International Journal of Advanced Research in Education and Society
e-ISSN: 2682-8138 | Vol. 7, No. 2, 37-49, 2025
https://asianscholarsnetwork.com/asnet-journals

Challenges in Integrating Design Thinking and Resources Utilisation in Science Classrooms: A Qualitative Exploration of the Malaysian Classrooms

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Received: 27 January 2025 | Accepted: 11 March 2025 | Published: 1 April 2025

DOI: https://doi.org/10.55057/ijares.2025.7.2.5

Abstract: *The quality of science education relies heavily on successful teaching and learning activities carried out by science teachers. Despite the ongoing argument about teachers' challenges, there is no single best approach to solve these issues. This study aims to explore the challenges faced by the science teachers in integrating design thinking and resource utilisation in science classrooms. In this study, a qualitative research method was employed. The interview protocol was administered on five science teachers following all research ethics and considerations. An inductive thematic analysis technique was employed to analyse the interview data. Three categories were identified to form the main theme, Teachers' Challenges of Integrating Design Thinking in Science Classrooms with Proper Resources. This study highlighted the challenges in implementing design thinking in education, teachers' challenges in the science classroom, and challenges with teaching materials and resources. This study suggests some interventions, such as professional development courses for science teachers on design thinking, resource enrichment, and curriculum reform. These would create a more supportive environment for teachers to use a design thinking approach in science classrooms and utilise resources to benefit the students. As for future research, researchers should explore the impact of such interventions on teachers' teaching efficacy and students' learning outcomes using a quantitative research method.*

Keywords: Science Education, Teachers' Challenges, Science Teaching, Design Thinking, Resources Utilisation

1. Introduction

The world without science is unimaginable. Today, science has become an important subject for every individual regardless of their age, as the entire world is rapidly chasing the digital development (Anto, Buagas, Ong, Naparan, & Villaver, 2023). From a simple concept to a complex concept, it requires a deep understanding. To deliver the scientific concepts from one to another can be a challenging task, especially for teachers who meet students of different levels in their science classrooms (Sumintono, 2015). Proper planning and meaningful teaching not only help students comprehend the scientific facts but also acquire crucial skills, such as critical thinking and creative thinking, for problem-solving in their daily lives (McLure, Won, & Treagust, 2024; Ramadhani, Azizah, & Nasrudin, 2024). Although many researchers have stated the benefits of various teaching methods, such as project-based learning and inquiry-based learning (Ramadhani et al., 2024; Zhang & Ma, 2023), in reality, many science teachers

face various challenges including but not limited to professional training in providing quality education in their classrooms (McLure et al., 2024). To be on the right track in achieving the sustainability goals, quality education needs to be secured in the first place (Ramadhani et al., 2024). Having said that, quality science education with design thinking is crucial in order to meet the demands of the digital era (Anto et al., 2023; Purwasih, Wilujeng, Wiyarsi, & Zakwandi, 2024). Therefore, blending design thinking with scientific inquiry could transform the students' potential while fostering continued learning and equipping them with the critical and creative thinking skills (McLure et al., 2024; Ramadhani et al., 2024; Wallace & Coffey, 2019). Having acquired critical thinking and creative thinking skills, students' curiosity and motivation to explore the solution for their problems can be harnessed while engaging actively in the scientific society (McLure et al., 2024). Hence, this would help them to understand further the interrelation between all aspects of life (Anto et al., 2023; Wallace & Coffey, 2019).

Consequently, Malaysia, on the same path as other developing countries, has set goals for achieving developed country status. In that sense, the national science curriculum is developed in line with the National Philosophy of Science Education, which focuses on individual development by acquiring scientific and technological knowledge (Ministry of Education Malaysia, 2018). On that note, technology is seen as crucial in science education as it improves students' learning experiences, provides access to teachers for resources and knowledge, promotes collaboration, and equips students with technological skills (Angeles, Naparan, Celesio, & Ecot, 2023; Anto et al., 2023; Karupaiah & Daniel, 2021). Through a dynamic science curriculum, the Ministry of Education Malaysia (2018) aims to emphasise science education by empowering the students not only in scientific and technological knowledge but also to acquire critical thinking and creative thinking skills in order to equip them to face the world while being more effective and innovative.

