The 3rd International Conference on Education Innovation and Social Science, August 2024
ISSN (Online): 2961-9602

INTEGRATING LOCAL CULTURE INTO STEM-BASED LEARNING IN ASEAN ELEMENTARY SCHOOLS: A LITERATURE REVIEW

Nurhairani[1]*, Sugito[2], Suyanta[2], Haryanto[2]
[1]Medan State University, [2]Yogyakarta State University
nurhairani84@unimed.ac.id

Keyword

STEM-Based Leaarning, , Culture, Elementary School.

Abstract

This article examines the implementation of Science, Technology, Engineering, and Mathematics (STEM) learning in several ASEAN countries, such as Singapore, Malaysia, Indonesia, and Thailand. This article uses an integrative literature review method to explore how culture in Southeast Asia (ASEAN) countries contributes to STEM learning in primary schools. Data were analyzed from journals and research relevant to the theme. The literature review indicates that STEM implementation in ASEAN countries has significant differences, influenced by government policies, culture, and language. While some countries, such as Singapore, show substantial progress in integrating STEM into the curriculum, implementation at the primary school level still lags behind in most ASEAN regions. This article emphasizes the importance of cultural integration in STEM learning design to create more engaging, relevant, and meaningful learning experiences for students. This integration involves understanding the context, utilizing local cultural resources, and developing learning materials tailored to students' needs and interests. Developing a cultural analysis framework in STEM approaches for primary school is a crucial step to achieve this. The research concludes that culturally responsive STEM approaches can potentially increase students' motivation, engagement, and understanding of STEM concepts while preparing them for future global challenges. Cultural integration in STEM will create a more inclusive and relevant education system for all students while supporting participation and collaboration in building a broader perspective.

INTRODUCTION

STEM learning is gaining popularity globally as innovative learning. The early introduction of STEM, especially at the elementary school level, is essential in building a learning culture that encourages creativity, active participation, and the ability to solve real-world problems. By integrating the four fields of science, STEM aims to foster comprehensive and innovative understanding among children, equipping them with the necessary skills to face the challenges of the 21st century.

The Industrial Revolution 4.0 has driven major transformations in various fields, including education. The global challenges this revolution poses, particularly in economics and industry, demand fundamental adjustments in learning design. Skills in STEM are increasingly necessary in dealing with these changes. A 2017 report by the U.S. Department of Commerce Economics and Statistics Administration Office of the Chief Economist noted a 17% growth in jobs requiring STEM skills between 2008-2018, compared to a 9.8% growth for non-STEM jobs (Langdon et al., 2011). This data shows that the United States has realized the importance of STEM in improving its citizens' economic and social well-being. The increased focus on STEM in the United States is

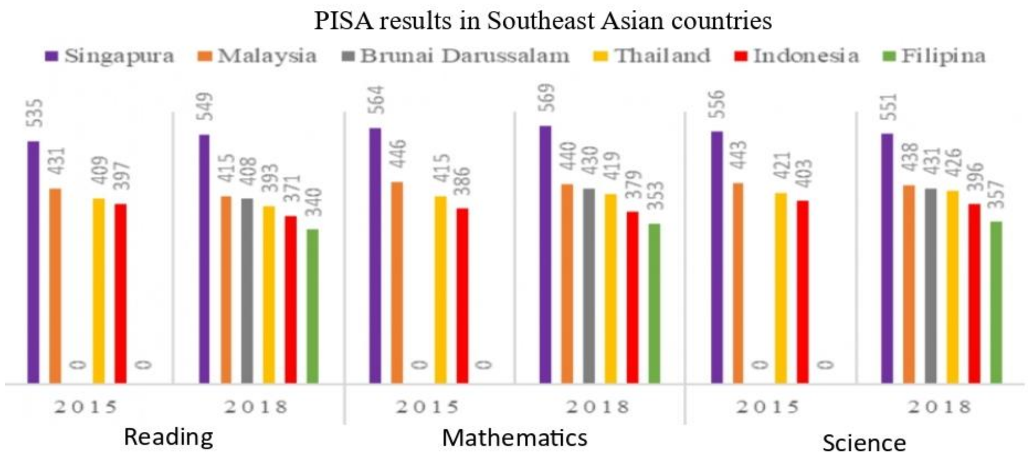
ISSN (Online): 2961-9602

also reflected in their efforts to design STEM-based learning systems from an early age. This reflects the realization that early development of STEM skills is a significant investment to create a generation of innovators who will play an important role in facing an uncertain future.

Successfully integrating the four disciplines in STEM-based learning depends on teachers' understanding and commitment to applying this approach. Teachers play an essential role in encouraging students' critical thinking through problem-solving in basic STEM and equipping them with the academic excellence needed in global competition. As stated by (Srikoom et al., 2018), STEM teaching requires teacher competence in asking challenging questions to motivate students, creating STEM learning contexts that are relevant to real life, and actively engaging students in the design process. Thus, the role of teachers in STEM implementation is critical in creating effective and meaningful learning for students.

