The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2022

Volume 25, Pages 133-138

IConSoS 2022: International Conference on Social Science Studies

Development of a Design Thinking Pedagogical Model for Secondary Schools Science Teachers in Malaysia: A Needs Analysis

Norzilawati Zainal ABIDIN
Universiti Utara Malaysia

Farah Mohamad ZAIN
Universiti Utara Malaysia

Abdul Hamid BUSTHAMI NUR
Universiti Utara Malaysia

Abstract: In line with UNESCO's goal of enhancing quality and innovation through various enhancements to Science, Technology, Engineering, and Mathematics (STEM) education, the Malaysian Ministry of Education also places a premium on information enhancement through STEM education and the Malaysia Education Blueprint (MEB) 2013-2025. Design thinking is an essential component of STEM education in modern schooling. The significance of design thinking, particularly in STEM education, fosters creativity and innovation in problem-solving among students. The needs analysis research is the early phase of Design and Development Research (DDR). This study aims to determine the requirements for developing a Design Thinking Pedagogical Model for secondary school science teachers in Malaysia. The interview method was used to perform the qualitative research. Thus, semi-structured interviews with three science teachers were conducted to explore teachers' perspectives on the need to develop a Design Thinking Pedagogical Model. Purposive sampling was used to choose these experts, and they all matched the criterion. Thematic techniques such as verbatim transcription, coding, and themes were used to examine the interview data. The findings of this study indicate that researchers need to develop a Design Thinking Pedagogical Model of Science by a panel of expert teachers in teaching sciences in secondary schools. As such, the development of this Design Thinking Pedagogical Model will serve as a practical guide for teachers in terms of training and utilizing design in students and practicing the skills necessary for the 21st century through learning and facilitation.

Keywords: Design thinking, STEM Education, Pedagogical model, Need analysis, Design and development research (DDR)

Introduction

Education is evolving in response to the rapid spread of information and communication technology during Industrial Revolution 4.0. IR 4.0 is a technological revolution that radically alters human thought, the global economy, and social roles (World Economic Forum, 2018). Due to IR 4.0, the economic, social, and political systems are changing, and so is the educational system. The 21st-century learning environment is transitioning from a teacher-centered to a learner-centered orientation. The Malaysian Ministry of Education (MOE) has developed the Malaysian Education Blueprint 2013 - 2025 (MEB) in order to educate students for the educational challenges of the 21st century so that they can compete internationally. It is aligned with MEB 2013-2025, which aims to prepare individuals to enter the workforce following labor market demands.

Design Thinking is an original, creative, and human-centered strategy and mindset that incorporates interdisciplinary teamwork to create user-focused products, services, and experiences (Lor, 2017). As a dynamic and non-linear framework (Scheer et al., 2011), Design Thinking employs a five-step iterative process: (1)

Empathy, (2) Definition, (3) Ideation, (4) Prototype, and (5) Testing. It has been proposed that design thinking might assist teachers by giving them with accessible and adaptive frameworks that can improve their creativity and contribute in the solution of real-world problems. In addition, a design thinking approach was shown to be an effective technique for enhancing the teaching or learning process, particularly when developing 21st-century skills among students (Razali et al., 2022). Numerous scholars and researchers in the field of education have investigated the prospect of design thinking enhancing curricula and teaching strategies (Abidin et al., 2022; Balakrishnan et al., 2021; Noh & Karim, 2021). In this context, "design thinking" refers to a more general way of thinking that incorporates the designer's approach to a real-world problem or difficulty. Therefore, the study of the development of this model is significant for integrating design thinking to solve a real-world problem related to education. As a result, science teachers will be better prepared to help their students meet the challenges of globalization on both the academic and personal fronts.

