Design Thinking Approaches in Education and Their Challenges: A Systematic Literature Review

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Abstract

Design thinking has become a phenomenon in various fields, including the field of education. Design thinking has become part of most industrial and commercial activities that promotes the understanding of customer needs by considering what is technically and economically qualified. The objective of this systematic literature review is to explore approaches to and challenges of the design thinking environment in education. To evaluate how the design thinking approach is used and integrated within the education context, the researchers have carried out a systematic literature review, which collected, categorized and reviewed 25 articles related to this topic. Based on the literature studied, it was evident that a design thinking approach was found to be a great tool to enhance the process of teaching or learning, especially when it comes to the cultivation of 21st Century Skills among students. However, in using design thinking in education, several challenges are faced by educators and students. Therefore, all parties should be prepared to improve and nurture design thinking in the context of education, because design thinking is useful for education.

Keywords

Design Thinking, Integrated, Challenge, Education

1. Introduction

Part of the learning process is the ability of the students to demonstrate their capacity to accomplish their tasks that indirectly demonstrate their ability to solve problems. In achieving problem-solving skills, students need to be guided on how to pursue any basic ideas and the following steps, and at the same time,

they need to ensure that the outcome will reflect their level of creativity. In this sense, design thinking skills can be crucial as they consist of a flexible sequence of process steps and iteration loops. Design thinking may therefore be considered a great tool to be used in teaching and learning to develop twenty-first century skills (Thoring & Müller, 2011).

Design and design thinking have become part of many industrial and commercial activities. In the current practice, the interest in design has not only intensified in traditional areas, but design thinking has also been taken into the public sector, as well as in many other sectors. Much of the interest in design thinking is based on its ability to tackle a variety of social, economic, technological, and political problems that are part of the new global complexity. In the Asia-Pacific region, China, South Korea, and India, design thinking has been promoted in university education, for example, through the establishment of programmes that focused on nurturing design thinking (Kurokawa, 2013).

Design Thinking Concept

Design thinking is described as a style of thought, or as a study of cognitive processes that is then manifested in design thinking action (Cross, 2007; Dunne & Martin, 2006), reflecting on design thinking, consider that design thinking refers to the cognitive process used by designers, rather than the objects they make. In addition, design thinking is a holistic concept for those forms of cognitive learning and design that allow students to work in multi-disciplinary ways, strengthening positive changes. As a problem-solving approach, it has been tested by addressing it to the complicated social problems of everyday life that are still difficult to solve, known as "nasty problem[s]" (Rittel & Webber, 1972). Thus, design thinking offers a concrete solution to complex problems that are vague and not easy to define or to understand. Design thinking focuses on this need to create ideas and seek solutions (products, services, systems) to malicious problems, and offers a new approach for a specific set of users (Lindberg et al., 2010).

Design thinking can be seen as a multi-disciplinary concept that provides a valuable methodology for creative work between disciplines, as it complements mono-disciplinary thinking (Lindberg et al., 2010). Unlike analytical thinking in science, which leads to the completion of mono-disciplinary, technical sheer and problem resolution solutions, teaching strategies in design thinking focus on various disciplines and the involvement of all their perspectives (Brown, 2008).

Creative work requires creativity and creativity is a twenty-first century core thinking skill for students (Mishra & Mehta, 2017). Researchers suggest that creativity is also important for educators, but given the challenges and difficulties faced by teachers, creativity is often seen as a leisure activity in class (Root-Bernstein & Root-Bernstein, 2017). For many people, creativity remains a sought-after but intimidating skill (Williams, 2002).

In the face of creative thinking or problem solving, many people are reluctant to identify themselves as "creative", or are uncomfortable taking intellectual risks

and assuming an open attitude (Weisberg, 1986). As creativity and openness are challenging, students need a flexible structure to guide their creativity, as a way to "intentionally work through getting stuck" (Watson, 2015).

It has been suggested that design thinking provides flexible and easily-accessible structures to guide educators, and to enhance their creativity in addressing practical problems. In addition, Robinson (2011) and Pendleton-Jullian and Brown (2015) assert that design thinking skills are key for the 21st Century creativity. Although design thinking is most often used in business or product design and services, it is also being considered in education. The potential of design thinking in enhancing the curriculum and pedagogical approaches has been considered by many scholars and educational researchers (Laurillard, 2012; Trebell, 2009; Tsai et al., 2013; Wong, 2011). In this study, the researchers use a literature review to discuss how the design thinking approach is used and integrated, as well as its surrounding challenges in education. Design thinking here is considered as a broad concept to cover the type of thinking that occurs when taking a design approach to addressing real-world problems or challenges. In other words, the researchers will elaborate and explore the challenges of the design thinking approach in education.

