A Systematic Literature Review of Design Thinking in Education in Korean Publications

Cheng Fei
Smart Learning Institute,
Beijing Normal University
Beijing, P.R.China
e-mail: feicheng@bnu.edu.cn

Boulus Shehata
Smart Learning Institute,
Beijing Normal University
Beijing, P.R.China
e-mail: boulus.shehata@qq.com

Ronghuai Huang
Smart Learning Institute,
Beijing Normal University
Beijing, P.R.China
e-mail: huangrh@bnu.edu.cn

Abstract— **Design Thinking (DT) has the potential to enhance products, services, and processes as a human-centered approach and has been recently used in education. While most of the literature on design thinking is dominated by English-published papers, and has a 'Western' perspective, it does not identify the state of research in other cultures. This systematic review addresses research on DT in education published in the Korean language due to its long history and considerable experience. It aims to identify the key trends, challenges, and future directions of DT in education as presented in peer-reviewed articles published between 2013 and 2022 in Korean journals. The study highlights the importance of cultural considerations, such as the self-concept and sociocultural background, in designing solutions that serve the community. The findings are useful for multicultural design centers, research institutes, and enterprises that are involved with the exploration of cultural characteristics related to DT for better intercultural human communication.**

Keywords-Design Thinking; Education; Korean publications; Systematic literature review.

I. INTRODUCTION

The origins of Design Thinking (DT) can be traced back to the late 1960s when design began to be seen as a scientific approach to problem-solving [1]. The term DT was first introduced in 1969 in the American book "Artificial Science" "Design is a way of Thinking". And its diffusion began in 2000 when SAP, a German software company, started to strongly support research. Since then, its meaning has expanded to include management's ability to lead innovation by effectively solving the company's current and difficult problems [2]. DT utilizes both analytical and intuitive thinking and is a process of divergence and integration, analysis, and consolidation through inspiration, conception, and execution [3]. It is a good choice for problem-solving in many fields because it allows for multiple perspectives on complex problems during execution [4]. Thus, DT can be redefined as a human-centered, higher-order thinking skill based on experimentation and a positive attitude that strives to imagine, collaborate, exchange different opinions, and restructure cognitive processes to find the best solutions to difficult and complex real-world problems faced by individuals and organizations. In teaching and learning, the strengths of DT lie in engaging learners, enhancing their understanding of content, facilitating learning by creating opportunities for application through tasks, and developing not only conceptual understanding but also functional and practical aspects through repeated practice. Koh et al. present a comprehensive conceptualization and application of design thinking in teaching and learning [5]. They present old and new concepts, as well as critical perspectives related to three major design theorists, namely Herbert Simon, Donald Schön, and Nigel Cross. In addition, in design thinking classes, teacher intervention is minimized and learners engage in team project activities under their own direction, which naturally develops self-directed learning skills as well as communication and collaboration skills. The process of DT involves intuition, analysis, analogy, and reasoning, enabling learners to solve creative problems, and through this problem-solving experience, learners gain a sense of purpose and take ownership of the project [6]. Based on the results of previous research on design thinking in teaching and learning, design thinking has been used as a pedagogical approach to foster creativity, which is important for sustainable development goals. With the extensive publication on DT education, Panke [7] provided a systematic literature review of case studies, reports, theoretical reflections, and several scholarly works to draw perspectives, opportunities, and challenges [7]. Her summary of previous literature reviews highlights the broad amount of studies that has been published and analyzed. Meinel and Leifer [8] stated that "with a deep belief that design must be rooted in people, culture and human values, ERGO believes in the power of Design Thinking in bringing innovation to one of the most culturally sensitive regions in the world." For example, Traifeh et al. [9] reported the early adoption of design thinking in Arabic-speaking countries, based on an analysis of Twitter data, which revealed differences in the rank order of countries tweeting about design thinking in Arabic and English. Based on the design education process, Chen [10] helped teachers to use the design thinking approach as a strategy for innovative change teaching and learning by integrating design literacy and disciplinary literacy as cultivation goals and instructing students to use the design thinking approach to complete practical activities in a diverse and pervasive curriculum, demonstrating that the design thinking approach to teaching and learning can promote the development of students' innovative abilities.