Enhancing the science education in Malaysia has been the utmost priority of the Ministry of Education since the inception of the early science curriculum in 1960 (Noor, 2022). At present, the curriculum is designed to cultivate students' interest in learning science while equipping them with the basic scientific knowledge and scientific skills to adapt to the world around them. In the latest curriculum, science is taught as a single subject in primary school, which formally begins in Year 1 (7 years old) and continues until Year 6 (12 years old). In the nature of science, through the detailed crafting of science curriculum for the students, it is expected that the students will be better prepared to think critically, be creative, solve problems, and make decisions based on information they are taught about through the design thinking framework (Purwasih et al., 2024).

Design thinking encompasses stages, namely, empathy, ideation, prototyping, and evaluation (Purwasih et al., 2024) that support students in enhancing critical, logical, creative, and evaluative skills for addressing scientific challenges (McLure et al., 2024; Padzil, Karim, & Husnin, 2022; Ramadhani et al., 2024). The implementation of the design thinking approach in project-based learning enables students to acquire scientific knowledge (Chang & Yen, 2021), identify solutions, exchange ideas, and foster mutual understanding through collaboration. On that note, peer collaboration potentially develops students' problem-solving skills and learning achievement (Anto et al., 2023; Karupaiah & Daniel, 2021; McLure et al., 2024). Moreover, design thinking could enhance the efficacy of science education among students and motivate them to engage more actively in their science classroom (Chang & Yen, 2021; Dotson et al., 2020). However, the aforementioned facts underscore design thinking as a skill that must be acquired by teachers prior to integrating it into their science classroom (Li et

al., 2019). The issue occurs when research on design thinking and the integration of design thinking in science education is still insufficient (Purwasih et al., 2024).

Design thinking was originally employed in business, especially in product design, to develop creative solutions that meet the public's needs and promote innovation (Purwasih et al., 2024). Purwasih et al. (2024) asserted that design thinking is relatively novel in the field of education, particularly in scientific education. Fortunately, the integration of design thinking in science education is picking up its pitch as it is thought to cultivate creative confidence, enabling students to engage in creative innovation, especially in learning science (Purwasih et al., 2024). Design thinking is a methodology that utilises design sensibility and techniques to address the needs of STEM education through suitable technology and educational practices, hence creating a significant learning opportunity for students. Past researchers define design thinking as a human-centric approach that emphasises empathy, defining, ideation, prototyping, and testing (Combs, Cennamo, & Newbill, 2009; McLure et al., 2024; Malele & Ramaboka, 2020). Besides that, design thinking is potentially useful in assisting students to achieve their objectives (Combs et al., 2009; Long, 2012). The application of design thinking in science classrooms would enhance the efficacy of scientific knowledge acquisition among the students (McLure et al., 2024; Purwasih et al., 2024).

In science education, there have been several other alarming issues being continuously discussed by researchers, including but not limited to resource utilisation from the past to the present. According to Ismail, Salleh, and Nasir (2019), it is notable that teachers were unable to carry out activities, especially the hands-on activity, due to a lack of resources such as laboratory supplies and equipment. Such insufficient resources may have a direct impact on students' learning, as evidenced by the recent TIMSS 2023 report by the Ministry of Education Malaysia (2024), which reveals a concerning decline in both mathematics and science assessments (Ministry of Education Malaysia, 2024). However, it is crucial to identify the causal factor for such a decline instead of highlighting the numbers and figures. Neither the students who took the assessment nor the teachers who instructed them should bear the blame. Instead, it should be a thorough reflection on identifying the challenges faced by students and the teachers. By doing so, a clearer picture would emerge, and a potential remedial process could take place.

