

Measuring the 21st Century Skills Using Design Thinking among Polytechnic Final-Year Students

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ABSTRACT

The 21st century has come with requirements of a new kind of skills which surpasses technical knowledge, especially to the final year polytechnic students who are about to join the job market. The proposed research aims at exploring the efficacy of applying the design thinking approach as a pedagogical instrument in assessing and improving the 21st century skills of polytechnic final-year students. Design thinking is a human-based and problem-solving approach that provides a semi structured and flexible framework that stimulates creative thinking, collaboration, and effective communication within repetitive and well-organized project development cycles. The study used quantitative method and the study results have managed to confirm that the design thinking process can greatly help students in acquiring and showing the skills. Students demonstrated significant progress in critical problem-solving skills, effective communication of their ideas, cooperation with peers, and the ability to find innovative solutions. The students claimed they felt more confident and engaged when using the problem-solving methods. This study has demonstrated that design thinking is not only a useful model that prepares the 21st century skills, but it also offers a viable platform through which the competencies can be evaluated in real learning contexts. These findings imply that design thinking has the potential to add value to the curriculum in polytechnics and equip students with real-life challenges in the contemporary job market. Some recommendations are provided to continue the implementation and elaboration of the design thinking in technical and vocational education.

Keywords: Design Thinking, Polytechnic Education, Final-Year Projects, Product Development, Innovation, Human-Centered Design

INTRODUCTION

Nowadays, since education and jobs are always developing, the demand for a trained workforce is higher than ever. Digital change, automation, and the gig economy are having an impact on careers and changing what it takes to do well in the current age. Some universities and graduate schools that have already implemented design thinking education have sent team members off-campus to see and hear about the issue in person, who then return with their experiences and generate ideas toward a solution (Kurokawa, 2012). Therefore, many educational institutions need to offer more than just regular teaching and focus on strengthening 21st century skills. According to Tee et al. (2019), one of the Six Strategic Trusts in the Eleventh Malaysia Plan, 2016-2020 is shifting towards industry-led programmes to produce a skilled workforce to meet the changes by employing Technical and Vocational Education and Training (TVET) programme.

These skills basically implement the recent ways of learning and teaching in the classroom, especially in creating teaching aids, which can increase the quality of students on par with the global benchmark, especially in fulfilling industrial or societal needs, (Mohd. Izham Shah, 2021). It includes many kinds of intellectual, social, and personal talents, such as communication, critical thinking, creativity, teamwork, and growing a positive character. Skills such as these help students excel at school and also increase the chances of finding good jobs and handling different social situations.

Since these competencies are essential for the development of well-rounded, outstanding, and responsible graduates, it is important to test how well students demonstrate and use them, especially when they start to enter the job market at the tertiary level. In the changing field of education, focusing on critical thinking skills has become a top priority at all educational levels (Hong et. al, 2024). Traditional teaching methods are not designed to advance all these different types of competencies. Therefore, educators and those who create curriculum are trying out different methods that make teaching and learning more interactive and learner-focused as design thinking methods show a lot of potential in enhancing the learning quality. It is also a repeatable approach to problem-solving by putting emphasis on knowing users' needs (empathy), clearly defining the problem, coming up with ideas, creating samples, and checking their usefulness.

In the context of problem-solving and critical thinking, several studies have highlighted soft skills emphasizing their role in enhancing employability and job performance (Abu Kasih et. al, 2024). Design thinking encourages creativity, innovation and also promotes working together. It also encourages an individual to be empathetic, flexible and therefore it is very much in line with what today's education wants students to achieve.

Polytechnics which are also known as institutions specializing in vocational and technical training are very active in ensuring that students are offered with the practical aspect of knowledge that will enable them to excel in different industries. It plays a vital role in feeding human capital demands in Malaysia as it is the largest TVET provider with 55% of the TVET graduates nationally (Chee et. al, 2020). Nevertheless, in the globalized society of the 21st century, polytechnics need to transform and integrate the 21st century skills into the curriculum so that the graduates could solve complex real-life problems. Design thinking is constantly emerging in the educational landscape, and it has penetrated into all aspects of classroom teaching and learning (Jinwen et. al, 2023). It is also one of such pedagogical approaches that have been gaining popularity in this regard.

Hence, this study looks into how design thinking helps final-year polytechnic students build important skills for the 21st century. It is the key part in advanced education which is result based and the dominant part of the learning is accomplished by creativity, analyzing skills, and evaluation (Noni & Abdullah 2019). To be specific, the study looks at students' perceptions of their skills in different areas and observes how much they join in during every step of the design thinking process. The analysis of these variables allows the research to find out if design thinking helps with skill development and examine the reliability and consistency of the instruments it uses. The investigation seeks to highlight how tertiary education can more effectively help students with design thinking to prepare them for work in the current age.