While the STEM approach has gained momentum globally, its implementation in some countries, especially ASEAN, faces significant challenges. Reforming STEM education at the classroom level faces obstacles, especially regarding teacher competence in teaching STEM. Many teachers in ASEAN do not have specialized certification to improve science, technology, and mathematics learning, regardless of grade level or subject area (Sorenson, 2010). In developing countries, including ASEAN, STEM implementation is minimal, except Singapore, which successfully implemented this approach. However, STEM-based learning design is still relatively weak in some ASEAN countries. Contemporary STEM learning practices in developing countries have yet to make a significant impact that encourages students to choose careers in STEM in the future (Kalolo, 2016). These challenges underscore the need to improve teacher capacity, develop effective STEM curricula, and encourage investment in STEM research and development in ASEAN countries.

This article investigates the implementation of STEM learning approaches in several Southeast ASEAN countries, particularly Singapore, Malaysia, Indonesia, and Thailand. ASEAN countries are currently focusing on learning design to achieve 21st-century skills, which is critical to improving regional competitiveness, especially in education. Although ASEAN countries have different political backgrounds, ideologies, histories, cultures, and educational structures, they share a common vision to strengthen regional competitiveness. Singapore, which consistently ranks high in the Program for International Student Assessment (PISA) results, is an example of a country strongly committed to designing STEM-based learning. 21st-century competencies are officially integrated into Singapore's education policy initiatives (Cheng, 2017). Singapore, through its strong education policy structure, provides an excellent example for other ASEAN countries in the process of formulating education policies to achieve 21st-century skills through tripartite reforms involving collaboration between the government, education practitioners, and education researchers, with the aim of continuous improvement (Cheng, 2017). Singapore's success in taking STEM-based learning design seriously is evident in the 2018 PISA data.



ISSN (Online): 2961-9602

Figure 1. PISA results data for 2015-2018(OECD, 2015, 2019)

The graphic data above is the result of the PISA achievement of countries in the Southeast Asia Region. There are only 6 countries that participate in the learning assessment index developed by the Organization for Economic Co-operation and Development (OECD), namely Singapore, Malaysia, Brunei Darussalam, Thailand, Indonesia, and the Philippines. Meanwhile, Cambodia and Myanmar are not yet affiliated with the assessment conducted by the OECD. The graphic data above shows that Singapore is one of the ASEAN countries with the second-highest score in the world after China. For the ASEAN region, Singapore is in the top position. Singapore, which is ranked top in the ASEAN region and second highest in the world after China, experienced an increase in reading and mathematics scores between 2015 and 2018 but a decrease in science (Organization for Economic Co-operation and Development, 2015)

Malaysia ranked second in ASEAN, showed a decline in scores across all domains between 2015 and 2018. In third place is Brunei Darussalam, where the indexation in Reading in 2018 reached a score of 408; in Mathematics, it reached a score of 430; and in Science, it reached 43 (Organization for Economic Co-operation and Development, 2019). Specifically for Brunei Darussalam their involvement in the OECD learning assessment began in 2018. Thailand ranked fourth in ASEAN and showed a decline in reading scores, an increase in mathematics, and an increase in Science between 2015 and 2018. (Organization for Economic Co-operation and Development, 2019). Indonesia ranked fifth in ASEAN, showed a decline in scores across all domains between 2015 and 2018. ((Organization for Economic Co-operation and Development,, 2015). The Philippines, which only participated in PISA in 2018, showed relatively lower scores than other ASEAN countries (Organization for Economic Co-operation and Development, 2019). The same thing happened to Brunei Darussalam when the Philippines was involved in the learning assessment indexation organized by the OECD starting in 2018.

The Program for International Student Assessment (PISA) results show fluctuations in learning outcomes across ASEAN countries, with Singapore as the best-performing country. The PISA results show the need for ASEAN countries to design learning to improve 21st-century skills, with the STEM approach as one alternative. However, considering that PISA only focuses on students aged 11-15 (middle grades), it is essential to review how to strengthen reading, mathematics, and science learning from elementary school. The STEM approach is considered to have a strong correlation in supporting the achievement of skills in these three areas because building a solid foundation early on can help students hone 21st-century skills.

