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Development and Implementation of Integrated STEM-Based Science Textbooks and Local Potential of Coffee Agroecosystems to Improve Science Literacy for Junior High School Students

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ABSTRACT

The purpose of this research is to describe the characteristics of STEM-based teaching materials and to find out the increase in scientific literacy skills of junior high school students. The method used in this research is research and development. The design of this study uses the ADDIE model, with the stages of analysis, design, development, implementation, and evaluation. The trial design used the One Group Pretest-Posttest Design. The test subjects were class VII SMP Walisongo Mayang. The characteristics of this integrated STEM-based textbook and local potential contain material on temperature and heat, complemented by student environmental events as well as practicum procedures and project creation related to STEM aspects for students. The results of the validity of the textbooks developed by the validator show very valid criteria, with the results of the feasibility test using a student response questionnaire showing textbooks included in the practical category and good for students. As well as the results of the effectiveness of textbooks show that they can improve students' scientific literacy skills which are marked by an increase in pretest to posttest scores (t-test value 25,668 and n-gain 0.77). Make affective phrase: Developing textbooks for students makes it possible to develop them more broadly with STEM development and the problems and challenges students face in the surrounding environment.

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1. INTRODUCTION

Education in developed countries has begun to apply the concept of multidisciplinary science, namely Science, Technology, Engineering, and Mathematics (STEM) education. This relates to the complex demands of education in the 21st century. In practice, it cannot only be solved with one scientific discipline (Maeda, 2013). STEM is a term used to collectively refer to cross-disciplinary teaching and approaches, namely science, technology, engineering, and mathematics. The integration of STEM aspects can support the improvement of student learning outcomes in schools (Wahono & Chang, 2019).

STEM education can also incorporate elements such as inquiry, literacy, exploration, empathy, and collaboration into learning (Guyotte et al., 2015). In line with this opinion, the Partnership for 21st Century Skills (2006) emphasizes that 21st-century skills are formed from a solid understanding of content knowledge which is then supported by various skills, expertise, and literacy needed by an individual to support the success of both personally and professionally. In this case the most important and needed aspect in the 21st century besides the ability of STEM is the element of scientific literacy (Wefusa, 2015).

Scientific literacy must be trained in students, this is because scientific literacy is an indispensable life skill. To develop scientific literacy skills, it is necessary to have treatment using scientific knowledge that is applied in everyday life (Hoolbrok and Rannikme, 2009). Daskolia et al., (2012) revealed that scientific literacy skills are useful for forming students who can think of solutions to overcome problems that develop in the environment, both in the environment where they live. Scientific literacy can be carried out well if it is supported by the selection of media and the right learning approach.

The results of the 2018 PISA survey stated that Indonesia's science literacy score was 371, with this score, Indonesia was in the 74th position out of 79 other participants (OECD, 2019). This shows that Indonesia is still lagging behind other countries in the field of science. Assessments like this play an important role in improving the education system, curriculum, teaching quality, and student learning (Wahono, 2019).

Education in Indonesia is starting to change towards contextual learning according to regional potential. This is following the Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System, the curriculum at all levels and types of education is developed with the principle of diversification following educational units, regional potential, and students. So in the learning process in schools must always base and promote the potential, culture, and wealth of the area they have. Contextual education with the local potential of the surrounding area can produce good learning outcomes (Kurniawati et al., 2017). The local potential has many positive values that have the potential to build national identity and character (Alfian, 2013). These values include mutual cooperation, a culture of discipline, democracy, mutual respect, and tolerance. But the fact is that in schools, most schools in Indonesia still do not connect local or regional potential into the field of learning.

Jember Regency with its local potential, namely coffee, this makes Jember Regency one of the largest coffee producers in Indonesia. This is supported by the existence of an Indonesian coffee and cocoa research center in the Jember Regency. All aspects of the wealth owned by the community become the local potential of the Jember community. Local potential can be understood as local ideas that are wise, full of wisdom, and have good values, which are embedded and followed by community members. The local potential of this area can also be integrated with student learning at school.

The government has provided several efforts to improve the quality of education, and one of the efforts taken is through the development of teaching materials (Bappenas, 2013). Teaching materials need to be developed because they can help teachers deliver the material. The results of Onasanya & Omosewo's (2011) research prove that teaching materials can help teachers interact with students. This encourages students to use their intellectual abilities during the learning process. The research results of Al Azri & Al-Rashdi (2014) revealed that the use of teaching materials can expedite and facilitate the delivery of material. In addition, teaching materials are also effective for improving learning outcomes. According to Ginting's research (2012), teaching materials can improve learning outcomes. The purpose of this study was to describe the validity, practicality, and effectiveness of integrated STEM-based textbooks and the local potential in knowing the increase in scientific literacy skills of junior high school students.

