [49]. The design thinking model has been widely used in research in general.

Then there is the Design Thinking model known as the 3 Is model, which has the stages of Inspiration, Ideation, and Implementation. This model was developed by IDEO in 2001 in the context of social innovation. The 3-Is model has a minimalist concept that helps the ideation process, making it easy to absorb and implement ideas. However, the drawback is that most of the process of the stages is ideation, so it needs to be improved in terms of implementation. In the literature collected, some literature uses this model, including [18]. This research is less specific regarding the model used, but based on the objectives and processes carried out, this research is more inclined to design thinking with the 3-Is model. Then, in literature [21] in its research, the aim is clearly to generate ideas, so it uses the 3 Is design thinking model. Lastly, literature [46], wants to assess the perception of the user experience, so it is more focused on the inspiration and ideation stages.

Along with the times, the design thinking model also develops by following the needs. IDEO developed the Design Thinking model as a tool for NGOs and social enterprises working with poor communities in developing countries, while this model is known as Human Centered Design (HCD). Related to the process, three spaces need to be passed, namely hearing, creating, and delivering. This model is suitable for directly seeing user needs, but the too-general stages are free to interpret. Unfortunately, we have not found literature that applies the HCD model in design thinking research.

Then there is The Double Diamond design process model, developed at the Design Council in 2005. This model has four stages: Discover, Define, Develop, and Deliver. What distinguishes this model from the others with the divergent and convergent stages make this model very complex. The researcher found this model in the literature; in his research, the method refers to the double diamond with convergent and divergent iterations, although the definition of variables does not follow the double diamond model.

In the world of creative design, many models can be used; in this case, Kees Dorst 2009 put forward an idea in the abductive challenge, which stages include formulating, representing, moving, evaluating, and managing. This model is rarely used because there are several processes, such as design thinking models, levels of design thinking, and layers of design thinking. Moreover, we also have yet to find literature using related models.

The design thinking concept used in some studies still refers to the first design thinking model, which goes through five stages: empathize, define, ideate, prototype, and test. However, based on various literature, we know that the concept of design thinking continues to evolve. Design

thinking continues to innovate to adapt to the needs of various fields, from business, social, management, and creative fields.

B. RQ2. What kind of methods are employed at every stage in design thinking?

Many methods can be used at each stage in the design thinking approach so that it can be adjusted to the research needs. Several methods are used in the design thinking approach in the literature collected. The following are the results of the analysis of each literature in the design thinking approach.

TABLE IV
ANALYSIS OF DESIGN THINKING APPROACH STEPS

Stages	Method	Reference
Empathize	Observation	[6], [34], [20], [35], [22], [24], [36], [25], [40], [31], [39]
	Empathy Map	[6], [48], [45]
	Questionnaire	[8], [32], [17], [41], [34], [23], [26], [29]
	Interview	[9], [49], [32], [15], [16], [17], [18], [41], [19], [33], [21], [22], [23], [24], [36], [25], [26], [27], [28], [29], [37], [30], [38], [31], [39], [44], [43], [46], [42]
	Ice Breaking	[49]
	Affinity Map	[15]
	Diagram	
	Focus Group	[18], [21], [30], [51],
	Discussion	[47]
	Crowd Data	[20]
Define	Persona Creation	[44]
	User Action	[44]
	User Persona	[6], [8], [9], [15], [17], [41], [33], [34], [20], [36], [28], [48], [51], [44]
	User Journey Map	[8], [9], [15], [16], [41], [33], [20], [28], [43]
	User Scenario	[8], [9]
	User Needs	[49], [47]
	Brainstorming	[49]
	Problem Analysis	[32], [19], [23], [26], [27], [29], [38], [31], [39], [51]
	System Analysis	[16], [17], [35], [22], [23], [27], [40]
	Point of View	[15], [27], [46]
Ideate	User Mapping	[18], [24]
	Pain Point	[20], [28]
	Affinity Diagram	[36], [25]
	Information Architecture	
	How Might We	[37], [30], [48], [46]
	Empathy Map	[41], [31], [43], [42]
	Service Blueprint	[45]
	Brainstorming	[6], [8], [20], [21], [23], [24], [36], [26], [27], [28], [29], [37], [30], [31], [39], [51], [46], [47]
	User Flow	[9], [34], [35], [48], [45]
	Sketch Mockup	[49], [25],
	Sitemap	[32]

