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Framework-based Teacher Training Program: Cross-disciplinary Approaches in Early Childhood Education

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ABSTRACT
Today in Malaysia, an increased focus is on the importance of qualified educators training in early childhood education (ECE) and its effects on young learner skill development. However, a significant obstacle to ECE educators' professional development includes a lack of professional training in teacher standards. The Teacher Training Program helps educators to understand children's characteristics (specifically from birth to age eight), parents, and communities. This study examines the impact of the Teacher Training Program (TTP) in Malaysia, focusing on how it enhances preschool educators' professional development, particularly in implementing cross-disciplinary STEM education in early childhood settings. The study analyzed relevant online and print resources using a library research method to explore the challenges and opportunities in integrating STEM education into early childhood curricula. The novelty of this research lies in its focus on a structured professional development framework to address gaps in teacher training for STEM education. The findings highlight the critical role of TTP in supporting preschool teachers, providing strategies for engaging interdisciplinary learning environments, and improving teaching standards. The research emphasizes the importance of such programs in preparing educators to foster essential skills in young learners, ultimately contributing to the advancement of early childhood education in Malaysia.

Keywords: Early Childhood Education (ECE), Cross-disciplinary STEM Education, Preschool Teacher, Professional Development

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1. INTRODUCTION

Educators, especially preschool teachers, play a vital role in improving an educational system by boosting professional experience through training (Kelly et al., 2019). The cross-disciplinary STEM education approach is an area with the potential to revolutionize ECE to improve teaching practices and address the evolving challenges of the modern world that aim at further improvement of education system quality, fostering creativity, and providing a solid basis for lifelong learning and achievement into the Malaysian curriculum.

In teacher training programs, the National Association for the Education of Young Children (NAEYC) emphasizes addressing diversity, including race, culture, ethnicity, language, social class, and special needs. This diversity focus ensures that educators can create effective learning environments (Olmore, 2020). According to findings by Nasri and her colleagues, countries such as Finland, Japan, and Singapore pay more attention to high-quality teacher training. They base this main reason on the importance of teachers in uplifting the national education system (Nasri et al., 2020), which is the foundation for Malaysian Teacher Standards issued by the Ministry of Education Malaysia.

On the other point, the Malaysian curriculum and high-quality STEM program emphasize providing teachers with a comprehensive understanding of early childhood education through a framework that draws on insights from multiple fields that will provide practical resources, curriculum frameworks, and professional development strategies for ECE educators, teachers, program administrators, and policymakers to enhance the quality and quantity of the ECE program and seek to offer a more holistic and engaging learning experience for young children, potentially influencing their lifelong learning outcomes. However, many preschool teachers in Malaysia face challenges in integrating STEM education into their classrooms due to a lack of training and professional development in this area (Chai, 2019; Zaini et al., 2018). Studies indicate that preschool teachers often lack sufficient knowledge and preparation to implement STEM education effectively despite its recognized benefits for young learners (Brenneman et al., 2019). This gap indicates the need for teacher training programs prioritizing STEM integration and cross-disciplinary approaches to learning. To achieve this goal, the existing framework for the desired curriculum. Likewise, access to quality training programs can be unequal, especially for educators in underprivileged areas.

In Malaysia, specialized training programs are provided for early childhood educators to equip them with the skills to teach STEM concepts effectively. Since there is a significant focus on involving local communities in ECE, the Ministry of Education (MOE) emphasizes programs that encourage collaboration with community members to enhance resource sharing, provide diverse learning experiences, and monitor educational operations to ensure quality standards are met (Kelley & Knowles, 2016). Ensuring that training and professional development are tailored to individual needs is a challenge that needs to be addressed. International research also highlights that the lack of emphasis on STEM integration at the early childhood level is a global challenge, not limited to Malaysia (Cohen et al., 2020).

However, a critical issue remains the unequal access to quality teacher training programs, particularly in rural and underprivileged regions. Such disparities limit educators' ability to implement cutting-edge educational practices, such as cross-disciplinary STEM education, essential for fostering a comprehensive learning environment. Studies on the teacher training program have more effective cross-disciplinary STEM activities highlighted that many early childhood educators in Malaysia may lack specialized training in STEM subjects since the Ministry of Education in

Malaysia has focused on the literacy and numeracy of young learners (Kong, 2022; Bransby & Rawson, 2020).

