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Development of Ethno-STEM E-Module with Project Based Learning Model Based on Yogyakarta Local Wisdom to Improve Student's Creative Thinking Abilities

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ABSTRACT

This research aims to develop an Ethno-STEM E-module with a PjBL model based on local wisdom of the Special Region of Yogyakarta to improve students' creative thinking abilities in science and science learning in the Merdeka Curriculum on Energy Transformation material in class IV of SD Negeri Jambon 2 Yogyakarta to determine the quality of the e-module being developed. from valid, practical and effective aspects. This research uses the ADDIE development model. This model consists of 5 stages, namely Analyze, Design, Development, Implementation, and Evaluation. Data collection techniques use validation, questionnaires, tests, literature studies, observation and documentation. The research results show that: 1) The validity of the Ethno-STEM E-module with the PjBL model based on local wisdom of the Special Region of Yogyakarta is included in the High classification in the aspect of appropriateness of the e-module material content, obtaining an average Aiken's V score of 0.91 with a very valid classification. , in the media suitability aspect, the average score was 0.90 with a very valid classification, and in the language suitability aspect, the average score was 0.91 with a very valid classification. 2) Practicality based on the teacher response questionnaire obtained a score of 87% in the very good category and the student response questionnaire obtained a score of 88% with very practical criteria.

Keywords: Ethno-STEM; Project Based Learning; Creative Thinking Ability; Local wisdom

INTRODUCTION

Creativity is one of the basic abilities that students must have. In responding to the global challenges of the 21st century and the era of disruption 4.0, these abilities must continue to be developed in learning. OECD (2022) states that future education must include 21st century abilities which include eight soft skills that must be developed, including the ability to think critically, creatively, inquiry research, psychological intelligence, initiative, persistence, data processing ability, systematic thinking ability, communication and reflection. By having creativity, students will be able to survive and adapt to existing changes (Begheto, 2015).

The importance of students having the ability to think creatively is triggered by the rapid development of science and technology. Every individual is required to continue to be creative in adapting to the environment so as not to be left behind by the progress of the times. This is in line with the opinion of (Hennessey, 2010) that the main factor in encouraging the progress of a civilizational system is having the ability to think creatively. Creativity is one of the main keys in the current educational context (Lasky &

Yoon, 2011). In learning activities, creativity is a basic ability that is urgent to be developed (Yulaikhah, 2022).

Creativity will encourage students to be able to solve their problems in everyday life (Saveedra & Opfer, 2012). The majority of science and mathematics learning at elementary school level is still teacher-centered and students tend to be passive in participating in learning (Fitriarosah, 2016). Student activities in the classroom are dominated by listening to the teacher's explanation, taking notes and then working on the questions provided in the textbook. These learning activities will certainly make it difficult for students to construct their knowledge (Insyasiska, 2020).

Based on the results of interviews with fourth grade teachers at SD Negeri Jambon 2 Sleman Yogyakarta, data was obtained that in implementing learning, teachers still had difficulty integrating learning material into project activities that were appropriate to the environment where students lived. Apart from that, teachers still have not developed teaching materials optimally and there is a lack of variety in the learning models used during the learning process. This can be seen from the practice questions given to students which tend to measure students' abilities in the Lower Order Thinking Skills (LOTs) and Middle Order Thinking Skills (MODs) categories which can be seen from the type of questions addressed to students which are still in the form of the ability to remember, say, Complete and explain simply.

The results of observations of students show that during the learning process, students still find it difficult to understand material that requires in-depth analysis and cannot apply the learning material learned in class to everyday life. This makes it difficult for students to come up with new ideas and thoughts that provoke students to think creatively. During learning activities, students have difficulty understanding the material and lack focus on the explanations given by the teacher. With these problems, learning becomes less meaningful.

The results of observations of student grades also showed unsatisfactory results. At Mayangan Elementary School the minimum completion criteria (KKM) for science lessons is 70, and the results of the final student assessment (PAS) that reached the KKM were only 11 students with a percentage of 28.20% and as many as 28 students or the equivalent of 71.79% of students had not completed or has not reached the KKM value. By analyzing data on student scores and existing problems, teachers should develop a learning product that is able to improve students' creative thinking abilities and innovate learning that is appropriate to the area where they live so that learning becomes more meaningful.