Stages	Method	Reference
Prototype	Wireframe	[32], [16], [17], [25][34], [35], [22]
	Idea Priority	[15]
	High Fidelity	[16]
	Prototype	
	Low Fidelity	[40]
	Prototype	
	User Workshop	[18]
	Ideation Report	[19]
	Focus Group	[29]
	Discussion	
	User Story	[38], [44]
	Mind Mapping	[48]
	Storyboard	[43], [42]
	User Interface	[6], [32], [16], [41], [20], [21], [22], [23], [24], [25], [40], [31], [39], [51], [43], [45], [46]
	Low Fidelity	[8], [27], [29], [37], [30], [38]
	Prototype	
	High Fidelity	[8], [32], [34], [35], [27], [28], [29], [37], [30], [38]
	Prototype	
Test	Wireframe	[37], [45]
	Mockup	[34], [24], [36], [48], [43], [42]
	Website	[19]
	Application	
	Sketch Prototype	[26]
	Prototype	[44], [47]
	User Scenario	[6], [41], [40], [29]
	Evaluator	[8], [26]
	Task Scenario	[8]
	User Experience	[8]
	Questionnaire	
	Usability Testing	[9], [49], [32], [15], [16], [17], [34], [20], [21], [23], [36], [25], [28], [37], [31], [51], [43]
	Software Quality	[19]
	Evaluation	
	System Usability	[35], [38], [51], [44]
	Scale	
	Component	[22]
	Testing	
	Integration Testing	[22]
	Feedback Capture	[27], [30], [39], [46], [47]
	Matrix	[47]
	Single Ease	[48]
	Question	
	Maze Scoring	[44]
	PSSUQ Analysis	[43], [42]

Researchers have analyzed various methods used in design thinking from several works of literature obtained. Several methods are often used in the design thinking approach, including at the empathize stage to collect research data. Most researchers use the interview method. Of the 39 pieces of literature, 26 of them use the interview method in data collection, including [9], [49], [32], [15], [16], [17], [18], [41], [19], [33], [21], [22], [23], [24], [36], [25], [26], [27], [28], [29], [37], [30], [38], [31], [39], [44], [43], [46], and [42]. Then the define stage, from some of the literature studied, many synthesized data have been collected and analyzed into user personas to understand the user and his needs better. 14

literature applies this method, including [6], [8], [9], [16], [18], [20], [22], [23], [24], [30], [34], [42], [43], and [44]. In the ideate stage, researchers try to find ideas and solutions to the problems that have been found. At this stage, many use the brainstorming method in the process. At this stage, 18 pieces of literature use the brainstorming method, including [6], [8], [20], [21], [23], [24], [36], [26], [27], [28], [29], [37], [30], [31], [39], [51], [46], and [47]. After the ideate stage is completed, then enter the prototype stage. The researcher will now begin putting the concepts she has acquired into practice. In its application, the method that is often used in the creation of user interfaces, 17 pieces of literature applies this method at the prototype stage, including [6], [32], [16], [41], [20], [21], [22], [23], [24], [25], [40], [31], [39], [51], [43], [45], and [46]. Furthermore, the last stage is testing, and researchers evaluate the design's effectiveness by testing the outcomes of the design they have created. At the 17 stages, the literature uses usability testing methods for testing, including [9], [49], [32], [15], [16], [17], [34], [20], [21], [23], [36], [25], [28], [37], [31], [51], and [43].

C. Discussion

Based on the analysis and discussion of the literature collected, many methods are used in the design thinking approach. In addition to the most widely used methods, as discussed earlier, many methods can adjust the problem and research object. As in the literature [49], they use the ice-breaking method at the empathize stage because their respondent is a cancer patient aged 55 years undergoing routine treatment. Because of this, they use an approach of ice breaking to find information and support treatment for their recovery. As with literature [44], researchers use the user creation method at the empathize stage. This method is intended to represent the target by conducting surveys and interviews. This method is intended to classify users into several persona categories.

Meanwhile, at the stage of defining literature [37], [30], [48], and [46] using the How Might We (HMW) method. This method turns a problem into a question to see it differently. Literature [37], [30], [48], and [46] use this method because they are target-oriented by identifying specific problems in order to get a solution that suits the needs of the user. Furthermore, in literature [15] and [27], researchers used the point of view method at the define stage. Just like HMW, the point of view is to examine the issue from several angles to provide a clear image of the intended user. In literature, [15], [27], and [46], point of view is used to assess further the analysis results obtained from user personas or journey maps to get more specific results.