LITERATURE REVIEW

The concept of 21st-century skills means a group of abilities that are essential to achieve success in the contemporary world. This literature review explores the significance of 21st century skills and examines their impact on students' overall development. Through evaluation of current academic effort, this literature will hopefully explain the way 21st century skills incorporation into educational frameworks can help learners to develop in a holistic way and be much prepared to face the challenges and opportunities of the century ahead.

The skills needed in the 21st century

In this present day, education is mainly meant to help students to gain the 4Cs which stands for Communication, Critical Thinking, Creativity, and Collaboration. Supported by Rapti and Sapounidis (2024) Critical thinking, Communication, Collaboration, and Creativity are regarded as key skills for today's learners. Today's students need to think critically, communicate effectively, collaborate effortlessly, and create by innovating to meet the demanding needs of modern society. As emphasized by Rusdin and Ali (2019), the 4Cs can contribute to an individual's social and cognitive development. Students form closer social bonds able to build better cognitive skills when they are nurtured to collaborate with each other, share their ideas, and think in an independent way.

Living in the 21st century urges people to have current skills, especially higher education students who think that ideally, they will be employed upon graduation (Abdullah et. al, 2020). For students to do well in the

modern, technological, and connected world, the development of these four competencies is necessary. Students can communicate their thoughts effectively in different settings and using many forms. It is possible to provide the students with the necessary experiences to support the development of their practical creative problem-solving skills without sacrificing the science content or the education of disciplinary knowledge (Laakso & Clavert, 2014). Critical thinking helps students to study facts, solve complicated issues, and decide on the best course of action. When creativity is encouraged, students can face challenges with fresh strategies and make use of various resources. Meanwhile, collaboration means people need to cooperate, respect the opinions of others, and achieve common objectives as a group.

Nowadays, education frameworks often include ethics in their lists of priorities, especially integrity, empathy, and responsibility, as well as being global and digital citizens. These values give young people the ability to think and act with moral sensitivity and awareness in a world where cultures mix and technology links many communities. When seen together, these skills show how development should consider the mind, heart, and relationships. That is why curricula for every educational stage are being updated to ensure that 21st century skills are central to what is taught.

Design Thinking as a pedagogical tool

Brown (2019) claims that design thinking promotes imaginative and new ideas by making users' needs the main focus. These skills are essential to cope with the complexity of a fast-paced world especially in a globalized market where technological change is constantly increasing. There are five parts of the design thinking process as shown in Figure 1. The process also defines as below:

1. Empathize - define as the needs, experiences and challenges of users or stakeholders
2. Define - precisely stating the problem with regards to the insights acquired
3. Ideate - development of a set of ideas or possible solutions
4. Prototype - creating prototypes or miniature versions of the possible solutions
5. Test - getting feedback and solutions



Fig. 1 Design Thinking Process

Design Thinking is a problem-solving process that believes in a user-centered approach and conceives in empathizing with the needs of the people concerned. It is commonly employed in the sphere of innovation and product development, and it has recently been introduced into the educational process as the means of stimulating creativity and critical thinking. Design Thinking has been broadly perceived as a useful method of teaching 21st century skills due to its collaborative, creativity and problem-solving stimulating nature. According to Panke (2019), Design Thinking seeks to go beyond the immediate boundaries of a problem in order to ensure that the proper questions are being asked. Beyond its applications in industry, Design Thinking is starting to be explored as a valuable pedagogical practice in educational settings across various academic disciplines (Hatt & Davidson, 2023). When applied to polytechnic education it provides the student with the option of undertaking practical hands-on learning which is based on real world issues.

Working with design thinking in a learning situation improves how engaged students are, requires them to understand more deeply, and builds their social skills (Razzouk & Shute, 2012). It is similar to project-based and experiential learning because it allows students to face real-life challenges. The application of Design Thinking within polytechnic environments which focus on applied learning approaches is aligned to the

student needs to creatively and dynamically solve real world problems. When students are involved in Design Thinking activities, their problem-solving and creative abilities are not the only skills that are developed; they also enhance their communication skills alongside flexibility and teamwork, which are major elements of the 21st century skills.

How related it is to Polytechnic Education

Malaysia's polytechnic system encourages learning how to use knowledge and skills in real-life industries. Therefore, including design thinking in final-year projects helps students develop important soft skills as they reach the objectives for their curriculum. The polytechnic is aimed at equipping the students with some practical and theoretical skills to enable them to gain employment in technical fields. Incorporating Design Thinking into polytechnic studying will enable students to work on ill-defined problems, which are interdisciplinary and need creative problem solving and efficient teamwork. Also, Design Thinking helps create a culture of constant learning and iteration where students should get used to the idea of adjusting to difficulties and improving their solutions depending on the feedback.