2. Methodology

This study aims to evaluate how design thinking approaches are used and integrated, and the challenges of their use in education. For this purpose, we have used a systematic literature review, with the objective to assess and understand large amounts of information to solve problems in education. In this study, the researchers explored various databases, namely Emerald, Google Scholar, Scopus and Sci Direct. We found more than 500 studies using the keywords "design thinking challenge in education", but have taken into consideration only 25 studies that are related to aims of the study. The literature review covers articles published between 2013 to 2020. In order to analyse the research, the researchers used the Nvivo Plus 12 and Mendeley applications.

The overall research questions are:

1) What are the approaches to design thinking in education?

2) What are the challenges of design thinking in education?

The research questions are based on the focus of the literature that has been analysed: the design thinking approach is focused more on the educational context, while the challenges around design thinking relate more to the experiences of teachers and students (Table 1).

3. Results and Findings

3.1. Approaches to Design Thinking in Education

Design thinking is a method of approaching the design process that offers a solution to a problem. This approach will greatly influence the way decisions are made, which will in turn produce new and innovative ideas in the field of education.

Table 1. Summary of 25 articles.

Research design	Location	Research focus	Area of study
Concept paper (6) Qualitative (9) Quantitative (10)	Australia (2) China (1) USA (9) Switzerland (1) Toronto (1) Denmark (1) Austria (2) New Zealand (1) Norway (1) Japan (1) Germany (1) UK (1) Taiwan (2) Finland (1)	Educators (12) Students (13)	Teaching and learning (17) Planning (3) Design (1) Technology (3) Cognitive (1)

The following section discusses and elaborates on the approaches to design thinking in education by focusing in more depth on design thinking in education through pedagogical approaches.

1) Design Thinking in Education

Design thinking is often referred to as a new paradigm for dealing with problems in many professions and fields, including IT, business, research, innovation and education. Design thinking may therefore be considered a great tool to be used in teaching and learning to develop twenty-first century skills (Kurokawa, 2013; Glen et al., 2014), as it involves involves collaboration in order to solve problems by finding and processing information, taking into consideration the real world, people's experiences and feedback, and by applying creativity, critical thinking and communication (Ray, 2020).

In some literature, design thinking is sometimes referred to as "design-based learning". It is perceived as a "model for enhancing creativity, endurance, engagement and innovation" (Dolak et al., 2013). The benefit of design thinking in pedagogy refers to the way in which it "enables students to work successfully in multi-disciplinary teams and enact positive, design-led change in the world". In other words, design thinking approach can be considered as a problem-solving approach that deals with the solution of everyday problems (Kijima et al., 2021).

Education is a massive and collectively designed human system. Schools are designed and built with functionality in mind. However, the limitations of the traditional school system have inspired serious efforts to re-envision how education should be used to address challenges today, and those that may emerge in the future. Thus, the current emphasis on twenty-first century learning reflects this desire to change educational practices. In addition, describe the importance of teacher education based on design, because teachers are increasingly challenged to be creative and to use novel practices for twenty-first century educational contexts (Pendleton-Jullian & Brown, 2015).

2) Design Thinking in Education through Pedagogical Approaches

Design thinking skills can also be developed through various activities at school, especially in group work and projects, as one of the preconditions for design thinking is team working and open communication (Kijima et al., 2021). Ray (2020) suggests that working in small groups, or "collabs", requires the following six steps: 1) identify the opportunity; 2) design; 3) create prototypes; 4) get feedback; 5) scale and spread; and 6) present. He proposed that students are encouraged to say "yes" when they agree with each other's ideas, and "yes, but…" when they disagree. This is done in order not to discourage other students from expressing their opinions, and to search for alternative ideas, which are essential for building prototypes. This idea demonstrates that sometimes even small changes can greatly impact on results. The activity starts with a problem that is offered for the students to solve. The activity comprises six steps as illustrated in Figure 1.