The quality of science education depends a lot on how well science teachers teach and how students learn. This requires initial training for new teachers and ongoing professional development for current teachers. McLure et al. (2024) and Mustafa et al. (2022) addressed that there are many factors that cause challenges for science teachers. The main points they have highlighted were teachers' professional development and readiness in teaching science. Mustafa et al. (2022) alarmed that language could be a contributing factor in hindering quality science education. According to these researchers, teachers faced problems associating modules written in English into their classrooms because the teachers' native language is not English. Translating the English language-based modules into the teachers' spoken language have become barrier as the teachers did not master the English language.

In the study headed by Mustafa et al. (2022), it is learnt that socio-cultural preferences in social activities were also a key issue faced by the teachers. Besides that, it is clear and evident that the teachers are not tech-savvy, as their technology skills were below par (Ahmad, 2014; Mustafa et al., 2022). Furthermore, it is evident that many teachers have mentioned time and schedules that were a serious constraint (Mustafa et al., 2022). Similarly, Ahmad (2014) and McLure et al. (2024) also asserted that the teachers face insufficient class time to accommodate

quality teaching. In the realism of a classroom environment, it is not as easy as it may be to integrate technological and ICT tools into science classrooms (Ahmad, 2014). It is a complicated process, and teachers often face challenges.

On the other hand, teachers do face challenges in incorporating higher-order thinking skills in their classrooms because it is evident that many teachers are lacking in competency for integrating higher-order thinking skills (McLure et al., 2024; Ramadhani et al., 2024; Soh, Ajmain@Jima'ain, Hehsan, & Mohamed, 2020). To overcome such an alarming issue, Mahmud et al. (2018) and McLure et al. (2024) suggest that in-service and pre-service teachers must be equipped with the right amount of training and skill to integrate thinking skills and ways to assess the skills of their students efficiently.

Additionally, many teachers encounter challenges in producing a quality higher-order thinking lesson due to a lack of quality teaching references and resources (Perman, 2021; Soh et al., 2020). According to Soh et al. (2020) and Ramadhani et al. (2024), the lower competency level for higher-order thinking skills among teachers could potentially put risk on students' learning as the teacher acts as the mediator between content and the students. In the literature addressed by many researchers, including Soh et al. (2020), most teachers are tending to teach students using the old-school method, such as spoon-fed, chalk-and-talk, and textbook-based teaching.

In another study, a problem that is beyond teachers' control was addressed, which is the funding received by the school from the government. Although the government provides allocation based on the enrolment in each school, procuring science tools for the purpose of teaching and learning science is not always affordable (Perman, 2021). In his study, Perman (2021) raised a claim that furnishing a better science laboratory with a sufficient number of tools and apparatuses could lead to better teaching and learning. However, in most cases, this is not addressed as a serious issue, which, along the way, the knowledge acquisition among the students becomes a challenge to overcome by the teachers.

There has been debate about science teachers challenges worldwide, including resource utilisation (McLure et al., 2024). However, till today, there is no one best approach to solve the existing issues. Hence, the significance of addressing these challenges is seen as crucial for the stakeholders, prominently the science teachers.

Therefore, this study was aimed at achieving the following objective:

i. To identify the emerging theme pertaining to science teachers' challenges with design thinking and resources in science classrooms.

