

## Design thinking mindset to enhance education 4.0 competitiveness in Malaysia

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### ABSTRACT

Education 4.0 will be the next aspect of the curriculum since programming has been taught from the primary school level. Training 4.0 requires teachers to equip students with not only the knowledge and information but also encourage students to be able to process information, develop creative thinking, and acquire problem-solving skills. However, the competency of teachers to encourage creative thinking and problem-solving skills is still questionable. The purpose of this concept paper is to provide an understanding of the conceptual framework for enhancing the teachers' competency to enhance creativity and innovation in fulfilling the desire of education 4.0. design thinking is an innovative method that places people right at the center of problem solving. It discusses the variables that may affect the quality of teachers in education 4.0 and presents a literature review of approaches that can contribute to the creation of effective teaching methods to develop successful students and satisfy the demands of the workforce for industrial revolution 4.0. It is found that teachers need to be competent to build students' skills in meeting a competitive and innovative workforce in the wake of the industrial revolution 4.0. There are seven dimensions in the design thinking mindset that teachers need to understand to meet the 4.0 education requirements.

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## 1. INTRODUCTION

Education is changing due to the rapid development in information and communications technology and technology advancement in the era of Industrial Revolution 4.0 (IR 4.0). IR 4.0 involves technology that changes the way humans think, the world's economic system, and social roles [1]. The development and advancement in IR 4.0 are not only changing the economic, social, and political systems but are also affecting the education system [2]. The 21st-century learning changes the students' learning landscape from teacher-centred to a more learner-centred approach. It focuses on the use of technology for information searching and act as a catalyst for inquiry-based learning [3]. This is in line with the Malaysia Education Blueprint 2013-2025 that aims to prepare individuals to enter the workforce in accordance with the employment needs [4], [5]. To ensure that these demands are met, teachers should no longer be dependent on the traditional method to carry out teaching activities in the classroom.

As technology permeates into all aspects of life, it is pertinent that students understand how to best use technology to improve the quality of life. Teachers must therefore, equip themselves with the knowledge

and the necessary teaching skills so that they could prepare students not only for careers that increasingly require the use of new technologies, but also to understand the impact of technology on society [6], [7]. Based on the literature, a few studies were identified to focus on teaching or developing 21st-century skills and competencies [8]. Teachers today should be attentive to the development and demands in the field of technology in education 4.0. Students cannot develop the skills if the teachers do not have sufficient knowledge in imparting the skills to them. It is important for students to master the skills that cannot be replaced with technology [9]. Hence, teachers need to change their teaching methods and approaches according to the 21st-century teaching and learning framework that adapted to market needs [10], [11]. Teachers must build their own competencies so that they could develop students' creative and innovative skills in technology [12]. This statement is supported by Dillon, *et al.* [13] who emphasized that technology will continue to change the teaching and learning method in today's world and in the future. Teachers and educators should train students with the 21st century skills in meeting the demands for IR 4.0.

Among the approaches that has been found to be successful in creating students who are prepared for IR 4.0 is design thinking (DT). DT is a way of learning that acts as a cycle and a series of methods in developing creativity and innovation. Both aspects have important consequences for industrial enhancement [14]. DT guides and shapes behaviours as a process and a toolkit when facing uncertainty and problem-solving skills. DT provides a robust and adaptive approach for directing teachers and influence their creativity in dealing with practical problems [15]. To ensure that teachers can practice DT, they must be conditioned to have a DT Mindset. DT is more commonly accepted in the industry or in product and service design, but currently has gained a growing interest in education [16]. However, the growing complexity and dependency on technology needs teachers conserve with the seven-dimensional elements of DT in the teaching and learning technology.

While there is a lot of debate, education evidence on this topic is still weak [17]. Therefore, teachers need to change their teaching methods and approach. Thus, it is important for students nowadays to master the skills that cannot be replaced with technology [9]. This is where there is a need to develop 21st-century teaching and learning skills in today's education. However, students cannot develop the skills if the teachers do not have sufficient knowledge in training the skills to the students. The 21st-century teaching and learning method is important in the effort towards building teachers' competencies in teaching students to develop a good foundation in technology [12].