Then, at the ideate stage, in literature [15], researchers use the idea priority method. This method is intended to determine the priority of each feature that will be finalized and implemented into prototype form. This method is done by collecting ideas that become solutions to the problems that have been found. This research divides the idea collection process into four parts: Do it now, Do it next, Do it Last, and Later. In addition to the idea priority method, the user story method is also used in the ideate stage, and this method is conducted by collecting user needs based on stories. Literature [38] and [44] apply this method to their research by

collecting interview results and compiling them into a story to make it easy to understand user needs.

Creating a user interface is the main goal of most of the literature collected, but not all create a user interface at the prototype stage. Low-fidelity prototypes (Lo-fi) and High-fidelity prototypes (Hi-fi) are alternative methods at the prototype stage. Lo-Fi and Hi-fi are stages in making a user interface, so this method is still one concept of making a user interface. As for the literature that uses this method [8], [32], [34], [35], [27], [28], [29], [37], [30], and [38]. In addition to using Hi-fi and Lo-fi, some studies also complement it with mockups. In some studies, mockups are intended as a tool at the prototype stage, which provides a direct example in the form of an application to the media to be used, making it easier for users to assess and test the design results. The literature that applies this method is [34], [24], [36], [48], [43], and [42].

Testing is the final phase of design thinking, and in this case, the usability testing approach is a widely used technique, but it does not rule out the possibility that other methods can

also be used to conduct testing. In literature [8] and [26], researchers conducted testing using the evaluator method, where an expert carries out testing to assess the results that have been made. This method is objective but highly credible because an expert directly assesses it. In addition, literature [27], [30], [39], [46], and [47] apply the capture feedback matrix method at the testing stage. Just like the evaluation method, this method also uses the assessment of participants. Participants who are directly involved are end users who are intended to conduct assessments and provide feedback in the form of recommendations for improvements to the system. This method is highly accurate because it assesses directly based on user assessment.

However, what needs to be underlined is that the methods used in each design thinking stage have many variations. All methods were used to adjust to the case study raised in the research. So, it does not rule out the possibility of variations in methods used in each research. Related to the method in design thinking, we tried to map it as a diagram based on the extraction results, attached in Fig. 5.