One of several learning approaches that can be used to improve students' creative thinking abilities is by using the Science, Technology, Engineering and Mathematics (STEM) approach. Ethno-STEM is culture-based or local wisdom-based STEM learning by making greater use of local regional culture in the learning process (Azalia, 2020). STEM allows students to learn academic concepts precisely by applying four scientific disciplines. Ethno learning according to (Ardianti, et al., 2019) is learning that involves local excellence in the surrounding area which is connected to the learning material. In line with the opinion of Ismaya & Santoso (2019) who say that the study of surrounding culture can be included in learning. Based on the opinion of Aziz & Yulkifli (2021) who state that with the Ethno-STEM approach learning becomes more meaningful because learning science is based on regional culture, unique knowledge of a region and the behavior of the community around where students live can help make 21st century learning a success, especially in improving abilities. students' creative thinking.

The Ethno-STEM approach is an alternative learning approach that can be used to increase student creativity by integrating regional cultural values into learning. As is well known, Indonesia has very diverse regional cultures. In the research, various

cultures of the Special Region of Yogyakarta were taken. To make the learning process more active and meaningful, the Ethno-STEM approach being developed will be combined with the Project Based Learning (PjBL) model in developing learning project activities.

Project strategy as a learning tool to achieve competency in attitudes, knowledge and skills (Nuraini & Waluyo, 2021). The PjBL model involves the 4Cs which support criticality, student creativity and cooperation (Renandika & Mahmudi, 2020). This is in line with Nuraini & Waluyo (2021) who state that the PjBL model is a learning model that provides teachers with the opportunity to manage learning by involving project work. The project work in question is presenting complex tasks for students to solve problems, as well as providing opportunities for students to work independently.

PjBL is a learning model that encourages developing soft skills such as creative thinking, problem solving, innovation, team work, communication and presentation skills where students learn to collaborate with groups in planning activities (Prastyaningtyas & Wulansari, 2021). With project activities, the PjBL model can guide students to solve a given problem through contextual learning activities and complex learning activities (Trimawati et al., 2020). Yulaikah et al., (2022) also revealed that through project-based learning students will be guided to improve their ability to solve complex problems by presenting them in the form of a work, so that learning will be more meaningful and students will understand better and then students can draw conclusions from the learning. the.

Based on existing problems and literature studies regarding alternative solutions to these problems, this research will develop learning E-modules that are adapted to the environmental conditions of the area where students live in order to improve students' creative thinking abilities. Researchers will develop an E-module for Ethno-STEM learning with a PJBL model based on local wisdom of the special region of Yogyakarta which is the closest option according to the area where the research object is carried out to improve students' 21st century abilities.

The Ethno-STEM learning approach has the ability to improve students' creative thinking skills (Sumarni & Kadarwati, 2020a). This is in line with Wahono et al., (2020) who state that students must be motivated to create, discover, explore, imagine and predict in order to develop a creative attitude towards life. Azis & Yulkifli (2021) stated that the interdisciplinary nature of STEM, which is built on the integration of science, mathematics, engineering and technology, helps students apply their knowledge from various disciplines to create new products. Thus, the process of creating, exploring, discovering involving knowledge of science, engineering and the use of technology in STEM can develop students' creative attitudes.

Previous research results show that creativity concepts consisting of fluency, flexibility, originality and elaboration can be increased by implementing STEM learning through PjBL model-based learning (Priyani & Nawawi, 2020; Ariyatun, 2021; Saw et al., 2019). The PjBL model is also a learning model recommended in the independent elementary school curriculum. Ethno-STEM learning with the PjBL model is learning that integrates ethnoscience, technology, design or engineering and mathematics with steps in project-based learning activities. It is very possible to carry out elementary school science lessons using Ethno-STEM learning with the PjBL model because it has quite a lot of applications in everyday life. Science learning activities use the Ethno-STEM approach with the PjBL model, making students active so as to provide a more meaningful learning experience, so students have the potential to develop creativity and understanding of science concepts. Therefore, this research is important to improve students' creative thinking abilities by developing the Etno-STEM E-module with the PjBL model based on local wisdom of the Special Region of Yogyakarta.

Thus, this research is important to carry out with the aim of developing an Etno-STEM E-module with a Project Based Learning model based on local wisdom of the Special Region of Yogyakarta to improve students' creative thinking abilities with valid and practical criteria.

