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Implementation of Design Thinking to Support Creativity-Oriented Learning: A Literature Review

Dina Syaflita[1], Ridwan Efendi[2*], Muslim[2], Azhar[3]

[1] Doctoral Program Students in Science Education, Universitas Pendidikan Indonesia, Bandung, Indonesia
[2] Science Education Program, Universitas Pendidikan Indonesia, Bandung, Indonesia
[3] Physics Education, University of Riau, Pekanbaru, Indonesia

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Corresponding Author:
Ridwan Efendi
ridwanefendi@upi.edu

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Abstract: Learning to Support the Implementation of Concepts for Real-World Problem Solving can be achieved by applying outcome-oriented learning that produces products as problem-solving solutions. Design Thinking is a strategy that can be utilized to support the achievement of these goals. This research aims to specifically examine the stages and characteristics of design thinking as a learning strategy oriented towards enhancing creativity. This research is a literature review study conducted using the narrative review method. The source of information used is secondary data in the form of literature related to design thinking in international journals. The literature selected is deemed capable of addressing the research questions. The results of this study indicate that design thinking is a learning process that can foster creativity. Design thinking involves a divergent thinking process in the problem-finding stage (empathy and design) and ideation. Creativity in both problem-finding and ideation resides in the realm of creative thinking. Problem-finding refers to the process of discovering various ways to obtain information about users. Ideation refers to the process of generating various solutions to solve user problems. Various literature studies demonstrate the role of design thinking in generating creative ideas and products to solve problems.

Keywords: Creativity; Design Thinking; Divergent Thinking; Literature Review

Introduction

The 21st century learning is characterized by increased efforts in developing creativity competence, which is recognized as one of the competencies essential for the 21st century (Calavia et al., 2023; Sari et al., 2023; Azmi & Festiyed, 2023). Creativity is the ability of an individual to generate products that are original and beneficial (Hassan, 2018). This competence is considered crucial given its importance in the problem-solving process (Bao & Koenig, 2019). Many problems require creativity for their resolution (Sun et al., 2020; Teo, 2019). In the future, problems may be more complex and unpredictable than they are today, thus efforts to enhance creativity become essential as a means to address the challenges of current and future societal and professional landscapes (Chin et al., 2019; Raymundo, 2020; Chang et al., 2016).

Creativity is not a matter of chance but rather something that can be cultivated (Nurhaisa et al., 2023). In contemporary education, various learning processes are geared towards enhancing students' creativity. Learning that supports creativity improvement is typically problem-oriented, especially focusing on real-world problems within the students' environment (Cheng, 2019; Matahari et al., 2023). Problem-based

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learning and project-based learning are instructional approaches that can be employed to enhance students' creativity. The difference lies in problem-based learning, which is oriented towards improving creative thinking (Boye & Agyei, 2023; Webster et al., 2022; Agustin et al., 2023), meanwhile, project-based learning is oriented towards the process of creative thinking and generating creative products as artifacts to solve real-world problems (Guo et al., 2020; MacLeod & Van Der Veen, 2020; Barak & Yuan, 2021; Hasibuan et al., 2023; Nurulwati et al., 2023).

Creativity is honed by optimizing both divergent and convergent thinking processes (Calavia et al., 2023). The divergent thinking process involves generating various possible solutions to solve a problem (Zhu et al., 2019; Madore et al., 2019). The solutions generated may arise from focused thinking processes or from incubation moments when the brain is in a relaxed state and discovers solutions deemed appropriate (referred to as 'aha' moments) (Shi et al., 2019; Unrau, 2019). Creative products, as outcomes of creativity, are characterized by the values of originality and utility (Hassan, 2018; Allen & Thomas, 2011; Chalsum et al., 2023). In addition, they are also regarded as open-minded thinking, flexibility, and divergent thinking (Léger et al., 2020). Originality means the product is different from existing products, or the method used is not a routine method commonly employed by others. Utility signifies that the produced product genuinely serves as a solution to the problem intended to be addressed and is used by the community in need (Lou et al., 2017; Yin et al., 2021; Alves et al., 2021). The community in need, in this context, is referred to as end-users. In order to generate original products with high utility value, an approach oriented towards end-users is required.