Implementing the STEM approach in elementary schools is essential to equip students with basic skills, knowledge, and curiosity about STEM concepts, ultimately preparing them to actively and skillfully participate in STEM fields at the next level of education (Hattie, 2016). However, implementing STEM in elementary schools, especially in developing countries such as the ASEAN region, faces several significant challenges. These challenges include more government policy support to encourage STEM learning, the lack of cultural adaptation to critical learning, language barriers, limited science and technology facilities, and uneven STEM teacher competencies in various ASEAN countries. Therefore, the following discussion will focus on implementing STEM in ASEAN countries, considering cultural characteristics different from those of developed countries

METHOD

This article uses the literature review method to analyze the implementation of STEM in ASEAN countries. More specifically, the literature review method used is an integrative literature review (Torraco, 2005). Integrative literature reviews, critiques, and synthesizes representative literature on a topic in an integrated manner, resulting in new frameworks and perspectives (Torraco, 2005). On the other hand, Cooper, et al (2018) offer a systematic review of literature

ISSN (Online): 2961-9602

methods. *Systematic literature* is defined as a systematic search for studies that fit the topic of discussion. The aim is to report the results of identifying existing studies transparently so that the reader understands what has been done in the studies and how the review findings are placed within the relevant evidence. Several literature reviews of research results on STEM approaches in ASEAN countries, especially at the elementary school level, are essential references in this study. Through an integrative literature review, this article will contribute to our knowledge of how STEM is implemented in ASEAN countries with different cultural characteristics from those of developed countries such as the United States, Finland, and other European countries.

The writing of this article follows the method presented by Torraco, which uses the integrative literature method. The determination of integrative literature, as Torraco (2005) stated, has four forms that need to be taken seriously so that the article's writing remains focused on the intended discussion objectives. The following are four forms of synthesis of integrative literature review (Torraco, 2005).

1. A research agenda: In this section, the research agenda is expected to flow logically through a critical analysis of the literature on which the research is based. It should pose provocative questions (or propositions) that provide direction for future research.
2. A taxonomy or other conceptual classification of constructs: In this section, taxonomies or other conceptual classifications are interpreted as constructs often developed to classify previous research. In turn, this section lays the foundation for new theories.
3. Alternative models or conceptual frameworks: This section discusses alternative models or conceptual frameworks. The integrative review addresses new ways of thinking about the topic. Alternative models or conceptions proposed by researchers or authors should be derived directly from the critical analysis and synthesis provided.
4. Metatheory: This section integrates and synthesizes the literature review to develop a metatheory across theoretical domains that is expected to serve as a framework for future research.

The literature study in writing this article is directed at "a research agenda." The results of research on STEM in several ASEAN countries and reports from several countries are used as references to see how the implementation of STEM in several ASEAN countries with different cultures and cultures with American and European countries that have first conducted such learning. This is important to explore because different cultural characteristics will contribute significantly to research plans that raise the theme of learning using the STEM approach, specifically at the elementary school level.

STEM PHILOSOPHY

STEM education has a solid philosophical foundation, covering ontology, epistemology, and axiology. Ontologically, STEM refers to a conceptual understanding of these fields and the relationships between them (Chesky & Wolfmeyer, 2015). Epistemologically, the focus lies on the best methods for STEM teaching, while axiologically, it centers on the purpose of STEM learning for students. STEM learning approaches are driven by the desire to actively engage students in addressing global issues, such as social and environmental crises. Chesky & Wolfmeyer (2015) suggest the responsive use of technology in STEM education, where scientific knowledge is applied in a global and social justice context. Axiologically, STEM education fosters aesthetic awareness, environmental sensitivity, and critical awareness of cultural, gender, and class issues.

Key to STEM education is building students' ability to understand and apply knowledge to conclude, interpret results, develop explanations and solutions, and think critically and metacognitively (Franco & Patel, 2013). STEM embodies three dimensions: cognitive strategies through project-based learning (PBL) and inquiry, content knowledge through interdisciplinary curriculum, and academic skills through collaborative and cooperative structures.

To maximize student engagement, supporting their initiative and curiosity with teacher guidance is necessary, thus enabling them to achieve higher academic achievement. Student engagement

ISSN (Online): 2961-9602

can be seen from academic (knowledge and cognitive strategies), behavioral (academic performance and cognitive strategies), and emotional (feeling connected to the school) aspects. Emotional engagement arises when students feel part of the school community and realize the importance of the school's role. Studies show that students who experience STEM education tend to show higher cognitive engagement in academic content and problem-solving and greater social engagement than students in traditional schools.

RESULTS

The literature review used in this article refers to the research results on the implementation of STEM learning in ASEAN countries with different cultural characteristics. The demands of the 21st century emphasize the importance of technology integration in learning to hone students' critical thinking skills in understanding the world's reality. The STEM approach is relevant in producing a generation that can adapt to technological advances. However, a technology-based approach without considering culture and social environment can be counterproductive.

Anhalt et al., (2018) gave an example of how one aspect of STEM, namely mathematics, tries to redefine how a general understanding of culture is currently fundamental in the development of mathematics learning. Taylor (Anhalt et al., 2018) defines *culture* as the abilities and habits humans acquire as members of society. This concept shows the importance of cultural integration in scientific thinking, which serves as a marker of social difference. Cultural thinking embedded in people's daily lives must be integrated with science-based approaches. The following literature review shows that culture is an essential element in the analytical framework of the STEM approach to learning.