Most literature reviews of DT Education focus on English published papers [11] [12] [13] and are from a 'Western' perspective. To the best of our knowledge, there is no systematic literature review that covered DT research in Korean language. Therefore, this paper presents a systematic

literature review of top Korean journals for their trends in research on DT education, the processes and models of DT, the challenges of DT education and future research recommendations. Furthermore, with the rise of globalization, it is important to uncover non-Western cultural diversity and bring it to light, especially when it comes to art and design [14] [15] [16]. For instance, Kim M. [15]writes about non-Western perspectives on human communication, which involves cultural variations in self-concept and the sociocultural ground for the self. Collinge et al. [14] further explore this field by discovering the quality of life assessment in non-Western cultures. Ito et al. [16] provided a systematic review of non-Western and cross-cultural/national leisure research. This inspired us to find out if different cultures have different design thinking approaches. Therefore, this paper presents a systematic literature review to answer these questions:

RQ1. What is the trend of Design Thinking in education in terms of publication year, research methods, target groups and subjects/domains involved in Korean publications?

RQ2. What are the processes of Design Thinking in education according to Korean publications?

RQ3. What are the challenges for Design Thinking in education and future research directions according to Korean publications?

This study is divided into six sections where the introduction is in Section 1, methodology is in Section 2, findings and discussion is in Section 3, future recommendations is in Section 4, conclusion is in Section 5 and references is in Section 6.

II. METHODOLOGY

This study synthesizes quantitative and qualitative studies to review DT education according to Korean publications. Since the reporting of systematic reviews can be prone to being biased, and the interpretation of results is inclined to be subjective [17], Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines will be followed to produce this systematic review [18]. The flow chart in Figure 1 shows the process of selecting studies for this review.

A. Searching the databases

The first step of the review was by one of the authors to search the Web of Science database using the strings "design thinking (topic)" and "education (topic)," while limiting the search results to the Korea Citation Index (KCI) database. KCI is a Korean citation index released by the National Research Foundation of Korea (NRF) in 2008 and is also known as the Korean core journal indexing system. The KCI database on Web of Science provides access to more than 1.4 million articles from more than 2,500 multidisciplinary journals covered by the Korea Journal Database and contains bibliographic information on scholarly literature published in Korean language. The data for this study included scholarly research published before December 31, 2022, the date when

the literature was searched in the database, with a total of 2858 relevant articles by over 200 authors from 1999 to 2022.
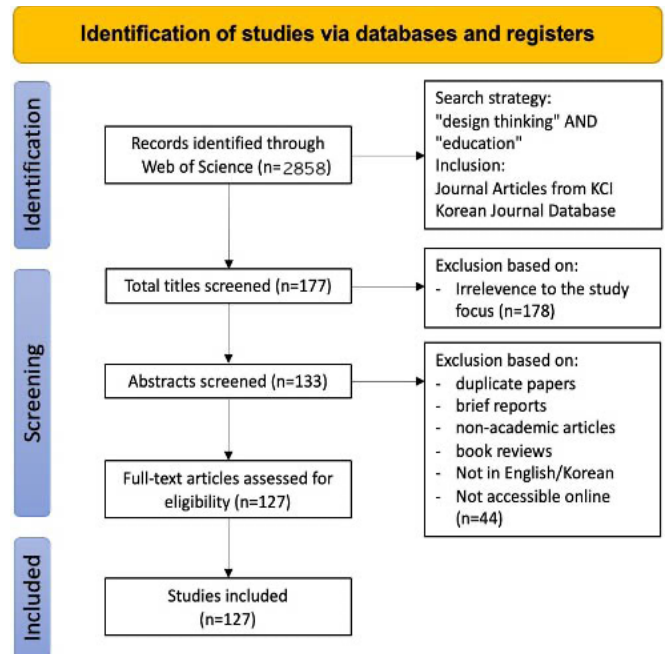

Figure 1. PRISMA chart for study identification and selection process

B. Selecting the studies

966 records were identified, and after initial screening, the author identified 177 records and 789 records were excluded because they were not relevant to the focus of the study. After re-screening of abstracts, 127 records were identified, of which 50 were excluded because they were duplicate papers, brief reports, non-academic articles, book reviews, not in English or Korean, or they were not accessible online.

III. FINDINGS AND DISCUSSION

In this section, we present the findings according to each research question.

RQ1. What is the trend of Design Thinking in education in terms of publication year, research methods, target groups and subjects/domains involved in Korean publications?