2. Methodology

This research used the qualitative method. The rationale for employing qualitative method is to enable the researcher to gather open responses regarding the practices in science classrooms and the challenges encountered by the teachers. The qualitative approach is a beneficial way to gather detailed information from participants (Ismail et al., 2022) because interviews let them share their ideas openly instead of being restricted to survey questions. The researchers prepared an interview protocol for teachers consisting of twelve items. In order to ensure the consistency and accuracy of the interview process and data collection, the reliability and validity of the interview protocol are crucial for upholding the rigour of qualitative research (Creswell, 2014). Therefore, to assess the extent to which the interview questions can measure the objectives of the current study, the researchers have consulted the initial interview protocol

with two science education experts, who are lecturers from two higher education institutions. The experts' views and suggestions were important for the researchers in revising the initial interview protocol (Yeong, Ismail, Ismail, & Hamzah, 2018). A final interview protocol, incorporating all reviews and comments from experts, was provided to a peer of the researchers to assess the comprehensibility of the interview questions for the respondents. Table 1 presents the selected items from the interview protocol.

Table 1: Selected Items from The Interview Protocol

Item Number	Section	Item
2	General Experience	What made you and your pupils face difficulty in the said topic(s)?
6	Design Thinking in Science Classroom	What are the difficulties/obstacles to integrating design thinking in your teaching and learning process in the science classroom?
9	Critical Thinking Skill	Have you ever used a design thinking-based STEM module in physical science that helps students to acquire their critical thinking skill? How?
13	Creative Thinking Skill	How do you inculcate creative thinking in your student in learning physical science? Please explain in detail elements such as defining the problem, brainstorming alternatives, visualising, and designing a prototype.
18	Problem-solving Skill	In your opinion, is there a need to have a module to assess students' critical thinking and creative thinking through a problem-based task/activity? Why?

3. Data Collection

Five science teachers from three different schools at Kinta Utara District, Perak, took part in this study. They were selected by using the convenience sampling method. Despite its general unpopularity among researchers, convenience sampling was deemed most appropriate for this study due to its method of selecting teachers based on their availability, willingness, and ease of contact (Galvan & Galvan, 2017). All five teachers possess extensive training in science teaching, holding at least a bachelor's degree from local universities and teacher training institutions. Each possesses over ten years of teaching experience. Before meeting them in person, the researchers secured the necessary permissions from the Education Planning and Research Division (EPRD), State Education Department of Perak (JPN Perak), and the school headmasters. The teachers were provided with a consent letter to participate in the interview. To safeguard the privacy of the teachers, schools, and research ethics, all five teachers and their respective schools were addressed with pseudonyms.

The interview sessions were conducted separately for each teacher without compromising their official instructional hours. This is because the researchers were informed by the school headmasters that no teachers are allowed to take part in any research during instructional hours. Therefore, the researchers complied with the administrative orders to ease the data collection process. The interview sessions were held for about forty minutes on average.

4. Data Analysis

An inductive thematic analysis technique was employed to analyse the interview data, as recommended by Galvan & Galvan (2017). The researchers used a manual coding process by using the keywords to codes in a tabulation method. Upon successful identification of keywords, a combination of two coding frameworks by Creswell (2014) and Braun and Clarke (2008) guided the researchers to obtain the codes. Thereafter, the codes were categorised to

form themes. Beforehand, as suggested by Braun and Clarke (2008), repeated listening and reading transcribed data helped the researchers to be familiar with the data to form themes. After coming up with themes, to ensure the credibility of the analysis, the researchers asked the participants to check how correctly the researchers understood what they were saying. Galvan and Galvan (2017) and Braun and Clarke (2008) said that member checking by getting comments from the participants is important in a qualitative study setting to back up the idea that the participants came up with. Peer review is essential for enhancing confidence in findings (Galvan & Galvan, 2017). Therefore, to ensure trustworthiness, the researchers referred two science expert teachers to conduct a peer review of the transcripts and codes thereafter to validate the findings. This paper is intended to address the challenges faced by science teachers, especially in integrating design thinking in science lessons and resource utilisation. To protect the research ethics, only partial data were presented in this paper without compromising the clarity of the narratives.

5. Findings

In relation to this paper, the main theme that emerged was the 'Teachers' Challenges of Integrating Design Thinking in Science Classrooms with Proper Resources'. The emergence of this theme indicates that there are some challenges faced by the science teachers in their classrooms, specifically in the integration of design thinking and resource utilisation. To explain in detail about this, there were three categories that were mutually exclusive and collectively supported to obtain the theme. Figure 1 below shows the triangular form framework of categories that became the pillar of the supporting theme for this paper.

