Integrating STEM Education With Local Culture in Indonesia: Teachers' Perspective and Practice

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Abstract
STEM education based on local culture produces a more contextual and meaningful learning experience for students. However, the practical implementation has led to numerous issues. The study aims to describe the challenges teachers face in implementing STEM education based on local culture and explore the teacher practice related to understanding and teaching strategies in STEM education. The total participants were 143 teachers who taught science, social, and other subjects. The data were collected using the survey method and analyzed with descriptive statistics. The results show that 51% of teachers answered that integrating local culture into learning is essential because it can preserve local culture and introduce culture to the younger generation by presenting contextual learning. However, 59.4% of teachers have never applied STEM in learning, and 40.6% of teachers are still confused about its application, even though they have heard of STEM before. The data indicated that the teachers faced many challenges regarding their understanding, practical constraints, teaching strategies, and STEM integrated with local wisdom. Notably, the findings show that most teachers have a lack of understanding of how to link STEM education and local contextual values. The strategy of integrating culture into learning is considered the most effective if it is done by developing teaching materials based on STEM. The implications of teaching strategies of STEM education related to local wisdom are discussed.

Keywords: Local Culture, STEM, Contextual Learning

Introduction

Indonesia is known to have a rich cultural heritage, which is an important aspect of its national identity. The lack of culture-based learning in schools has become a major concern in education (Susilo & Irwansyah, 2019). Educational curricula tend to ignore society's rich and diverse cultural aspects. The current learning process only focuses on understanding general concepts, which do not integrate local cultural elements. As a result, students lose the opportunity to explore their cultural roots, hindering their understanding of cultural diversity (Affandy, 2017). In this context, the lack of integration of cultural elements in the curriculum affects the overall quality of education. Also, it affects students' understanding of cultural values that influence their daily lives.

One of the direct impacts of the lack of culture-based learning is that few students know their local culture. Students are often more familiar with global culture than their environment. This can result in indifference to local cultural heritage and a lack of appreciation for the values, traditions, and history that shape their regional identity. The small number of students who know their own local culture can lead to a loss of students' sense of attachment to their local community and culture, which is an important element in forming individual identity.

Apart from the lack of culture-based learning and a lack of understanding of local culture, a problem that often occurs in the classroom is an uninteresting and contextual learning process (Firmadani, 2020). Teaching methods that are monotonous and less relevant to everyday life make students feel bored and less motivated to learn (Insani, et al., 2023; Syaparudin, 2020). Contextual learning and linking the subject matter to local culture can make learning more interesting, relevant, and meaningful for students (Anikarnisia & Wilujeng, 2020). This way, students will be more involved in learning and naturally better understand and appreciate their local culture. In line with current technological developments, one of the efforts that can be made to make learning more interesting is to integrate learning with a STEM approach, thereby producing learning with a STEM approach based on local culture.

The STEM approach makes learning more interesting and relevant to everyday life and encourages students to be innovative and creative in designing solutions to face real-world problems. STEM education equips students with the knowledge and skills they need to succeed in the 21st century (Kennedy & Odell, 2023). The STEM approach is very relevant to the demands and developments of the 21st century because it provides a strong framework for teaching students how to think critically and creatively in solving problems (Prasadi et al., 2020; Anikatnisia & Wilujeng, Irhasyuarna, 2022). The STEM approach can also improve students' soft skills, such as communication, collaboration, and leadership, which are very important in the 21st century.

The learning process in Taiwan starts from the STEM curriculum and makes students the center of learning. The curriculum defines five main objectives: increasing students' abilities, involvement, and interest in STEM, increasing teacher capacity and the quality of teaching of STEM subjects, supporting opportunities for STEM education in schools, and promoting effective partnerships (Permanasari et al., 2021). Learning activities the application of the STEM approach can increase student involvement in the learning process so that students will be more motivated and enthusiastic to participate in the learning process. However, the integration of local culture into STEM-based learning is needed to increase cultural preservation (Agusty et al., 2021; Hikmawati et al., 2020; Kartini et al., 2021).

