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Research Article

Teaching Science Education through Project-Based Learning with the Integration of Blended Learning in the Context of Preschool Education in Malaysia

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ABSTRACT

The efficacy of the blinded learning method in enhancing children's enjoyment has been empirically demonstrated through the introduction of various concepts and knowledge. Nevertheless, while considering preschool education in Malaysia, blended learning integration is a new and unfamiliar approach by educators to bring 21st century learning into the classroom. Therefore, the purpose of this paper is to discuss preschool educators' perceptions of utilizing the Project-based Learning (PBL) approach with the integration of blended learning and explore the importance of PBL approach to children's development. This preliminary study was professionally conducted in a virtual setting, utilizing a sample of nine proficient preschool educators who participated in semi-structured interviews. Based on the thematic analysis findings of the study, a significant proportion of the samples expressed agreement about the utilization of PBL in conjunction with blended learning for science education due to its impactful approach in this contemporary education. Therefore, the integration of these elements presents a viable opportunity to enhance the educational standards for preschool children in the future, while also serving as a standard for enhancing Malaysia's educational system. As an implication, through these preliminary findings, it will serve as a guideline for future researchers to develop suitable and interesting learning modules for preschool children.

Keywords: Science Education, Project-based Learning, Blended Learning, Preschool Education.

INTRODUCTION

From the way we live to the education system, technology has revolutionized every part of our daily lives. Education has grown more accessible, interesting, adaptive, collaborative, and effective as technology has advanced. Without a doubt, technology has caused a paradigm shift in the traditional educational system, altering the way children learn and educators teach. Moreover, U.S. Department of Education Office of Educational Technology [1] outlined that technology has the potential to transform learning. It has the potential to help educator and children strengthen their relationships, reimagine our approaches to learning and collaboration, close long-standing equity and accessibility gaps, and tailor learning experiences to match the needs of all learners while integrating technology into the classroom can help children learn in new ways and get ready for the workforce [2].

Numerous nations endeavor to emphasize the significance of the element of technology in their plans and programmes for education. And they believe that the factor that must be attained in order to achieve educational quality is the empowerment of the education system through digital-based learning through the use of technological resources in the classroom. A study conducted by [3] revealed that the countries of Southeast Asia (ASEAN) have shown the best development in applying information and communication technology (ICT) in their respective education systems, with Singapore being the most advanced country in empowering the use of it as well as Thailand and Indonesia still in developing progress respectively. In addition, Malaysia Education Blueprint 2013 - 2025 Foreword 1 (PPPM) was introduced by Malaysia government itself with the goal of raising educational levels to meet global benchmarks. According to Ministry of Education Malaysia [4], this Blueprint strives to the following goals for the Malaysian education system as a whole: accessibility, quality, equity, collaboration, and efficiency, with education being driven by the introduction of digital-based learning all over the country. Thus, the digitalization of technology resources, particularly education, has become a new pattern in today's world of education, where most countries have recognized the relevance of technology to society. Even in African countries, technological growth has a significant impact on their respective government systems [5]

The use of technology has become a benchmark in 21st century education. Integration of technology has been envisioned to support the development of 21st century skills and abilities in the teaching and learning of life sciences. Educators specifically mentioned that the use of technology in the classroom helps children improve critical thinking, problem-solving, interaction, teamwork, and computational thinking skills [6]. Besides, by utilising digital tools in the classroom, educator and children can acquire new information, abilities, and experiences [7]. Furthermore, exposing children to technology-based learning (TBL) will help them learn about things that are outside of their assumptions and thinking box. When juxtaposed with the impact of technological innovation on the transformation of society and the social lives of individuals outside the classroom, the metamorphosis of learning through the incorporation of technology has gained traction [8]. As a result, the usage or incorporation of technology in schools, such as the use of digital tools during teaching and facilitating sessions, assists educators and students in strengthening their knowledge through 21st century thinking [9]. This can be demonstrated as what mentioned by [10] that the integration of technology in classroom can assist children to may assist children in studying abstraction (the use of technology in communication and data visualization), analysis (the use of technology to categorize data), automation (the use of technology for understanding human anatomy), and modelling (the use of technology to discover human anatomy through 3-D applications).

Moving on, project-based learning (PBL) is also a new paradigm in 21st century education where it promotes children to gain knowledge directly through active, interesting, cheerful, and proactive learning at school. According to [10] the adoption of the PBL approach in learning and facilitation sessions promotes children’s participation by facilitating knowledge and information sharing and discussion. As a result, the PBL approach is highly recommended for educational applications in classrooms and should be advocated at various levels of education including ECE centers. In ECE settings, the empowerment of PBL through TBL plays a significant role in boosting children's holistic development. According to [11], the PBL approach with ICT makes it easier for students to acquire technological capabilities, which are connected to the growth of their social and communication competencies and their ability to work cooperatively and collaboratively. However, to ensure that these developments can occur through the correct process, the educator's role as a guide is very important in motivating children to complete activities well. The most important element influencing the success of technology integration in PBL is the educator's capacity to provide assistance during the learning process [12].