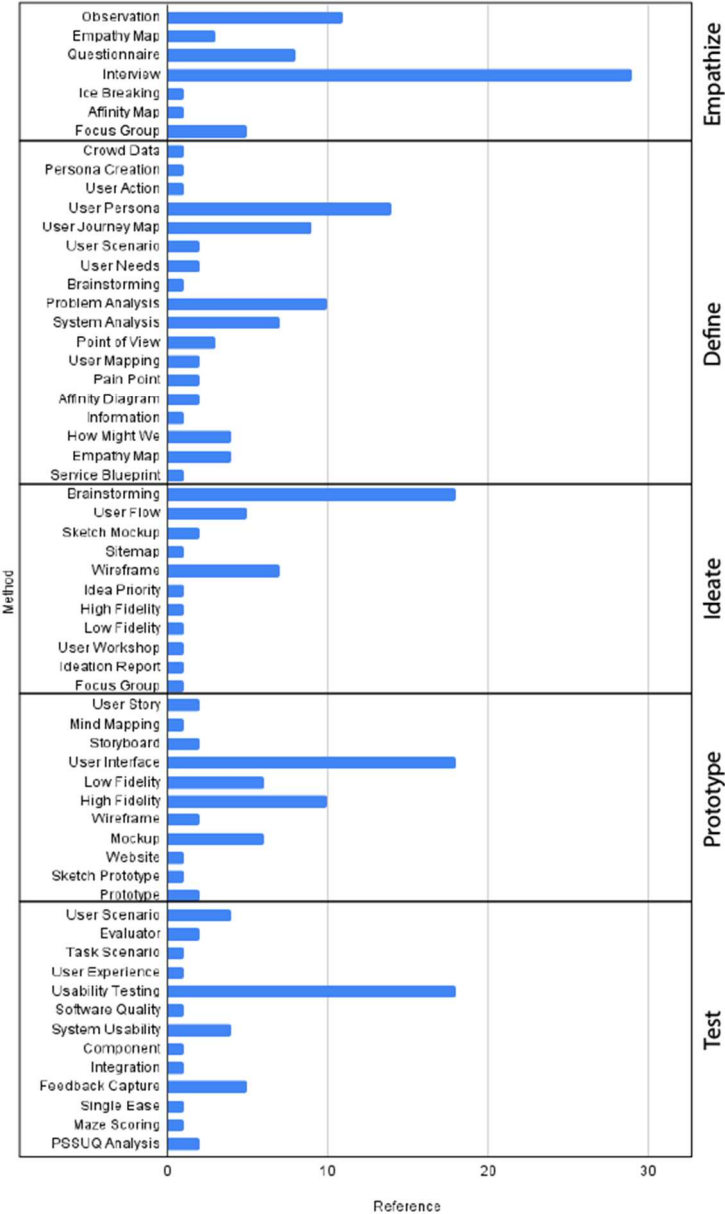


Fig. 5 Methods Used in Design Thinking

Based on Fig. 5, several methods are used in most research, including the interview method used in almost every study. At the define stage, creating user personas is the primary choice for some researchers; besides that, brainstorming at the ideate stage also dominates in some literature, and at the testing stage, usability testing is still widely used. Then, the researcher also presents data related to the percentage of methods at each stage in design thinking, which is attached in Fig. 6.

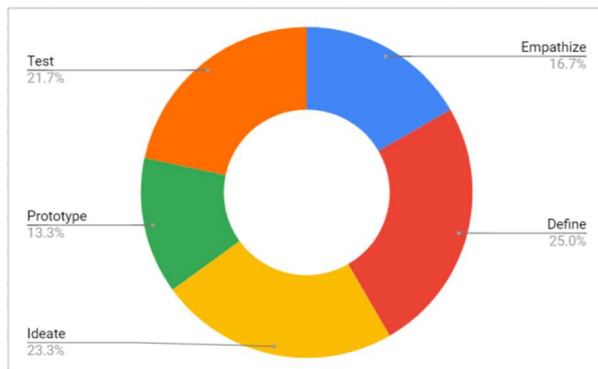


Fig. 6 Percentage of Methods at Design Thinking Stages

At each stage in design thinking, there are many variants of methods that can be used according to needs. In this case, researchers tried to map the percentage of methods at each stage of design thinking, and the following results were obtained. The empathize stage has a percentage method of 16.7%, then the define stage has a percentage of 25%, and this stage ranks first in method variation. Then, the ideate stage has a percentage of method variation of 23.3%, followed by the prototype stage with a magnitude of 13.3. This stage has the smallest percentage related to method variation. Moreover, finally, the testing stage has a percentage of 21.7%.

IV. CONCLUSIONS

The Design Thinking paradigm continues to develop in its journey; many new design paradigms are developing, including the 3I model developed by IDEO Design Agency, the Human Centered Design (HCD) Model developed by the IDEO Design Agency, the Double Diamond model by the British Design Council, and several other design models. There are wide variations in the methods normally employed in each design thinking stage. We found ten different methods in the empathize stage, 15 in the define stage, 14 in the ideate stage, 8 in the prototype stage, and 13 in the test stage. The most widely practiced method during those five stages is an interview, user persona, brainstorming, user interface, and usability testing. However, there is no consensus on what kind of stage(s) and which particular method(s) should be employed when following the design thinking approach for user interface design.

REFERENCES

- [1] Nikolai Gervas, "Analysis of User Interface design methods," *Int. Symp. Comput. Sci. Comput. Eng. Educ. Technol.*, pp. 57–60, 2020.
- [2] C. Diehl et al., "Defining Recommendations to Guide User Interface Design: Multimethod Approach," *JMIR Human Factors*, vol. 9, no. 3, p. e37894, Sep. 2022, doi: 10.2196/37894..
- [3] J. Dul et al., "A strategy for human factors/ergonomics: developing the discipline and profession," *Ergonomics*, vol. 55, no. 4, pp. 377–395,