Table 1. Results of the literature review

Country	STEM Learning Themes	Research Findings
Malaysia	STEM ASEAN Project to Promote 21st Century Teaching and Learning. (Baharin & Kamarudin, 2017)	This study implemented collaborative project-based STEM learning between students from two ASEAN countries, Malaysia and Myanmar, on the topic of "Endangered Species in ASEAN Countries." Eleven groups of students were formed, each choosing an endangered animal found in ASEAN countries. Once the endangered animals were selected, research was conducted through information gathering and collaborative learning. Collaboration between students from different countries and info sharing was facilitated through Skype and Microsoft One Note software. Upon completing the task, the groups created simple presentations as tangible evidence to exemplify their understanding of their research. This project shows that collaborative STEM learning can be done even between different countries, although there are undeniably various challenges, such as different cultures and languages, in the project.
Malaysia	Preliminary Review On Preparations In Malaysia To Improve Stem Education (Chong, 2019)	This article analyzes Malaysia's readiness to implement STEM Education and compares it with the preparation of East Asian countries. This research aims to understand the extent of Malaysia's efforts to achieve the Sustainable Development Goals (SDGs). The results show that the effectiveness of learning methods in Malaysia needs to be systematically improved by using

ISSN (Online): 2961-9602

		the STEM approach to achieve learning that is aligned with the SDGs' demands in Malaysia
Singapora	International comparison of K-12 STEM teaching practices (Tawbush et al., 2020)	This article compares the implementation of STEM learning at the secondary level in Italy, India, and Singapore. The results show that Singapore's STEM learning practices are more student-centered than India's.
Singapura	STEM Education Landscape: The Case of Singapore (Teo, 2019)	STEM approaches have been integrated into the curriculum in many secondary schools, particularly in STEM-focused career and technical education. As a concrete example, schools in Singapore have collaborated with the Shell Singapore company to encourage creative ideas to create vibrant, healthy, and clean cities for the future. This collaboration is realized through competitions and workshops designed to stimulate innovative thinking.
Vietnam	Students And Teachers' Perspective Of The Importance Of Arts In Steam Education In Vietnam (Hau et al., 2020)	The findings of this study show that STEM-based learning in Vietnam emphasizes the creative role in problem solving. Some schools in Vietnam integrate arts in STEAM (Science, Technology, Engineering, Arts, and Mathematics) education to enhance creativity and innovation.
Vietnam	Integrated Science, Technology, Engineering and Mathematics (STEM) Education through Active Experience of Designing Technical Toys in Vietnamese Schools (Quang et al., 2015)	This article discusses integrating STEM education with creative activity design and practical experience in Vietnamese education. Schools in Vietnam have implemented a practical learning model by integrating STEM into teaching technology in secondary schools, particularly through developing technical games. This practical model is implemented through STEM learning and is designed with technical games for Vietnamese secondary school students.
Philippina	Social Equity and Access to a Philippine STEM School (Talaue, 2014)	This research discusses how the Philippines made tremendous efforts to establish STEM schools to develop a scientific workforce geared towards advancement in the economic and technological fields in the long run.
Thailand	Approaches for Implementing STEM (Science, Technology, Engineering & Mathematics) Activities among Middle School Students in Thailand. (Changtong et al., 2020)	This article compares three different models for implementing STEM activities of secondary school students in Thailand: the stand-alone engineering model, the linear model, and the jigsaw model. The results show that the linear and jigsaw models are significantly superior in solving problems in STEM learning compared to the stand-alone engineering design models.
Indonesia	Implementation Of Stem Education In Indonesia: Teacher Analysis Result Of Stem Education (Suwarma & Kumano, 2014)	This article analyzes teachers' perceptions of STEM coherence in curriculum implementation. The results show that the 2013 Curriculum in Indonesia has higher coherence compared to the Education Unit Level Curriculum (KTSP).

ISSN (Online): 2961-9602

Indonesia	The Types of STEM Education Implementation in Indonesia (Arlinwibowo et al., 2020)	This study aims to identify variations in STEM implementation in Indonesia. The findings show that STEM implementation in Indonesia is divided into three types: STEM integration at the school scale, the establishment of STEM subjects, and STEM integration within a subject. Each type of implementation in schools has characteristics influenced by factors such as principal commitment, school facilities, student characteristics, and peer support.