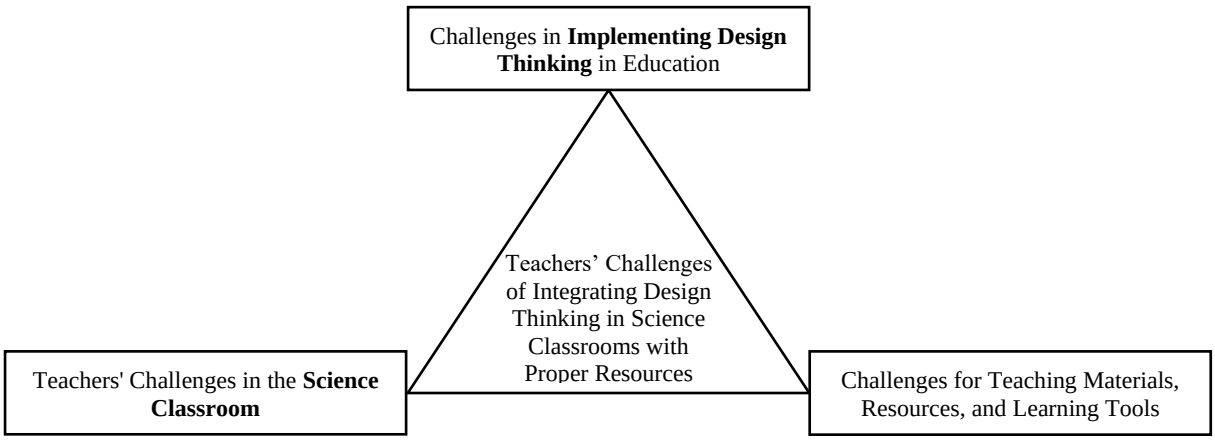

Figure 1: The overarching categories that are mutually exclusive to form the theme

To explain the complexity of the challenges, the following will explain the categories in detail.

Challenges in Implementing Design Thinking in Education. Teachers generally teach the scientific content as printed in the textbooks. The data obtained in this study indicates the teacher's lack of familiarity with the concept of design thinking. Although the concept of design thinking is growing in the education field, teachers did not know much about it and consider the term as somewhat new to them. The existence of the perception of design thinking as new reflects the teacher's view that design thinking is a relatively new concept in their teaching practice. As the concept of design thinking is new, or rather a lack of exposure to the concept, teachers do face difficulties when applying design thinking in lessons. This problem led to

almost ordinary teaching of science concepts in the classroom. The following excerpts indicate that teachers do face challenges in implementing design thinking in science classrooms.

"To be honest, I am quite unfamiliar with the concept of design thinking. It is some kind of new."
Elisa
Item 4, Line 1

"I am not familiar with our design at design thinking is not in science but in Design and Technology education but it can be applied in science..."
Ramlah
Item 4, Line 1

In addition, it is learnt that inadequate facilities are another reason that puts limitations on the implementation of design thinking in science classrooms. The excerpt below indicates that inadequate facilities hinder the effective application of design thinking.

"I think there are no physical activities with design thinking due to the facilities."
Elisa
Item 7, Line 1

Another factor that grounds the challenges in implementing design thinking in science education is that teachers are uncertain about the design thinking implementation even if they are supplied with design thinking-based modules. Having lower competency in employing design thinking also makes the teachers lacking in confidence. Teachers need to be confident prior to entering their class. Having a lack of confidence in their teaching plan would lead pupils to acquire lower-order thinking skills. The excerpts below address the challenges in implementing design thinking.