- Feb. 2012, doi: 10.1080/00140139.2012.661087.
- [4] T. Zubkova and L. Tagirova, "Intelligent user interface design of application programs," *Journal of Physics: Conference Series*, vol. 1278, no. 1, p. 012026, Jul. 2019, doi: 10.1088/1742-6596/1278/1/012026.
- [5] H. Joo, "A study on understanding of UI and UX, and understanding of design according to user interface change," *Int. J. Appl. Eng. Res.*, vol. 12, no. 20, pp. 9931–9935, 2017.
- [6] H. Herfandi, Y. Yuliadi, M. T. A. Zaen, F. Hamdani, and A. M. Safira, "Penerapan Metode Design Thinking Dalam Pengembangan UI dan UX," *Building of Informatics, Technology and Science (BITS)*, vol. 4, no. 1, Jun. 2022, doi: 10.47065/bits.v4i1.1716.
- [7] A. W. Rudiastuti et al., "Design and Implementation of a User-Centered Web-App using Open Source Platform: Indonesia Disaster Data (InDITA)," *JOIV : International Journal on Informatics Visualization*, vol. 4, no. 4, p. 243, Dec. 2020, doi: 10.30630/joiv.4.4.460.
- [8] I. Darmawan, M. Saiful Anwar, A. Rahmatulloh, and H. Sulastri, "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: 10.30630/joiv.6.2.997.
- [9] K. Angelina, E. Sutomo, and V. Nurcahyawati, "Desain UI UX Aplikasi Penjualan dengan Menyelaraskan Kebutuhan Bisnis menggunakan Pendekatan Design Thinking," *TEMATIK*, vol. 9, no. 1, pp. 70–78, Jun. 2022, doi: 10.38204/tematik.v9i1.915.
- [10] M. Jaspers, T. Steen, C. Bos, and M. Geenen, "The think aloud method: a guide to user interface design," *International Journal of Medical Informatics*, vol. 73, no. 11–12, pp. 781–795, Nov. 2004, doi:10.1016/j.ijmedinf.2004.08.003.
- [11] M. Y. N. Putra and S. N. Huda, "Literatur Review dengan Pendekatan Pengembangan Design Thinking untuk Sistem Informasi Studi Kasus SPP dan Beasiswa," *Automata*, vol. 2, no. 2, 2021.
- [12] K. Tschimmel, "Design Thinking as an effective Toolkit for Innovation. sl, sn UniPlanet, 2018," *XXIII ISPIIM Conf. Action Innov. Innov. from Exp.*, 2012.
- [13] R. J. Hernández, R. Cooper, B. Tether, and E. Murphy, "Design, the Language of Innovation: A Review of the Design Studies Literature," *She Ji: The Journal of Design, Economics, and Innovation*, vol. 4, no. 3, pp. 249–274, 2018, doi: 10.1016/j.sheji.2018.06.001.
- [14] G. Faisal, N. F. Najwa, M. A. Furqon, and F. Rozi, "IT-Architecture Study Literature Research Collaboration: Malay Architecture Context," *JOIV : International Journal on Informatics Visualization*, vol. 5, no. 3, p. 212, Sep. 2021, doi: 10.30630/joiv.5.3.479.
- [15] M. A. D. Pratama, Y. R. Ramadhan, and T. I. Hermanto, "Rancangan UI/UX Design Aplikasi Pembelajaran Bahasa Jepang Pada Sekolah Menengah Atas Menggunakan Metode Design Thinking," *Jurikom (Jurnal Riset Komputer)*, vol. 9, no. 4, p. 980, Aug. 2022, doi: 10.30865/jurikom.v9i4.4442.
- [16] N. Aulia, S. Andryana, and A. Gunaryati, "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.
- [17] G. Karnawan, "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.
- [18] U. Kenny, Á. Regan, D. Hearne, and C. O'Meara, "Empathising, defining and ideating with the farming community to develop a geotagged photo app for smart devices: A design thinking approach," *Agricultural Systems*, vol. 194, p. 103248, Dec. 2021, doi:10.1016/j.agry.2021.103248.
- [19] Z. Meidani et al., "Development and Testing Requirements for an Integrated Maternal and Child Health Information System in Iran: A Design Thinking Case Study," *Methods of Information in Medicine*, vol. 61, no. S 02, pp. e64–e72, May 2022, doi: 10.1055/a-1860-8618.
- [20] D. P. A. R. Lestari, Intan Tresna; Sari, "Redesign User Interface Aplikasi Ipusnas Berdasarkan User Experience Dengan Metode Design Thinking," *J. Ilm. Betrik*, vol. 13, p. 10, 2022.
- [21] C. E. Arbierto-Batallanos, L. D. Villanueva-Montoya, D. S. Chavez-Ponce, R. Alfante-Zapana, and M. del C. Córdova-Martínez, "Mobile application based on design thinking for teaching kinematics," in *CEUR Workshop Proceedings*, 2019, vol. 2555, pp. 257–266.
- [22] E. Susanti, E. Fatkhayah, and E. Efendi, "Pengembangan UI/UX pada Aplikasi M-Voting," pp. 364–370, 2019.
- [23] F. Fariyanto and F. Ulum, "Perancangan Aplikasi Pemilihan Kepala Desa Dengan Metode UX Design Thinking (Studi Kasus: Kampung