DISCUSSION

Based on the literature review results above, there are differences in the implementation of STEM learning in ASEAN countries with diverse cultural characteristics. Singapore shows better readiness to integrate STEM into the curriculum with the support of government policies. Singapore also has a more advanced technology infrastructure and a dominant English language, reducing language barriers. Malaysia also appears better prepared than Vietnam, Thailand, the Philippines, and Indonesia. Malaysia has integrated STEM into the education curriculum and linked STEM learning to the Sustainable Development Goals (SDGs). The culture of Malaysian citizens also contributes to supporting STEM-based learning, with parents giving their full support.

On the other hand, Indonesia, Vietnam, and the Philippines have similarities in developing STEM-based learning. In terms of culture, these three countries are still developing towards better education. These three countries show their characteristics in applying STEM in the learning process. In Indonesia, STEM is integrated with Curriculum 2013, while in the Philippines and Vietnam, the implementation of STEM involves different techniques, such as through art activities to solve problems in learning.

The STEM approach can be integrated in various ways, including with existing cultural values. The argument is not without reason because technological advances will directly relate to various aspects of human life in the economic, social, political, and cultural fields. In practice, STEM educators lack a cohesive understanding of the STEM approach Kelley & Knowles (2016).

It seems that STEM is only geared toward answering technology-related challenges, which may lead to individualistic goals. As a result, students are often disinterested in science and math when they learn isolated and disconnectedly, missing connections to cross-cutting concepts and real-world applications. Therefore, (Kelley & Knowles, 2016) suggest using a STEM approach that integrates other theories to build a comprehensive STEM education framework. Combining STEM approaches with interdisciplinary subjects such as culture and history is an alternative to removing the negative stigma of STEM, which only focuses on producing the generation of "workers" needed to face global demands. Ironically, educational institutions such as schools and universities have yet to recognize the need to integrate STEM with cultural and historical aspects.

In many countries, efforts to integrate STEM with culture are gaining attention. For example, Aronson and Laughter (Lopez, 2016) have formulated the concept of "culturally relevant education" as a synthesis of education that integrates math, science, social studies, and language arts. This concept describes a system of social justice-oriented pedagogy, otherwise known as culturally responsive teaching. An important question is how the process of synthesizing culturally relevant education can be applied in STEM. Aronson dan Laughter (Lopez, 2016) revealed four main aspects of synthesizing culturally relevant education with STEM approaches:

1. Building Cultural Bridges: Using constructivist methods to connect students' cultural references with academic skills and concepts.
2. Critical Reflection: Engage students in critical reflection on their lives and society.

ISSN (Online): 2961-9602

3. Cultural Competence: Facilitating students in achieving cultural competence means "helping students to recognize and respect their own cultural beliefs and practices while gaining access to broader cultures" and STEM cultures (Ladson-Billings in Lopez, 2016);
4. System Deconstruction: Unmasking and exposing oppressive systems through critiquing the discourse of power.

Cultural integration in STEM is essential to creating a more inclusive and relevant education system for all students. This approach will help eliminate cultural gaps in education and create a generation with the necessary skills and insights to face future global challenges. STEM approaches should be encouraged to support participation through real-life experiences. This will enhance collaboration and generate a broader perspective, allowing STEM to resonate with other approaches, including integrating cultural values. Cultural integration in STEM will connect scientific concepts with real-life aspects without compromising academic value. The following is the design of a culturally responsive STEM approach.

Table 2: Design of culturally responsive STEM approach

STEM is Culturally Responsive	Example of Culturally Responsive STEM Implementation
Field of Mathematics	Development of Understanding and Action: Students select relevant topics for inquiry and utilize mathematical analysis to affect social change in their communities.
	Math in Context: Students solve math problems connected to their daily lives and communities, enhancing their understanding of the practical applications of math.
	Collaboration and Application: Students engage in collaborative projects with families, focusing on real-world applications, such as construction and other social projects, enhancing their understanding of the application of math and the development of collaborative skills.
	Inequality Analysis: Students use mathematical analysis to examine inequalities in social life, increasing their awareness of social issues and developing their analytical skills.
Science of Field	Application of Scientific Principles to Social Problem Solving: Students apply scientific principles to analyze and seek solutions to social injustices, such as local water pollution, encouraging their engagement in seeking scientifically-based solutions to social problems.
	Integration of Culture and Scientific Concepts: Students make connections between traditional cultural practices, such as arrow making and throwing, and science concepts, such as accelerated motion, demonstrating how science can be understood in a cultural context.
	Cultural Awareness and Instructional Relevance: Students explicitly express how their linguistic and cultural experiences and values relate to science through instructional appropriateness, increasing their awareness of the importance of connecting culture to science.
	Development of Scientific Inquiry Skills: Students develop their lines of scientific inquiry, which, combined with authentic models of scientific inquiry, enhance their scientific inquiry skills and enable them to develop scientific ideas independently.
	Engineering Applying Scientific Concepts in Real Contexts: Students apply scientific concepts learned in school in real-world contexts in their immediate

ISSN (Online): 2961-9602

Engineering and Technology of Field	environment, connecting theory with practice and enhancing their understanding of the applications of science.
	Integration of Traditional Knowledge and Innovation: Students learn from the traditional knowledge held by elders in their community (e.g., tribal elders), who introduce them to traditional ways of seeking solutions to local problems. Students then use new or traditional tools and approaches to develop solutions to similar problems, integrating traditional knowledge with modern approaches.
	Development of Culture-Based Solutions: Students imbibe the cultural values of their community, including the desire to help their family and community and the courage to overcome adverse structures. They apply engineering and technical principles to manage existing resources to find culturally-based and sustainable solutions.