Research by Budiarti (2022) on the development of STEAM-based learning tools to promote the preservation of local culture in Indonesia shows that this approach can increase students' interest and understanding of local culture. However, the initial survey results show that many teachers still experience obstacles in integrating culture and STEM approaches in learning. Teachers do not yet understand the characteristics of STEM implementation, and there is a lack of socialization of local culture in learning at school, so researchers feel it is necessary to examine teachers' perceptions of local culture-based STEM learning. Therefore, this article aims to describe teachers' understanding of STEM approaches and local culture, implementation strategies, and experienced strategies.

Method

This research uses a descriptive approach with a survey method. The number of respondents involved was 143 teachers who taught science, social studies, and other subjects at the junior and senior high school levels. The instrument used in this research was a questionnaire distributed via Google Forms. Data was collected using a survey method and analyzed with descriptive statistics.

Results and Discussion

Researchers carry out needs analysis activities or needs assessments to collect information based on conditions in the field that have occurred so far. The information studied is related to the needs, problems, and challenges that have been faced by the research object and require overcoming.

Based on the survey results, information was obtained that 40.6% of teachers had heard the term STEM but were still confused about its application, 36.4% of teachers had often heard the term STEM but had not fully understood the concept of its application, and only 9.8% had often heard it and had applied it. Although it is not optimal, 11.2% of teachers have never heard of the term STEM. This finding is a reference for researchers that STEM application is still rarely implemented by teachers in schools.

Strategies of Implementation STEM

Besides a survey of teachers' understanding of STEM, researchers also investigated teachers' responses regarding effective STEM implementation strategies. This was done to determine teachers' responses regarding effective strategies for implementing STEM in the classroom learning process. The survey results can be seen in the following graph:

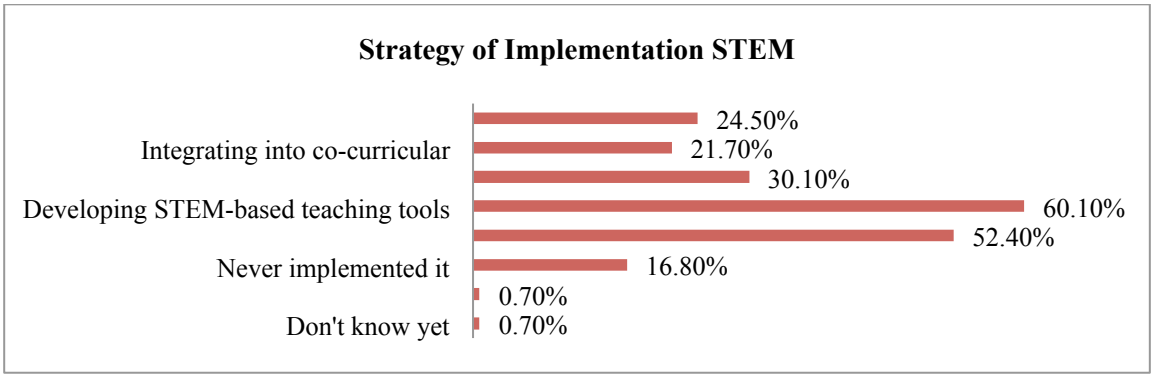

Figure 1. The Strategy of Implementation STEM

Developing STEM-based teaching tools is a strategy that is often chosen by teachers, with a percentage of 60.1%. This follows the results of research conducted by Widiyanti & Mizan (2020), who found that students effectively use the development of learning tools and can improve STEM abilities and 21st-century skills. Furthermore, 52.4% of teachers chose to develop STEM-based media. In addition, 30.1% of teachers chose to integrate STEM intra-curricular, and 24.5% considered integrating extra-curricular as an effective STEM implementation strategy. Based on the data, the researcher obtained information according to teachers' responses regarding the most effective strategy in implementing STEM, namely developing STEM-based teaching tools. Murphy (2023), in his research, found that leadership practices also contribute to the success of STEM education. There are five leadership practices identified as contributing to the success of STEM education in schools, namely utilizing community relations, utilizing local resources, empowering STEM teaching staff, promoting the value of STEM education and supporting STEM pathways.

