Trends and Future Outlook for Mobile Application Development Using Design Thinking Approach: A Systematic Literature Review

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Abstract—**In today's technological world, mobile-based application development has become a crucial and integral element for achieving competitive advantage. Various fields have tried to create mobile applications. One widely used method is Design Thinking, which focuses on creating more innovative, user-focused, and contextual solutions. This writing reviews mobile application development using the Design Thinking approach as the main method. In this research, the author explores the basic principles of Design Thinking, its processes, and how they can be applied effectively in the stages of mobile application development. The authors also analyze the benefits derived from this approach, including improved product quality, positive user response, and the potential to meet changing market needs. The results illustrate that the Design Thinking approach is not just an application development tool, but also a philosophy that drives better innovation and more relevant solutions. This SLR will display research results to what extent the Design Thinking approach in mobile application development has been used.**

Keywords— Mobile Application Development, Design Thinking, Systematic Literature Review, innovative, User-Focused, Contextual Solution

I. INTRODUCTION

The rapid development of mobile applications has changed the digital landscape, influencing the way we live, work, and interact [1]. In this dynamic world, the adoption of innovative development methodologies has become essential to remain competitive and meet evolving user needs [2]. Among these methodologies, Design Thinking has emerged as an interesting approach that places human-centered design at its core, fostering creativity, empathy, and problem solving [3].

This systematic literature review investigates the evolving landscape of mobile application development through the lens of Design Thinking. Our investigation aims to provide a comprehensive overview of the trends, insights and best practices that have shaped this field [4]. By synthesizing existing research and examining the key principles and processes of Design Thinking, author seek to offer a deeper understanding of how this approach is systematically applied in the context of mobile application development [5].

Throughout this review, author will explore various dimensions of the interaction between Design Thinking and mobile application development, including its impact on user experience, market competitiveness, and the ability to effectively address complex challenges. By highlighting recent trends and emerging patterns, this research aims to contribute to the ongoing discourse on how Design Thinking can be utilized as a valuable tool in the growing field of mobile application development.

II. LITERATURE REVIEW

A. Design Thinking

Design thinking is a series of problem-solving processes that emphasize human-centric approach [6], this means that design thinking prioritizes the needs and comfort of design users. Thus, in carrying out design thinking, it is necessary to have a deep understanding of human needs and ensure that these needs are met [7].

The elements of design thinking are:

- o Empathize: The first step in the design-thinking process is to empathize. To understand the demands of their users personally, design teams do research. They let go of preconceived notions to observe and speak with users to gain insights into their environment. They are more able to comprehend the challenges, motives, and experiences of users.

- o Define: At this stage, the information and observation results that have been collected in the previous step will be analyzed to determine the core of the

problem. Identification of this problem must be human-centered.

o   Ideate: The next stage in the design thinking process is ideate. After knowing and understanding the problems that occur, now is the time to translate these needs into the form of innovative ideas and solutions. This process is usually carried out by brainstorming. The more people discuss, the more diverse the ideas that are produced. Make sure all ideas about the problem have been identified, even the ones that don't make sense.

o   Prototype: At the prototype stage, the designer will produce a prototype according to the ideas that have been developed. Not all ideas will be prototyped. This is because not all ideas really make sense and can be turned into products. Sometimes, there are some ideas that cannot be realized due to technological limitations, costs, etc. For this reason, screening needs to be done before it can enter the prototype stage.

o   Test: After the prototype, the next stage is the test or testing stage. The prototype that has been developed will be tested directly with the user to ensure everything is running well. Any input from the user will be accommodated. If necessary, a prototype can be made again and tested again afterwards.
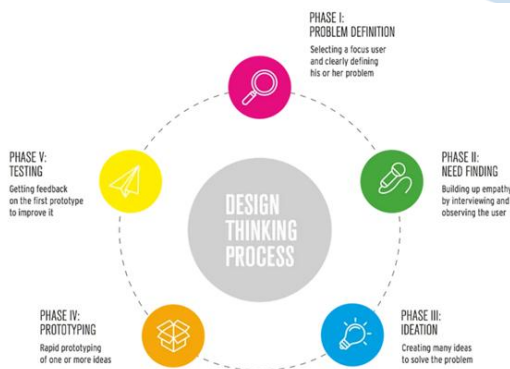

Figure 1 Phases of Design Thinking [8]

B. Design Thinking in Mobile Application Development

Design Thinking, as a human-centered approach, has gained significant traction in mobile app development over the last decade. Researchers and practitioners have recognized its potential to improve user experience and drive innovation. Studies such as the seminal work [9] on design thinking have laid the foundation for its application in the context of mobile applications. Several studies have explored the principles of empathy, ideation, and prototyping in the field of mobile application design [10]. These early works provide a basis for understanding how Design Thinking principles can be systematically integrated into the mobile application development process.