Based on this explanation, the idea is to inspire students to be creative and innovative. Therefore, one thing that needs to be considered is the competency of teachers who need to adapt with the competitiveness of education 4.0. This paper aims to present a conceptual framework for improving teacher's creativity and innovation skills through the design thinking mindset, in the effort to enhance education 4.0 competitiveness in Malaysia.

## 2. RESEARCH METHOD

The researcher used data analysis for a systematic study of evaluations, reviews and findings in peer-reviewed articles, reports, and dissertations. Digital repositories such as Scopus, Springer, JSTOR and Google Scholar were searched comprehensively using the terms check and research on learning, creative and innovative thinking, design thinking, design thinking mindset, Industry Revolution 4.0, and Education 4.0. Based on the search, 50 articles from 2010 to 2020 were obtained and systematically analyzed. The articles were carefully reviewed in order to better understand the principles of concept, idea and contribution and how they are used in educational studies [18], particularly in the context of Malaysia. Authenticity, credibility, and specificity were the key characteristics of the review's interpretive document analysis [19], [20]. Many articles were read in order to truly understand their conceptual perspectives. Figure 1 presents the flowchart of reviewed articles selection processes that contribute a conceptual framework for new knowledge to validate the statements, theories, and concepts of scholars in DT, DT mindset, IR 4.0 and education 4.0 towards creative and innovative thinking. Ultimately, a detailed debate on the principles and how they are used to determine the academic success of learners was discussed.

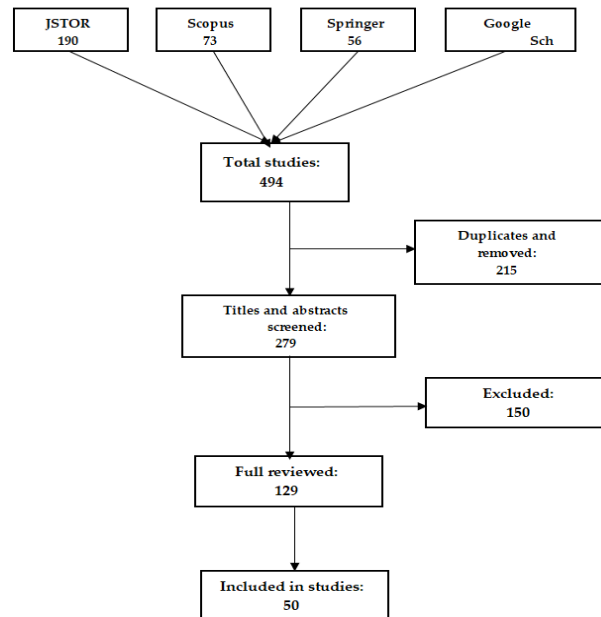


Figure 1. Flowchart of reviewed articles selection process

### 3. RESULTS AND DISCUSSION

#### 3.1. Design thinking in education

The field of education is continuously changing with new methods to increase students' learning. Along with that is to equip the students with skills that would enable them to face the demands of the 21st century skills and IR 4.0. One approach that promises to fulfil the above needs is design thinking (DT). This study examines issues and challenges in adapting DT in IR 4.0 teaching. There is a lack of empirical inquiries on the DT application and implementation processes in the educational context in Malaysia. The second wave in the Malaysian Education 2013-2025 blueprint aims to create a problem-solving thinking development model that supports epistemological shift through DT thinking in a high-quality learning environment (Ministry of Education Malaysia, 2018). DT application in the curriculum offers vast potentials to enrich better learning in various fields through the DT Mindset integration.

Design thinking (DT) is generally defined as a creative and analytical process for an individual in giving an opportunity to create, to try and produce prototype models, and to produce feedbacks and change a design [21]. According to Henriksen, Richardson, and Mehta [17], DT is a thinking framework to solve complex problems in this "conceptual age" where creativity and innovation has become the main contributors to the increase of productivity in various sectors. Koh, *et al.* [22], define DT as the stimulation to analytic and intuitive thinking. Various definitions show that DT needs different ways of approach in solving problems, which involves a systematic process to achieve the desired output. Understanding and fulfilling users' needs by ways of thinking and different innovations, are the gains from the output of DT. Based on this definition, innovations can happen in multiple forms such as service, products, behaviours, and organizational culture fields through DT practice. Overall, DT can be regarded as an intelligent process and organizations can benefit from using DT to excel in a competitive environment [23], [24].