LITERATURE REVIEW

The results of previous research also state that through learning using STEM-PjBL can significantly increase students' creative thinking abilities both in thinking fluently, elaboration, flexibility, and originality (Qadafi et al. , 2022; Ariyatun 2021; Surita et al., 2022; Salampessy & Suparman, 2019; Sumarni & Kadarwati, 2020; Karim et al., 2022; Bozkurt Altan & Tan, 2021; Lou et al., 2017). The results of previous research further strengthen the results of this research that ethno-STEM learning which is integrated with the PjBL model is effective in increasing student creativity.

MATERIALS & METHODS

This research was developed with a research and development design using the ADDIE (Analyze, Design, Development, Implementation, Evaluation) development model. The research product developed in this research is the Etno-STEM E-module with a PjBL model based on local wisdom of the Special Region of Yogyakarta.

At the development stage, product validity trials were carried out on three aspects of validity, namely material validator, media validator, language validator. The fourth stage is the implementation stage. At the implementation stage, a small group test was carried out with 9 students and a large group test (field group) with 24 students at SD Negeri Jambon 2 Yogyakarta. The fifth stage of the development process carried out by researchers is the evaluation stage. At this stage, formative and summative evaluations will be carried out on the development product. Evaluation of the product using a questionnaire on the Etno-STEM E-module product with the PjBL model containing Ethno-STEM that has been implemented will be given to teachers and students as research objects.

In the e-module validity test, the following Aiken's v formula is used:

$$V = \sum S/[n(c-1)]$$

(Febriandi et al., 2019)

Table 1. Validity Criteria Using Aiken's V Coefficient

Coefficient Correlation	Validity Interpretation
$\geq 0{,}80$	very valid
$0{,}60 \leq V < 0{,}80$	Valid
$0{,}40 \leq V < 0{,}60$	fairly valid
$0 \leq V < 0{,}40$	Invalid

(Azwar, 2015)

The practicality test was carried out with the aim of testing the E-module with the PjBL model containing Ethno-STEM as practical to use or not using a questionnaire and was calculated using the following formula:

Percentage (%) = (total score from data collection) / (criterion score) x100%

(Zuhriah, 2019)

RESULT

Analyze

Observations and interviews were carried out to analyze the need for teaching materials required by the school. This activity was carried out with a resource person, namely Mrs. Nisrina Wisnu Putri, S.Pd who is the homeroom teacher of class IV at SD Negeri Jambon 2 Yogyakarta. The results of the teaching analysis used by teachers follow learning resources that have been developed by the government. In its implementation, schools have not been able to develop their own teaching materials that strengthen students' 21st century skills and have not been able to develop teaching materials based on projects to strengthen the Pancasila student profile (P5). The initial needs analysis was carried out using structured interviews with class IV teachers because this class was the first class to implement the Merdeka curriculum at school, so the class teachers were still unfamiliar and were trying out learning activities based on the Merdeka curriculum.

Design

The second stage is the design stage. The design stage aims to produce a draft ethno-STEM e-module based on a project-based learning model with local wisdom from the Special Region of Yogyakarta. The e-module developed is in digital form that can be used on smartphones and computers and contains material about the energy transformation process. The typical Yogyakarta culture which is integrated in the material in chapter 4 changes the form of energy in the form of project activities in the form of the process of making the typical Yogyakarta food bakpia, Yogyakarta kasongan pottery, the Talang Krasak water wheel, and the process of making a wayang performance using 3D holograms. The project activities were then arranged according to the development of a project to strengthen Pancasila students with the theme of entrepreneurship with the sub-theme of becoming a successful entrepreneur and with character through market day activities at school.

The ethno-STEM E-module design has been realized. The characteristics of the resulting e-module are: 1) E-Module with ethno-STEM content; 2) The material that has been developed is adapted to the culture of the Yogyakarta region; 3) Colorful and attractive images and animations; 4) learning modules are developed in digital form so they are easy to learn anywhere and anytime; 5) There is a video explaining the process of making an ethno-STEM project in the e-module; 6) Developing students' creative thinking processes. The following is an overview of the typical characteristics of the ethno-STEM e-module being developed:

1) Making Bakpia as Etno-STEM Project

Science:

Factual Knowledge:

Factual knowledge obtained by students from scientific reconstruction of the process of making bakpia.

Conceptual:

Potential energy-motion energy transformation

Procedural:

Making bakpia with new innovations, namely with new flavors that are prepared according to the student's level of creativity.
ng obtained by students from the scientific reconstruction of the process of making bakpia.

Conceptual:

Potential energy-motion energy transformation
Transformation of electrical energy-thermal energy-chemical energy

Procedural:

Making bakpia with new innovations, namely with new flavors that are prepared according to the student's level of creativity.