- Kuripan),” *J. Teknol. dan Sist. Inf.*, vol. 2, no. 2, pp. 52–60, 2021.
- [24] B. Zhang, N. Dong, and L. Rischmoller, “Design Thinking in Action: A DPR Case Study to Develop a Sustainable Digital Solution for Labor Resource Management,” *Annual Conference of the International Group for Lean Construction*, Jul. 2020, doi: 10.24928/2020/0137.
- [25] H. Ilham, B. Wijayanto, and S. P. Rahayu, “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: 10.20884/1.jutif.2021.2.1.30.
- [26] S. Y. Ma’arief, A. P. Yudhapurnomo, S. Fatimah, and R. F. Wiharifin, “Implementasi Prototipe Sila (Social Media Self Development Indonesia) dalam Design Thinking Digital Product Development,” *RESEARCH: Journal of Computer, Information System & Technology Management*, vol. 4, no. 2, p. 109, Oct. 2021, doi:10.25273/research.v4i2.9938.
- [27] A. Mursyidah, I. Aknuranda, and H. Muslimah Az-Zahra, “Perancangan Antarmuka Pengguna Sistem Informasi Prosedur Pelayanan Umum Menggunakan Metode Design Thinking (Studi Kasus: Fakultas Ilmu Komputer Universitas Brawijaya),” *J. Pengemb. Teknol. Inf. dan Ilmu Komput.*, vol. 3, no. 4, pp. 3931–3938, 2019.
- [28] T. Srisombut, S. Thamlersak, P. Chaitantipong, and T. Siriborvornratanakul, “Design Thinking Approach for the Development of Theme Park Application,” *Augmented Human Research*, vol. 6, no. 1, Nov. 2021, doi: 10.1007/s41133-021-00054-2.
- [29] L. Ashana et al., “Design-Thinking and UCD Combination for Designing Effective Time Management Assistant Mobile App,” *RoCHI - International Conference on Human-Computer Interaction*, 2021, doi: 10.37789/rochi.2021.1.1.17.
- [30] K. Lawrence, J. Cho, C. Torres, and V. Alfaro-arias, “Building Virtual Health Training Tools for Residents: A Design Thinking Approach,” *Frontiers in Digital Health*, vol. 4, Jun. 2022, doi:10.3389/fdgth.2022.861579.
- [31] H. Karimah, M. Suryani, and A. Hidayat, “Implementation of design thinking in part 30 of the Qur ’ an augmented reality based learning application to improve user experience and cognitive ability Implementation of Design Thinking in Part 30 of The Qur ’ an Augmented Reality Based Learning Applic,” in *AIP Conference Proceedings*, 2022, vol. 020019.
- [32] T. V. L. Makalalag, AH; Ekawardhani, YA; Gaol, “User Interface/User Experience Design for Mobile Based Project Management Application Using Design Thinking Approach,” *Int. J. Educ. Inf. Technol. Others*, vol. 4, no. 2, p. 6, 2021, doi: 10.5281/zenodo.5055189.
- [33] P. Fehér and K. Varga, “Digital transformation in the Hungarian banking industry – Experiences with Design Thinking,” *Society and Economy*, vol. 41, no. 3, pp. 293–310, Sep. 2019, doi:10.1556/204.2019.41.3.2.
- [34] A. N. R. Refly Ilham Syabana1, Pramana Yoga Saputra2, “Penerapan Metode Design Thinking pada Perancangan User Interface Aplikasi Kotakku,” *J. Phys. A Math. Theor.*, vol. 44, no. 8, pp. 40–60, 2011.
- [35] Ilham Firman Ashari and Rahmat Rizky Muharram, “Pengembangan Antarmuka Pengguna Kolepa Mobile App Menggunakan Metode Design Thinking dan System Usability Scale,” *JSiI (Jurnal Sistem Informasi)*, vol. 9, no. 2, pp. 168–176, Sep. 2022, doi:10.30656/jsii.v9i2.4993.
- [36] V. A. Subarjah and Ari Purno Wahyu, “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: 10.25139/inform.v7i2.4729.
- [37] R. Saputra, Dandi; Kania, “Designing User Interface of Mobile Learning Application by a Using Design Thinking Approach : A Case Study on UNI Course,” *J. Mark. Innov.*, vol. 2, no. 2, pp. 14–32, 2022.