"I am really not sure. Did I ever use a design thinking-based STEM module in science..."
Elisa
Item 9, Line 1

"If I actually want to say it directly, I'm not the only one who known it...."
Ramlah
Item 9, Line 1

Another category that became the building block of the theme is **Teachers' Challenges in the Science Classroom**. Similar to past studies, the present study does reveal similar data about the challenges that teachers face in science classrooms. A challenge that arises in science classrooms is the modern education that focuses on 21st-century learning. The 21st-century learning demand creates complexities in delivering contemporary educational practices by the teachers. Teachers struggle with practical experiments in the science classroom captures the factor about the teachers having difficulty in conducting experiments. The excerpt below from the interview reveals the above claim.

"I also sometimes find it hard to handle the experiment..."
Elisa
Item 2, Line 2

The science syllabus for the primary school serves as the fundamental science knowledge for the students to advance to a higher level. However, given a limited learning hour per week, which is around two hours for the upper primary level, the year four students are expected to learn a huge number of topics each year. This has led to a surface learning of the complex contents. Besides that, the interview data reveals that teachers tend to rush to complete the syllabus before the academic session final test. Hence, teachers often deliver important content superficially to students, regardless of their ability. Besides that, teachers perceive the limited learning hours as a barrier to delivering meaningful instruction. The excerpts below address the statement that highlights the limited instructional hours for science education.

"The constraints or obstacles faced are too many science syllabuses. Time constraints, which are only four periods (2 hours) for science subjects, lack of equipment, and different student abilities"
Jeniffer
Item 6, Line 1

"...It is hard for me to do many activities in the science room because the period for science class is only two hours weekly. If there are any holidays, then that one is also gone..."
Rajoo
Item 6, Line 7

These factors are not only limiting the students' ability to master the content but also hindering them from polishing their creativity while learning and being innovative. The challenges in fostering creativity are seen through the difficulty students have in generating their own ideas. Due to students' reliance on teachers for direction and problem-solving, teacher frustration was reflected in their emotional state. The following excerpt shows the teacher claims that the students faced challenges in generating new ideas as well as having difficulty in solving problems.

"...is where the kids are very hard to create their new idea and very dependent on the teacher to give ideas and sometimes. They expect us to solve the problem."
Elisa
Item 6, Line 2

In line with that, science teachers often face another issue, which is the limited application of innovative methods. The interview data indicated a possible lack of integration of new teaching methodologies like design thinking in the curriculum, which contributes to the teachers' challenges in the science classroom. The excerpt below indicates that teachers are relying on merely textbooks and not exploring for new and innovative methodologies.

"I am really not sure. Did I ever use a design thinking-based STEM module in science but the thing we used to do in physical science is by following the experiment given in the textbook"
Elisa
Item 9, Line 1

Another building block for teachers' challenges is the **Challenges for Teaching Materials, Resources, and Learning Tools**. Lack of teaching resources and materials, especially to integrate the design thinking in the science classroom is a crucial point that needs to be looked into by the curriculum development division. Despite the textbook carrying a wealth of knowledge, a variety of design thinking-based teaching materials are needed in order to ease

the teachers to teach the students passionately. As per the statement by the participant teacher in this study, it is learnt that lack of hands-on and physical activities in design thinking in the science classroom. Another participant addressed the issue that even if a teacher plans any activity related to design thinking, the materials are insufficient. Students seldom bring materials for their additional design thinking-based activity. The following excerpts from the interview supports the statement.

"I think there is no any physical activities with design thinking due to the facilities"
Elisa
Item 7, Line 1

"...mostly teachers are the ones who prepare because when we ask students to bring, not all students give a good response. That slows down the process a bit."
Ramlah
Item 6, Line 10

6. Discussion

This study aimed to explore the emerging theme pertaining to science teachers' challenges with design thinking and resources in science classrooms, particularly in the Malaysian primary school context. The challenges were identified through three categories, namely, Challenges in Implementing Design Thinking in Education, Teachers' Challenges in the Science Classroom, and Challenges for Teaching Materials, Resources, and Learning Tools. The emergence of the theme, Teachers' Challenges of Integrating Design Thinking in Science Classrooms with Proper Resources, highlights there is a significant gap that needs to be addressed, particularly for science teachers' preparedness, material and resource allocation, and systemic support from the ministry of education. This section discusses these findings in relation to existing literature, shedding light on potential implications for policy and practice.