The Urgency of STEM Education

According to the urgency of STEM, the data revealed teachers' responses regarding the important of STEM education in teaching and learning activities. Survey results regarding teachers' views on the importance of STEM will provide valuable insight into efforts to increase understanding and application of STEM in school learning. Researchers asked questions in multiple complex forms so that teachers could choose several answers to discover teachers' perceptions about the urgency of STEM in learning. The results obtained can be seen in the table 1.

No	The Urgency of STEM in Learning	(%)
1	Have never applied STEM in learning	59.4%
2.	It has been implemented even though the implementation concept has not been maximized	36.5%
3.	Have already implemented and understand the implementation strategy	2.1%
4.	Have applied STEM several times	2%

Table 1.The Urgency of Applying STEM in Learning

Table 1 shows that more than half of the respondents, 59.4% of teachers, have never applied STEM in learning, only 2.1% have implemented and understood implementation strategies, and 2% have applied it several times. This shows a need for follow-up action that can raise teachers' enthusiasm to apply STEM in learning. Based on the results of this research, researchers found that few teachers apply STEM in learning, even though as many as 62% of teachers think that STEM can help students solve problems. The application of STEM in learning activities can train students' skills in developing creativity, critical thinking, collaborating, communicating (4C), and problem-solving so that they can find solutions to problems faced in real life and can convey them well (Astuti et al., 2021; Sarwi et al., 2020). This is in accordance with research conducted by Sudarsono et al. (2022), which found that the problem-solving abilities of students who received learning through STEM improved better than students who received regular learning. Also, 54.5% of teachers think STEM can help students produce products. STEM programs have a positive and significant impact on various grade levels in schools. Overall, students in high school benefit from STEM programs, on average, students outperform their same-age and same-age peers who do not participate in STEM programs (Thomas & Larwin, 2023).

The Barriers of STEM Implementation

The survey in this research was also carried out to find out information regarding the obstacles experienced by teachers regarding the application of STEM in learning. The results obtained can be seen in the following graph:

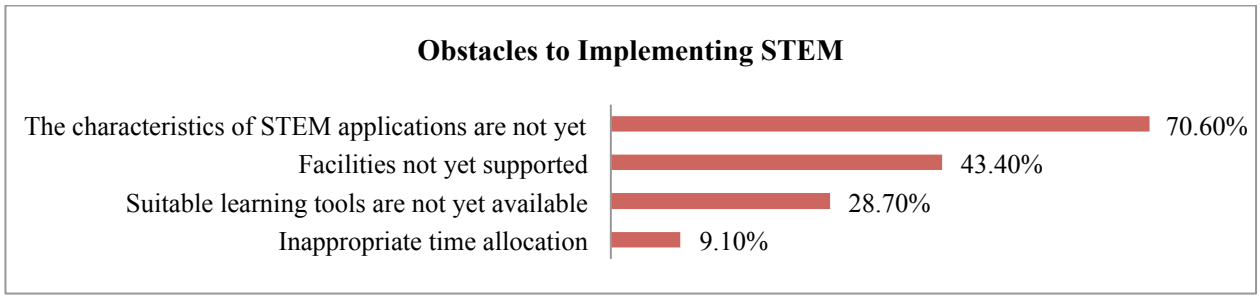

Figure 2. Barriers of Implementation STEM

Based on Figure 2 above, information is obtained that the biggest obstacle experienced by teachers in implementing STEM is that teachers experience problems with the characteristics of STEM implementation, which are not yet understood in depth. This aligns with research conducted by Diana & Turmudi (2021) that teachers' knowledge of STEM is still dominated by knowledge of what STEM stands for. Then, 70.6% of teachers chose this answer. Apart from that, as many as 43.4% experienced problems with unsupported facilities, 28.7% with unavailability of supporting learning tools, and 9.1% with inadequate time allocation. Based on this data, it turns out that many teachers do not understand in depth the characteristics of applying STEM in learning, so many teachers do not apply STEM in the learning process as per the results of research conducted by Oktavia (2019).