In terms of publication year in Korean journals, there was a rise of published research on DT education from 2018 to 2019 as can be seen in Figure 2. Much of this rise covers studies on the topic of Maker Education (ME). This may be explained by the fact that the Korean government announced its ME policy in 2017 and 2018 [19]. It is also evident that design thinking is actively used as a pedagogical approach to develop future talent in various educational institutions including universities and companies. The number of DT research related to teaching and learning has steadily increased since 2016 and exploded in 2020, showing a blossoming academic journal, reflecting the interest in DT among various alternatives in the era of the fourth industrial revolution, when educational

institutions, including universities, are thinking about how to develop and improve the core competencies that future talents should have through teaching methods. increased. The number of research subjects is dominated by the curriculum, while the number of research topics is dominated by the curriculum or curriculum development. Therefore, there is a need to recognize the importance of teachers as facilitators in design thinking pedagogy and to study it in more depth.
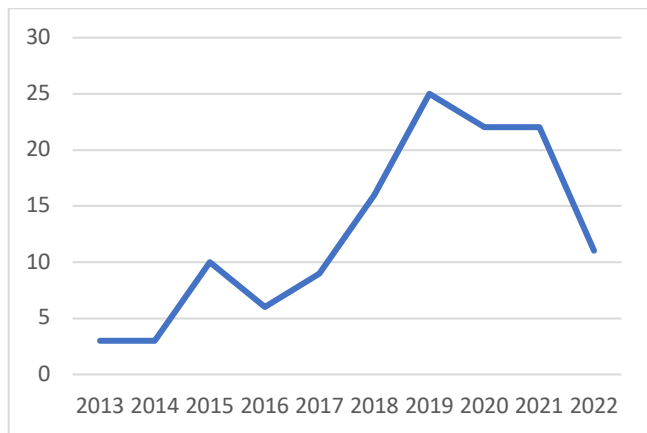

Figure 2. Distribution of DT education in Korean publications based on publication year

Figure 3 shows research methods used in the reviewed papers. The majority of the studies conducted Qualitative (30%) or Quantitative (28%) research. We also notice several theoretical studies (24%), review papers (7%) and articles using the Delphi method (2%). One study applied a meta-analysis [20] to calculate the overall Effect Size and ES for different variables of ME. Through the analysis, it was found that the most frequently mentioned tool for collecting data was observation, followed by interviews and survey. Due to the DT 'artistic' nature, we observe that a large portion of studies did not conduct experiments, except for a few. DT research in the field of teaching and learning published in Korean journals tends to focus on programs, with learners coming second. Among learners, a large number of studies were conducted on university students, while a similar proportion of studies were conducted on on-campus programs and off-campus programs. This is consistent with Kim's study that most DT research in design and the arts is about introducing concepts and applications, while most educational research using DT is about developing and applying curriculum in offline learning environments. This is also in line with the findings of Kim [21], who analyzed 85 design-related liberal arts courses offered as liberal arts programs at the top 33 universities in Korea from 2017 to 2019 and found that 25% of them were related to DT. Research on teaching DT in Korea is most often related to development, followed by validation of effectiveness. The most common topics were program development, curriculum development, and model and process development, suggesting that the use of design

thinking in teaching and learning is widely present in all areas of the university, not just in the major disciplines. As for effectiveness validation research, we find that the most active are classroom effectiveness topics based on curriculum development and utilization. We can see that there is a trend to quickly diagnose and complement the actual effectiveness of the developed DT programs by validating their effectiveness, not just their development. Therefore, there is a need for more research on the educational effectiveness of collaborative activities through DT. In addition, in-depth theoretical research should be conducted to balance the development of DT research related to teaching and learning and to complete the construction of DT scholarship.
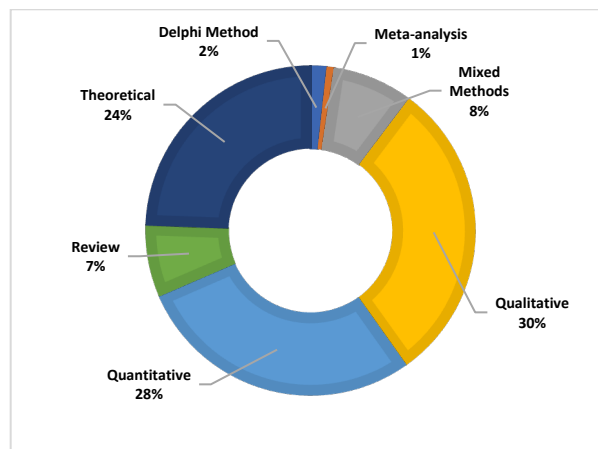

Figure 3. Distribution of DT education in Korean publications based on research methods