Learning oriented towards creating creative products by considering the needs of end-users can be facilitated through design thinking-based learning (Wolcott & McLaughlin, 2020; Schwarz et al., 2023). Design thinking is an approach popularly utilized in design disciplines. This approach is highly open to other fields, especially in courses within different academic programs (Linton & Klinton, 2019). Design thinking can be applied in various fields of study, including science, mathematics, and engineering, as well as in multidisciplinary project-based learning (Chin et al., 2019; Araújo et al., 2019). In the field of education, design thinking is utilized for learning experiences that require students to generate creative products (Liu, 2023). For teachers, design thinking is employed to design learning products such as teaching materials and instructional media (Wu et al., 2019; Calavia et al., 2023).

In education, design thinking is widely used in multidisciplinary learning (Alexandrakis, 2021) and often focuses on socio-scientific issues. Environmentally oriented problem-solving learning through the creation of creative artifact products commonly utilizes the design thinking approach (Calavia et al., 2023) to produce products that are useful for end-users (Hahn-Goldberg et al., 2022; Liu, 2023; Tsai et al., 2023). This literature review study discusses the components of design thinking and their relationship with divergent thinking skills and user-oriented approaches. This is considered the state of the art in this research. The purpose of this study is to theoretically and practically examine through literature review the components of design thinking, the relationship between design thinking and divergent thinking, design thinking as a user-oriented approach, and several examples of the application of design thinking in education.

Method

This study is a literature review research, with the main topic being 'design thinking'. The selected literature serves as reference material and is related to studies on the components of design thinking, the relationship between design thinking and divergent thinking, and various applications of design thinking in education. The literature used is aimed at addressing the research questions in this study. The research consists of two questions. First, what are the core components of design thinking? This question is intended to provide a detailed description of the stages and specifications of design thinking. Second, How do the stages in design thinking contribute to the development of divergent thinking processes? This question aims to review the processes in design thinking that can enhance creativity. The stages of this research are presented in Figure 1.

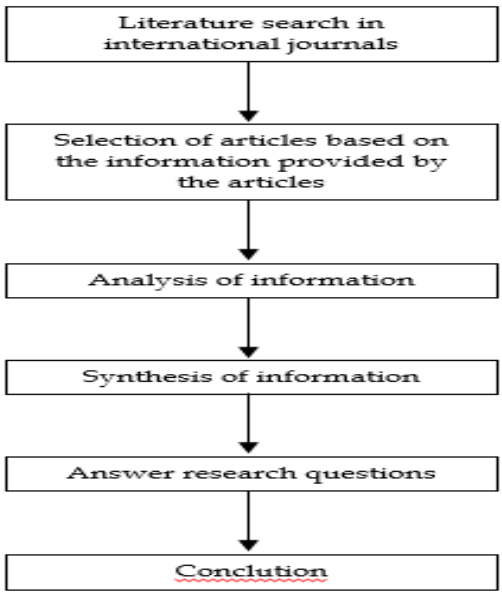

Figure 1. The Stages of The Research

This research begins with a literature search in international journals. The literature is selected, and only literature related to design thinking that answers the research questions is used. The selected articles are then analyzed and synthesized in the form of core formulations of the stages of design thinking and the divergent thinking processes within those stages of design thinking. Finally, conclusions are drawn to answer the research questions.

Result and Discussion

Design Thinking Components

Design thinking is a problem-solving process that involves generating products tailored to needs (Linton & Klinton, 2019). It is a form of learning aimed at generating new ideas and exploring alternative solutions, rather than choosing among existing alternatives. Design thinking introduces students to complex, poorly defined problems, preparing them to face challenges in the future (Lynch et al., 2021). Widely interpreted as an iterative approach to problem-solving, design thinking positions people as sources of inspiration and guidance in overcoming challenges (Liu, 2023). Design thinking facilitates transformative learning to apply learned material in solving real-world problems (Tsai et al., 2023) thus fostering creativity (Winiasri et al., 2023).

