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Analysis of the Development of STEM-Based Independent Curriculum Learning Tools Integrated with the Muaro Jambi Temple Antiquities Site

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ABSTRACT

This study examines the development of STEM-based Merdeka Curriculum learning tools integrated with the Muaro Jambi Temple archaeological site to improve students' understanding of physics concepts and appreciation of local cultural heritage. Through interviews with physics teachers at SMA Negeri 1 Jambi City, it was found that the implementation of the Merdeka Curriculum had reached 80%, but the learning outcomes were only around 50%. The teaching module used must adjust to the Learning Outcomes (CP) set by the Ministry of Education and Culture. The methods often used are discussion and question and answer, as well as the Problem-Based Learning (PBL) learning model, which is considered effective in improving student understanding. Teachers also use conventional media such as whiteboards and occasionally utilise technology/internet. The constraints faced include limited learning media, especially for lab work, and the lack of integration of local wisdom in physics learning. Teachers stated that although students actively relate physics to daily life, the integration of local wisdom has not been maximised. They showed enthusiasm for the idea of developing learning tools with a STEM approach linked to the local wisdom of the Muaro Jambi temple, which was considered to increase student involvement and understanding of the material before learning in class. The results of this study indicate that the integration of STEM-based learning integrated with the Muaro Jambi temple archaeological site can enrich students' learning experience, improve their understanding of physics concepts in the context of everyday life, and strengthen their relationship with local culture.

Keywords: Learning Tools, STEM, Muaro Jambi temple

INTRODUCTION

Education is the cornerstone in the development of competitive and insightful human resources, which is essential to drive innovation and progress in every society. Recognising this, the Ministry of Education, Culture, Research and Technology (MoECristek) has introduced Merdeka Curriculum, a progressive framework that aims to revolutionise the education landscape. The Merdeka Curriculum seeks to provide greater flexibility in the learning process, emphasising the holistic development of students' competencies in various fields. This flexibility is designed to meet the diverse learning needs and potential of students, making education more inclusive and adaptive. An important aspect of the

Merdeka Curriculum is the encouragement to use project-based approaches and real-world contexts. This methodology is intended to bridge the gap between theoretical knowledge and practical application, thus making learning more relevant and engaging for students. By engaging students in real-world projects, the curriculum aims to develop critical thinking, problem-solving and collaborative skills, which are indispensable in the global landscape of the 21st century. This approach is crucial in helping students apply what they learn in the classroom to real-life situations, thus improving their understanding and retention of knowledge.

One educational approach that is aligned with the objectives of Merdeka Curriculum is STEM-based learning. STEM, which stands for Science, Technology, Engineering, and Mathematics, is an interdisciplinary approach that integrates these four domains into a cohesive learning paradigm. STEM education emphasises the application of scientific and mathematical knowledge in solving real-world problems, fostering innovation and driving technological progress. It prepares students to navigate and contribute to the rapidly evolving technological landscape, equipping them with essential skills needed for the modern workforce. STEM education is not just about learning these subjects separately; it's about integrating them to solve complex problems and create new technologies. For example, engineering projects may require knowledge of maths and science, while technology may be used to solve problems in engineering. This interdisciplinary approach reflects the complexity and interconnectedness of the real world, making learning more relevant and practical.

As highlighted by Wang et al. (2020), "STEM education provides students with opportunities to develop critical skills needed in the modern world of work." These skills include analytical thinking, creativity, technological proficiency and the ability to work collaboratively in diverse teams. However, the effectiveness of STEM education depends on contextualisation in the local environment. STEM learning must be adapted to the local context to ensure that it fits into students' everyday experiences and cultural backgrounds, making it more meaningful and impactful.