Findings also reveal target groups used in the DT education research (see Figure 4). In order not to present a fairly long list, only the top 5 groups are presented. The majority of studies involved college students (n = 53) followed by primary school students (n = 16), teachers (n = 15), secondary school (n = 13), secondary school (n = 13) and K-12 (n = 12). The findings show that DT can be applied in several college majors, such as robotics [22], engineering [23], medicine [24], nursing [25], entrepreneurship[26], and several others.
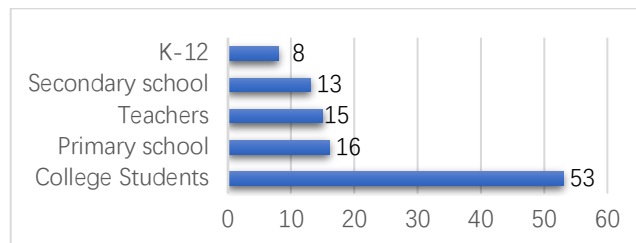

Figure 4. Distribution of DT education in Korean publications based on target group in the research

As can be seen in Table 1, DT education research within Korean journals covered several subjects ranging from general domains, such as multidisciplinary (n = 30) or teacher

preparation (n = 24), to specific domains, such as in Maker Education (n = 14), STE(A)M subjects (n = 9), entrepreneurship (n = 9), or even dance programs (n = 1). In multidisciplinary domains, studies looked at how DT can develop 21st-century skills, such as creativity [6] or creative problem-solving [27]. In teacher preparation, studies looked at generic courses for pre-service or in-service teachers to design thinking for different purposes, such as with early childhood [28], with students' anxiety and resilience [29] or with teaching mathematics [30]. DT education in specific subjects seems to offer valuable findings. For instance, in STE(A)M education, Lee and Tae [31] exploded the effects related to DT on primary school students' problem-solving and interest in mathematics and science. In entrepreneurship, Jung and Kim [32] presented how DT can influence K-12 students' entrepreneurship skills. In languages, Bae [33] made action research for teachers to apply DT in improving early childhood language learning. Arts and Kim [21] suggested a framework for ceramics education. In addition, the active research variables related to DT in Korean education are design thinking literacy, step-by-step learning experiences in DT, DT-based teaching methods, DT-based team projects, and DT-based creative education curriculum. The dependent variables are mostly learner-related variables that can be subdivided into learning, competence, and affect. The learning category includes variables such as motivation, classroom satisfaction, and academic performance; the competency category includes problem-solving skills, articulation skills, self-directed learning skills, career development skills, creativity, collaboration, and teamwork efficiency. This is consistent with the findings of Hong, Ji-Myung, who found that a curriculum using DT helped to strengthen preschool teachers' emotional intelligence and creative personality, and Lee, Soo-Jin, and Yoon, Ok-Han [34], who found that a DT curriculum was meaningful for improving empathic problem-solving skills related to creative thinking and emotional intelligence. This confirms that the use of DT courses or programs has a direct impact on the development and improvement of various factors related to learners' learning, abilities, and emotions. Therefore, design thinking research on teaching and learning needs to focus more on the instructor. By its very nature, DT often implemented in the form of PBL(Project-Based Learning), focuses on the learner rather than the instructor. This does not mean that the role of the instructor is diminished, but rather that the role of the facilitator is increased, i.e., facilitating team projects and encouraging learner participation. In other words, the instructor in a DT classroom is an instructor who needs to develop learners' understanding of the concepts and processes of DT, a project manager who needs to coordinate and support the successful completion of each team's project, and a facilitator who helps learners learn to learn on their own through the process of experiencing a series of activities. Despite the important role of the instructor as a facilitator of DT, existing DT research on teaching and learning is biased toward the learner and the program. There is a need for more research on instructors in DT classrooms, including the competencies of DT instructors who value the learner experience, the achievements of DT instructors and learners, and the application and effectiveness of DT instructors and programs.

TABLE I. FREQUENCIES OF DT EDUCATION IN KOREAN PUBLICATIONS BASED ON SUBJECT/DOMAIN

Subject/domain	Frequency
Multidisciplinary	30
Teacher Preparation	24
Maker Education	14
Psychology-related	10
STE(A)M Education	9
Technology	9
Entrepreneurship	8
Science	5
Language	3
Arts (Music, Dance)	5
Environmental Issues	2
Medicine	2
Engineering	1
Management	1
Research Skills	1
N/A	3
Total	**127**

RQ2. What are the processes of Design Thinking in education according to Korean publications?