Challenges in Implementing Design Thinking in Education

Similar to past studies by Anto et al. (2023), Mustafa et al. (2022) and Soh et al. (2020) the interview results show that science teachers are not familiar with design thinking and understand that design thinking in science classrooms is a relatively new concept. Therefore, to overcome the issue, the present researchers support the recommendations by Mahmud et al. (2018) and McLure et al. (2024) for a professional development course that specifically emphasises equipping teachers with the knowledge and skills to integrate the design thinking effectively in the science classroom (Purwasih et al., 2024). Furthermore, the habit of continuity on traditional teaching methods, such as the textbook-based instructional process, reflects a missed opportunity for students to learn through innovative design thinking approaches that also align with 21st-century learning skills (Anto et al., 2023; Zhang & Ma, 2023). Ahmad (2014) and Mustafa et al. (2022) similarly asserted that many teachers are lacking the technological and pedagogical skills that become crucial for an effective and contemporary teaching approach (Wallace & Coffey, 2019). Therefore, to overcome the problem, more design thinking exposure needs to be vitalised in teacher education while they are at the pre-service stage in teacher training institutes (McLure et al., 2024; Purwasih et al., 2024).

Teachers' Challenges in the Science Classroom

Similar to the study by Anto et al. (2023) and McLure et al. (2024), teachers in this study have reported having difficulties in conducting practical experiments and engaging students in

meaningful learning through hands-on activities due to a lack of support, limited instructional time, and a heavy science syllabus for the year four students. Rushing to complete the syllabus in a given academic session, causing challenges for the teachers from putting efforts into integrating the design thinking-based teaching strategies. Similar to the claim from the past studies, the present researchers have pointed out that time constraints act as a significant barrier to effective teaching (Ahmad, 2014; McLure et al., 2024; Mustafa et al., 2022; Sumintono, 2015). As for the level two science lessons in Malaysia, the limited two-hour weekly allocation for science instructional hours restricts teachers' ability to conduct comprehensive lessons that foster critical thinking and creativity through a design thinking-based approach. Besides that, results from a past study by Anto et al. (2023) and McLure et al. (2024) highly parallel the present study, whereby it is indicated that teachers do face challenges in encouraging their students' creativity and independence because many students are relying heavily on teachers' guidance. This dependence not only hinders the development of higher-order thinking skills among the students but also places an emotional burden on teachers, as also identified by Anto et al. (2023) and Soh et al. (2020). To mitigate this, there is a need for curriculum reforms that prioritise depth over breadth, allowing teachers to focus on developing students' critical thinking and creative thinking skills for problem solving through innovative pedagogies (Anto et al., 2023; McLure et al., 2024; Wallace & Coffey, 2019). Adding to that, science teachers should encourage their students to learn collaboratively (McLure et al., 2024) while scaffolding each other during peer collaboration, which could reduce the teachers burden in inculcating learning awareness (Anto et al., 2023; Karupaiah & Daniel, 2021). Past studies have revealed that collaborative learning has contributed to students' responsibility and accountability in their own learning (Karupaiah & Daniel, 2021). This approach not only fosters and harnesses engagement and participation but also increases the ability to solve problems through critical and creative thinking (Anto et al., 2023; Karupaiah & Daniel, 2021; McLure et al., 2024; Ramadhani et al., 2024).