In the field of education, the a characteristic of design thinking and the importance should be discussed in promoting problem-solving skills to the students in the 21st century [25]. DT enables students to develop skills like collaboration, empathy, creativity, and problem-solving, as well as helping teachers to create efficiency in learning by applying the integration of curriculum to fulfil future learning by fulfilling high technological needs [26]. Global Initiative Sharing for 21st Century Skills or P21 has described a new teaching style that has emerged as a way for the students to adapt to new needs. Various studies at the global levels [27]-[30] had implemented DT as the strategy in applying empathy, problem-solving, prototype processing and multidisciplinary collaborative approach in teaching creativity, and building creative confidence and innovative minds. Thus, Figure 2 represents the DT application framework in education by Lor [29] which shows the relationship between three dimensions and four themes. The gist of the idea is that a successful application of DT in education needs systematic programs and integrated informing curriculum, teaching approach usage, and support resources for teachers' training. Teachers' involvement in DT has this potential.

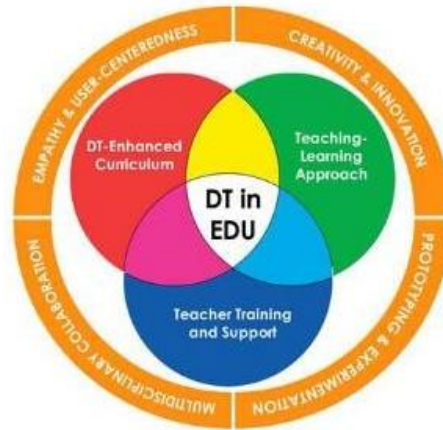


Figure 2. DT application framework in education field sources [29]

Brown [31] indicates that design thinking is a concept that involves the imagination, vision, and strategies of a creator. This meets the concerns of end-users to establish a technologically feasible and successful solution. In addition, Serrat [32] also states why concept analysis is a non-linear technique to look at to give insights into the mechanism to cope with unforeseen issues. Such questions are what most product theorists found as false problems or problems, which remain unsolved or can only be overcome through solutions via multidisciplinary approaches.

### 3.2. Design thinking mindset in education 4.0

The concept of thinking, as an increasingly common approach to creativity, involves a certain type of mindset. People who want to innovate and create better experiences, products and services for their users or customers may benefit from the application of certain attitudes that can enhance their thinking and creativity. Therefore, DT Mindset focusing on modifying, altering, or enhancing the mentalities of students, or even teachers, can build an intricate concept thought mindset in the classroom. In the context of teaching and learning, DT Mindset is based on Cognitive Psychology that provides guidance to achieve learning objectives through teaching activities and encourages thinking culture in Education 4.0 [33]. The teaching process in IR 4.0 demands students to develop creativity and innovation through computing skills and to build a skill set that balances the expert workers in the future [4].

Throughout the domain of DT, the process of approaching the integrated problems in the education curriculum is to incorporate technology into pedagogy in order to improve the professionalism of teachers [34]. However, teachers are aware that the importance and values of certain types of thinking are different attributes that will help students in building creativity and innovation. A teaching approach through creativity and innovation building is a global initiative towards the 21st-century skills building which focuses the effort in providing skills for students' careers. The initiative from Partnership for 21st Century Skills (P21) has played active and important roles in guiding education policy by building the 21st century skills framework. Through this initiative, 21st-century skills are integrated through the main subjects such as English, Mathematics, Computer Science, Geography, Social Studies, and Art [22].

Driven by the effort to incorporate 21st century learning capabilities, DT Mindset is required to be integrated into the curriculum. Brown [31] and Carroll, *et al.* [35] explain that DT Mindset is an approach for students to focus on developing creative confidence and also facing challenges in building creativity by developing empathy, encouraging a tendency to action, encouraging idea building, developing metacognitive awareness and cultivating creative problem-solving. Thus, a study by Lor [29] has divided DT Mindset, into seven dimensions, namely empathy, human-centredness, process awareness, prototype culture, experimentation, collaboration, and optimism in building creativity and innovation in teaching. Table 1 explains the seven dimensions in DT Mindset, which are the abilities that form skills in P21. It is a formal method of problem-solving or solving practical issues creatively, with the intention of better output in the future [36].