There are several DT processes/stages/phases/models, ranging from 3 to 9 process, as can be seen in Table 2. Three-step processes was seen in business or economics related programs [35]. Four-step processes was common with Maker Education that involves 'Tinkering – Making – Sharing – Improving' [36], or 'Word – Image – Prototype – Role playing' [37] which can be applied to objects of various backgrounds and can be used by extending basic models according to their field. Five-step processes was the most common DT models, specially the 'Empathize – Define – Ideate – Prototype – Test' model, with multidisciplinary, teacher education and STE(A)M education fields. Six-step processes are basically an extension of the five-step process by adding an extra stage, such as evaluation [38] or sharing [39] after testing the design. Seven, Eight, and Nine-step processes are further complex extensions of the five-step process. Studies that used longer processes were few. This is in accordance with Grönman and Lindfors [40] as they emphasized that DT process models are varied in their steps and has an iterative process. Therefore, it has four main phase categories, i.e., "empathy and user focus, problem, framing and defining, creating ideas and visualization, and experimentation and iteration". Thus, we can see that the influence of DT in the teaching field is slightly weaker in academia compared to other teaching methods, because it originated in the corporate world, where companies wanted to have an innovative organizational culture, improve their human resource capabilities, and develop new product development processes, such that the DT implementation process originated from the development of entrepreneurship. In recent years, there has been a growing interest in DT and

active research on DT in teaching, but most of the research has focused on practical research on the development, use, and validation of solutions. In order for DT to be considered a distinct pedagogical approach and not just a team project class or problem-solving class, it is necessary to continue to conduct research using a variety of research methods. In addition, in order for the study of design thinking to have balance and academic depth, it is necessary to actively pursue research that builds theory through in-depth reflection and exploration, including not only practical research but also theoretical and philosophical discussions.

TABLE II.   TYPES OF DT PROCESSES IN EDUCATION RESEARCH

DT Process type	Specific Design Thinking Processes	Examples
3 Steps	Inspiration – Ideation – Implementation	Choi, 2015
4 Steps	Tinkering – Making – Sharing – Improving	Lee, 2019
	Word – Image – Prototype – Role playing	Park & Nagan, 2020
5 Steps	Empathize – Define – Ideate – Prototype – Test	Lee & Tae, 2017
	Learn – Ideate – Design – Make – Share	Seo & Kim, 2018
6 Steps	Empathize – Define – Ideate – Prototype – Test – Evaluate/Share	Kim & Min, 2020
7 Steps	Orientation – Empathize – Define – Ideate – Prototype – Test – Summary	Shin et al., 2019
8 Steps	Tinkering – Finding issues – Empathizing – Planning – Making – Testing – Improving – Feedback	Yoon et al., 2019
9 Steps	Tinkering – Empathizing – Defining – Ideating – Prototyping – Sharing – Testing – Improving – Maker Fair	Choi & Bae, 2022

WITHIN KOREAN PUBLICATIONS

RQ3. What are the challenges for Design Thinking in education and future research directions according to Korean publications?

The findings revealed several challenges when it comes to DT in Education, which is mainly related to cultural traits, specifically the Confucian-heritage culture. Several studies pointed out that the Confucian-heritage culture is more assessment-driven, showing more reverence to authority, with less emphasis on higher order thinking, such as critical and creative thinking [41]. Affected by this culture, students may fear exhibiting different opinions or solutions that don't necessarily follow the norms [41], particularly in liberal arts [42]. In this sense, a common challenge to DT education in Korean culture is the complex design activities that demand higher order thinking. In such situations, the design process can be intimidating, and teachers may not be trained to ease an open and safe space for students to fully express their opinions without fear. This leads to another challenge, where DT leads to superficial embracing of form-centered designs, rather than human-centered design solutions. This may be a reason behind why some critics of DT mistakenly attribute the failure to use DT to the method itself, when it is the DT teaching and learning approaches. Other common challenges of incorporating design thinking into education with a focus on cultural aspects include the following:

1. Lack of cultural sensitivity: DT approaches may not be culturally sensitive, causing resistance and difficulties in implementation among diverse communities [43].

2. Resistance to cultural change: Incorporating cultural dimensions into DT may represent a departure from traditional approaches to education and may be met with resistance from educators and students who are accustomed to the status quo [44].

3. Inconsistent application across cultural contexts: DT may not be consistently applied across different cultural contexts, due to variations in cultural values, norms, and beliefs [45].

4. Limited cultural resources: Implementing DT in education in a culturally sensitive manner may require additional resources, such as specialized training on cultural competency and culturally responsive teaching [46].

5. Assessment and evaluation across cultural contexts: Assessing and evaluating the effectiveness of DT in diverse cultural contexts can be challenging, as cultural variations may impact DT outcomes [47].

6. Integration with existing curricula in a culturally responsive manner: Integrating DT into existing curricula in a culturally sensitive manner can be challenging, as it may require rethinking traditional teaching and learning approaches to be more culturally responsive [48].