Source: Tate 1995, Ensign 2003, Razfar 2012, Civil & Khan, 2001, Gutstein 2003, Dimick 2012, Grimberg & Gummer 2013, Buxton 2006, Lee & Buxton 2013, Wilson-Lopez, Mejia,Hasbún & Kasun 2016, Kern, Howard, Brasch, Fiedler, & Cadwell 2015, Samuelson & Litzler, 2016 (in Lopez, 2016)

The description of the table above provides an understanding of how STEM is applied by integrating existing cultural values through the analysis of math, science, and engineering. Of course, this will tremendously impact students because it places students as subjects directly dealing with existing realities. Learning from a cultural context involves the concept of self and others, social relationships, and the concept of knowledge. Therefore, it will undoubtedly be better for learning because it incorporates logical thinking and creative problem-solving skills, which are then transformed into communication skills and employability skills into the inputs needed for success in STEM-based education development outcomes (Hossain & Robinson, 2012)

Each country has characteristics in terms of culture and other local wisdom values. For ASEAN countries, the STEM approach integrates distinctive local cultural values, creating many learning opportunities. However, a literature review shows minimal research on STEM implementation in primary schools, especially those considering cultural integration.

The study results of STEM learning implementation in ASEAN countries are still too focused on middle and high school levels. Studies on STEM implementation at the primary school level are still relatively minimal. This raises an important question: Why is the implementation of STEM learning in primary schools still lagging? The need for further exploration of the factors that hinder STEM implementation at the primary level is an essential agenda for further research. Understanding how STEM learning can be effectively designed for primary school students in ASEAN countries with diverse cultural characteristics is essential.

ISSN (Online): 2961-9602

Developing a cultural analysis framework in STEM approaches for primary school can be a crucial starting point. This involves: 1) Understanding the cultural context: Understanding the prevailing cultural values, traditions and languages in each ASEAN country to ensure that STEM learning is aligned with the local culture; 2) Utilization of local cultural resources: Incorporating local cultural resources such as folklore, traditional games, and cultural objects in STEM learning activities to enhance engagement and relevance; 3) Development of relevant learning materials: Designing STEM learning materials tailored to the needs and interests of students in primary schools, taking into account relevant cultural aspects.

