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Development of Ethno-STEM-based Science Learning Tools

Meida Wulan Sari[1], Icha Kurnia Wati[1], Febriani Sarwenda Asri Nugraheni[1], Suciati[1], Annisa Widyastuti[1], Kiki Kamaliah[1], Arinta Sekar Raihana[1], and Ellis Octavia[1].
[1]Universitas Sebelas Maret, Surabaya, Indonesia

Abstract. Ethno-STEM science learning integrates local wisdom into science materials and is taught using the STEM approach. This research is a process of activities to produce valid learning tools. The learning tools developed in this study are lesson plans (RPP), Student Activity Sheets (LKPD), and student creative thinking skills test sheets. This research focused on the validation test (construct and content as well) and the response test of junior high school students. The data collection technique used was a questionnaire. The instruments used in this study were a validation questionnaire and a student response questionnaire. The validators in this study were two people, namely content experts and learning media experts with a background in science education. The final result of this research is to produce ethno-STEM-based science learning tool development products with valid to very valid categories, and student responses related to the learning tools provided show the highest percentage in the good to excellent category.

Keywords: *Etno-STEM; Science learning; Learning Tools*

INTRODUCTION

Primary skills such as thinking, working, working tools, and living skills are needed by students in the 21st century (Erdem, 2020). Other skills needed in the 21st century are learning and innovation, digital literacy, and career and life skills (Trilling & Fadel, 2009). Even so, basic conceptual knowledge of a subject is still needed. Therefore, learning conducted by teachers, in addition to emphasizing 21st-century skills, also emphasizes basic concepts that students must understand (Craig, 2009).

The learning approach trains 21st-century skills in Science, Technology, Engineering, and Mathematics (STEM)-based learning (White, 2014). This is because learning using STEM requires students to understand the problem, analyze the root of the problem, think about solutions, and test the solutions offered. Indirectly, learning using this approach makes students more trained in 21st-century skills and also makes students try to understand concepts to solve the problems presented (Permanasari, 2016). In addition to training students in the cognitive domain, STEM-based

Corresponding author: Meida Wulan Sari. Email: meidawulan@staff.uns.ac.id

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learning also trains students to be realistic, investigative, value achievement, independent, and someone who is easy to respect others (Carnevale et al., 2011).

While designing STEM-based learning, we need to understand that the learning process is individual and contextual, meaning that the learning process occurs within the individual according to their development and environment. Learning is essentially a process of interaction between students and their environment, students and other students, students and learning resources, and students and teachers. This learning activity will be meaningful for students if it is carried out in a comfortable environment that provides a sense of security for students. One of the comfortable environments for students is an environment in accordance with the region's culture where they grow and develop. The learning given to students according to their environment is integrating local wisdom into science learning.

However, in its relevance to local wisdom, learning (IPA) tends to instill less local wisdom values (Suastra 2010). According to Baker et al. (1995), if science learning in schools ignores culture (local wisdom), then the consequence is that students will reject or only accept some of the science concepts they are learning. The importance of local wisdom-based learning is contained in the Regulation of the Minister of Education and Culture Number 68 of 2013, which states that the 2013 Curriculum was developed using the following philosophy: education is rooted in national culture to build the present and future life of the nation. This is also strengthened in the Law on the National Education System No. 20 of 2013, which states that curriculum development is carried out by referring to national education standards and curricula at all levels and types of education related to the principle of diversification by educational units, regional potential, and students so that the development of the learning process in schools needs to refer to local potential area and environment. According to Kartono et al. (2010), local wisdom-based education can be developed by relying on the uniqueness and superiority of an area, including local (traditional) culture and technology, where the learning process makes local wisdom a part of learning so that students can link their daily lives with existing theories—presented in class.

Ethno-STEM-based learning in 21st-century learning can be realized with the teacher's role in planning the implementation of learning. Teachers must be able to adjust the use of technology in learning, a balance between project-based learning and direct learning, use various assessment strategies, act as mentors, participate in active learning communities (Beatty, 2011), and improve professional skills (Sulaiman & Ismail, 2020). Another crucial thing is the quality of learning tools which must contain all the skills expected of students (AACTE & P21, 2013; Cretu, 2017).

Appropriate learning tools are needed for the continuity of learning in all fields, including Ethno-STEM (Education et al., 2011). These learning tools consist of the teacher's handbook and the student's handbook. Good quality learning tools will help teachers carry out learning and help students know what they should do or achieve in learning. Proper learning tools are characterized by presenting leveled material, providing essential questions, required materials, exercises, and checks for students, success criteria, support, independent practice, and weekly or monthly review (Mazgon & Stefanc, 2012; Rosenshine, 2012). Because of the critical function of learning tools in directing the course of a lesson, the development process needs to be validated to get input in improving the tools being developed. Based on the background description above, it is necessary to develop an Ethno-STEM-based science learning tool.

METHOD

This research is a Research and Development (R&D) using Tahiagarajan's (1974) 4D model. The Ethno-STEM-based science learning tools developed are Learning Implementation Plans (RPP), Learner Activity Sheets (LKPD), and student creative thinking ability test sheets. The data collection technique used is a questionnaire. The instruments used in this study were a validation questionnaire and a student response questionnaire. Validators in this study were two people, namely content experts and learning media with a background in science education. The learning material developed in this study is environmental pollution and damage in seventh grade even semester students to empower creative thinking skills. The research was conducted at one of the State Junior High Schools in Karanganyar Regency, Central Java. The number of students who participated in this study was 24 students.

Validation data analysis was conducted on the developed learning tools. The validity rating scale guides each aspect assessed in Table 1.