C. User-Centered Design and Mobile Apps

The main principle of Design Thinking, user-centered design, aligns with the mobile application development philosophy. As mobile applications continue to develop across industries, there is an increasing emphasis on understanding user needs and preferences. As a result, much research has explored the integration of Design Thinking to improve the usability and user experience of mobile applications [11].

D. Innovation and Creativity in Mobile Application Development

Innovation is the driving force in the mobile app industry, where staying ahead of the competition requires creative problem solving. Design Thinking's emphasis on brainstorming, prototyping, and iteration has attracted attention as a way to foster creativity in mobile app development. Several studies have highlighted the role of Design Thinking in fostering innovative ideas and translating them into successful mobile applications [12].

E. Design Thinking Process and Framework for Mobile Apps

The systematic application of Design Thinking principles to mobile application development often involves the use of specific processes and frameworks. Researchers have proposed and refined frameworks tailored to the unique challenges of mobile app design. This framework offers a structured guide for integrating Design Thinking into the mobile application development lifecycle [13].

F. Challenges and Limitations

Although Design Thinking offers promising benefits, it is not without challenges and limitations in the context of mobile application development. Managing time constraints, balancing user preferences with technical feasibility, and ensuring scalability are some of the challenges faced by developers and researchers. Acknowledging these challenges is critical to a holistic understanding of the practical implications of applying Design Thinking in this domain [14].

G. Future Directions

The literature reviewed here underscores the growing importance of Design Thinking in mobile application development. As the field continues to develop, future research avenues may include exploring the integration of emerging technologies (e.g., Artificial Intelligence, Augmented Reality, Virtual Reality) with Design Thinking, examining the impact of cultural factors on user-centered design, and investigating the long-term sustainability of mobile apps developed through this approach.

III. Research Methodology

The methodology used in this research uses a method developed by Barbara Kichenham [15]. This methodology is popular and widely used by researchers in Systematic Literature Review-based research because the stages are systematic and clear. Using the SCOPUS research database, the steps to be carried out can be seen in the figure below:
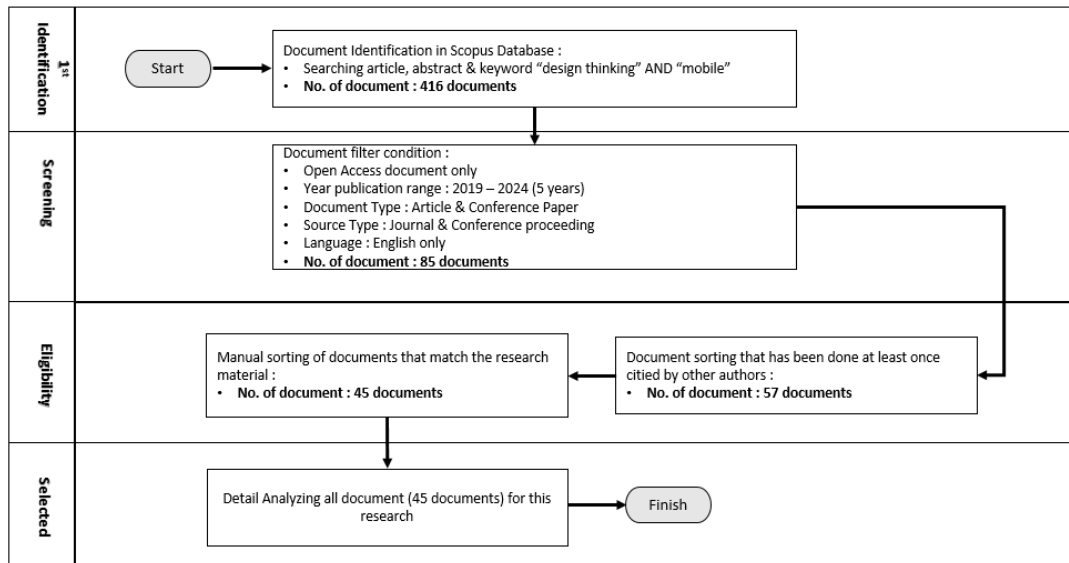

Figure 2 Systematic Literature Review

The initial stage is to identify and determine the keywords that will be used. This stage determined that the keyword used was "design thinking" and would only search for articles in English. From a search using the search engine on SCOPUS, 416 articles were found that met these criteria.