- [38] W. S. L. Nasution and P. Nusa, “UI/UX Design Web-Based Learning Application Using Design Thinking Method,” *ARRUS Journal of Engineering and Technology*, vol. 1, no. 1, pp. 18–27, Aug. 2021, doi:10.35877/jetech532.
- [39] G. I. Ector et al., “The Development of a Web-Based, Patient-Centered Intervention for Patients With Chronic Myeloid Leukemia (CMylife): Design Thinking Development Approach,” *Journal of Medical Internet Research*, vol. 22, no. 5, p. e15895, May 2020, doi:10.2196/15895.
- [40] M. R. Kurniawan, Felix; Firmansyah, Muhammad; Rijaya, Rheza; Sutanto, Steven Yesua; Pribadi, “Penerapan Design Thinking pada Perancangan User Interface Aplikasi Supper Sayur,” in *MDP Conference*, 2022.
- [41] J. Suratno, Bambang, Shafira, “Development of User Experience/User Interface Using Design Thinking Approach for GMS Service Company,” *J. Inf. Syst. Informatics*, vol. 4, no. 2, p. 26, 2022.
- [42] A. Suzianti and G. Arrafah, “User Interface Redesign of Dental Clinic ERP System using Design Thinking,” *Proceedings of the 2019 5th International Conference on Industrial and Business Engineering*, Sep. 2019, doi: 10.1145/3364335.3364369.
- [43] A. Suzianti, F. Edrisy, and A. Mubarak, “User Interface of Zakat Information System Redesign using Design Thinking Approach. Case Study: KNEKS,” 2020 The 6th International Conference on Industrial and Business Engineerin, Sep. 2020, doi: 10.1145/3429551.3429588.
- [44] M. R. Yusaliano, A. Syahrina, and T. F. Kusumasari, “User Interface Design of P2P Lending Mobile Application Using Design Thinking,” 2020 12th International Conference on Information Technology and Electrical Engineering (ICITEE), Oct. 2020, doi:10.1109/icitee49829.2020.9271780.
- [45] S. S. Jadhav and P. Ch. Kalita, “Design Thinking Approach in Planning E-commerce for Domestic Plumbing Services,” *Proceedings of the 2019 International Conference on E-Business and E-commerce Engineering*, Dec. 2019, doi: 10.1145/3385061.3385067.
- [46] G. L. Diaz Intal, D. Senoro, and T. Palaoag, “User Experience Design for Disaster Management Mobile Application using Design Thinking Approach,” 2020 The 4th International Conference on Software and e-Business, Dec. 2020, doi: 10.1145/3446569.3446587.
- [47] Y. D. Pham, D. Fucci, and W. Maalej, “A first implementation of a design thinking workshop during a mobile app development course project,” *Proceedings of the 2nd International Workshop on Software Engineering Education for Millennials*, Jun. 2018, doi:10.1145/3194779.3194785.
- [48] A. A. Krishnavarty, M. Defriani, and T. I. Hermanto, “UI/UX Design for Language Learning Mobile Application Chob Learn Thai Using the Design Thinking Method,” *Sinkron*, vol. 7, no. 3, pp. 1044–1053, Aug. 2022, doi: 10.33395/sinkron.v7i3.11585.
- [49] I.-C. Hou et al., “The Development of a Mobile Health App for Breast Cancer Self-Management Support in Taiwan: Design Thinking Approach,” *JMIR mHealth and uHealth*, vol. 8, no. 4, p. e15780, Apr. 2020, doi: 10.2196/15780.
- [50] N. H. Maulida and U. P. Raya, “Studi Literatur Penerapan Metode Prototipe dan Waterfall,” no. April, 2022.
- [51] G. L. Diaz Intal, D. Senoro, and T. Palaoag, “User Experience Design for Disaster Management Mobile Application using Design Thinking Approach,” 2020 The 4th International Conference on Software and e-Business, Dec. 2020, doi: 10.1145/3446569.3446587.