In design thinking, there are processes of inspiration, ideation, and implementation (Linton & Klinton, 2019). Design thinking encompasses a broad range of activities, including problem definition, brainstorming, planning, creation, testing, and evaluation (Chin et al., 2019). Design thinking gained popularity after being introduced by the team led by Tim Brown in the Harvard Business Review in 2008. This team presented the design thinking process in three phases: inspiration, ideation, and implementation. Subsequent researchers and teams presented design thinking in five stages: empathy, definition, ideation, prototype, and testing (Wolcott & McLaughlin, 2020). The HPI School of Design Thinking suggests six steps: understanding, observing, perspective, ideation, prototyping, and testing (Schwarz et al., 2023). Essentially, in design thinking, there are phases of understanding and identifying problems, generating solutions, and implementation. The learning process involving problem investigation, finding solutions, and producing products can enhance creativity (Ratnasari et al., 2023).

Attention to users makes design thinking products more responsive and adaptive (Dell'Era et al., 2020). The processes involved in design thinking are more holistic (Dell'Era et al., 2020), iterative, reflective, and dynamic (Wu et al., 2019). On one hand, design thinking emphasizes user-centered empathy, while on the other hand, it emphasizes the brilliance of brainstorming (Chin et al., 2019). User needs and behavior are crucial foundations in designing products as they have significant environmental impacts (Buhl et al., 2019). Empathy prevents individuals from overgeneralizing their personal experiences and hastily deciding on solutions that may seem most appropriate (Chin et al., 2019).

The use of design thinking in the learning process enables the enhancement of creative synthesis skills and processes. Design thinking can support the improvement of imagination, empathy, optimism, experimentalism, and collaboration (Liu, 2023). There are variations in the stages of design thinking in different literature. Some literature indicates that design thinking is a cycle. Redante et al. (2019) presents the stages of design thinking in a cyclical form. Wolcott & McLaughlin (2020), Hahn-Goldberg et al. (2022), and Katoppo & Sudradjat (2015) state that design thinking is an iterative process that can occur repeatedly. In general, design thinking consists of the stages of empathy, define the problem, ideate, prototype, and test. Further explanation about each stage of design thinking is as follows.

Empathy

Empathy is focused on obtaining empathetic understanding of the needs and challenges of users. In this stage, information is gathered to serve as a foundation in the design process and to develop an understanding of users: what matters to them, their needs, and the issues underlying the development of a particular product. The principle is that user problems are often unrelated to designers, and therefore, designers need to empathize with users to design solutions that meet their needs (Kenny et al., 2021). The goal of the empathy stage is to connect with users through observation, interviews, and other strategies to understand their experiences (Wolcott & McLaughlin, 2020). The key to producing strong innovation is understanding and addressing human needs (Lynch et al., 2021).

Design thinking (DT) forms public–private–community partnerships, akin to the collaborative nature of Sustainable Living Lab. DT can be a solution for challenging problems with uncertain solutions (Alexandrakis, 2021). Empathy involves efforts to understand those experiencing a situation, gather insights from their experiences, engage in numerous brainstorming sessions to generate ideas, and apply an iterative approach (Albay & Eisma, 2021). Design thinking pays equal attention to the problem as it does to the solution. It is crucial to define the problem according to the user's experiences, perspectives, and

contextual situations (Léger et al., 2020). Design thinkers gather data from various sources to connect macro and micro levels, fostering empathy with the contexts in which they are involved (Mortati et al., 2023).

Define

The Define stage involves creating statements about what the user's problems and needs are (Li et al., 2019). In this stage, user needs are analyzed and summarized through aggregative thinking, and the problems to be solved are determined. This stage can be completed through discussion, information sorting, filtering, and other methods (Qian et al., 2019). The Define stage is where researchers or designers test apparent patterns and identify user problems that need to be addressed (Kenny et al., 2021). The Define stage guides the identification of specific needs to be addressed. Each identified problem serves as a trigger for generating ideas in the next phase (Wolcott & McLaughlin, 2020).