PROBLEM STATEMENT

The Sustainable Development Goal for Quality Education (SDG 4) emphasizes the significance of quality education for children today. According to the Department of Economic and Social Affairs Sustainable Development [13], there are several major challenges to maximizing a quality education that is equitable and inclusive as well as encouraging lifelong learning opportunities for all but regrettably, there would be approximately 300 million individuals who will lack basic numeracy and literacy skills by 2030. More specifically, although the rate of Malaysian children dropping out to come to school has positively decreased from 0.29 percent in 2017 to 0.06 percent in 2023 [14], the PISA (Programme for International Student Assessment) 2024 scores globally have shown that Malaysia stood out the highest drop record compared to other neighboring countries where the overall scores of Indonesia and Thailand decreased by 4.09% and 4.36% respectively, while Malaysia dropped 6.26% from 431 in 2018 to 404. It is even more unexpected that Malaysia only receives a score of 416 in the science category, a modest value when compared to Singapore, which receives a score of 561 points and is ranked as the greatest country in the world in this category [15]. To delve into more depth regarding why the reduction in scores occurred in Malaysia, the researchers argues that it has been caused by an amalgamation of external and internal factors and challenges.

In the context of science education in Malaysia in general, the most significant factor in the reduction in PISA scores was the implementation of 'Teaching and Learning at Home' [16] during the pre- and post-pandemic periods of COVID-19. During this emergency period, the fundamental scientific process skills such as observing, classifying, and predicting were not fully explored due to a lack of materials at home, such as the absence of basic devices owned by the children because the majority of Malaysian children used their parents' mobile phones. Furthermore, poor Internet access is a major barrier, preventing complete contact with educators [17]. Meanwhile, [18] has explained in greater detail in her research that children are unable to concentrate on science activities while the educator is carrying out activities, as well as they have been provided with less meaningful experiences due to inadequate equipment in science activities and finally it did not meet the complex learning standards. Otherwise, [19] discovered that children believe the concepts introduced in science are difficult and challenging, which leads to their negative perceptions about the quality of science education itself.

Previous studies have advocated that broader notions of science are included in preschool teaching to make it more relevant to children's lives as citizens now and in the future [20], [21]. But a different situation occurs in today's world where children and preschool educators experience critical problems in making science education a "weapon" to empower society. In early childhood education settings especially in Malaysia, quality science education [22] is difficult to carry out due to some very serious obstacles [23] but it is not given a comprehensive focus by the preschool itself. As a proof, analyzing the shortcomings of educators in implementing high-quality instruction in science education, [24] stated that the five primary challenges faced by science educators are as follows:

a. Science educators' misunderstanding of how to implement and promote STEM education in school contexts.
b. Educators' incompetence in conducting science activities utilizing the dual language program (DLP) method.
c. Science educators' inability to integrate computational thinking-based science learning in the classroom.
d. A lack of scientific educators' knowledge, understanding, and use of higher-level thinking skills.
e. The inability of scientific educators to master ICT abilities.

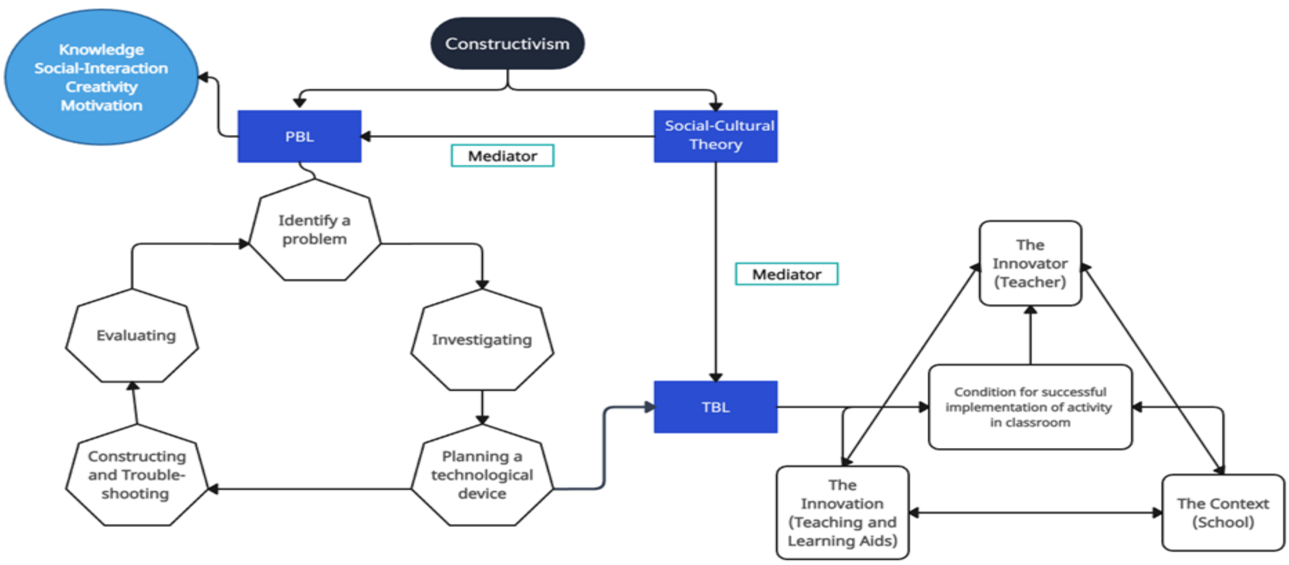

Figure 1: The Implementation of PBL-TBL in Early Childhood Education Settings

Thus, to ensure how these challenges could be decreased and enhance the effective teaching and learning classes in improving the quality of children's learning in preschool, there are two research questions that would be explored as follows:

1. What approach is the most suitable to be implemented in early science classroom at preschool?
2. Are PBL activities with the integration of blended learning important for the development of children?