There is also a concern in curriculum implementation to capacitate children's holistic development, including sports, science, technology, and arts, while at the same time encouraging good personality development (Rahmatullah et al., 2021). In line with this, the Ministry of Education (MOE) 2010 included 45.58 percent of preschools. The Ministry of Rural and Regional Development (MRRD), known as the KEMAS preschool, is located in rural areas (Boon, 2010) and introduces several types of training for school teachers. The Malaysia curriculum has only started to implement STEM-integrated education in the year 2017 for grade 1 (year 1 in primary school) and grade 7 (year 1 in secondary school) (Chong, 2019). In this regard, Saracho's (1988) activities on reading, listening, and observing, Drummond's (2002) storytelling, and Putnam and Borko's (2000) have introduced using observation as an educational activity in the teacher training curriculum.

Focusing on hands-on learning and integration into everyday activities makes STEM accessible and enjoyable for young children (Rahmatullah et al., 2020), setting the stage for future academic and personal success. However, in the early stages of compulsory education (technology and engineering subjects) are refused to take notice of development (Kelley & Knowles, 2016). Despite the emphasis on STEM education in the Malaysian curriculum, there remains a significant gap in research concerning the effective integration of cross-disciplinary STEM principles in early childhood education. Specifically, there is limited insight into how teachers can be supported in implementing these concepts within the preschool classroom and how existing professional development programs can be enhanced to meet these needs and provide a stronger foundation for lifelong learning outcomes in young children across Malaysia. As the truth or facts of this situation, this study tries to find out how best to design a framework to boost and sustain teacher training programs for the continuation of teachers and students.

2. METHOD

This study utilizes a theory of change (ToC) framework to explore the impact of teacher training programs on integrating cross-disciplinary STEM education into early childhood education in Malaysia. The ToC framework helps to clarify the causal pathways between the inputs, activities, and outcomes of the teacher training programs and how these elements contribute to the intended educational improvements in preschool settings. Document analysis of curriculum materials, training program guidelines, and policy documents to evaluate how the theory of change is represented in practice within the educational system.

3. RESULTS AND DISCUSSION

Asia is the largest continent with a vast diversity of young children getting less attention, and yet they have, and there is a fundamental issue in the education system among poverty rate countries in this region despite disparities. Ministry of Education Malaysia requires teachers to achieve a diploma qualification (Foong et al., 2014). According to the current need for high-quality development in training preschool educators in Malaysia, it is more important to understand the professional development rules in the cross-disciplinary approach. Therefore, the main question researched in this study is: How can we create and develop innovative curriculum frameworks and teaching strategies to integrate multiple disciplines in ECE? The Teacher Training Program (TTP)