The Define stage is also referred to as the understanding stage. In this stage, insights gathered from users during the empathy stage are consolidated. The primary goal of the Define stage is to formulate problem statements or relevant and achievable design challenge statements. Proper execution of the Define stage will provide focus and frame the problem, express the team's understanding of the user, and synthesize the most critical needs to be addressed (Albay & Eisma, 2021). Various research techniques in understanding user problems and needs will form the basis for the design process (Redante et al., 2019).

Ideate

In the Ideate stage, learners generate various methods to solve problems through divergent thinking. There are many different ways to think in this stage, such as brainstorming, SCAMPER strategies, and so on (Qian et al., 2019). This phase aims to produce innovative ideas for project themes, stimulating creativity to generate solutions that fit the context of the subject being worked on. In addition to the multidisciplinary project team, other members can be chosen as users and professionals from fields relevant to the research topic. The goal is to provide different perspectives, making the final result richer and more convincing (Araújo et al., 2019). The ideation stage is usually done in groups, assuming the number of groups is proportional to the ideas generated (Knight et al., 2019).

In the process of generating creative ideas, the term lateral thinking is known. Lateral thinking is a deliberate process of seeking irrelevant inspiration and trying to generate as many options as possible (Eissa, 2019). Lateral thinking ideas serve as stimuli to generate new ideas. Stimuli can be in the form of words, images, and sounds to stimulate new ways of thinking about a problem (Knight et al., 2019). Lateral thinking techniques consist of two phases: ignoring existing ideas and perspectives and motivating the emergence of new ideas (Srikongchan & Kaewkuekool, 2021). This technique is considered to train both creative and systematic thinking skills (Mustofa & Hidayah, 2020).

Prototype

A prototype involves using suitable methods to visualize various solutions that have been generated. This stage is part of the aggregative thinking process. Various visual methods are available at this stage, such as building models, designing software, hand-drawing, and so on (Qian et al., 2019). Prototypes can take the form of a storyboard illustrating a new process to support small-scale trial programs. Prototyping allows designers to receive feedback and insights on how to refine ideas to better address problems. Prototyping leads to the ongoing convergence of ideas until the final proposed solution is decided. The more detailed product or process is then implemented on a larger scale during the testing phase (Wolcott & McLaughlin, 2020).

The prototype stage is marked by experimentation and transforming possible solutions into tangible and concrete products. In this stage, the team will produce smaller-sized models or anything that can be interacted with by users regarding possible solutions to address user problems. These prototypes will be tested and investigated. Prototypes can be shared and tested by the team or different individual groups, including users. The results could either be accepted, improved, redesigned, or rejected (Albay & Eisma, 2021; Henriksen et al., 2017). These prototypes are not intended to be seen as something real; instead, prototypes are incomplete fictional attributes that provide ample room for imagination by observers (Magistretti et al., 2022).

The prototypes created, whether digital or physical, aim to convey ideas and transform them from abstraction into valuable solutions. Additionally, based on a deeper understanding of end-user needs, the prototyping process becomes a pathway to realizing these abstract needs and stimulating productive dialogue within the team and with users (Redante et al., 2019). Prototypes are presented to others with both competence and users to assess their potential implementation (Léger et al., 2020). Some benefits of creating prototypes include gaining empathy from users, exploring innovative ways, testing prototypes before actual implementation, inspiring the team and users, gaining a deeper understanding of the problems being solved, build to think, and refining solutions (Pande & Bharathi, 2020).