The results of the study show that Human-centredness, Empathy, Collaboration, Optimism, Experimentalism, Culture of prototyping and Mindfulness of process are required for student's employment needs in the era of IR 4.0. The application of these seven dimensions will result in the development of creativity and innovation among students [4], [17], [37]. The conceptual framework is shown in Figure 3.

Table 1. Seven dimensions of DT mindset in education field

Dimension	DT Mindset in education field	Source
1. Human-centredness	The philosophy of design begins with a clear understanding and empathy of needs and motivates students. The aim is to encourage and direct people to solve the challenges of design.	Carroll <i>et al.</i> [35]
2. Empathy	Imagine the future in specific details from a differing point of view of "initial others", approaching problems certain others would not want to do. To develop empathy through a method of "need seeking," which focuses on specific and tacit needs of people.	Brown [31]; Carroll <i>et al.</i> [35]
3. Collaboration	Combination of great minds among students to build critical thinking as an attempt to increase innovation when solving problems. Collaborate enthusiastically with, and with other disciplines.	Brown [31]
4. Optimism	Embrace the culture confidence that all students should create improvements, irrespective of how big the issue is, how fast the duration it requires or how limited the budget will be. Suppose at least one solution is better than current one irrespective of how complex the problem is.	Brown [31]
5. Experimentalism	Teachers should exercise experimentalism or study about learning that forms new ideas from the failure's students did in building innovation.	Brown [31]; Carroll <i>et al.</i> [35]
6. Culture of prototyping	The central principle of DT philosophy is to develop students' skills by practice. In the invention cycle, prototype is vital. Prototype is a sculpting philosophy that is intuitive and easy to build inventions. Concentrate on being highly experimental, building to dissolve and involving people with artefacts to generate feedback for better solutions.	Carroll <i>et al.</i> [35]
7. Mindfulness of process	Mindful of the method is a way of thought that will extended to students in order to ensure that any task or project is guided by phases of the design cycle and the correct estimated period in the fulfilment of the assignments or their tasks. Realize where the design process and the methods are in and the strategic goals have become.	Carroll <i>et al.</i> [35]

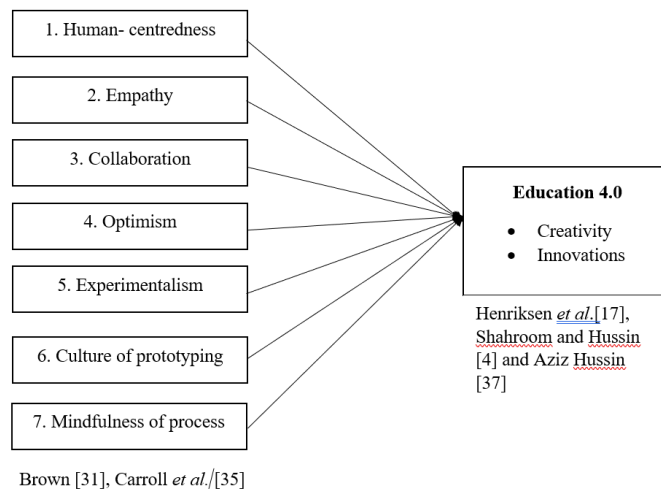


Figure 3. Conceptual framework

### 3.3. Issues and challenges of DT mindset in education 4.0

Modern schooling is distinguished by the diffusion of information by teachers. The focus is on curriculum integrity as far as the learning setting is concerned; teachers play a dominant role in teaching, where teaching styles are structured and the primary teaching goal is to gain skills [38], [39]. It is important to empower students with problem-solving skills that can retain continuity in theoretical, innovative, and creative thinking [40]. The important aim of creativity and innovative thought is to stimulate and develop the problem-solving skills of students. However, according to Malaysian Education Growth 2001–2010, most teachers still use traditional teaching strategies and not many had implemented creative and innovative thinking in the teaching and learning process [41]. Prior studies [2], [17], [42], that have noted the importance of implemented DT Mindset to apply all the elements to build creative and innovative thinking. Table 2 demonstrates the contrasts of the two instructional approaches that teachers need to apply to enhance creative and innovative thinking that dealing with DT mindset.