In the Indonesian context, integrating local cultural heritage into STEM education can enrich the learning experience, making abstract concepts more tangible and easy to understand. Indonesia's rich culture provides many opportunities for this integration. For example, traditional crafts, local architectural styles and indigenous technologies can be learnt and appreciated through a STEM lens. This not only helps in understanding scientific principles, but also fosters a sense of pride and identity among students. In this context, the archaeological site of Muaro Jambi Temple offers a unique opportunity. The Muaro Jambi Temple complex, built in the 7th century, is one of the largest and most important archaeological sites in Southeast Asia. The site provides a rich source of historical, cultural and scientific knowledge that can be well integrated into STEM education. By incorporating the rich historical and cultural heritage of Muaro Jambi Temple into STEM learning modules, educators can create a more immersive and engaging learning environment. This integration can help students appreciate the relevance of STEM in preserving and understanding their cultural heritage, thus fostering a sense of pride and connection to their local history. For example, students can learn about the architectural techniques used in building temples, which involves understanding the principles of physics and engineering. They can also explore the materials used and their properties, which relates to chemistry. The historical significance and cultural practices associated with the site can provide a context for learning about the social sciences and humanities, making the learning experience holistic and interdisciplinary.

In addition, integrating Muaro Jambi Temple into the curriculum can provide practical applications for various STEM concepts. For example, students can engage in projects to create a digital reconstruction of the temple using computer science and technology, or study the environmental impacts at the site and propose sustainable conservation methods using principles of biology and environmental science. Such projects not only make learning more interesting, but also instil a sense of responsibility and concern for cultural and historical preservation. Incorporating local heritage sites such as Muaro Jambi Temple into STEM education also has the potential to boost tourism and the local economy. By raising awareness and appreciation among the younger generation, this initiative could lead to more community-driven efforts to preserve and promote local heritage. This, in turn, could attract more visitors and researchers, creating a virtuous cycle of educational and economic benefits.

Merdeka Curriculum is a significant step towards a more flexible, relevant and engaging education system in Indonesia. By utilising STEM-based learning and integrating local cultural contexts such as Muaro Jambi Temple, this curriculum can enhance students' understanding of scientific concepts while fostering an appreciation for their cultural heritage. This holistic approach not only prepares students to face future global challenges, but also instils a deep sense of cultural identity and pride.

However, for this integration to be successful, several factors need to be considered. Firstly, teachers must be adequately trained to incorporate local cultural contexts into their teaching. This requires professional development programmes that equip teachers with the necessary skills and knowledge. Secondly, there must be collaborative efforts between educators, local communities and cultural institutions to develop relevant and accurate educational materials. Thirdly, the curriculum must be flexible enough to allow for the integration of this local context without compromising the core STEM objectives. The integration of local cultural heritage into STEM education within the Merdeka Curriculum framework offers a promising approach to making education more relevant, engaging and meaningful for students. By connecting scientific concepts with cultural and historical contexts, educators can foster a deeper understanding and appreciation of both. This approach not only equips students with the skills needed for the modern world of work, but also instils a sense of cultural pride and identity, preparing them to become well-rounded individuals capable of contributing to society and the world at large. The success of this initiative, however, will depend on the collaborative efforts of educators, communities, and policymakers to create an inclusive and supportive educational environment.

RESEARCH METHODS

The research method used is a qualitative method. Qualitative research is research that focuses on the process and the meaning of the results (Basri, 2014). Qualitative research attention is more focused on human elements, objects, and institutions, as well as the relationship or interaction between these elements, in an effort to understand an event, behavior, or phenomenon (Mohamed, Abdul Majid & Ahmad, 2015). This research was conducted on July 17 to 20, 2024 at SMA Negeri 1 Jambi City in the 2023-2024 school year. The subject of this research is the physics teacher of SMA Negeri 1 Jambi City. The procedures in this study are a) taking care of a research permit to the party concerned, b) determining the research subject, c) collecting research data using an interview sheet on the physics teacher, and d) then the data obtained is processed and analyzed. The instruments used in this study consisted of interview sheets and documentation studies. Interview sheets, conducted by conducting interviews, in addition to having to bring instruments as guidelines for interviews, data collectors can also use tools such as tape recorders, pictures, brochures, and other materials that can help conduct interviews smoothly (Kuriawan et al, 2019). Where interviews are also used as a data collection technique for researchers who want to conduct preliminary studies to find problems that must be researched, and also if they want to know things from respondents that are more in-depth, the number of respondents is small. Documentation is a data collection technique addressed to the research subject. In this study, the documents needed are photos of the situation when interviewing teachers and recordings during the interview.