Testing

The design needs to be presented to users for feedback. However, this is not the final step in the design thinking process. All steps can be iterative. If the test results are not ideal, previous steps will be revisited for correction and adjustment until the optimal plan is finally designed (Qian et al., 2019). This phase is characterized by the process of seeking feedback from customers. This feedback provides information on what needs to be improved in the prototype. In this phase, the prototype is evaluated by gathering opinions from users and experts about the problems faced, and the successful prototype is then corrected or improved (Léger et al., 2020). Although the testing stage is the last step in the design thinking process, its results can lead the design team to review the previous stages, understand more about users, redefine design challenge statements and solution concepts, and refine prototypes and solutions (Pande & Bharathi, 2020; Albay & Eisma, 2021). It is crucial for the team to listen and learn from what users say, ask, and suggest. It is not good practice to ask users whether they like the product or not. Instead, the design team should inquire about what the team can do better to meet user needs (Albay & Eisma, 2021).

The evolution of knowledge and researchers' perspectives has led to variations in the stages of design thinking. Initially, design thinking consisted of three stages: inspiration to discover problems, generating ideas to address problems, and implementing ideas. Later, these stages evolved into five stages, where the inspiration process was detailed into the empathy and define stages, and the implementation process was detailed into prototyping and testing. Furthermore, other research identifies six stages of design thinking as proposed by Léger et al. (2020) and Redante et al. (2019). Léger et al. (2020) introduces a communication stage after testing, while Redante et al. (2019) details the stages of identifying and formulating problems into three stages: problem comprehension, need finding, and conceptualization. In this article, the design thinking stages focus on five stages. These five stages include empathy, define, ideate, prototype, and testing. The five stages of design thinking are iterative. The design thinking stage diagram is presented in Figure 2.

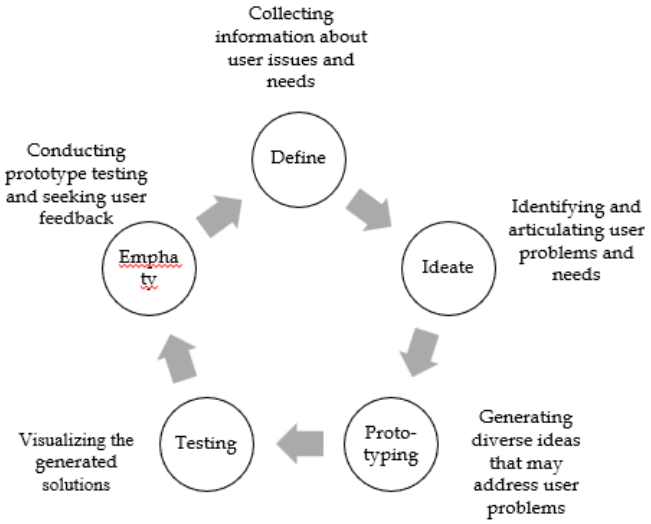

Figure 2. Stages of Design Thinking

Various literature indicates that the stages of design thinking are iterative or can be structured as a cycle, thus Figure 1 is considered a logical illustration of the design thinking stages. Design thinking begins with the process of discovering user problems, identifying and formulating user problems, generating various ideas to solve user problems, visualizing these ideas, and testing them to assess user satisfaction and product effectiveness. The iterative stages of design thinking can repeat at each stage, not just after the testing stage. The testing stage concludes by seeking feedback from users; this stage can be completed within the context of solving user problems or may return to the previous stage to refine the solution or gain a clearer understanding of user needs.

Design Thinking and Divergent Thinking

Design thinking is a learning approach that involves stages in developing creativity. Creativity is cultivated through the 'ideate' stage, where researchers think of a variety of possible solutions to address the challenges related to user needs and problems. According to Hu et al. (2019), during divergent thinking, designers strive to gather information as effectively as possible, and their analysis comes from various perspectives, directions, ways, or different methods. Divergent thinking is the ability to generate various answers or solutions to a single question, measured by fluency, flexibility, and originality (Zhu et al., 2019; Acar et al., 2019; Fusi et al., 2020; Weiss et al., 2021). Divergent thinking is also defined as the process of associating and combining unrelated knowledge in a new and meaningful way (Sun et al., 2020). In the realm of brain function, functional neuroimaging studies indicate that activity in the lateral prefrontal, anterior cingulate, and posterior parietal and temporal cortices forms the basis

of the divergent thinking process (Madore et al., 2019). Therefore, the ability to think divergently is considered a reliable indicator of creativity (Sun et al., 2020).