LITERATURE REVIEW

PBL in Early Science

In early childhood education, the implementation of teaching and facilitation activities needs to be creatively implemented by educators to ensure that children can improve their development holistically. There are various approaches that can be implemented by educators in making the classroom atmosphere more conducive. [25] emphasized educators in preschool utilize a variety of approaches to teaching management in classrooms that are appropriate for personal development, needs, abilities, talents, and student interest. To flourish and attain professional satisfaction, preschool educator needs to acquire knowledge about teaching approaches for children to grasp basic skills before entering the mainstream [26]. Nowadays, the world of education and academia has observed that the PBL approach is an effective teaching method for creating a favorable environment for students when they begin receiving education in the early stages of school. A prior study by [27] discovered that the PBL projects that he carried out helped children develop and enhance their capacity for creative thought. According to the study's findings, there has been a rise in children's involvement in their learning as a result ofthe activity, which was well-received. Additionally, the researcher observed that children were highly engaged in the tasks and projects they were given, demonstrating their capacity for critical thought. From these findings, it could be synthesized that PBL is a systematic learning strategy that allows students to enhance their abilities and receive in-depth knowledge through the execution of the project, collaboration, and 'hands-on' procedures [28]. Children can also cooperate with the educator by applying what they have learned to create an outcome that addresses the investigated issue or solves the desired problem [29].

Next, PBL is an effective approach for immersing children in the real world of the twenty-first century, according to numerous research studies [30]. A study carried out [31] also revealed that children who learn early science which is the topic of personal health through the PBL approach can help them understand the topic more easily. In addition, there are physical changes shown by them where positive behavior can be seen throughout children's participation in this activity. In addition, a study conducted by [32] also revealed that PBL can help children understand the topic of plants more easily. In addition, the development of children's social interaction also became more positive through several projects implemented such as the project of researching types of plants using a magnifying lens and the project of planting plants. Besides that, a study conducted by [33] revealed that PBL can be classified as a learning model that can increase children's performance in science learning and provide them with problem solving skills (critical thinking) on average. Additionally, the researcher observed that children were highly engaged in the assignments and projects they were given, demonstrating their capacity for critical thought. Furthermore, as demonstrated by [34], project-based learning (PBL) has the potential to enhance children's understanding as they work through educator-prepared projects. It can also foster cooperation, interaction, and communication between students and educators as well as between students and peers. Finally, PBL can help children develop compassionate and understanding friendships through the completion of projects together.

THEORITICAL FRAMEWORK

Social Constructivism: The Application Vygotsky's Theory in Implementing of PBL Activities through TBL Integration

Based on the Figure 1 below, it provides a comprehensive framework for demonstrating how the application of Vygotsky's socio-cultural theory [35] plays an important role in PBL-TBL activities at school via the adaptation of the PBL process model [36] and the framework for determining the conditions required for using digital [37]. Referring to children's learning based on the environment, individual development relies heavily on awareness of social interaction. Child-educator and child-peer relationships are critical for increasing children's conceptual comprehension. As a result, the learning process begins with a powerful, broad, and deep network that promotes knowledge sharing and social values. By analogy, social engagement will actively activate learning through involvement in two-way communication, which will develop children's intelligence in receiving varied information from group members. Based on the view of [35] was more concerned with children's immediate social and cultural milieu, as well as their relationships with adults and peers. He contended that cognitive development began with children's immediate social contacts and then progressed to the individual level as they internalized their learning. In the context of ECE, especially when they study in kindergarten or preschool, the contacts that are near them are their educators and peers. Children's relationships with peers and educators are important aspects of the classroom setting and are a major topic in theories about how children learn and develop [38].

In the context of the current study, the most important contact for children to wisely conduct the activities associated with PBL-TBL is the role of ECE educators. To achieve the learning objectives that have been compiled, the educator is going to carry out a series of learning by organizing a sequence of learning that begins with the creation and preparation of learning and ends with the implementation and evaluation of a series of learning actions that have been implemented in ECE centers [39]. Additionally, [40] emphasized that it is hypothesized that in order to properly scaffold children's development, educators need to have a broad range of content knowledge. Educators in particular must be aware of the traits and competencies of the twenty-first century, which include information, media, and technology skills, learning and innovation skills, and life and career skills, in order to successfully carry out a project intended for children.