The next stage is to expand the criteria in order to narrow down the number of articles obtained. The criteria included are that only articles of the "open access" type are selected with the aim that the articles obtained can later be downloaded in full, and the publication time range is only up to 5 years ago (2019 to 2024), source type from journal and conference proceeding, language : English only and document type are article and conference paper only. From these criteria the number of articles obtained was 85 articles. After this stage, it was continued with the "Eligibility" stage by adding criteria, namely the articles searched were only documents that have been cited at least once by other authors. From this stage author obtained 57 journals and proceedings. The 57 documents were then manually selected based on the material that was suitable for this research and obtained 45 documents that were applied for more detailed analysis for the Systematic Literature Review (SLR) research to be carried out..

IV. Research Findings and Discussion

Design thinking as an approach in mobile application development has been widely adopted by various countries. This can be seen from the distribution of writers who come from various countries and are not dominated by a particular country. Figure 3 shows the top 10 countries that have published writing on the design thinking approach for developing mobile-based applications. This illustrates that the mobile-based application development approach using the Design Thinking concept is still relatively popular. And, referring to the positive trend of writing on this theme in the last 5 years (2020-2024), it is estimated that this theme will continue to be researched and developed. This can be seen in the figure below:
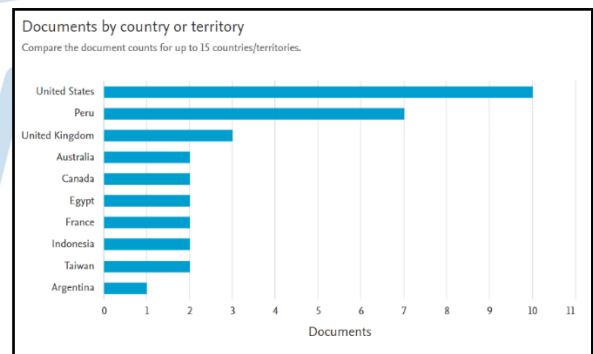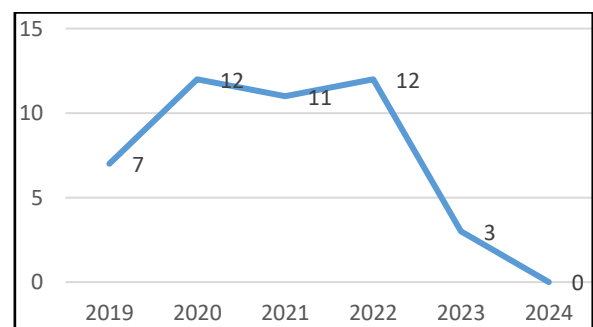

Figure 3 Origin of Documents by Country

Figure 4 Origin of Documents by Year

Turns out, design thinking method is used in various disciplines. Computer science is the field with the highest percentage (25%), followed by health (12.9%) and engineering (10.9%). This indicates that the application of design thinking for mobile-based application development can be applied in many fields. This is because the design thinking framework is designed to be universal and can be applied anywhere. To see which fields use the design thinking approach the most, see the figure below.
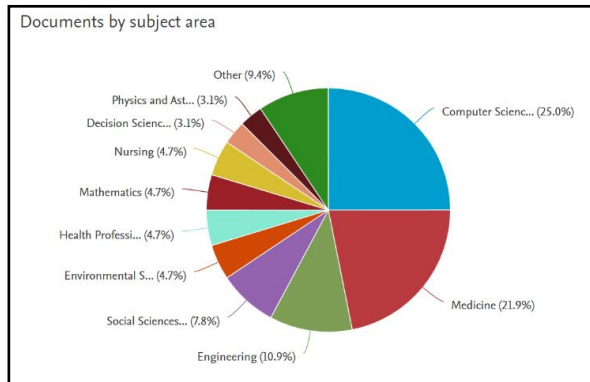