Step 1: Identify Opportunity. This may be done as a frontal activity in class, or as group work. During this stage, students have to identify the need for the problem to be solved, as well as who will benefit from the solution. Then it is recommended that students choose someone external, who is personally affected by the issue, to share their experiences. Students should interview them. This can be done personally, involving an out-of-class activity; alternatively, these persons may be invited to participate in the lesson, during which students may question them, or interviews may be organized via online platforms.

Step 2: Design Process. During this phase, students review the stories that they have heard during the previous phase, and brainstorm solutions. One of the ways of doing this is to give the students sticky notes and pens, and let them brainstorm solutions. When students have finished brainstorming, the main themes must be identified, and at this point, students from smaller groups to research the initial ideas.
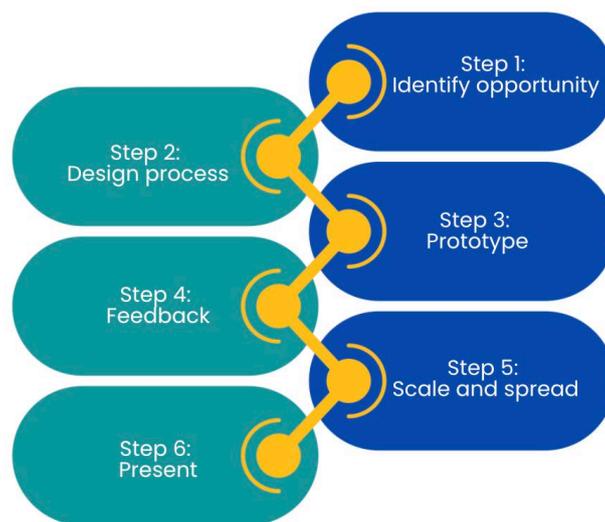

Figure 1. Six steps in design thinking (Adapted from Ray, 2020).

Step 3: Prototype. Next, it is necessary to review the ideas and choose one prototype. This prototype has to solve one aspect of the problem. At this point, the students will focus on this one solution offered to solve a specific aspect of the given problem. Then students select the next aspect of the problem and approach it similarly. In order to visualize the thinking process it is recommended to draw a brainstorming map which clearly demonstrates this process. The brainstorming map may also be made by attaching sticky notes to paper. This brainstorming map will be useful for the next stage of the activity.

Step 4: Feedback. During this stage, the groups present their solutions to external experts for feedback. It is recommended to have at least two experts from different stakeholders' groups. For example, if students are discussing the problem of young people's employability during summer holidays, one expert might be from a group of pedagogues or parents who support young people's summer work, whereas another expert might be from a group of employers who are unwilling to employ young people.

Step 5: Scale and Spread. During this stage students continue working in groups to find the best solution to the feedback received during the previous stage. In this process, the teacher's help in guiding the students' ideas is needed. If the group has received numerous comments from the experts, it can be split into several smaller groups, with each group working on one issue. The sub-groups can then come together and agree on a common variant for presentation.

Step 6: Present. The groups present their solutions to the problem. In order to make the process more significant for students, the people whom the students interviewed during the first phase might be invited.

Such an activity is an opportunity for students to solve a real-world problem and offer a solution for the people who need it. There are no bad or incorrect solutions, as, according to the theory of the design thinking approach, problems may be solved in different ways (Rittel & Webber, 1972). The challenge for the teacher might lie in the fact that this activity is time-consuming and cannot be done in one lesson or lecture. As with any project-based activity, it extends over a longer period of time, so the teacher may guide the process by setting a definite timeline for each part of the activity to be done. Teachers may adapt the existing material to their pedagogical needs and to the target groups, as well as taking into consideration design thinking principles to create their own teaching and learning aids, in order to motivate students' learning.

3.2. Challenges for Design Thinking

Design thinking has come to be seen as an important part of teaching and learning. However, there are various challenges and obstacles to be overcome. Therefore, the challenges of design thinking in education for teachers and students will be further discussed below.

1) Challenges for Teachers

Design thinking is a very effective learning process that enhances creativity, builds skills, helps students think outside the box, engages students with design

activities, and highlights the talents of the students (Tsalapatas et al., 2019). However, there are also some challenges that the educational world faces in achieving world-class outcomes by using design thinking in education (Harden & Moore, 2019; Laferriere et al., 2019; Panke, 2020).