Table 2. Comparison between traditional teaching and creative and innovative thinking teaching with DT mindset

Item	Traditional teaching	Creative and innovative thinking teaching with DT Mindset
Teaching philosophy	Conservative, realism Teachers are expected to lead students to become familiar with textbooks	Focus on the training of creativity with applied human-centredness, culture of prototyping, experimentalism, and optimism
Teaching outcomes/objective	Emphasis on academic skills in traditional core areas/ measured objectively Realize the objectives set in the textbooks (direct instruction by teachers)	Equip students with the ability of creative thinking (collaboration, mindfulness of process and empathy)
Teaching approach	Instructors plays a dominant role	Project-based approach that implemented seven elements in DT mindset Diverse and flexible
Teacher's and student's role	One-way: dominance by teachers (academic instructor, source of knowledge and authority) Student's learn what teacher teach, focus on intellectual	Inspirer and helper; focus on teacher-student interaction Collaboration, culture of prototyping and Mindfulness of process
Teaching material and tool	Textbooks, blackboards, and chalk	Diversified teaching materials, social media and web 2.0
Teaching assessment/evaluation	Periodic utilization of objective outcome evaluations Students evaluated by grades that they will earn Written exam-based evaluation and standard answers	Diversified evaluations and flexible answers dealing with optimism and experimentalism

Design thinking development in Malaysia started with the initiative from the inception of Genovasi Malaysia in August 2012, with its aim to train the public and private communities using design thinking model from the Stanford d school and Hasso Plattner-Institute. Genovasi Malaysia aims to encourage and build Malaysian school students' with creative and innovative skills [43]. The emphasis on integrating creativity and innovation in teaching and learning captured the attention of the former Minister of Education who wanted creativity and innovation to be integrated in the school curriculum. This has also become the emphasis to achieve the vision of increasing the 21st-century education system quality through the Malaysian Education Blueprint 2013-2025. The believed that DT Mindset has the potential to develop creativity and innovation has led to a demand from many parties to implement DT in the education curriculum [44]. As the key success factor lies with the teachers, it is therefore valuable to observe DT Mindset's learning constraints from the perspective of teachers. As the engine of transformation, teachers play a vital role in the success or failure of an innovation.

Creativity and innovation is an important element in building labour skills in the IR 4.0 era [45]. Hence, Education 4.0 emphasizes on building teachers' competencies so that they could develop students' creative and innovative ability, leverage on information and technology in their teaching, and to equip their students with the skills to communicate and cooperate effectively. Based on Adnan, *et al.* [46], creativity is the core of 21st-century thinking skills and education 4.0. Teachers should master the creative element in this education 4.0 era not only to fulfil enrichment activities in class. However, in a recent study it was found that 45% of teachers stated that they never practice creative thinking, while 70% of the teachers stated that they only sometimes practice creative thinking skills in teaching [47].

Findings centred on this evidence based rely on the assumption that the issue of teaching and learning has emerged owing to the inadequate growth in professionalism and competence among teachers [5]. Hence, teachers need support to increase their capability to guide students' design thinking [48]. Chai, *et al.* [6] recommended that the further studies need to be conducted for in-service teachers to form teachers' awareness and competencies related to DT Mindset. Previous studies, have showed that teachers are still unclear about DT Mindset and how it could be applied in the classroom [29], [49], [50].

#### 4. CONCLUSION

This concept paper makes a link of expertise to instructional planning and to the professional advancement of teachers in addressing the needs of education 4.0. While several studies have been undertaken on 21st-century education, this concept paper aims to fill the gap, to the benefit of academician and researchers in the context of education 4.0. Exposure to DT, DT Mindset and education 4.0 may improve students' success by developing creativity and innovation and thus improving the core skills required for the Industrial Revolution 4.0. This concept paper is intended to be a reference for teachers in Malaysia in instilling DT Mindset to develop creativity and innovation among students as per the requirements of education 4.0. The hope is that the paper will encourage understanding and awareness to all the teachers and

those who are interested in creative thinking and innovation and encouraging students to describe their thoughts competence.

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