By introducing Design Thinking into the polytechnic curriculum, colleges can produce graduates who are not just technically competent, but who also possess the much-needed soft skills to succeed in employment. Specifically, the empathy, user-centered design, and iterative problem-solving oriented towards Design Thinking can help in shaping the adaptability, communication, and teamwork of the final year students.

METHODOLOGY

This study employs quantitative data collection and analysis methods as it allows for a comprehensive understanding of how Design Thinking impacts 21st century skill development among polytechnic final year students. This study involves 156 final-year students from a range of diploma courses in Malaysian polytechnics who took part in the study. To ensure that every field of study was included, the participants were chosen through stratified random sampling. This approach allows for a comprehensive understanding of how Design Thinking impacts 21st-century skill development in polytechnic students.

Instrumentation

The questionnaire contained Likert-scale items divided into two main constructs: 21st century skills and the five stages of design thinking. Each construct was operationalized into sub-variables, as outlined accordingly. Cronbach's Alpha was used to assess if the survey questions were consistent and trustworthy. All the scales measured well, due to their alpha values of more than 0.7. This matches the criteria advised by Nunnally as well as other researchers. Learning platforms within the institution were used to hand out the survey online. To work with demographic information, descriptive statistics were chosen, but for the Likert-scale replies, both reliability checks and frequency analysis were applied. Besides, a mean score was computed for each student to indicate their proficiency in the skills. The data proves that the 21st century skills and design thinking variables are highly consistent. The values show how accurate and dependable the instrument is in this research.

Findings

According to the results, students demonstrated a high level of 21st century skills and were especially successful in working with others and expressing themselves. The use of design thinking showed that students were highly engaged, mostly during the empathy and testing stages. These are the important points that have emerged and shown in Table 1 and Table 2

Table I Cronbach Alpha Reliability Scores

No	21 st Century Skills		
	Variable	No of Items	Cronbach Alpha Value

1	Communication	8	0.909
2	Creative Thinking	7	0.886
3	Critical Thinking	7	0.920
4	Collaboration	7	0.944
5	Character/Ethical Values	5	0.911
Design Thinking			
1	Empathy	5	0.907
2	Problem Definition	5	0.867
3	Idea Generation	5	0.870
4	Prototype Development	5	0.871
5	Testing	5	0.881

All the Cronbach Alpha values were above 0.7, proving high reliability. Teamwork abilities seemed the strongest, as scoring the highest was the type of collaboration ($\alpha = 0.944$). Empathy (with an α of 0.907) and Testing (with an α of 0.881) scored very well in design thinking, demonstrating that most students kept users in mind during their projects. These results prove that design thinking is helpful for developing important 21st century skills among polytechnic students.

Communication is shown as the cooperative aspect of Design Thinking projects helps the students to learn how to communicate effectively in groups. They also get the experience to present their idea to the others and get feedback. Meanwhile Creativity Thinking has indicated that the cyclic process of Design Thinking, ideation, and prototyping should also result in increased levels of creativity in students. The process of testing and improvement of ideas helps the students to learn how to explore different possibilities and not to be limited to the traditional solutions. Critical Thinking has proven the improvement of students in terms of problem analysis and production of solutions is bound to be significant.

The approach of Design Thinking helps students to analyze the problems critically in many different ways and to create thoroughly thought out solutions. Collaboration also indicates Design Thinking activities done in a team will result in closer collaboration and teamwork. The students were taught how to solve these conflicting perspectives and inculcate the different concepts into harmonious solutions. Lastly, Character/Ethical Values has enabled the cyclical process of Design Thinking which entails the refinement of prototypes and customization of the solution to fitted feedback is likely to result in the students being more adaptable when faced with complications.

Although Design Thinking has been found to be beneficial, the barriers to its systemic adoption in polytechnics are instructor training required, time, and the unwillingness to embrace new teaching approaches. The students can also experience problems with adapting to the non-linear, exploration-oriented approach of Design Thinking, potentially having gotten used to a more structured and traditional way of learning. Some polytechnic institutions are currently re-examining the conventional system of learning and are incorporating the skills of the 21st century in their learning programs. Inclusions of critical thinking, problem-solving, creativity, and communication into the technical education domain are currently being considered more important than ever in making sure that the students will be able to adapt to and succeed in the respective industries that they will be working in.

CONCLUSIONS

It is confirmed in this study that design thinking is an effective and practical solution for developing important skills among final-year polytechnic students. Since the evaluation instrument has been tested and shown reliable, it will be useful for future educational assessments. Students were very skilled in using both design thinking and their creative domains. Design Thinking has held a lot of promise as a pedagogical method that assists in developing the much needed 21st century skills in polytechnic students.

By teaching and reinforcing the importance of critical thinking, creativity, collaboration, communication, and adaptability, Design Thinking equips students with the challenges they would encounter when they start their careers. The results of the study indicate that Design Thinking can play an important role in the process of training these abilities when introduced to polytechnic education.

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