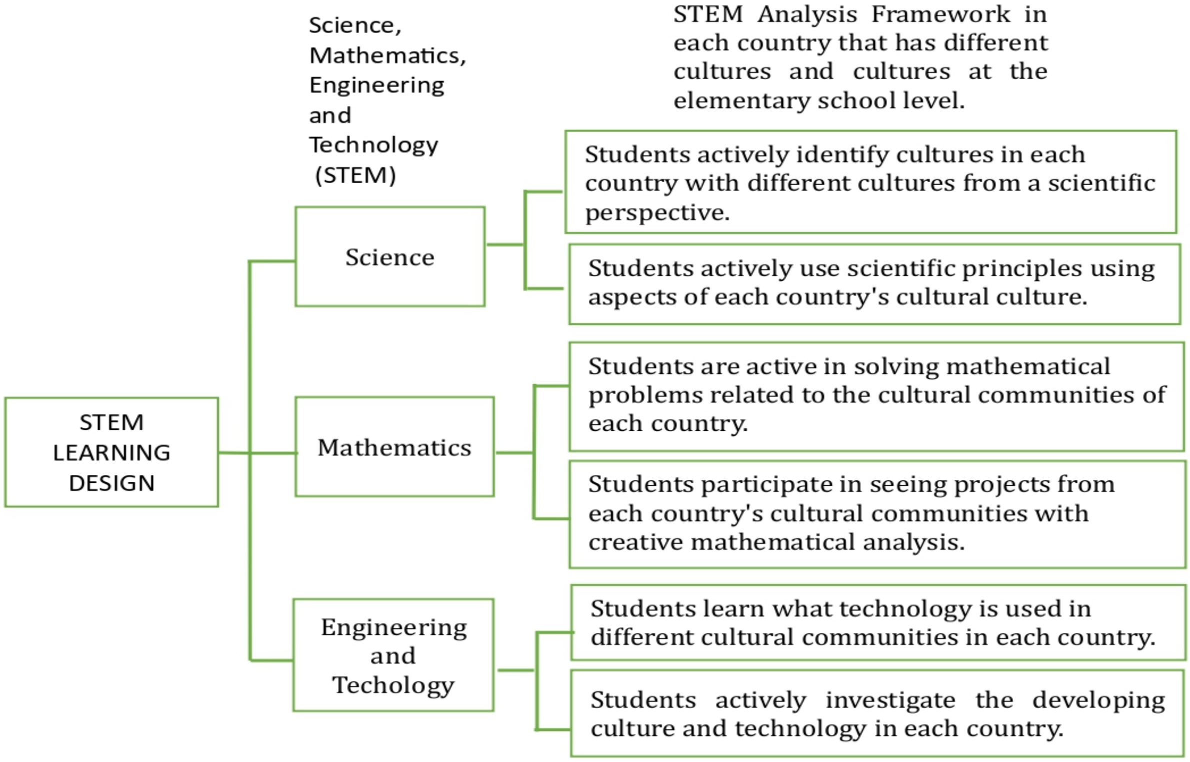


Figure 1. Cultural analysis scheme in the stem approach in elementary schools

By building a deeper understanding of the cultural context and designing learning strategies responsive to primary school students' needs, the potential of STEM education in the ASEAN region can be maximized. Further research focusing on the implementation of STEM in primary schools can contribute to driving educational progress in the ASEAN region. The following is a schematic design of cultural analysis using the STEM approach at the primary school level. The figure-1 explains how the characteristics of cultural values owned by each country are used as a framework for analyzing STEM learning approaches in elementary schools. Activity is vital in STEM learning at the primary level, so the design of this approach should not ignore students' outward instincts.

Put, science, math, and technology activities must be combined with a series of play activities to support a fun and meaningful learning process for students. The challenge lies in the ability of primary school teachers to design STEM learning designs that take into account students' characteristics and relate their cultural dimensions. The next question is how primary school teachers implement cultural relevance in STEM teaching. Brown et al. (2019) emphasized that teachers must have a concrete understanding of cultural information (including values and habits) to integrate it with STEM approaches. By understanding and integrating culture in STEM

ISSN (Online): 2961-9602

learning, teachers can create more engaging, relevant, and meaningful learning experiences for students, thus increasing their motivation and understanding of STEM concepts.

CONCLUSION

This article highlights the importance of integrating cultural values in STEM approaches to create more engaging, relevant, and meaningful learning experiences for students. This cultural integration involves understanding the cultural context, utilizing local cultural resources, and developing learning materials tailored to students' needs and interests. Further research focusing on the implementation of STEM in primary schools by considering the diverse cultural contexts in ASEAN can significantly contribute to promoting educational progress in the region. Developing a cultural analysis framework in the STEM approach for primary schools is a crucial first step. This article concludes that culturally responsive STEM approaches can potentially increase students' motivation, engagement, and understanding of STEM concepts while preparing them to face future global challenges. Integrating culture in STEM will create a more inclusive and relevant education system for all students while supporting participation and collaboration in building a broader perspective.

REFERENCES

Anhalt, C. O., Staats, S., Cortez, R., & Civil, M. (2018). Mathematical Modeling and Culturally Relevant Pedagogy. In Y. J. Dori, Z. R. Mevarech, & D. R. Baker (Eds.), Cognitiion, Metacognition, and Culture in STEM Education (pp. 307–330). Springer.

Arlinwibowo, J., Retnawati, H., & Badrun, K. (2020). The Types of STEM Education Implementation in Indonesia. Journal of Xi'an University of Architecture & Technology, XII(Viii), 606–613.

Baharin, N., & Kamarudin, N. (2017). STEM ASEAN Project to Promote 21 st Century Teaching and Learning. Learning Science and Mathematics, 13, 98–114. http://www.recsam.edu.my/joomla/lsmjournal/98http://www.recsam.edu.my/joomla/lsmjournal/99

Brown, B. A., Boda, P., Lemmi, C., & Monroe, X. (2019). Moving Culturally Relevant Pedagogy From Theory to Practice: Exploring Teachers' Application of Culturally Relevant Education in Science and Mathematics. Urban Education, 54(6), 775–803. https://doi.org/10.1177/0042085918794802

Changtong, N., Maneejek, N., & Yasri, P. (2020). Approaches for Implementing STEM (Science, Technology, Engineering & Mathematics) Activities among Middle School Students in Thailand. International Journal of Educational Methodology, 6(1), 185–198. https://doi.org/10.12973/ijem.6.1.185

Cheng, K. (2017). Advancing 21st Century Competencies in East Asian Education Systems (Issue February). https://asiasociety.org/files/21st-century-competencies-east-asian-education-systems.pdf

Chesky, N. Z., & Wolfmeyer, M. R. (2015). Philosophy of STEM Education: A Critical Investigation. In A. G. Rud (Ed.), Palgrave Macmillan (The cultur). Palgrave Macmillan. https://doi.org/10.1057/9781137535467

Chong, C. J. (2019). Preliminary review on preparations in Malyasia to improve STEM Education. Journal of Sustainability Science and Management, 14(5), 135–147.