Design Thinking and STEM Education

Research has shown the significance and reciprocal advantages of design thinking and integrated STEM knowledge. Integration of STEM pedagogical approaches has been cited in the literature as a means by which students can learn and develop design thinking (English, 2019; Fan & Yu, 2017). Experimental research was conducted by Fan and Yu (2017), who compared the performance of high school students in STEM technology courses. Students' talents were examined over 10 weeks while the course material and other crucial factors were strictly monitored. Students majoring in STEM fields in engineering outperformed those majoring in a technology education module in terms of conceived knowledge base, high-order design thinking, and project activities for engineering designs. Additional research and analysis highlighted the most salient distinctions between the two modules' design-thinking methods (Fan & Yu, 2017). The following research featured and described the beneficial and practical consequences of teaching STEM subjects together in high school. The research conducted by English provided a concise explanation of the positive outcomes associated with STEM education that was integrated into the curriculum and the teaching methods. Further, Fan and Yu devised an engineering design experiment to compare teaching modules across different groups of students. Critical thinking skills were observed to be utilized by gifted and talented students in integrated STEM activities based on the EDP in the following situations: providing explanations, making associations, questioning information, providing justifications, solving problems, thinking creatively, making generalizations, and attempting to persuade others (Sen et al., 2021). Similar benefits in students to learn and improve design thinking were revealed in the previous study (English, 2019).

Methodology

This research employs the Design and Development Research (DDR) methodology described by Richey and Klein (2007). It is divided into three stages: Need Analysis (Phase I), Design and Development (Phase II), and Evaluation (Phase III). This study will solely discuss Phase I. The needs of the informants (Science teachers) were assessed using a needs analysis to develop Design-Thinking pedagogical model. McKillip (1987) described those needs are a value judgment that a particular group has a problem that must be solved. In this study, researchers employed the purposive sampling approach to identify informants with certain characteristics to obtain specific information from them (Palys, 2008).

Needs analysis is crucial to determine the primary research issue before developing a model (Saedah et al., al., 2013). In addition, needs analysis seeks to explore current problems and evaluate the necessity of designing a model (Mohd Ridhuan & Nurul Rabihah, 2020). The McKillip Discrepancy Model (1987) is used to assess the contrast between the actual condition and the desired situation. According to Mckillip (1987), the needs analysis phase entails the phase of identifying and analyzing the subject's needs, which will determine the results obtained. Identifying and analyzing needs is also known as identifying and offering solutions to existing problems. Face-to-face interviews, telephone interviews, and questionnaires are the three methods typically utilized in needs analysis (McKillip, 1987). This paradigm places emphasis on normative norms and professional judgement. It is also a model that has been widely adapted to several circumstances involving needs analysis, a model that is highly transparent and widely utilized, particularly in the field of education.

In this study, the needs analysis is the first phase in DDR. The researcher uses a qualitative technique with three experts' science teacher. An experts' science teacher needs analysis was done to determine the need for a Design-Thinking pedagogical model. Based on the literature study, an interview protocol was created. Before the interview, the protocol was validated for language, content, and quality. Face-to-face interviews allow the

researcher to dominate the discussion and get the informant's view (Cohen et al., 2018; Cresswell & Creswell, 2018). Experts are science educators with more than five years of experience (Berliner, 2004). Sampling informants to meet institution-set criteria: Consenting informants were interviewed and verbatim transcribed. All informants verified transcriptions before analysis, classification, and coding (Cohen et al., 2018).

Results and Discussion

Based on the verbatim analysis of the transcriptions, all informants agreed that a design thinking pedagogical model for secondary school science teachers need to be developed.

Table 1. Demography of informants

Aspects	Category	Count
Experience in education fields	5-10 years	0
	11-15 years	2
	>20 years	1
Level taught	Form 1	1
	Form 2	1
	Form 3	1
Gender	Male	1
	Female	2
Workplace	Kuala Lumpur	2
	Selangor	1

According to Table 1, all of the informants chosen for this study are considered experts because they have more than 11 years of experience in the field. They come from a variety of workplaces, including Kuala Lumpur and Selangor. In addition, all the chosen informants have expertise in the required fields, including Science Education; thus, they are from science teachers of different levels thought in secondary schools.

All informants agreed that a design thinking educational model should be developed for secondary schools, as evidenced by an analysis of the interview transcripts. In addition, informants indicated why the design thinking pedagogical model need to be developed.