In addition, educators also need to know about the processes that children need to go through before, during, and after the activity is carried out. Through the PBL Process Model, there are 5 main steps that educators need to scaffold children when implementing PBL activities at school [36]. The first step is the educator's role in guiding children to identify problems. Identifying the instructional problems that may come up as children are learning the material and acquiring the intellectual abilities required for their disciplines is one of the first actions a educator may take to promote their learning. Consequently, to ensure that children understand the problem in any given task, the educator can introduce the core of the problem through group discussion, or storytelling session. For example, the educator can show a picture of an erupting volcano. And through this way, children can brainstorm and get ideas about what actually caused the volcano to erupt.

Then, to find out what really happened, educators can initiate children to actively participate in investigative activity. To ensure that children can investigate the problem earlier, the educator's role is to encourage them to get information related to volcanoes from various sources such as books, videos, pictures and the internet [41]. It is critical at this point to give children time and space to explore together. Educators do not need to be an encyclopedia to the children in order to convey answers clearly, but there are various types of teaching techniques that can be employed, such as informing children, "I don't know the real answer, let's explore together" [42]. From here, children will show enthusiasm to continue to search and find real answers.

The next process is that educators need to guide children to find deeper answers to problems that arise through the provision of technological devices. This is primarily due to the rising number of novel experiences attempting to integrate technological tools to teaching in order to improve student learning quality [43]. In order to ensure that planning the use of technological devices can be integrated in the implementation of the project can be implemented well, there are 3 elements that educators need to pay attention to, namely innovation, innovator, and context. The innovator included here is a educator. The educator needs to plan what technology equipment needs to be applied in this activity. In the current study, the educator serves as a pedagogical innovator in the classroom and at the school [44] by making topic and projects more engaging. Educators need to play an important role in understanding how technological aids can be applied properly and ensure that all children can obtain quality education through the chosen learning techniques.

Furthermore, once the educator has determined the right teaching and learning pedagogy, the following aspect must be executed through the use of relevant innovation. When individuals refer to "innovation," they are not limited to the use of computers or other technology-based teaching tools. While technological improvements are a part of innovation, innovation involves much more than just technology [45]. To put it simply, innovation in education is the application of imagination and creativity by educators to continuously refine their existing approaches and find new, more effective ways to impart subject matter knowledge to children, develop their skills, and guarantee that children always receive the best learning opportunities possible, regardless of the setting in which they are taught. Once the educator can identify what innovation is suitable to be implemented and used by the children, the next element is to understand the context of the implementation of the TBL activity. In the context of education, the topic that needs to be taught is in line with the age of the child and it needs to be appropriate to the school environment.

The application of good technology to children needs to be seen in terms of their age and level of education as well so that all learning and activities can be carried out more easily and have fun. In early learning environments, technology should be incorporated into the curriculum and used interchangeably with other educational resources like books, art supplies, writing supplies, and play materials. It should also allow children to express themselves without taking the place of traditional classroom learning materials [46]. When using technological tools, educators must also take other factors into account, such as whether a given device would replace interactions with peers and educators or whether it contains capabilities that could be distracting to children.

The following step for the educator is to construct and troubleshoot the problem after they have a firm understanding of the three components of TBL. At this point, the initiative really needs to be implemented hands-on by giving the children worthwhile and meaningful experiences. The educator must give the students the chance to address problems using a troubleshooting technique after providing the necessary materials to complete a project, such as determining a volcano's response. During the initial phase, the educator may request children to construct a model of the volcano alongside them. Educators may typically ask children to use a troubleshooting method to address a problem if the initial attempt does not yield the desired outcomes. This method is frequently applied in production systems to identify the root cause of faulty products. This method is also used to fix rejected goods and identify the underlying causes of issues so that unsuccessful goods can be repaired and used once again [47]. In terms of project implementation in kindergarten, if children cannot solve a problem for the first time, the concept of trial and error [48] is a simple concept that can be understood about how children solve problems through the troubleshooting method.

Next, after obtaining the results and unraveling the answers to the problems on a topic, the educator can guide the children to make an evaluation. The evaluation here is that the educator has to ask the children to present what they got from producing the volcano project. In addition, to ensure that the project selection process is more effective, children can be guided to make documentation through written reports about the construction processes up to the manufacturing results. Subsequently, how to evaluate other people's work can also be done through the gallery walk method. This method can also focus children's understanding to evaluate the work of others ethically and academically. What can be understood is that through this evaluation process, indirectly they can also reflect on the learning and activities. Hence, children develop abilities such as recall, inquiry, exploration, elucidation, translation, sharing, and returning as they reflect. These are life and education-related skills.

METHODOLOGY

Research Method

Since this study focused more closely on educators' views of the significance of PBL-TBL activities to attributes including knowledge, social interaction, creativity, and motivation, it employs a qualitative grounded theory method. This methodology aims to clarify the significance of individuals' experiences, social acts, and relationships. Stated differently, these explanations stem from the individual interpretations or explanations of the participants [49]. [50] claimed that this methodology uses comparative analysis to methodically gather and examine evidence in order to create or develop theory. In this study, in addition to wanting to obtain the perception of ECE educators about PBL-TBL, at the end of the research findings, the researcher will look again at the relationship of theories that are closely related to those perceptions and then develop those theories in further studies. As consequence of this purpose, qualitative preliminary research design was selected in this research.