Cooper, C., Booth, A., Varley-Campbell, J., Britten, N., & Garside, R. (2018). Defining the process to literature searching in systematic reviews: A literature review of guidance and supporting studies. BMC Medical Research Methodology, 18(1), 1–14. https://doi.org/10.1186/s12874-018-0545-3

Franco, M. S., & Patel, N. H. (2013). STEM Schools: Facilitating Student Engagement and College Readiness. In M. M. Capraro, R. M. Capraro, & C. W. Lewis (Eds.), Improving Urban Schools Education for All Students: Equity and access in K-12 STEM Education fo all students (A volume i). Information Age Publishing Inc.

Hattie, J. (2016). Making STEM a primary priority (Issue March). https://www.pwc.com.au/pdf/making-stem-a-primary-priority.pdf

Hau, N. H., Cuong, T. V., & Tinh, T. T. (2020). Students and teachers' perspective of the importance of arts in steam education in Vietnam. Journal of Critical Reviews, 7(11), 666–671. https://doi.org/10.31838/jcr.07.11.121

Hossain, M. M., & Robinson, M. G. (2012). How to Motivate US Students to Pursue STEM (Science, Technology, Engineering and Mathematics) Careers. US-China Education Review, 442–451.

Kalolo, J. F. (2016). Re-Aligning Approaches for Successful Implementation of STEM Education in Today's Elementary Schools in Developing Countries: Policy Commitments and Practices. Journal of Education and Literature, 4(2), 61–76. http://www.rassweb.com

Kelley, T. R., & Knowles, J. G. (2016). A conceptual framework for integrated STEM education. International Journal of STEM Education, 3(11). https://doi.org/10.1186/s40594-016-0046-z

Langdon, D., McKittrick, G., Beede, D., Khan, B., & Doms, M. (2011). STEM: Good jobs now and for the future. https://www.commerce.gov/sites/default/files/migrated/reports/stemfinalyjuly14_1.pdf

Lopez, A. W. (2016). Culturally responsive STEM education. In Culturally Relevant Education. https://cadrek12.org/sites/default/files/Culturally Responsive STEM Education.pdf

Organisation for Economic Co-operation and Development (OECD). (2015). PISA results in Focus 2015. https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf

Organisation for Economic Co-operation and Development (OECD). (2019). PISA 2018: Insights and interpretations. https://doi.org/10.1787/d0f4a644-en

Quang, L. X., Hoang, L. H., Chuan, V. D., Nam, N. H., Anh, N. T. T., & Nhung, V. T. H. (2015). Integrated Science, Technology, Engineering and Mathematics (STEM) Education through Active Experience of Designing Technical Toys in Vietnamese Schools. British Journal of Education, Society & Behavioural Science, 11(2), 1–12. https://doi.org/10.9734/bjesbs/2015/19429

Sorenson, B. (2010). Alaska STEM edocation and the economy: Report on the need for improved engineering and mathematics education in Alaska (Issue November). https://www.jedc.org/forms/STEMEducationJEDCFinal.pdf

Srikoom, W., Faikhamta, C., & Hanuscin, D. L. (2018). Dimensions of Effective STEM Integrated Teaching Practice. K-12 STEM Education, 4(2), 313–330. https://pdfs.semanticscholar.org/f70e/61c9196d3af8ae6990753d12ecbc4c0ea758.pdf?_ga=2.194362734.2132636689.1570570157-155469691.1570570157

Suwarma, I. R., & Kumano, Y. . (2014). Implementation of STEM Education in Indonesia: Teacher analysis result of STEM education. Japan Society for Science Education, 38.

Talaue, F. T. (2014). Social Equity and Access to a Philippine STEM School. Theory into Practice, 53(1), 33–40. https://doi.org/10.1080/00405841.2014.862120

Tawbush, R. L., Stanley, S. D., Campbell, T. G., & Webb, M. A. (2020). International comparison of K-12 STEM teaching practices. Journal of Research in Innovative Teaching & Learning, 13(1), 115–128. https://doi.org/10.1108/jrit-01-2020-0004

Teo, T. W. (2019). STEM Education Landscape: The Case of Singapore. Journal of Physics: Conference Series, 1340(1). https://doi.org/10.1088/1742-6596/1340/1/012002

Torraco, R. J. (2005). Writing Integrative Literature Reviews: Guidelines and Examples. Human Resource Development Review, 4(3), 356–367. https://doi.org/10.1177/1534484305278283