Table1. Validity Rating Scale

Assessment	Value/score
Very good	4
Good	3
Bad	2
Very Bad	1

(Adaptation of Riduwan, 2013)

Furthermore, the validity data were analyzed using quantitative descriptive analysis by calculating the average score given by the validators (P). This score was then described qualitatively by interpreting it according to the criteria in Table 2.

Table 2. Learning Device Validation Score

Score Interval	Score Criteria	Description
$3,6 \leq\leq P \leq\leq 4$	Highly Valid	Can be used without revision
$2,6 \leq\leq P \leq\leq 3,5$	Valid	Usable with minor revisions
$1,6 \leq\leq P \leq\leq 2,5$	Less Valid	Usable with major revisions
$1 \leq\leq P \leq\leq 1,5$	Not Valid	Not yet usable

(Adaptation of Ratumanan & Lauren, 2011)

The learning tools developed in this study are said to be valid for use in the learning process if they obtain a score ≥ 2.6, which meets the minimum valid criteria. Student response is the opinion of students after participating in learning by using Ethno-STEM-based Science Learning Tools. Student response was measured using an instrument in the form of a student response questionnaire and calculated using the percentage of the number of students who responded divided by the total number of students. The response is categorized as getting a positive response from students if it reaches a percentage $\geq 61\%$ with good criteria (Riduwan, 2013).

RESULT AND DISCUSSION

The Ethno-STEM-based science learning tools developed are Learning Implementation Plans (RPP), Learner Activity Sheets (LKPD), and student creative thinking ability test sheets. The activities carried out by students are projects to prevent environmental pollution. The first activity is making environmentally friendly fabric dyes using materials around them. The second activity is to conduct a trial to determine whether the coloring materials they have used are environmentally friendly rather than textile dyes. The third activity is to apply the natural dyes they have made to the fabric to make batik motifs, and then the material is created to be used as clothing and presented in front of the class.

The device developed first needs to be tested for validity before carrying out trial activities for learning instruments on junior high school students. Learning tools assessed for validity are lesson plans, worksheets, and test sheets for students' creative thinking skills. Learning device validation was carried out by two experts. Learning tools validation scores range from 3.0 to 4.0 with valid to very valid criteria. Suggestions from validator 1, namely several sentences on learning objectives and learning stages (syntax), need to be clarified according to the comments written in the lesson plan and improve the grammar and punctuation in several parts. Assessment from validator 2, an overall lesson plan is good.

The LKS validation score in terms of content ranges from 3.5 to 4.0 with valid to very valid criteria. Suggestion from validator 1, LKPD is given clear work instructions in making batik dress costumes. Suggestion from validator 2, LKPD is good; the appearance of LKPD must be made attractive so that students are motivated and given clear instructions for work.

The score of the content validation results of the concept mastery test sheet and students' creative thinking skills ranged from 3.5 - 4 with valid to very valid criteria. The advice given by validator one is that the questions are excellent and contextual. It is better if the question grid table describes the C1-C6 cognitive level. Suggestions from validator two, namely the making of the question, are very good because it is in accordance with the indicators on the grid, the indicators of creative thinking skills, and the cognitive level of the question, the description of the assessment guidelines is also good to suppress the subjectivity of the corrector, the description of the case on the logical question but it is quite long which might affect students' interest in reading the whole question carefully.

After the validity test is conducted, the learning tools are tested on junior high school students, and it is necessary to see how students respond to the learning tools given to them. Student responses to the learning tools provided show the highest percentage in the good to excellent category. Students argue that the learning tools developed are very interesting and able to make students understand learning very well because they can connect learning materials with life in their environment. Students realize that activities carried out by people in their environment can be studied scientifically. The following is the work of grade 7 junior high school students on environmental pollution and damaged material.

Figure 1. The work of junior high school students in grade 7 when coloring on nori cloth using various environmentally friendly dyes.

The ethnoscience approach is a way to create a learning environment and atmosphere and design learning experiences that integrate culture as a component of the science learning process. The ethnoscience approach is a strategy for creating learning environments and designing culturally inclusive learning experiences as part of the science learning process (Sarini & Selamet, 2019). Integrating ethnoscience into learning science is very important to have a significant impact on efforts to improve learning outcomes and motivation (Azmi Asra et al., 2021). Local wisdom-based learning is also an effort to preserve the traditional culture of an area so that it is not eroded by the times and is maintained for future generations. Through this integration, students will know that the habits and culture that they do every day contain many concepts and principles of learning science. Another benefit of integrating the culture and traditions of students in learning science, students can strengthen, preserve and take back the local wisdom of the area to give birth to science learning based on local excellence, as instructed in PP No. 17 of 2010 articles 34 and 35 (Asra et al., 2021).

Ethno-STEM is a learning approach that combines ethnoscience thinking with the STEM approach. STEM learning integrates four disciplines, namely Science, Technology, Engineering, and Mathematics; STEM is believed to be innovative learning that can be a solution in building a generation that can face challenges in the era of the Industrial Revolution 4.0 and Society 5.0. Through STEM learning, students not only memorize concepts but are also directly involved in discovering concepts and their relation to real life so that students get more meaningful learning. STEM learning can be maximized by integrating it with learning resources that involve teaching materials with everyday life. This learning resource can be realized through students' knowledge of local wisdom and culture that they are familiar with, allowing learning to be more readily accepted by students. Through Etno-STEM, it is hoped that the process of reconstructing the original science of the local community will be integrated with scientific science so that students can be actively involved in learning and be able to shape students into a generation that can face challenges in the era of Industry 4.0 and Society 5.0. Therefore, Ethno-STEM learning is very well applied in junior high school students.

CONCLUSION

Ethno-STEM-based learning tools developed based on the results of validation by experts obtained valid to very valid scores. Student responses related to the learning tools provided showed the highest percentage in the good to excellent category.

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