Future direction of DT Education as highlighted in the reviewed papers point to the importance of establishing an educational 'learning community' to provide an open platform for teachers and project experts to exchange and discuss. This would facilitate the exchange of open and creative teaching and learning practices in the process of using design thinking. At the same time, it would offer students to reflect on their designs to promote their own culture, instead 'imitating' other cultures imported by the media (such as Hollywood). This can also uncover new approaches to design thinking, based on the Confucian culture within the Korean context. For instance, DT education can consider using Korean-inspired designs from the Hangul (Alphabet), Hansik (Food), Hanok (Traditional Housing), Hanbok (Clothing), and Hanguk-Eumak (Music). Another common highlight from the reviewed papers was the integration between schools and enterprises to set medium- and long-term educational projects, rather than short-term seminars or experimental- projects. This will provide an opportunity to conduct an in-depth, longitudinal study exploring the intrinsic motivations and interactions of the participants, which will enrich the industry-academia collaboration. In addition to this, there is a need to explore the importance and educational effectiveness of collaboration through pedagogical research in DT. In modern society, where there are increasingly complex problems that are not well defined, DT places a strong emphasis on unlocking the power of collective intelligence through collaboration. DT is a pedagogical approach that looks to leverage the strengths of teams by combining individual excellence with a collaborative attitude. Although there is some prior research on design thinking and team effectiveness, team collaboration effectiveness, and collegiality, there is a

dearth of research on improving competencies through collaborative activities in DT team projects. Therefore, in addition to improving individual creativity and problem-solving skills, more research should be conducted on developing empathy, collaborative problem-solving, and collaborative creativity through design thinking.

IV.   FUTURE RECOMMENDATIONS

We conducted a systematic review on Korean published studies to explore trends, research methods, target groups and subjects/domains, as well as processes, challenges, and future research directions on DT Education. The reviewed papers reveal a lack of research on designs inspired from the Asian culture, such as Korea. According to the review findings, we suggest for future research to address the following recommendations:

• The role of cultural variations in self-concept and sociocultural background in DT:

    a.   Understanding cultural differences in self-concept and identity.

    b.   The influence of cultural values and norms on DT approaches.

    c.   The impact of sociocultural background on DT outcomes.

Cultural dimensions play a significant role in shaping the design of solutions that serve a particular community. An understanding of cultural variations in self-concept and sociocultural background can inform DT approaches to better serve the needs of diverse communities.

• The limited focus on DT from non-Western perspectives:

    a.   The dominance of Western perspectives in DT literature.

    b.   The need for more research on DT from diverse cultural dimensions.

    c.   The potential benefits of incorporating diverse cultural perspectives in DT education.

Most of the literature on DT has a Western perspective, and there is a need for more research on DT from other cultural dimensions, such as Arab, Chinese, Japanese, and Korean.

• The importance of considering cultural dimensions in DT education:

    a.   Enhancing the effectiveness of DT in serving diverse communities.

    b.   Improving intercultural communication in DT.

    c.   Encouraging the development of culturally responsive DT approaches.

Incorporating cultural dimensions into DT education can enhance the effectiveness of DT in serving diverse communities and improve intercultural human communication.

• The need for further exploration of cultural characteristics related to DT:

    a.   Uncovering variations in design approaches in different cultural contexts.

    b.   Improving our understanding of the relationship between culture and DT.

    c.   Encouraging the development of culturally sensitive DT practices.

Further exploration of cultural characteristics related to DT can uncover variations in design approaches in education, which will be crucial for understanding the relationship between culture and DT.

According to the review findings, we suggest to explore more DT educational approaches in atypical disciplines such as science, environmental studies, medicine, or management. Moreover, future research can utilize longer processes in different subjects/domains and conduct in-depth interviews or experimental research approaches to explore how these extra steps have an influence on design-thinking competence.

V. CONCLUSION AND FUTURE WORK

This study covered that there a great attention to Design Thinking (DT) education, especially with the increasing use of educational technology platforms and tools such as the metaverse and robots. Though several literature reviews were made on DT education, the attention is mainly focused on the published studies in English. This study conducted a systematic review on DT research in education published in Korean language to explore trends, research methods, target groups and subjects/domains, as well as processes, challenges, and future research directions on DT Education. The reviewed papers reveal a lack of research on designs inspired from the Asian culture. We ask, how can design thinking in education uncover and teach characteristics of the Korean culture, such as Hangul (Alphabet), Hanok (Traditional Housing), Hanbok (Clothing), and many more elements rooted in the society? It is recommended that the research community explore cultural characteristics related to design thinking. This would uncover variations in design approaches in education that is vital for intercultural human communication. Systematic reviews can be made on publications from other languages as well, such as in Arabic or Chinese. In addition to this, we also suggest that the use of DT in teaching and learning needs to be widely used and studied as a curriculum for adults through continuing education institutions. Previous research has focused on university courses, such as developing DT programs for university course management and validating the effectiveness of classes for university students. In Asia, which has entered a rapidly aging society, the importance of establishing an appropriate lifelong learning system for adults and developing effective programs cannot be overemphasized. Therefore, DT should be applied not only to university students but also to adults in general, and design thinking research on teaching and learning should continue not only for university disciplines but also for adults in general.