can help to plan and implement educational activities based on specific learning goals and objectives across different developmental domains. There are various programs such as the Reggio Emilia approach, Montessori method, Te Whariki, and creative curriculum for training teachers based on gender prejudice, immigrant-origin young learners, Waldorf curricula, and distance learning (Sattin-Bajaj et al., 2023; Bransby & Rawson, 2020; Spear & da Costa, 2018) to develop a training mode for teachers, create engaging environment and fostering holistic growth as the value of diverse perspectives and knowledge bases in problem-solving and innovation. On the other hand, most studies implemented play-based learning in STEM education (Sydon & Phuntsho, 2021), and there is still a lack of knowledge among early childhood educators in teaching that requires more attention to collaboration to perform integrated Cross-disciplinary STEM Education in their classrooms (Ramli & Zain, 2018). To prove this claim, a recent study by Abd Ghani et al. (2023) used 22 articles by year (2018 to 2022) that investigate STEM Education subjects. This highlights the need for ongoing professional development to help educators effectively meet the diverse needs of young learners. Teachers themselves affect their classroom environment and may employ cultural and social goals in children's beliefs (Spear & da Costa, 2018). However, high turnover rates and teacher burnout are common problems in ECE. For this reason, elements of teacher training programs guarantee the achievement of desired outcomes and evaluate evidence of the knowledge of experts. When teachers start to share knowledge with other colloquies based on teaching, it may be professional knowledge. Cross-disciplinary STEM education activities, integrated projects (multiple key disciplines to incorporate science, math, and art), and technology are effective strategies for holistic development and preparation for future education in a rapidly changing world (So et al., 2024). Therefore, it is more important to investigate the role of a cross-disciplinary approach in retaining educators and preventing burnout. Studies, especially Asian-based teacher training programs, need to determine whether it is adequate to equip ECE educators with the skills and knowledge to be effective in their classrooms. The Ministry of Education (MOE) in Malaysia applied several approaches to the education system to impact teacher training, but it is still challenging (Malaysia, 2013). Research by Grapin, Llosa, and Lee (2024), Li and Boon (2021), and Wan et al. (2024) indicated that there is a long way to promote cross-disciplinary education in Asian communities. The Malaysian Association of Kindergartens, known as Persatuan Tadika Malaysia (PTM), conducted a preschool skills training course with a 7-steps course named Child Psychology, Teacher Education, Administration and Management, Curriculum areas in Language and Communication, Spiritual/Moral Education, Physical Development, Socio-emotional Development, Creativity and Aesthetics for Preschool teachers (Foong et al., 2014). Initiatives under the Nation Key Result Areas (NKRA) include building more preschools in underserved regions such as Sabah and Sarawak and addressing the unique challenges faced by Indigenous and marginalized communities (Boon, 2010). In contrast, a learning-oriented environment as a segment of teacher professional development requires a focus on hands-on learning effectively. Therefore, a holistic curriculum framework focuses on the interconnectedness of children learning across different areas such as well-being, communication, and exploration that follow the theory of change viewpoint. Researchers need to develop appropriate assessment tools and methodologies to measure this impact accurately. The STEM Productive Learning (STEMPL) program promotes STEM education in the Ministry of Education in Malaysia. This program aims to foster creative and critical thinking skills among students by integrating hands-on learning experiences and industry collaborations into the curriculum (Jin, T.C. 2024, Jan 13). On the other sides, it is more important to investigate how

training programs can effectively integrate technology and digital tools into ECE classrooms (Shernoff et al., 2021). The National Digital Infrastructure Plan (Jendela) is another plan that the ministry is implementing strategies to improve internet access and digital infrastructure across schools. It includes the development of online learning platforms and the promotion of digital literacy among students and educators (Rahim, R.; Tan, T. and Carvalho, M. 2020, Nov 16). According to these themes, high-quality early childhood education is critical for children's development and future success. Initiative PERMATA Program, themed Every Child a Jewel, focuses on children aged four and below and utilizes special modules in early learning and care. Therefore, creating interdisciplinary training programs that address this challenge is a subject of research.

The STEM approaches must foster creative children and enable them to face issues in evidence-based decision-making (Arshad et al., 2018). STEM education practices and approaches currently vary from school to school and teacher to teacher (Kurup & Li, 2022) to foster holistic learning through cross-disciplinary approaches in Early Childhood Education. In Malaysia, the Department of Community Development (KEMAS) established the first public preschool and later preschools in the urban areas known as T*ABIKA* PERPADUAN under the Ministry of Rural Development's responsibilities to encourage children from various races (Mamat, 2019, as cited in Rahmatullah et al., 2021). Therefore, there is a duty on Malaysian teachers' shoulders to bring back the passion and quality of learning among young learners. However, educators who did not achieve appropriate training on integrated cross-disciplinary approaches face several difficulties (Masnan et al., 2018). A study on the integration of STEM education by Thibaut et al. (2018) emphasizes the need for interdisciplinary approaches to enhance student learning and engagement to contribute significantly to the theoretical framework for integrating cross-disciplinary STEM education.