The Needs to Develop a Design Thinking Pedagogical Model for Secondary Science Teachers in Malaysia

The needs analysis results indicated that a design thinking pedagogical model for secondary school science teachers was needed. This was supported even more by Informant 1's experience in the STEM and science fields. Based on their experience in the field science, Informants 2 and 3 had the same viewpoint:

> *"....I'm trying to figure out how to implement a method or approach in my classroom that will enable Project-Based Learning (PBL), ensure that the learning objectives of the activities being carried out are accomplished, and allow me to evaluate and assess student progress in a way that appears fair and objective."*

> *".....Yes, we need a teaching guideline that science teachers may refer to make sure implementing Project Based-Learning (PBL) appear more beneficial to teachers and students."* (Informant_1)

This viewpoint is also confirmed by informant 2, who claimed that it is critical to develop a pedagogical model that facilitates more innovative and effective teaching by teachers, as shown below:

> *".....I have attended design thinking training, but I could not use project-based learning effectively because there was no particular guide on how to implement it. If there is a model or guideline for teachers to follow, I will be able to execute science teaching and learning with creative solutions."*

> *".....In addition, I discovered that I could create a more engaging learning environment through design thinking and project-based learning. I feel that students will be motivated to finish assigned activities if they enjoy learning. In reality, students would be able to recall smoothly all taught knowledge."* (Informant_2)

In addition, it was determined that Informant 3's perceptions aligned with the purpose of this study and were rather direct as follows:

> *"....Time constraints exist because teachers do not have sufficient time to implement project-based learning while teaching in the classroom. In addition, limits on student attendance due to the covid-19 pandemic and inadequate and limited ICT equipment restrict teachers' teaching ability."*

> *".....Project-based learning and design thinking is a great way to get students interested in learning since they can get their hands dirty while doing something genuinely enjoyable. By making something creative, students can exercise their higher-order thinking skills. This is a place where students can incorporate their original ideas. Also, just by making one product, it fosters all the talents needed in the modern workplace."*

> *".....Yes, a model that teachers may use as a guide is needed since teachers do not know how to implement teaching and learning design thinking in project-based learning.* (Informant_3)

As indicated in the verbatim analysis of the interviews, all informants agreed that it was essential to develop a design thinking pedagogical model for secondary school science teachers as a flexible educational guideline to incorporate 21st-century abilities into the teaching and learning of sciences. Through this interview's findings, it is possible to conclude that all informants have reached a consensus about developing a design-thinking pedagogical model for secondary school science teachers. Their statements were supported by their expertise in their respective professions, science teacher. The conclusions of the performed needs analysis are consistent with those of prior research, in which the construction of a model was considered crucial since it provides a guide for teachers to integrate STEM into their classroom instruction (Dare et al., 2019; Muhammad Nasiru et al., 2018). The inputs of the first phase will contribute to the model development that will be applied during the study.

Conclusion

Based on the research obtained, it can be determined that the needs analysis phase should be implemented as the initial stage of the Design and Development Research (DDR). Through needs analysis, most informants agreed that a Design-Thinking pedagogical model should be developed in secondary schools as a guide for science teachers to apply Design-Thinking to enhance the delivery of successful teaching and learning processes consistent with a student-centered 21st-century learning environment. Therefore, the development of this Design-Thinking pedagogical model can be included in the education system of Malaysia's 4.0 Industrial Revolution period to face the challenges of globalization.

Recommendations

In conclusion, the findings of this study contribute to the body of knowledge and research on Design-Thinking in science education by providing the Ministry of Education, educators and instructors, parents, and science students with a better understanding of the possibilities. This study focuses solely on the need for Design-Thinking learning model for secondary science teachers. Therefore, the researcher recommends conducting more research to produce a design thinking pedagogical model in schools for disciplines other than science so that teachers have more options for implementing Design-Thinking based learning in schools. Future studies are suggested to concentrate on Design-Thinking in additional elementary and secondary school subjects other than science.

Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in EPESS journal belongs to the authors.

Acknowledgements

* This article was presented as an oral presentation at the International Conference on Social Science Studies (www.iconsos.net) conference held in Istanbul/Turkey on August 25-28, 2022

* Our special thanks go to the Malaysian Ministry of Education for funding this project and their ongoing feedback and recommendations for enhancement. The first author is thankful to the Malaysian Ministry of Education for providing the scholarship funding for her doctorate study.

References

Balakrishnan, B., Azman, M.N.A, Sharif, A.M., Yaacob, M.I.H., Zain, H.H.M. & Kway, E.H.. (2021). The effectiveness of a design thinking tool for the development of creativity in teaching stem subjects among special needs education teachers. *The International Journal of Science, Mathematics and Technology Learning*. *28*. 15-26. 10.18848/2327-7971/CGP/v28i01/15-26.