REFERENCES

[1] Ahn, Youngsik (2021). Reflections on Design Thinking: Focusing on the processes of concept formation and meaning expansion. Research in Learner-Centered Instruction, 21(24), 647-665.

[2] Kelly, T. and Littman, J. (2001). The art of innovation, Lesoons in creativity from IDEOP, America's leading design firm. New York.

[3] Tim Brown (2009). Focus on design, book, Youngsa Kim, Seoul.

[4] Roger, S. Pressman. and Bruce, R. Maxim. (2020) Software engineering: a practitioners approach. New York: McGraw-Hill Education.

[5] Koh, J. H. L., Chai, C. S., Wong, B., and Hong, H. Y. (2015). Design thinking for education: Conceptions and applications in teaching and learning. Springer.

[6] Choi, H., and Park, J. (2014). Developing the design process in education to improve creativity based on design thinking. Journal of Digital Design, 14(4), 677-686

[7] Panke, S. (2019). Design thinking in education: Perspectives, opportunities and challenges. Open Education Studies, 1(1), 281-306.

[8] Meinel, C., and Leifer, L. (2012). Design thinking research (pp. 1-11). Springer Berlin Heidelberg.

[9] Traifeh, H., Bin Tareaf, R., Abou Refaie, R., Meinel, C., and Von Thienen, J. (2021). How Did Design Thinking Develop in the Arab World? Findings from Twitter Analysis. Journal of Design Thinking, 2(2).

[10] Chen, P., Huang, R. H. (2021) Exploring the paths and strategies of design education: a new perspective on the cultivation of innovative talents. 3(335),18-24.

[11] Razzouk, R., & Shute, V. (2012). What is design thinking and why is it important?. Review of educational research, 82(3), 330-348.

[12] Lor, R. (2017). Design thinking in education: A critical review of literature.

[13] McLaughlin, J. E., Wolcott, M. D., Hubbard, D., Umstead, K., & Rider, T. R. (2019). A qualitative review of the design thinking framework in health professions education. BMC Medical Education, 19, 98.

[14] Collinge, A., Rüdell, K., & Bhui, K. (2002). Quality of life assessment in non-Western cultures. International Review of Psychiatry, 14(3), 212-218.

[15] Kim, M. S. (2002). Non-Western perspectives on human communication: Implications for theory and practice. Sage.

[16] Ito, E., Walker, G. J., & Liang, H. (2014). A systematic review of non-Western and cross-cultural/national leisure research. Journal of Leisure Research, 46(2), 226-239.

[17] Sinha, M. K., & Montori, V. M. (2006). Reporting bias and other biases affecting systematic reviews and meta-analyses: a methodological commentary. Expert review of pharmacoeconomics & outcomes research, 6(5), 603–611. https://doi.org/10.1586/14737167.6.5.603

[18] Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., Prisma Group. (2010). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. International Journal of Surgery (london, England), 8(5), 336–341.

[19] Lee, Dongkuk & Kwon, Hyuksoo. (2022). Keyword analysis of the mass media's news articles on maker education in South Korea. International Journal of Technology and Design Education. 32. 10.1007/s10798-020-09615-9.

[20] Lee, D. K. (2019). A meta-analysis of the effects in maker education. The Journal of Educational Information and Media, 25(3), 577-600.

[21] Kim, Y. Y. (2021). Suggestion for creative idea frame of ceramic collaboration education through design thinking. 한국과학예술융합학회, 39(3), 69-75.

[22] Lim, D., & Ahn, J. (2019). A Case Study: Designeer Education Program and Application of Capstone Design-Focusing on Design Thinking Process of a Robot Vacuum Cleaner. Journal of Engineering Education Research, 22(2), 61-70.

[23] Kim, Y. A., & Han, Y. S. (2016). An Analysis of the Design Activities in Appropriate Technology based Engineering Design in order to utilize the Concept of Design Thinking. Journal of Engineering Education Research, 19(5), 25-34

[24] Yoo, J. Y. (2020). The effect of medical service design thinking teaching-learning on empathic problem solving ability: Convergence analysis of structured and unstructured data. Journal of Digital Convergence, 18(6), 311-321.