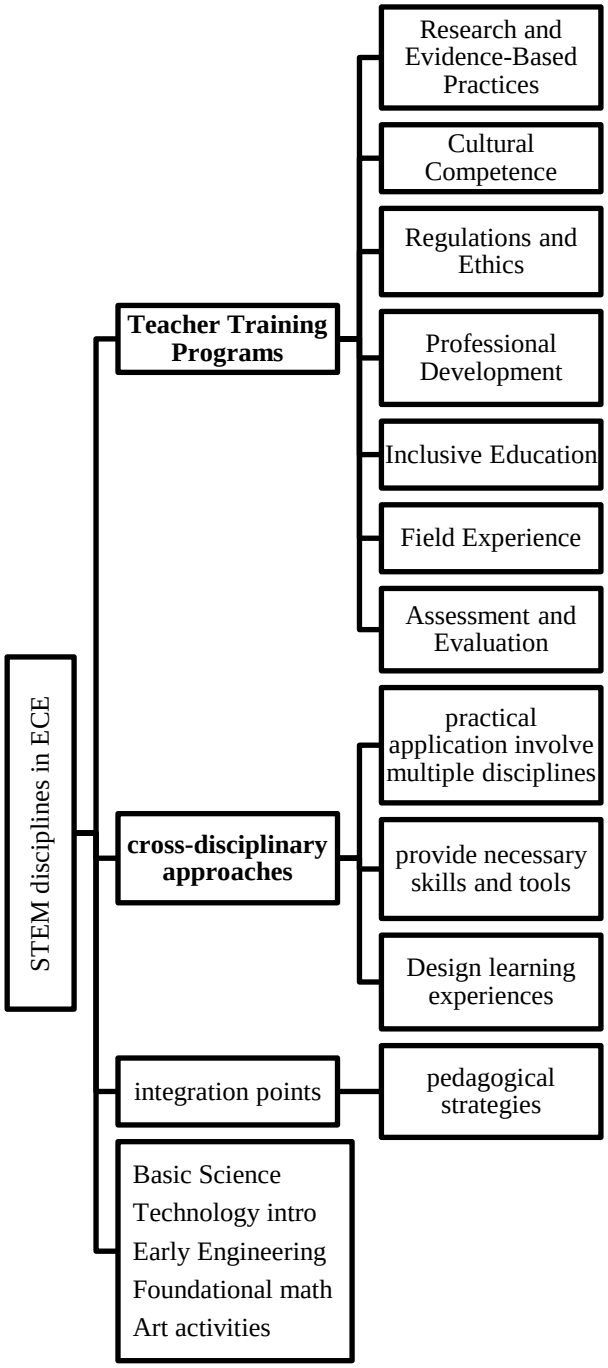

Fig 1. Developing a Conceptual Framework in Early Childhood Education

This figure illustrates a comprehensive conceptual framework to outline key components such as teacher training programs, cross-disciplinary approaches, and integration points in basic science, technology, early engineering, foundational math, and art activities. The framework emphasizes the importance of holistic teacher training and interdisciplinary strategies to foster practical learning experiences in early childhood education.

Traditionally, early childhood education compartmentalizes into distinct subject areas, with minimal collaboration across disciplines. Interconnecting resources and materials from various disciplines can be complex (Boon, 2010). However, to support cross-disciplinary integration, a framework-based teacher training program follows a structured framework that guides educators to deliver curriculum and ensure various components integration effectively. These gaps represent areas where our understanding can be limited, and more research is needed to explore and develop cross-disciplinary teaching practices. There is a need for standardized models and frameworks for implementing cross-disciplinary approaches in ECE. Research should focus on developing and validating such models to provide consistency and guidance for educators.

THEORETICAL FRAMEWORK

The Theory of Change underpinning this study is based on the assumption that improving teacher training programs, specifically in STEM education, will lead to enhanced teaching practices and better educational outcomes for preschool children.