Berliner, D. C. (2004). Expert teachers : *Their characteristics, development and accomplish* https://www.researchgate.net/publication/255666969_Expert_Teachers_Their_Characteristics_Development_and_Accomplishments

Cohen, L., Manion, L., & Morrison, K. (2018). *Research methods in education (8 th ed.)*. Routledge.

Cresswell, J. W, & Creswell, J. D. (2018). *Research design: Qualitative, quantitative and mixed method approaches (5 th ed.)*. SAGE Publications Inc

English, L. D. (2019). Learning while designing in a fourth-grade integrated STEM problem. *International Journal of Technology and Design Education*, 29(5), 1011-1032. https://doi.org/10.1007/s10798-018-9482-z

Fan, S. C., & Yu, K. C. (2017). How an integrative STEM curriculum can benefit students in engineering design practices. *International Journal of Technology and Design Education*, 27(1), 107-129. https://doi.org/10.1007/s10798-015-9328-x

Jamil,M.R.M. & Noh, N.R.M. (2020). *Kepelbagaian methodologi dalam penyelidikan reka bentuk dan pembangunan (1 st ed.)*. Qaisar Prestige Resources.

Lor, R. R. (2017). Design thinking in education: A critical review of literaturefile:///Users/ntlafferty/Downloads/JECS20201420282292063.74.pdf. In *Asian Conference on Education and Psychology* (Issue May 2017).

Mckillip, J. (1987). *Need analysis- Tools for the human services and education (1 st ed.)*.SAGE Publications Inc

Hassan, M. N., Abdullah, A. H., Ismail, N., Suhud, S. N. A., & Hamzah, M. H. (2019). Mathematics Curriculum Framework for Early Childhood Education Based on Science, Technology, Engineering and Mathematics (STEM). *International Electronic Journal of Mathematics Education, 14*(1), 15-31.

Noh, S. C., & Karim, A. M. A. (2021). Design thinking mindset to enhance education 4.0 competitiveness in Malaysia. *International Journal of Evaluation and Research in Education*, *10*(2), 494–501. https://doi.org/10.11591/ijere.v10i2.20988

Palys, T. (2008). Purposive sampling. *In L. M. Given (Ed.). The Sage encyclopedia of qualitative research methods*, Sage Publication.

Razali, N. H., Nurasyikin, N., Ali, N., Safiyuddin, S. K., & Khalid, F. (2022). Design thinking approaches in education and their challenges : A systematic literature review. *Creative Education, 13*(7), 2289–2299. https://doi.org/10.4236/ce.2022.137145

Richey, R.C. & Klein, J. D. (2007). *Design and development research method, strategies and issues*. Routledge

Scheer, A., Noweski, C., & Meinel, C. (2011). From_Constructivism_to_design_Thinking. *Design and Technology Education: An International Journal*, *17*(3), 8–19.

Sen, C., Ay, Z. S., & Kiray, S. A. (2021). Computational thinking skills of gifted and talented students in integrated STEM activities based on the engineering design process: The case of robotics and 3D robot modeling. *Thinking Skills and Creativity*, *42*(August), 100931. https://doi.org/10.1016/j.tsc.2021.100931

Siraj, S., Alias, N., DeWitt, D., & Hussin, Z. (2013). *Design and developmental research: Emergent trends in educational research*. Pearson Malaysia Sdn Bhd.

Author Information

Norzilawati Zainal Abidin
Universiti Utara Malaysia
06010 UUM Sintok, Kedah, Malaysia
Contact E-mail: *zilzainal2021@gmail.com*

Farah Mohamad Zain
Universiti Utara Malaysia
06010 UUM Sintok, Kedah, Malaysia

Abdul Hamid Busthami Nur
Universiti Utara Malaysia
06010 UUM Sintok, Kedah, Malaysia

To cite this article:

Abidin, N. Z., Zain, F. M., & Busthami Nur, A.H. (2022). Development of a design thinking pedagogical model for secondary schools science teachers in Malaysia: A needs analysis. *The Eurasia Proceedings of Educational & Social Sciences (EPESS), 25,* 133-138.