To deliver systematic and effective teaching, the preparation of materials for learning is essential to ensure effective teaching and learning (Retna, 2015; Hanghøj et al., 2019; Panke, 2020; Kayali et al., 2019). In a study conducted by Tseng et al. (2019) on how pre-service English teachers enact Technology Pedagogy and Content Knowledge (TPACK) in the context of web-conferencing, the researchers state that the design thinking materials used in online learning have technical problems in the form of poor sound quality, causing students not to be able to clearly hear the teacher's voice when delivering the lesson.

Lack of experience among teachers in the use of design thinking for learning in schools is another challenge faced by teachers in providing the latest and most relevant information in using design thinking methods (Anastasiadis et al., 2020; Clark et al., 2020). This can lead to misunderstandings occuring among students, when the teacher cannot provide the assistance that is expected by students while the learning is taking place (Harden & Moore, 2019).

In addition, a long time is required for teachers to adapt design thinking to learning in the classroom to ensure that students understand design thinking, but the time that is allocated to the teachers is very brief, and teachers' schedules are too dense, leading to a lack of time to practice design thinking for students' learning (Harden & Moore, 2019).

Apart from that, the lack of training on design thinking in education will also contribute to the problem of educators to think in a more creative and innovative in learning will be taught in the classroom and will lead to fewer students interested in using learning design thinking (Panke, 2020), due to the lack of training, communication between teachers in the school has also been limited and has an impact on students as well as student performance (Baniya et al., 2019).

2) Challenge for Students

When students learn about design thinking for the first time, they will suffer from confusion and frustration, because they will try to understand and learn design thinking with the thinking of each when they are given the project to handle (Panke, 2020). Researchers suggest that students should strive to create opportunities by understanding the perspectives required for learning design thinking (Tsalapatas et al., 2019; Baniya et al., 2019).

Additionally, students have difficulties in learning design thinking because of the lack of creativity when students have to solve a problem using design thinking (Henriksen et al., 2017; Clark et al., 2020). They do not see the problem as an opportunity to increase their creativity to solve the (Henriksen et al., 2017). Therefore, creativity is the most important foundation for design thinking in education (Linton & Klinton, 2019; Tsalapatas et al., 2019).

Table 2. Summary of challenges.

Challenges for teachers	Challenges for students
1) Insufficient resources	1) Confusion and frustration
2) Lack of experience	2) Lack of creativity
3) Time constraints	3) Lack of good ideas
4) Lack of training	4) Teamwork difficulties

Another challenge faced by students when learning through design thinking is that they lack good ideas to design a project as required by their teachers. This lack of good ideas will encourage students to take things for granted, and they will not be eager to complete the work given by their teacher (Linton & Klinton, 2019; Panke, 2020). With the advent of good ideas, students will be more excited and more engaged in class activities (Hanghøj et al., 2019; De la Fuente et al., 2019).

In addition, students may face teamwork challenges in conducting design thinking projects in the classroom because of conflicts or difficulties within their teams, due to disagreements and lack of cooperation (Lynch et al., 2019; Panke, 2020). Misunderstandings in communication will also cause a breakdown in teamwork between students (Lynch et al., 2019). Teamwork is very important in design thinking because it requires a lot of different opinions to ensure that the work can be prepared properly (Krüger, 2019). The overall summary of the challenges are listed in Table 2.

4. Conclusion

Based on the review of the 25 articles that have been chosen, the thought of a form can be used as an approach that supports teaching and learning in various disciplines and helps students to solve complex problems. Unlike conventional learning, which requires students to have skills or knowledge of certain subjects, design thinking challenges students and educators to apply various forms of knowledge, including social, technological and other skills. This is, many aspects of design thinking have been used, but barely covers the design approach of thinking as a way to go beyond the conventional troubleshooting solution today.

Of course, there are obstacles to the use of design thinking in education, such as challenges to teachers and students. Among the challenges teachers face are: insufficiency of resources, lack of experience, time constraints, and lack of training. The design thinking challenges faced by students include confusion and frustration, lack of creativity, lack of good ideas and teamwork difficulties. To address these challenges, educators should always be open to receiving new and up-to-date learning, so that they will not feel pressured to teach new techniques such as learning using design thinking. In addition, design thinking also has a large impact on the development of the teacher. Design thinking culture will encourage positive impressions of teaching and learning in schools, as well as

teachers' professional development and the development of student skills, as an essential part of twenty-first century teaching.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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