Cultural Integrating Strategies

The integration of local culture in learning is considered important by teachers, and this is proven by 51% of teachers who answered that integrating local culture into learning is very important because it can preserve local culture and introduce culture to the younger generation by presenting contextual learning.

Integrating local culture in teaching materials is the strategy considered the most effective by teachers, with a percentage of 66.4%. As many as 62.2% of teachers chose to package IT-based cultural content as a cultural integration strategy in learning. Other strategies are developing culture-based teaching tools by 53.1% and culture-based media by 42.7%. With this data, researchers can obtain information about an effective strategy for integrating culture in learning by integrating culture into teaching materials. Apart from that, the method of integrating local culture in learning that is considered the most effective according to teachers is the demonstration of local culture at school (75.5%), knowledge management system (57.3%), and local culture FGD between schools and indigenous communities (45 .5%). Integrating cultural values in the learning process has an important role in forming students' personalities (Syarif et al., 2016). Instilling local culture in education is important to instill national identity and identity. This is a strategic step to integrate local culture in learning (Prihatsari, & Widyaningrum, 2021). The presence of learning innovation is very necessary to make learning more enjoyable. One way is to link local culture to learning (Widyaningrum & Prihatsari, 2021).

Integrating Local Culture Methods

Using local culture in learning, either as a learning model, media, or teaching materials, both as a learning model or media, can introduce forms of local culture to students and internalize the values contained in that local culture (Syaputra, 2019). Local culture demonstrations in schools are the integration method most often chosen by teachers, with a percentage of 75%, knowledge management systems with a percentage of 57.6%, and 45.1% of teachers choose local culture FGDs between schools and indigenous communities. In addition, 51.4% of teachers think that teachers need to utilize ICT to integrate local culture into learning. ICT in integrating local culture can be used through a STEM approach. Technology aims to modify the world of science and technology to meet human needs. One of the goals of STEM education is for students to become problem solvers, inventors, innovators, independent, logical thinkers, and technologically literate and able to make connections between cultural history, education, and their knowledge which is applied in real life. Therefore, implementing STEM-based learning integrated with local culture needs to be encouraged among students (Limba & Jamarua, 2021). Technology is essential in shaping STEM identity; the two mutually reinforce each other. Based on research by Sumarni et al. (2020), local culture can also be integrated with religion. Combining religion and culture into science learning will be an exciting combination and a STEM identity needs to be developed based on the differences between students' religious beliefs and learning concepts in the classroom. Yuecheng (2023) stated that although traditional culture and STEM education seem different, there is a relationship between the two, integrating traditional culture and STEM education in education can provide students with more comprehensive and diverse content and broader skills and knowledge for their future careers. Tabarés & Alejandra (2023) in their research stated that culture can provide some potential to encourage an integrative vision of STEM education and other disciplines from the social sciences and humanities.

Conclusion

More than 50% of teachers have never applied STEM in learning. Only 2% of teachers have applied STEM several times, even though teachers think that STEM can help students solve problems, practice 4C skills, and help students produce products. Many teachers do not understand STEM characteristics, and no supporting facilities are available. Apart from that, 51.4% of teachers think integrating local culture into learning is very important, and teachers must utilize ICT to integrate local culture. ICT in integrating local culture can be used through a STEM approach by developing STEM-based teaching tools, as 60.1% of teachers chose to develop STEM-based teaching tools as a strategy for implementing STEM.

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