A preliminary study is necessary because the researchers seek to design a learning e-module employing PBL-TBL in the setting of early childhood education in Malaysia, specifically for children aged 5-6 years. It is impossible to develop suitable research question without first conducting some exploratory investigation. Preliminary research provides background information about a topic to researchers, addressing questions such as who, what, when, and where. This research design will also assist researchers in determining conflicts around their topic and determining whether there are sufficient sources accessible to address the topic adequately [51]. On the other hand, [52] explained that preliminary studies are frequently carried out in order to refine the intervention and assess its acceptability, practicality, cost, and uptake. In this study, the researcher will see the requirements that need to be checked before generating strong research questions for further research in the future.

In this study, the researchers have used an interview research instrument protocol. Interviews are a useful tool for both gathering information from study participants and gathering data. "An interchange of views between two or more people on a topic that shares their passion, sees the essential importance of human interaction for the creation of knowledge, and emphasizes the social situatedness of research data," is how [53] characterized interviews. In this study, the researcher only used four questions where the questions included the four attributes mentioned in the first paragraph above and there was a protocol provided to all participants before they took part in this study. In order to ensure that the researcher can collect rich data, the researchers have chosen the type of semi-structured interview in this study. In qualitative research, semi-structured in-depth interviews are widely employed. When the researchers greeting to collect qualitative, open-ended data, investigate participant thoughts, feelings, and opinions about a certain topic and delve deeply into personal and often sensitive problems, this form of interview is a useful data collection method of operation [54]. The researchers will re-explain the questions to each research participant to ensure that the recorded dialogue does not deviate from the intended context of the research inquiry. Simply stated, the following Figure 2 depicts the process and design of this preliminary study:

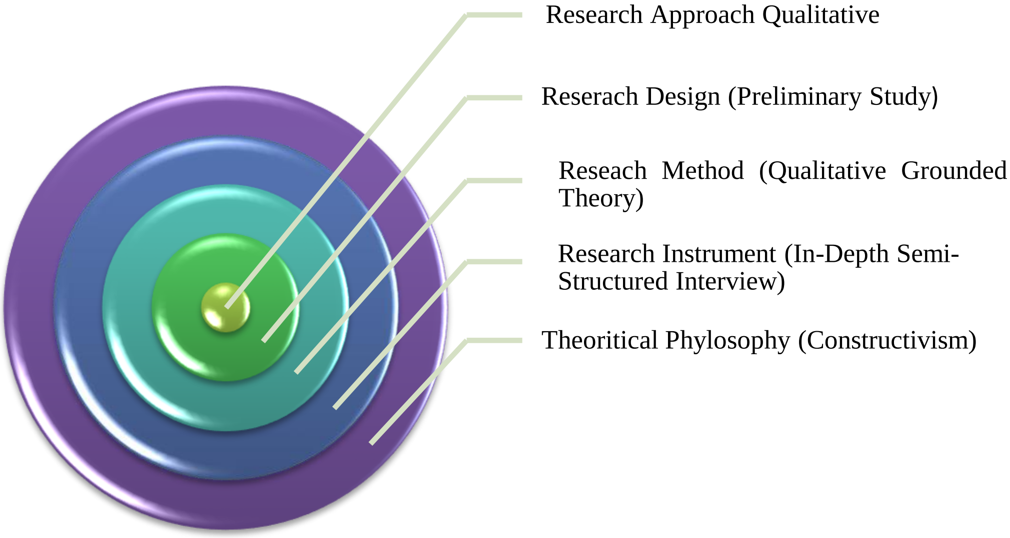

Figure 2: Preliminary Study Research Design

Sampling

In order to provide the most effective response to the research questions, a specific group of ECE educators, primarily kindergarten and preschool educators throughout Malaysia with at least 5 years of teaching experience, were purposefully chosen for their ability to 'inform an understanding of the research problem' [55]. Even though a vast number of publications, book chapters, and books offer guidance and recommend 5 to 50 participants as adequate [56] to be employed in interviews, but a sample of nine educators consisting of 3 male educators and 6 female educators was chosen to ensure that what is collected is sufficient to answer the research questions. Furthermore, having a variety of educators based on snowball sampling, it relies on referrals from initially sampled participants to additional people deemed to exhibit the feature of interest [57]. This sampling strategy also helps to eliminate bias in the data collected and to meet the diverse perceptions of the value of PBL-TBL implementation in ECE contexts.

Data collection

Figure 3 illustrates the five elements involved in conducting this research. Initially, researchers identified the specific data required for the study. Consequently, this qualitative study focused on collecting nominal data, which consists of names or variables with multiple categories that lack an inherent order [58]. Since the interview employed open-ended questions without a predetermined scale, the responses naturally fell into categories. Subsequently, the participants in the study were experienced early childhood education (ECE) educators, who served as a vital source of primary data, providing authentic and reliable insights regarding the research problem. Primary data is information directly obtained by the researcher [59].

Each recorded response was tailored to the specific needs of the study. The implementation process involved interviewing all participants online. While many academics have traditionally used Skype for data collection [60], this study employed Google Meet (GM) for the interview sessions. The study spanned nine weeks, with one interview session conducted per week, from early June 2023 to early August 2023.