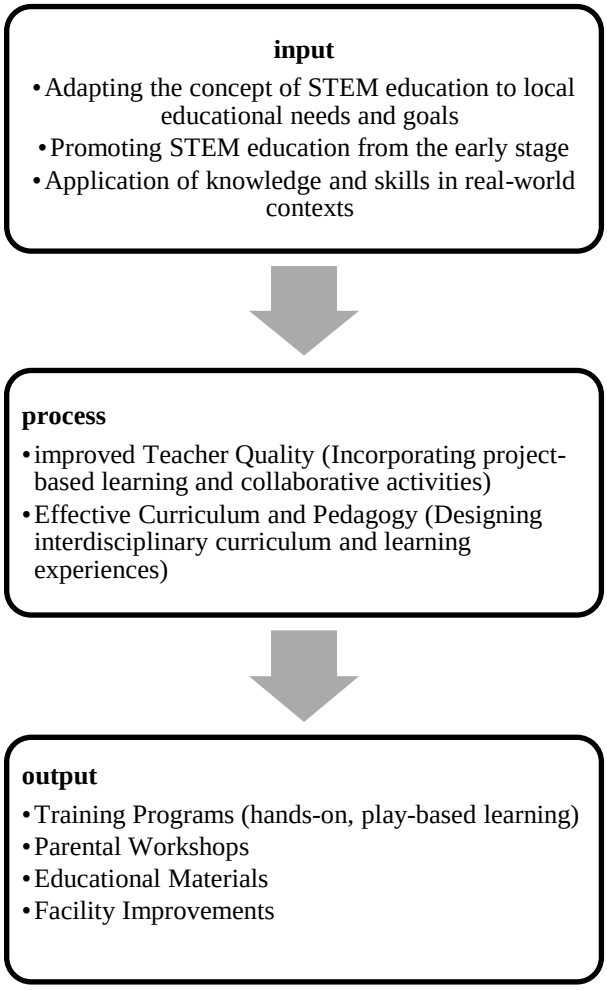

Fig. 2. Implementing the theory of change framework into the Teacher Training Program

In this figure, we refer to some key components and aspects of such a teacher training program: An essential component of ensuring quality Teacher Training Program (TTP) equips educators with the knowledge, skills, and ongoing professional development needed to meet the unique demands of teaching young children. Teachers and educators in early childhood education (ECE) have diverse needs and backgrounds to implement cross-disciplinary STEM education and training. Therefore, the complex challenges of the modern world still require diverse perspectives and skills (Park et al., 2018; Egert et al., 2018). To foster the quality of STEM education and ensure it improves to increase students' academic achievement and the overall quality of education (Nasri et al., 2020). The ToC framework outlines the following key components:

1. Inputs: Resources such as specialized training programs, professional development workshops, curriculum materials, and policy support from the Ministry of Education.
2. process: Delivering teacher training programs, integrating STEM concepts into the preschool curriculum, and implementing cross-disciplinary teaching strategies.
3. Outputs: Increased teacher confidence in STEM integration, improved pedagogical practices, and more engaging student classroom activities. Enhanced early childhood learning outcomes, fostering preschoolers' critical thinking and problem-solving skills, and enhanced long-term academic success. The long-term effect is creating a more sustainable, quality early childhood education system in Malaysia, which can address future educational challenges through cross-disciplinary STEM approaches.

This study highlights the significant role of professional development, mainly through Teacher Training Programs (TTP), in enhancing the quality of early childhood education (ECE). By focusing on integrating cross-disciplinary STEM education, this research contributes to understanding how interdisciplinary training can equip preschool teachers with the skills necessary to meet the evolving demands of young learners in a rapidly changing world.

However, several important areas remain unexplored. First, future research should examine how to effectively combine resources from math, science, language, and the arts in an age-appropriate and meaningful way for young children. Despite the growing emphasis on cross-disciplinary approaches, there is still a need for practical strategies and frameworks that can guide educators in integrating these diverse academic disciplines. Additionally, further research should focus on creating and implementing interdisciplinary teacher training programs that address the specific needs of teachers from diverse backgrounds, particularly in rural and underserved areas. These programs can ensure equitable access to high-quality professional development and are crucial to improving educational outcomes across different communities.

Lastly, this study opens avenues for longitudinal research to assess the long-term impact of cross-disciplinary STEM training on teacher effectiveness and student academic achievement. By exploring these under-examined areas, future research can further contribute to the transformation of early childhood education, making it more inclusive, engaging, and effective for all young learners. This article concludes the transformative potential of integrating cross-disciplinary approaches within a framework-based TTP model.