Figure 5 Fields of Research

The comparison of the number of documents in this Systematic Literature Review (SLR) research is : 38 documents come from articles/journals with a percentage of 84% and 7 documents are conference papers with a percentage of 16%. This comparison graph can be seen in the figure 7.
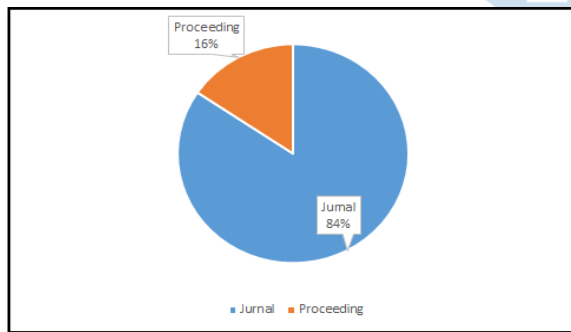

Figure 7 Proceeding & Journal Comparison

To see the themes of each 45 document in detail, see table 1. The contents of this table provide an overview of the current trends in the development of mobile-based applications, especially those using the Design Thinking approach. As an approach that is not very old compared to other approaches in developing mobile-based applications, the Design Thinking approach is mostly used in the health sector, the second ranking use of design thinking in mobile-based applications is used for education and next is games.

TABLE I. LIST OF PAPERS

No.	Research Area	Article/Journal
1	Health and Medicine	1. [16],

No.	Research Area	Article/Journal
		2. (Marko-Holguin et al., 2019),
		3. [18]
		4. (Farao et al., 2020),
		5. (Hou et al., 2020),
		6. (Schoenthaler et al., 2020),
		7. (Kamran & Dal Cin, 2020),
		8. (Korpershoek et al., 2020),
		9. (Cunyarachi et al., 2020),
		10. [25],
		11. [26],
		12. (Fontenot et al., 2020),
		13. [28],
		14. (Polhemus et al., 2020),
		15. [30],
		16. (Nimmolrat et al., 2021),
		17. (Pinnarong et al., 2021),
		18. [33],
		19. [34],
		20. (Jarman et al., 2022),
		21. (Thomas et al., 2022),
		22. [37]
2	Education	1. [38],
		2. [39],
		3. [40],
		4. [41],
		5. [42],
		6. (Darmawan et al., 2022),
		7. [44],
		8. (Puebla et al., 2022),
		9. (Zapata-Paulini et al., 2023),
		10. (Lazo-Amado & Andrade-Arenas, 2023),
		11. (Purbasari et al., 2021),
		12. [49]
3	Games	(Olivares-Rodríguez et al., 2022), (Koutsabasis et al., 2022), [52], (Challiol et al., 2019), [54], [55]
4	Farming/Agriculture	1. (Kenny et al., 2021), 2. [57]
5	Ecology	1. [58]
6	Marketing	1. [59]
7	Transportation	1. [60]

Based on the keywords used in searches in the SCOPUS database, when using the VOSViewer keyword analysis software, it gives a picture as seen in Figure 8. Design Thinking is the center of keywords which then have many branches for various types of research.
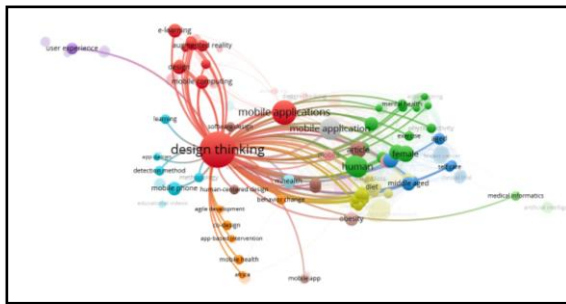
Figure 8 VOSViewer Analysis

V. CONCLUSION

In order to achieve sustainable success in mobile application development with a Design Thinking approach, developers need to consider existing challenges, but must also remain focused on the main goal: creating solutions that are better, more innovative, and more suited to user needs. This conclusion underscores the importance of a user-centered approach in the ever-evolving world of mobile application technology. As a final insight, this research also confirms that the role of Design Thinking in mobile application development will continue to grow and become more important along with ongoing changes in the mobile technology ecosystem.

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