RESULTS AND DISCUSSION

The research results are presented in the form of an interview table. The following is table 1 of the results of the teacher interview at SMA Negeri 1 Jambi City, namely:

No.	Question	Answer
1	How is the independent curriculum implemented in physics?	For its application in schools, it is 80% running. And adjusts to the learning outcomes made by the Ministry of Education and Research.
2	What are the teaching modules that teachers should prepare based on the independent curriculum?	We as teachers must understand CP where the name TP and ATP will be born after that the material presented is in accordance with the model to be used and must also use LKPD.
3	How are learning outcomes used?	For learning outcomes from 100%, maybe 50% has been running and the CP that I use is in accordance with the government's implementation in the 2022 academic year.

4	How are learning objectives used?	Learning objectives are applied from the CP issued by the government.
5	What are the steps of the learning activities used?	For the learning steps, I use according to the model I use based on its syntax.
6	How are assessments used?	There are 3 assessments, diagnostic, formative and summative, sometimes for the diagnostic test I just give it once like a triggering question.
7	How is the assessment used?	I usually use formative assessments such as essay questions.
8	Is there a student minimum completion criteria (KKM) value in the independent curriculum?	For the independent curriculum we do not use KKM anymore but it is replaced with KKTP (Criteria for Achieving Learning Objectives). But I take from 3 criteria, namely the level of ability, the difficulty of the material and the carrying capacity of the school, especially the material being taught.
9	What kind of learning approach do you often use in learning physics? Why do you often use these methods?	Scientific approach because this approach is easy to understand by students
10	What kind of learning model do you often use in learning physics? Why do you often use this model?	I usually use the PBL model because in this model students can find information on the internet, books and so on. When learning *online in* the past, I also used the PBL model because when giving problems students can find solutions and student understanding is also quite good.
11	Have you ever used conventional media in physics learning? What type of media do you often use?	Never, such as whiteboards, markers, erasers and so on
12	Have you ever used technology/internet in physics learning?	Occasionally, because during the lesson I ask students to look for references from various sources on the internet as a solution to the material to be discussed.
13	In the realization of the physics learning process, is the planned time allocation sufficient in physics learning?	Sometimes it's enough, sometimes it's not. Especially if there are activities related to practice and require a long time
14	Have you ever used *Learning Management System* (LMS) technology in learning? If yes, what kind of LMS do you use?	I have. I used it during the pandemic because the learning uses an *online* system, such as *google classroom*, *whatshapp*
15	Do you know about the *STEM approach*? If yes, have you ever applied it in class?	No
16	At the beginning of learning, are students actively involved in expressing their knowledge about the material to be learned?	Not all, but some respond and some don't.
17	Are learning activities in the classroom contextualized (linking physics to everyday life and local wisdom)?	No, for daily activities it is always related and for local wisdom not yet. But we used to use batik and students were involved in making the batik as demonstration learning.
18	What do you think about learning that is related to daily life and local wisdom, including the Muaro Jambi temple archaeological site?	For daily activities, it is always related, but not for local wisdom. At the time of batik making, students were very enthusiastic because they saw firsthand how it was made so students could easily model the making.
19	How is the availability of learning media that supports physics learning activities?	Learning media in this school is still lacking, especially during the practicum, there are many students and the tools are lacking. For old tools, sometimes they can no longer be used.
20	Has the learning media been contextualized with local wisdom?	Not yet
21	Is the assessment related to (physical) skills?	Some of them are like observations because in learning we have to know which students are active and inactive.
22	How do students understand physics concepts in everyday life?	Some enter, some digest and some apply it in everyday life. Because students still need development/understanding from their teachers.