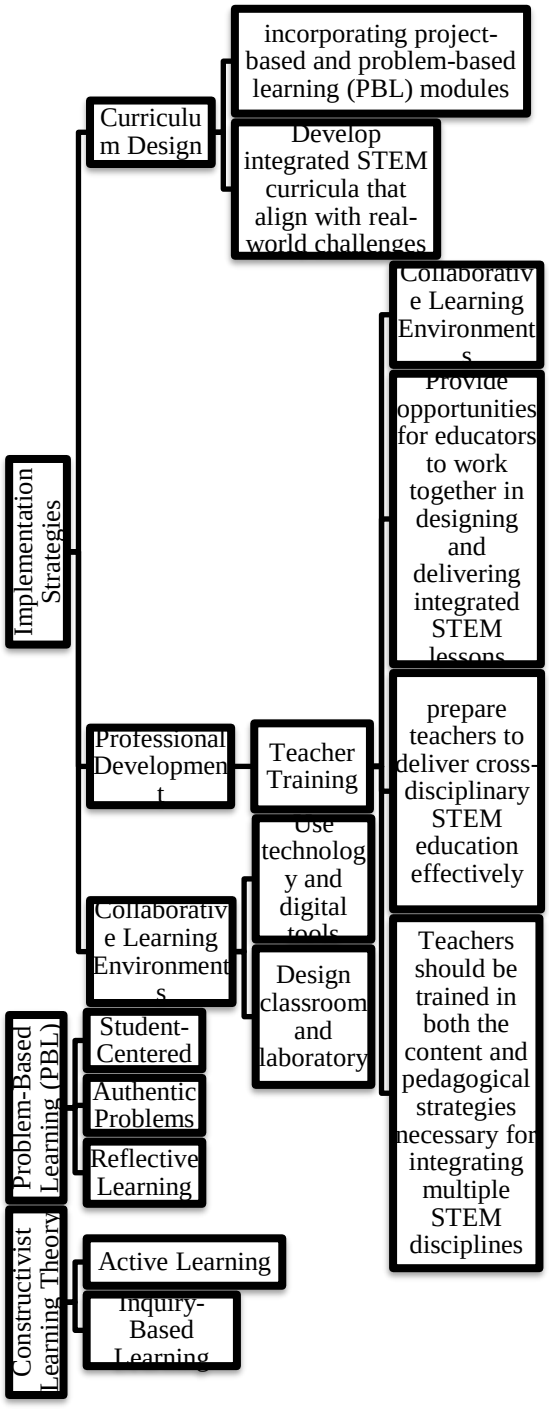

Fig. 2. Theoretical framework for integrated cross-disciplinary STEM education (Thibaut et al., 2018)

4. CONCLUSION

How to effectively combine resources from math, science, language, and the arts in an age-appropriate and meaningful way requires investigation. Due to the presence and emergence of diverse views and approaches, this attention has been more prominent in the past few decades. One of the concerns of educational researchers is to check and constantly monitor the quality of education (as an essential field, it has the necessary quality) in the preschool period (Corrigan, 2020). Therefore, professional development is a factor that influences the quality of preschool education (Barros et al., 2016). Teachers learn how to tailor their teaching approaches to meet the unique needs of each child. These programs may include training to understand and respect cultural and linguistic diversity among young learners and their families to create inclusive and culturally sensitive classrooms. Understanding and integrating knowledge and practices from various academic disciplines is central to teacher training programs (Felix & Rahman, 2021). A review of the research literature shows that professional development is the fundamental topic in studies related to early childhood education (Havice et al., 2018).

This outline provides a comprehensive structure for an article that explores the intersection of cross-disciplinary approaches and framework-based TTP models that offer insights and practical guidance for educators, researchers, and practitioners seeking to enhance collaboration and innovation in their respective fields. Further investigation is needed into the practicalities and challenges of creating interdisciplinary training programs that equip educators with the tools and strategies to implement integrated cross-disciplinary STEM education.

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