Technology

1. Use a cellphone or computer to view and search for information about the process of making bakpia using simple tools and modern tools.
2. Creating new flavor innovations in the bakpia production process.
3. Use the right equipment and materials when making bakpia.
4. Innovate a unique bakpia shape

Engineering

1. Design with creativity and develop different ideas
2. Create and design new flavor innovations for the bakpia that is being made.
3. Innovate the shape of the bakpia
4. Test the bakpia that has been made
5. Revise product results if they fail

Mathematics

1. Calculate the capital required for the process of making modern and traditional bakpia
2. Determine the selling price of bakpia.
3. Calculate the proceeds from selling bakpia.

2) Making a miniature water wheel in Talang Karasak Sleman
3) Making Kasongan Yogyakarta Pottery

4) Making a Yogyakarta leather puppet show project using 3D holograms

Development

After the ethno-STEM E-module prototype with the PjBL model has been realized, the next step is to carry out expert validation whether the module developed is valid or not yet used in the field.Material validation was carried out with 3 expert validators, namely validator 1 Mrs. Nisrina Wisnu Putri S.Pd as a teacher at SD Negeri Jambon 2 Yogyakarta, validator 2 Mrs. Lia Astuti, S.Pd as a teacher at SD Negeri Jambon 2 Yogyakarta validator 3 Tio Gusti Satria, M .Pd as a PGSD lecturer at PGRI Silampari University. The results of material validation obtained an Aiken's v score of 0.91 in the very valid category.

Aspects Assessed	Many Items	*Aiken's V Score*	*Aiken's V Criteria*
Material Suitability	3	0,91	High
Material accuracy	3	0,90	High
Sophistication of material	2	0,92	High
Encourages curiosity	3	0,90	High
Learning evaluation	3	0,91	High
V Average		**0,91**	**High**

Media Validation

Media validation was carried out by 3 validators including 1) Prof. Dr. Sri Wardani, M.Pd as a lecturer in the Department of Basic Education at the Postgraduate School of Semarang State University, 2) Dr. Ali Sunarso, M.Pd, lecturer in the Department of Primary Education at the Postgraduate School of Semarang State University 3) Tio Gusti Satria, M.Pd as a PGSD lecturer at PGRI University, Silampari. The results of media validation of the e-module developed obtained an average Aiken's v score of 0.90 with very valid criteria.

Aspects Assessed	Many Items	*Aiken's V Score*	*Aiken's V Criteria*
Cover design	2	0,90	High
Content design	3	0,90	High
Presentation of learning	6	0,90	High
V average		**0,90**	**High**

Language Validation

Language validation was carried out by 3 validator experts including 1) Dr. Haryadi, M.Pd lecturer majoring in Indonesian Language and Literature Education at Semarang State University Postgraduate 2) Dr. Ali Sunarso, M.Pd, lecturer in the Department of Basic Education at the Postgraduate School of Semarang State University 3) Tio Gusti Satria, M.Pd as a PGSD lecturer at PGRI University, Silampari. The average Aiken's v score obtained was 0.91 in the very valid category.

Aspects Assessed	Many Items	*Aiken's V Score*	*Aiken's V Criteria*
Direct	3	0,89	High
Communicative	2	0,91	High
Dialogic and Interactive	1	0,91	High
Suitability to student development	2	0,91	High
Conformity to EYD rules	6	0,91	High
V Average		**0,91**	**High**

Implemntation & Evaluation

Responses of students and teachers at SD Negeri Jambon 2 Yogyakarta to the E-Module Etno-STEM innovation with the PjBL Model containing Ethno-STEM obtained from the results of the questionnaire after the learning process was completed.

The results of student questionnaire responses after the learning process using E-Modules which were developed both theoretically and in practical activities in learning activities obtained a percentage of 88% with very good criteria for use. Apart from that, based on the results of responses to two teachers who taught in class IV at SD Negeri Jambon 2 Yogyakarta, it also showed positive results with a percentage of 87% with very good criteria.

Students and teachers are very interested in the E-Module being developed because the learning module contains animations, explanatory videos contained in the module barcode, attractive images and evaluation questions that require high level reasoning. Unique, interesting and practical learning modules will increase students' learning motivation both at school and studying independently at home.