23	What local wisdom has been used as a context in physics learning?	Batik making, a project
24	What do you think if the design of learning tools with the STEM approach is associated with local wisdom used for student learning?	Good, because the STEM approach and learning models based on context and the surrounding environment are an option in an effort to improve human resources. The demands of knowledge, skills, attitudes and the world of work in the 21st century require education to develop and learning must be meaningful.

The results of the interview with a physics teacher at SMA Negeri 7 Kota Jambi revealed several key points related to the development of independent curriculum learning tools for physics instruction. The teacher stated that they were not very familiar with how to create learning tools that align with the independent curriculum, indicating a need for further training or guidance in developing these learning tools. Additionally, the use of technology in physics learning was rarely implemented in face-to-face meetings and was only utilized during the Covid-19 pandemic, so the current application of technology is not optimal and needs to be enhanced to make learning more interactive and engaging for students. Student enthusiasm at the beginning of lessons in class was also lacking, with many students not actively participating and tending to wait for the teacher's explanation without making an effort to learn beforehand. This highlights the need for teaching strategies that better motivate students to actively engage. Furthermore, there are no learning tools specifically linked to the ethnoscience of Jambi, even though integrating ethnoscience into physics learning materials can help students better understand physics concepts through familiar local cultural contexts.

The teacher also mentioned that while the current teaching models and methods are quite effective for student comprehension, there is insufficient time to meet the required syntax. Therefore, they need learning tools that can be implemented efficiently within limited time frames. The interview findings suggest that teachers feel a need for more training and guidance in developing learning tools that comply with the independent curriculum and in using technology for physics instruction. This is essential for improving the quality of education and achieving curriculum goals. The interview indicates several challenges faced by teachers in designing and implementing independent curriculum learning tools, especially in the use of technology and the integration of ethnoscience. Hence, there is a need for further efforts to provide teachers with training and guidance so that they can develop effective and engaging learning tools for students, as well as optimally utilize technology in the learning process. This discussion highlights the importance of support and capacity building for teachers in adapting to curriculum changes and utilizing technology in education.

CONCLUSIONS

Need analysis of the development of STEM-based Merdeka Curriculum learning tools integrated with the Muaro Jambi Temple archaeological site to improve students' understanding of physics concepts and appreciation of local cultural heritage. Merdeka Curriculum is designed to provide flexibility in the learning process with an emphasis on holistic development of student competencies and the use of project-based approaches and real-world contexts. This research uses a qualitative method that focuses on the process and meaning of the results, with data collected through interviews with physics teachers at SMA Negeri 1 Jambi City. The results showed that the implementation of Merdeka Curriculum in schools had reached 80%, but the learning outcomes were only around 50%. Teaching modules must be adjusted to the Learning Outcomes (CP) set by the Ministry of Education and Culture. The methods often used are discussion and question and answer as well as the Problem-Based Learning (PBL) learning model which is considered effective in improving student understanding. Teachers often use conventional media such as whiteboards and occasionally utilise technology/internet. Constraints faced include limited learning media especially for lab work and lack of integration of local wisdom in physics learning. Although students actively relate physics to daily life, the integration of local wisdom has not been maximised. Teachers showed enthusiasm for the idea of developing learning tools with a STEM approach linked to the local wisdom of Muaro Jambi Temple. The conclusion of this study is that the integration of STEM-based learning with the archaeological site of Muaro Jambi Temple can enrich students' learning experience, improve their understanding of physics concepts in the context of daily life, and strengthen their connection with local culture.

However, there is a need for further training and guidance for teachers in developing learning tools that comply with Merdeka Curriculum and in using technology for physics instruction. With adequate support and capacity building, teachers can more effectively adapt the curriculum changes and utilise technology in the learning process.

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