Challenges with Teaching Materials and Resources

The lack of sufficient teaching materials and resources emerged as another significant barrier to the integration of design thinking in science education. Such a challenge was also reported by Anto et al. (2023), McLure et al. (2024) and Perman (2021) in which the participants had issues with the lack of laboratory materials. Teachers in this study have expressed concerns over the lack of physical science activity modules, insufficiency of hands-on activities, design thinking-based modules, and supporting materials, which are seen as a crucial factor for fostering design thinking-based learning. Thus, this issue underscores the need for better resource supply and the development of comprehensive teaching aids (McLure et al., 2024; Sumintono, 2015), such as a design thinking-based STEM module that supports design thinking integration in science classrooms (Anto et al. 2023). On the other hand, the apparatuses and tools in the science room and resources for teachers need to be given priority for better design thinking-based teaching, as also supported by findings from a past study conducted by Perman (2021), which highlighted the insufficiency of laboratory tools and other resources in Malaysian schools. Additionally, teachers also highlighted that limited students' participation in contributing to preparation in the classroom activity contributed to the scarcity of learning science. Similarly, Anto et al. (2023) and Perman (2021) asserted in their study that lack of participation among the students is related to poor interest in learning science, which could potentially reduce the learning achievements.

Implications for Policy and Practice

The challenges identified in this study have several implications for science education policy and practice in Malaysia. First, there is an urgent need for professional development courses

that focus on building teachers' pedagogical skills (McLure et al., 2024) in integrating the design thinking framework into their teaching (Purwasih et al., 2024). These courses should include practical training sessions, continuous support, and opportunities for peer collaboration among the teachers. Second, to solve the resource limitations, increased investment in educational infrastructure is required, particularly in equipping science classrooms with the tools and materials needed for hands-on learning. Therefore, school administrators are encouraged not to rely only on government funding. They should also work more with private companies to get financial support. This will help them provide better equipment and tools in science classrooms for improved learning (Anto et al., 2023). Finally, curriculum reforms are necessary by allocating more instructional hours for science lessons parallel to the number of chapters for better teaching of every aspect in the science syllabus. This would enable teachers to implement design thinking and other creative teaching strategies more effectively, ultimately enhancing the students' engagement and learning outcomes (McLure et al., 2024; Wallace & Coffey, 2019) through the design thinking approach.

7. Conclusion

This study highlights the challenges faced by Malaysian science teachers in integrating design thinking into their science classrooms. These challenges are specifically about a lack of familiarity with design thinking among teachers, inadequate resources, materials and tools, and instructional constraints such as insufficient instructional hours and heavy syllabi, highlighting the need for precise interventions by the stakeholders and policymakers. By addressing these issues through professional development courses for science teachers, resource enrichment, and curriculum reform, stakeholders can create a more supportive environment for teachers and foster a culture of innovation through design thinking in science classrooms, which, in the end, will benefit the students. As for future research, researchers should explore the impact of such interventions on teachers' efficacy and students' outcomes, which may contribute to the larger goal of enhancing science education in Malaysia.

Theoretical Contribution

This qualitative study contributes to the existing literature on the challenges faced by Malaysian primary school science teachers, especially in integrating design thinking in their classrooms. Although previous studies have explored the benefits of various teaching methods, empirical evidence for the integration of design thinking and resource utilisation in Malaysian science classrooms is still limited. This study, however, has highlighted several challenges faced by the teachers, which contribute to the theoretical understanding of how they relatively affect the design thinking approach in Malaysian science classrooms.

Contextual Contribution

Findings from this study revealed numerous challenges faced by Malaysian science teachers in integrating design thinking into science lessons. In relation to that, this study provides a contextual contribution by offering interventions to overcome the challenges. The suggestions presented in this study will be useful for curriculum development, resource allocation, and better school administration. Upon implementing all the suggested interventions, quality education can be achieved, which will benefit the students.

Acknowledgement

The authors would like to thank the Education Policy Planning and Research Division, Ministry of Education, Perak State Education Department, and school headmasters for supporting this study, as well as the science teachers who have participated in it.

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