Divergent thinking is not only present in the ideation stage but is also integral to the problem-finding process. Problem finding refers to the activity of identifying and formulating problems. According to Alabbasi et al. (2021), Problem Finding and Divergent Thinking are considered indicators of creative potential. Hooijdonk et al. (2023) state that in the problem discovery stage, students are asked to think about and articulate the problems they face. This process demands participants to consider various ways to gather information. The quality of problem finding predicts the quality of idea generation and originality.

In design thinking education, divergent thinking processes are found in the problem-finding and ideation stages (empathy, define, and ideate). Given the definition of divergent thinking as the process of generating diverse ideas from various unique and original perspectives, problem finding encompasses the thinking process of discovering various ways to obtain meaningful information about user needs, and the ideation stage is characterized by the process of generating a multitude of possible solutions to solve a problem. Therefore, the problem-finding and ideation stages are essentially processes related to divergent thinking. The relationship between problem finding and the ideation stage with divergent thinking is illustrated in Figure 2.

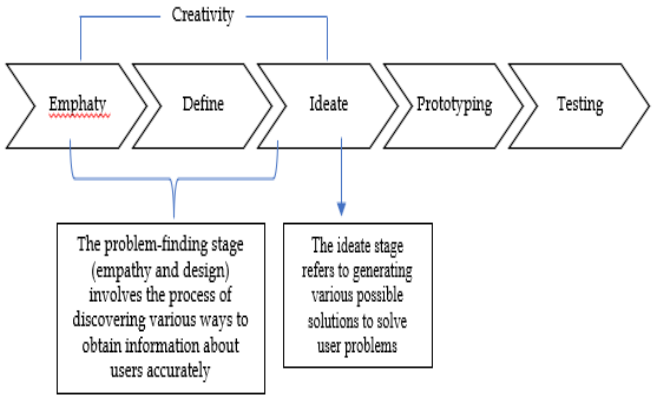

Figure 3. Divergent Thinking in Stages of Design Thinking

Based on Figure 2, the divergent thinking process in the design thinking stage is found in the empathy, define, and ideate stages. Empathy and define are included in the problem-finding process, where designers must think about various ways to obtain user needs. Meanwhile, ideate is a process that involves brainstorming aimed at generating diverse solutions. From the referenced literature, most sources elaborate more on brainstorming occurring in the ideation process. Allen & Thomas (2011) suggest there are two types of thinking: Type I (intuitive and fast thinking) and Type II (logical and deliberate thinking). Both types of thinking need to be involved in the creative thinking process. Type I thinking encourages problem discovery, while Type II thinking promotes the development of creative ideas and solutions.

Conclusion

Design thinking is a problem-solving learning strategy that addresses real-world challenges. It involves a process of discovering user needs, identifying those needs, generating problem-solving ideas, prototyping, and testing. User involvement in design thinking occurs during the empathy and testing stages. Empathy is the phase in which designers gather information about user needs, while testing involves obtaining user feedback to learn whether the design aligns with user needs, what needs improvement, addition, or reduction, and whether the design is accepted or rejected. The divergent thinking process in design thinking is present in the problem-finding and ideation stages. Problem finding involves empathy and design in the design thinking process, requiring various ideas to discover ways to identify user problems and needs. Ideation is the stage of generating diverse ideas that can be used as problem-solving solutions.

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The article was authored by three contributors. Dina Syaflita contributed to the writing of the introduction, methodology, literature review, results, and conclusion. Ridwan Efendi contributed to the conceptualization process, methodology, review, and finalization of the article. Muslim contributed to the finalization and improvement of the article's content. Azhar contributed to the review in the divergent thinking section.

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The content of this article does not raise any conflicts of interest.

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