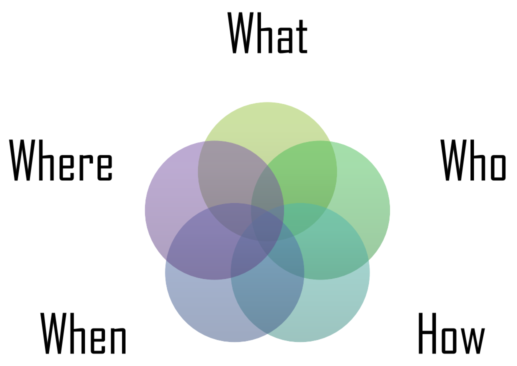

Figure 3: Data Collection Process

Data Analysis

The data generated is deemed relevant to the research problems and questions identified during the preliminary exploration phase. Consequently, the data analysis process employs an inductive data analysis approach, characterized as a "bottom-up" method for identifying themes and categories within the data [55]. According to [61], the primary objective of the inductive method is to enable research findings to emerge from the frequent, dominant, or significant themes present in the raw data, free from the restrictions of structured methodologies. On the other hand, this approach is adaptable, enabling researchers to adjust their focus based on emerging data and patterns. It does not constrain them to predefined hypotheses or frameworks.

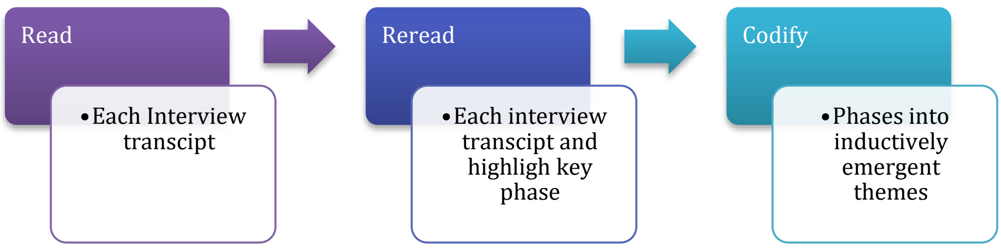

Figure 4: Inductive Data Analysis Process

Figure 4 illustrates three steps of how inductive data analysis was conducted in this study. In the first step, to ensure that the research focus and investigation areas were appropriately identified, this study emphasized the content of all nine sets of interview transcripts, originally in *Bahasa Malaysia* (Malay Language) and translated into English. In the second step, the researchers reread all transcripts, highlighting relevant points. The ATLAS.tisoftware version 9.1.3 was used for this step, as it is a promising tool for content analysis, enabling researchers to store essential information in one location, thereby enhancing organizational security and reducing laborious tasks [62]. In the third step, the data was codified using the software's coding system based on key phrases identified earlier. Subsequently, the codes were organized according to the appropriate themes, which were conceptualized into maps reflecting four main variables: knowledge, social interaction, creativity, and motivation. Finally, expert validation of the generated themes was sought to ensure alignment with the research questions. The reliability value of the themes was notably high, achieving a k = 1 when both experts agreed on all analyzed themes.

FINDINGS

In this sub-topic, researchers will elucidate the findings of the data that have been scrutinized using thematic analysis. The summary of the research will commence by presenting the theme through visual representations, followed by substantiating the codes through the highlighted conversations. Finally, the researchers will elucidate the implied meanings of the statements, supported by the interviews conducted in this present study.

1. What approach is the most suitable to be implemented in early science classroom at preschool?

Researchers successfully documented five themes (please refer to Figure 5) in response to the first research question. The researchers only emphasized the key codes that defined the themes, allowing the research questions to be answered effectively.

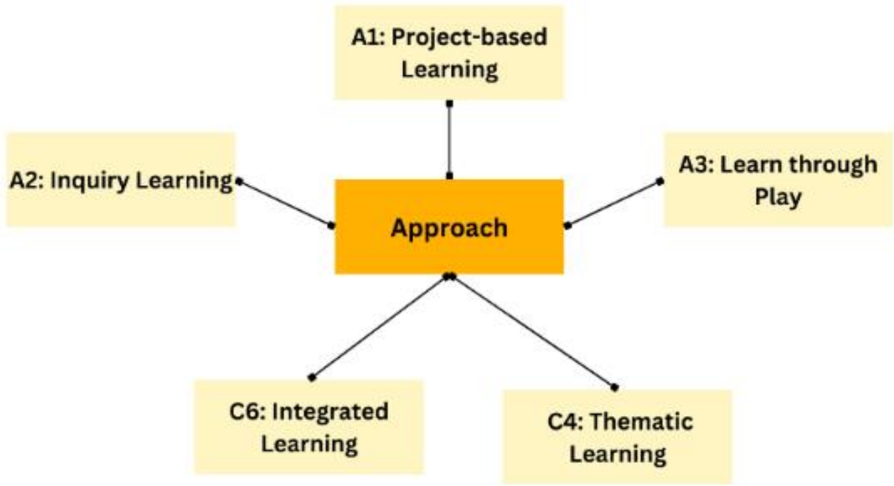

Figure 5: Thematic Analysis 1

Beginning with the perspectives of educators or research participants (P) on their knowledge of the PBL approach, they were initially prompted to openly express their opinions on the most suitable approach for early scientific education. The researchers successfully recorded 5 themes, with the most extensively documented codes belonging to theme A1: Project-based Learning (PBL). Despite not being specifically questioned about the significance of problem-based learning (PBL) for children and scientific education, they affirmed that this method is highly conducive to children's developmental progress. This can be substantiated by examining the interview transcript provided below:

P5: *"Normally, when I want to assemble a project in my science class, I use visible, or we call real materials. For example, what should we do if we wish to do an experiment? All sorts of things, right? However, the stuff chosen must be intriguing. We must provide them with fascinating stuff, and the voice must be clear."*

P7: *"So, I chose the 3E strategy for my project, which stands for "explore, experiment, and experience."*

P8: *"In our National child Development Research Centre this year, we have not followed the fixed timetable, so we are solely employing a project method, this time, the educator and children can conduct an investigation using a project approach together."*

P9: *"For example, in my classroom, I will implement a science project. The simplest activity for preschool children is to plant peanuts. Right? The procedure is the simplest one, resources are readily available, and they can be able to see the growth of the seeds from day to day. The peanut seeds germinated.*

As mentioned above, according to P7, she implements the project by choosing the 3E practice (Explore, Experiment, Experience) and encourages clear observation. She additionally remarked that this approach is quite significant in order to guarantee that children can comprehend an idea through practical experience. Furthermore, regarding P9, he believed that creating a project in kindergarten can be accomplished by the implementation of a long-term endeavor. Furthermore, in relation to P5, he posited that undertaking a project necessitates the utilization of preexisting materials, as this is a crucial factor in addressing issues within a scientific framework. Ultimately, P8 clarifies that he does not prioritize learning that has been predetermined by a set schedule, but instead opts for direct learning through science projects.

In addition, looking at the viewpoints of other study participants, they regard their approach to be their choice in performing early science activities. For instance, P1 acknowledged that in addition to conducting science activities in class, he also affirmed the implementation of A2: Inquiry Learning. This can be demonstrated through his answer below:

P1: *"Typically, I enjoyed introducing hands-on and inquiry-based approaches. It allows children to do it themselves. People say that they will learn by doing. He did it himself. He went exploring on his own exploration. I would like to offer him something he's interested in."*

In addition, for theme A3: Learn through Play, the study participants agreed that science should be acquired through play. For example, P2 and P6 indicated that through playing, children can provide feedback on the learning that has been introduced. This can be explained in the documented conversations as follows:

P2: *"The strategy I utilize is to play while learning, because play activities are directly tied to learning. For example, in science, we employ water and things. We employ heavy and light things or immerse them in water. And the educator will ask children what they gained from today's lessons, which are immersion and emergence. "Heavy objects sink while light objects rise."*

P6: *"So, in my opinion, learning through play is the ideal learning approach. Because such an approach is going to offer the children with some input in an enjoyable way."*

Furthermore, P3 and P4 each expressed their conviction that, in addition to the three approaches outlined above, A4: Integrated Learning Approach and A5: Thematic Approach can be used in early scientific education. P4 mentioned that in her science education, she introduced youngsters to learning by incorporating other aspects, such as spiritual and linguistic factors into the exercises. This can be seen in its description, as follows:

P3: *"Most of the time, I use an integrated approach in which I incorporate additional curriculum into my teaching. In scientific teaching, I use distinctive characteristics and spirituality to encourage children to cooperate. Or I use language elements in science."*

According to P4, using a theme approach to learning science is easier for him because she only has to teach one topic. Furthermore, she believes that this approach makes it easier for children to understand an idea, as outlined below:

P4: "I prefer conceptual approaches. With this theme, we know that children will understand what they want to explore because it is related to the theme. For example, today they learned about fruits. Consequently, children will be aware of different kinds of fruit. We are going to get through. It indicates they know based on their own experience. We reinforce their understanding of what we are teaching them about science."

2. Are PBL activities with the integration of blended learning important for the development of children's social interaction?

To answer the second research question, the researchers effectively represented four primary themes (refer to Figure 6). In general, every study participant understands the relevance of PBL activities in blended learning. They not only emphasize the relevance of the formal learning process, but they also try to explain their preschool project-based experience.

Figure 6: Thematic Analysis 2

The first significance of PBL with the integration of blended learning in science education is that it can assist children in acquiring knowledge related to a concept more easily because the criteria in the integration of this approach allow children to better understand the topic. For example, theme A1: Knowledge had been discussed by P1 and P3 where they described how the availability of technological tools in PBL learning allows them to develop their knowledge more quickly.

P1: *"Even if we do hands-on project activities and at the same time, we incorporate the elements of educational videos, it can assist the children to learn more about the topics that I teach them. For example, if we directly do hands-on activities, they become blurry to solve the tasks of the activities. However, the educational video will help them to gain knowledge more effectively. Children really enjoy seeing the movements of objects from video. If I show them an animated video, they will remember what they saw. They'll try relating it with what they are learning."*

P6: *For instance, children that participate in project activities with the integration of interactive technological activities consistently find learning enjoyable. Additionally, when children enjoy learning, their knowledge can grow and become more profound.*

In addition, S2: Social Interaction is the second theme that was successfully captured. Researchers can clearly grasp how PBL activities and the use of technology in the classroom might help students learn cooperatively based on the study participants' own experiences. This is demonstrated by the explanations given by P5 and P7, who indicate that through PBL activities that incorporate blended learning, children will demonstrate their willingness to communicate with friends.