[25] Kim, J. S. (2020). The effect of design thinking-based nursing learning program in students.

[26] Kim, Hyun-Min (2015) Design Entrepreneurship in Visual Communication Design Education. Journal of Basic Design & Art.

[27] Young-Jae, J. (2021). Development of Design Thinking Class Program Applying Creative Problem Solving (CPS) in College Classes. Jounal of Fisheries and Marine Sciences Education, 33(5), 1153-1171.

[28] Lee, Jongman (2020) Case study of 'Subject Logic and Essay' class based on Design Thinking: Focused on critical thinking and creative attitude of pre-service early childhood teacher. Journal of Learner-Centered Curriculum and Instruction

[29] Seong, G. B. (2019). The effects of problem-based activities with the design thinking process on teaching anxiety, resilience, and creative problem-solving competence of pre-service English teachers. The Journal of Foreign Studies, 47, 41-80.

[30] Lee, J., & Kim, H. (2020). Analysis of pre-service mathematics teachers' experience on design thinking based teaching practicum. Communications of Mathematical Education, 34(3), 235-256.

[31] Lee, E., & Tae, J. (2017). The effect of STEAM program based on design thinking on primary school pupil's convergent problem solving & interest in math-science. Journal of Curriculum Integration, 11(1), 143-162.

[32] Jung, H. J., & Kim, C. O. (2018). A Study on the Entrepreneurship Education Framework for Youth based on Design Thinking. Journal of the Korean Entrepreneurship Socieity, 13(1), 176-200.

[33] Bae, J. H. (2021). Action Research to Improve the Curriculum for Early Childhood Language Education Based on Design Thinking for Prospective Kindergarten Teachers. The Journal of the Korea Contents Association, 21(12), 119-131.

[34] Yoon, Okhan (2017). A Study of the Instructional Systems Design Model for STEAM Education- Focus on Design Thinking. Korean Journal of General Education, 11(2), 443~474.

[35] Choi, W. (2015). The holistic startup business model development by lean startup and design thinking: startup methodology and education program development for designers in the creative economy. Hongik University.

[36] Lee, S., Kim, T., Kim, J., Kang, S., & Yoon, J. (2019). The effect of a design thinking-based maker education program on the creative problem solving ability of elementary school students. Journal of The Korean Association of Information

Education, 23(1), 73-84.

[37] Park, hyeyoung, & Nagan. (2020). '공예 대중화'를 위한 메이커 교육 프로세스 연구-디자인 씽킹 방법론 (WIPR) 과 전문가 인터뷰를 통하여. 한국디자인문화학회지, 26(2), 185-196.

[38] Kim, Kyoungeun & Min Seonghye (2020) Preschool Teacher's Perception of Design Thinking. Journal of Learner-Centered Curriculum and Instruction

[39] Lee, Yeong-Chan (2021) Exploring the Direction to Apply Design Thinking to Invention Education in Practical Arts Subject of Elementary School. [초등학교 실과의 발명교육 영역에서 디자인씽킹 적용 방향 탐색] The Journal of Korean Practical Arts Education.

[40] Grönman, S., & Lindfors, E. (2021). The process models of design thinking: A literature review and consideration from the perspective of craft, design and technology education. Techne serien-Forskning i slöjdpedagogik och slöjdvetenskap, 28(2), 110-118.

[41] Stankov, L. (2010). Unforgiving Confucian culture: A breeding ground for high academic achievement, test anxiety and self-doubt?. Learning and Individual Differences, 20(6), 555-563.

[42] Cheng, B., & Zhang, D. (2020). Cultivating citizens with Confucian cosmopolitanism: Defining the purpose of liberal arts education in the Asian context. Frontiers of Education in China, 15(4), 564-587.

[43] Sungae Kim(2019). Effects of Robotics Education Program based on the Design Thinking Process on the Creativity for Engineering College Students in the field of IT.

[44] Park, Suhong(2021). Development of Entrepreneurship Education Model Based on Design Thinking for Community Value Realization.

[45] Kwon, Young-kook(2017). A Study on Combined Education for Design Thinking - Focusing on Stanford D. School Curriculum.

[46] Dohyun Lee(2015).The Suggestion of Design Thinking Process and its Feasibility Study for Fostering Group Creativity of Elementary-Secondary School Students in Science Education.

[47] Kristen Koeun Nam(2022). An Educational Program of Design Thinking class for Creative Problem Solving- Focused on the practical project of multidisciplinary curriculum.

[48] Yoon Hye Jean (2013). Creative Thinking and Convergence Education for Innovative Design.