DISCUSSION

Developing materials with local wisdom content will enable students to maintain the preservation of their regional culture and continue to develop their regional potential in accordance with developments and demands of the times (Sinta et al., 2020; Ismawati et al., 2023; Lestari et al., 2023; Jafar et al.., 2022; Sulistiawati et al., 2023). Students become active in the learning process with project activities in the teaching materials (Ferdiani & Pranyata, 2022). Apart from that, project activities that are integrated with P5 activities which are scheduled according to the learning activities in the E-Module enable students to directly implement the knowledge they have gained so that learning becomes more meaningful (Cahyani et al., 2020).

The increase in effectiveness of students' creativity after learning using e-modules is due to the fact that in the e-modules there is STEM learning with the PjBL model which contains local wisdom in the area around where the students live. These activities are packaged in each learning step and will hone students' creative ideas. Learning containing local wisdom is combined with the STEM approach and the PjBL model which integrates science, technology, engineering, mathematics with regional cultural themes and presents student activities in accordance with the Project based learning steps from The George Lucas Education Foundation and Dopplet, with steps learning consists of 6 phases as follows; 1) Determine the basic questions (start with essential question), (2) Prepare a project plan based on local regional wisdom (design project with local culture), 3) Prepare a schedule that is adapted to the project to strengthen the profile of Pancasila students (create schedule and synchronize with P5) , (4) Monitoring students and project progress (monitoring the students and progress of project), 5) Assessment of results (assess the outcome), (6) Evaluation of experience (evaluation the experience)

Determining basic questions in the activities in the e-module will provide a stimulus for students to think creatively in answering these basic questions and making questions about knowledge they do not yet understand. Next, students will be given problem topics in the form of examples of problems in daily activities which will train students to think creatively in solving the challenges described. This requires critical and creative thinking in order to develop an appropriate strategy for solving the topic being discussed. Next, the project work stage starts with preparing the schedule, new ideas for the project that have been determined, forming the team and group assignments. This of course requires creative ideas and well-conceptualized thinking so that the project can be realized optimally. In the process of working on the project, students are also trained to be able to analyze obstacles and develop new ideas from existing products, in this case students create creative ideas about innovations in the taste and shape of bakpia, innovations in miniature waterwheel projects, innovations in the shapes and motifs of Kasongan pottery, and Innovation of wayang kulid performances using 3D holograms. At the assessment stage, the results are adjusted to the P5 activities scheduled in the e-module being

developed, which is carried out during the "market day" activity where students will show off the products that have been developed in the form of a school bazaar. This assessment stage also requires students to be united in presenting the products they have worked on and to be able to provide creative and sportsmanlike assessments of products from other groups. Evaluation of the experience will be carried out after the activities are completed and reflection will be carried out on the activities that have been carried out from the beginning to the end of the project. At this evaluation stage, an assessment is also carried out in the form of a summative test on the knowledge gained during project work which requires creative thinking on the answers that will be expressed in written form. All project activities are supported by group learning activities, direct learning, so that students are facilitated in expressing their creative ideas and participating in preserving regional culture, especially Yogyakarta. The ethno-STEM learning series combined with the PjBL model provides meaningful experiences for students so they can hone their creativity into a form of activity. The creative thinking process in students can be stimulated through learning activities that provide opportunities for students to actively try, explore new knowledge on their own, and interpret ideas from the problem topics being discussed in learning activities. (Sharp, 2007) revealed that in exploring students' creative abilities, teachers must create lessons that contain tasks that have many correct answers or not only one correct answer, assess the activity process and not just the final result, provide space for students to try to innovate and discover for themselves whether the information/knowledge they have obtained is complete or not in order to be able to interpret the knowledge gained during the learning activities.

CONCLUSION

Based on the research results, it can be concluded that the Ethno-STEM E-module with the PjBL model based on local wisdom of the Yogyakarta Special Region is valid with a High classification in the feasibility aspect of the e-module material content, obtaining an Aiken's V average score of 0.91 with a very valid classification, at the media suitability aspect obtained an average score of 0.90 with a very valid classification, and the language suitability aspect obtained an average score of 0.91 with a very valid classification. 2) Practicality based on the teacher response questionnaire obtained a score of 87% in the very good category and the student response questionnaire obtained a score of 88% with very practical criteria.

This research only focuses on chapter IV of the independent curriculum of Science and Technology with the topic of changing forms of energy. It is hoped that there will be more research related to the ethno-STEM approach which is integrated with the project-based learning model with a wider range of material topics.

Declaration by Authors

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