P5: *"They will discuss; I mean they seemed really eager to talk. Everyone wants to talk about what they see in front of their eyes. This means that if we ask, they will offer to share their point of views more transparent."*

P7: *"For example, when I tried to present animals to them, these animals resemble newborn kangaroos. They will question why the baby kangaroo is in the pocket. So, they'll ask about that happening very quietly."*

Furthermore, the third significant theme identified by the analysis is S3: Creative Thinking. P3, P8, and P9 have demonstrated that integrating learning between the project approach and the use of technology in science education allows children to apply their creative ideas via what they learn. This is evident from each of their perceptions, which are as follows:

P3: "*Nowadays, we want children to develop reasoning skills. Children have excellent resembling skills. At this period of early childhood education, we teach children how to model behaviour. There is a well-known idea in early childhood education that suggests that as children observe, their cells become connected. And they'll apply what they observe."*

P8: *"We can witness children's creative thinking ability when the visualisation asks them a question."*

P9: *When children look at the graphic representation when we present it to them in groups, we need to ask them to redraw or do collage. That can boost their creative skills.*

Last but not least, the ultimate theme that has been effectively created is S4: Motivation. P2 and P4 discussed that PBL activities that incorporate integrated learning can help children become more motivated in their science learning in preschool. This can be demonstrated by the following conversations:

P2: "*Children will be more interested in this 21st century learning activity, and they may wish to request that I repeat the activity the next day. Because it differs from other approaches."*

P4: In terms of motivation, including PBL with blended learning is appropriate since we, as educators, can encourage children to learn about and explore the technology tools that they utilize.

DISCUSSION

According to the viewpoints of some preschool educators in Malaysia, they believe that the most effective approach of carrying out early science activities is to implement the PBL approach in the classroom. This is because they were confidently expressing that by offering tangible objects to children through project-based activities, children will be more engaged in learning scientific concepts. This is due to the PBL approach's transferability, which can improve the effectiveness of learning and knowledge gained [63]. In simple terms, practical learning and experience gained through executed projects can assist children in applying what they know in the real world. According to [64], in order for children to develop their understanding of STEM subjects, particularly science subjects, educators must apply a student-centered learning strategy in which learner could participate actively in learning and facilitation sessions. On the other hand, [64] indicated again that the educator's inability to demonstrate his function as a facilitator in the science class caused the struggle of controlling the class.

Furthermore, in terms of social interaction development, the educators stated that the 21st century features included in PBL activities might help children enhance their interaction skills when researching science problems. This is corroborated by the findings of a study by [65], which found a clear difference between the treatment group and the control group in response to the learning activities used. This revealed that the children group from treatment group engage in more active engagement and communication as a result of the cooperative project they have implemented. Further, [66] demonstrated through their research that providing children with the opportunity to do a science project can help them to be more receptive and tolerant of their peers.

Educators believe that incorporating blended learning into science projects allows children to build creative thinking skills by providing them with opportunities to generate innovative solutions to topic-related difficulties. This is unequivocally demonstrated by a study conducted by [67], which unveiled two primary advantages of blended learning, namely technological devices presented to children taught with blended learning approaches demonstrated a higher level of creative characteristics compared to the group of children from traditional educational settings. Furthermore, there exists an interaction impact between learning methodologies and creative thinking abilities on technical learning outcomes, while also accounting for prior knowledge.

Last but not least, the educators also shared more openly about the importance of PBL activities by integrating blended learning in preschool for the development of children's motivation to learn and deepen science at a younger age. This assertion is corroborated by the perspectives of [68], [69], and [70], which suggest that by promoting hands-on projects for children, they can be exposed to increased motivation in learning the topics being taught. To ensure that their excitement for learning science does not diminish at an early age, educators must be innovative in providing engaging activities for children to participate in early science education. Consequently, it is imperative for educators to assume greater accountability in implementing exceptional activities to prevent the waning of children's interest in science education at an early stage.

CONCLUSION

Various approaches, tactics, strategies, and techniques can be applied to incorporate empowerment in developing high-quality science education in early childhood. The study's findings provide a detailed explanation of the significance of the PBL approach, incorporated into blended learning. This approach not only enhanced children's motivation and confidence in learning early science but also fosters a collaborative environment for exploring science topics. Additionally, it promotes creative thinking in children's understanding of the subjects they learn. Hence, it is imperative for educators to assume a crucial role as facilitators within the educational setting for children. Educators must possess a strong enthusiasm for generating innovative and analytical ideas to deliver a science lesson that is both inclusive and transparent to pupils. Furthermore, educators should allocate additional time to familiarize themselves with previous research on the implementation of project-based activities. This will enable them to proactively address potential difficulties in a more methodical manner. Science education will be enhanced for children if educators assume the role of facilitators and offer them practical, hands-on experiences in preschool or other early childhood education center.

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