2. RESEARCH METHOD

This research is included in research and development because this research produces development products in the form of integrated STEM-based textbooks and local potential. The development model used is ADDIE (Branch, 2009). Product development in this study also aims to test the product being developed in terms of validity, practicality, and effectiveness. In this development research, it was carried out until the final stage, namely evaluation according to the ADDIE stages, namely (Analysis, Design, Develop, Implement, and Evaluate), but at the final stage, the dissemination was carried out through the publication of research results. Development activities begin with conducting a preliminary study which is then analysed. From the results of the preliminary study analysis, the researcher made a product development plan in the form of a draft, this draft is included in the design stage. The initial draft of the product enters the development stage which is then developed based on the planning results. The initial draft of the product that has been developed is then validated by four experts, namely a materials expert and a design expert. The validation results are in the form of a product validity score that is developed as well as suggestions for further product improvement or evaluation. Products that have been validated are then revised based on input from experts.

The revised product is then piloted in batches. The experimental subjects were thirty-four students of grade VII SMP Walisongo Mayang. This trial aims to determine the level of practicality and effectiveness of the product being developed. The practicality of the product is obtained from the average percentage of student responses, while the effectiveness is obtained from the difference in the average results of the pre-test and post-test. The data analysis technique used is quantitative descriptive analysis and qualitative descriptive analysis. Quantitative descriptive analysis was used to analyse data in the form of scores obtained from validation questionnaires, student response questionnaires, and tests on the results of improving students' scientific literacy abilities. Qualitative descriptive analysis was used to analyse descriptive data in the form of suggestions and responses from the validator.

3. RESULT AND DISCUSSION

The product developed in this study is an integrated STEM-based natural science textbook and local potential with temperature and heat material for class VII students of junior high school. The textbook contains science concepts that are integrated with technology, engineering, and mathematics concepts. The developed STEM-based textbook consists of 52 pages which were developed with four learning meetings as shown in table 1.

Table 1 Details of textbooks

No	Meeting	Topic
1	1	Temperature
2	2	Calor
3	3	Calor Transfer
4	4	Black base

The format of the textbook developed consists of instructions for using an integrated STEM-based textbook and the local potential created is as follows:

Figure 4.1 Display of the cover and contents of the textbook

The assessment stage includes the validation value of integrated STEM-based textbooks and local potential, which were validated by three expert lecturers in the Master of Science Education, Faculty of Teacher Training and Education, University of Jember. The validator criteria for expert lecturers are having a minimum educational criterion, namely a master's or lecturer certification, while for expert users, namely teachers with a minimum of 10 years of teaching experience in schools. Details of the overall score of integrated STEM-based textbook validation items and local potential can be seen in table 2 below:

Table 2 Textbook validation results

Validator average score-1	Validator average score-2	Validator average score-3	Validator average score-4	The average score of the four validators	Validity	Validity category
4,23	4,34	4,23	4,68	4,37	87,4%	Very valid

The validity score of integrated STEM-based textbooks and local potential from the calculation of the four validators shows a score of 4.37 and has a validity percentage of 87.4% with the results of the aspect criteria for each validator shown in table 3 below:

Table 3 Validation results for each aspect of the textbook

Observed aspects	Validator average score				The average score of the four validators	Validity	Validity category
	$V_{Ah.1}$	$V_{Ah.2}$	$V_{Ah.3}$	V_{pg}			
Theory	4,43	4,43	4,25	4,56	4,41	88,2 %	Very valid
Design	4,69	4,4	4,15	4,7	4,48	89,6 %	Very valid
Language	4,66	4,16	4,16	4,33	4,32	86,4 %	Very valid
Evaluation	4,66	4,33	3,00	4,66	4,16	83,2 %	Pretty valid

That the validity value obtained is in the range of 85.01% to 100.00% with very valid criteria.

Students' scientific literacy skills were analyzed based on the results of the pretest and posttest assessments. Providing pretest and posttests conducted to determine students' abilities before and after learning using integrated STEM-based textbooks and local potential. The following is a graph of the increase in treatment after using integrated STEM-based textbooks and local potential. The following graph increases the results of the pretest and posttest values can be seen in the following figure:

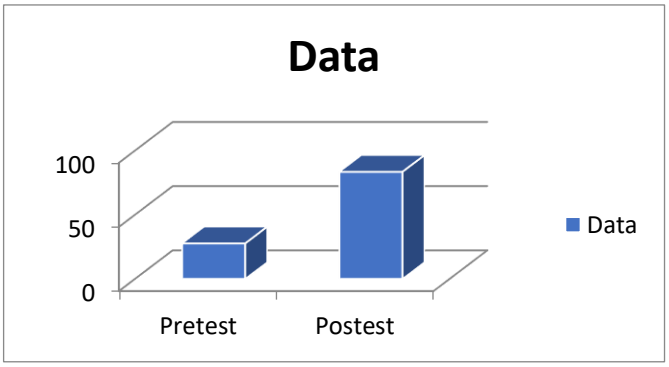

Figure 4.2 Graph of increasing scientific literacy

Table 4 details the pretest and posttest assessments

Respondens	Average		t-test	N-gain
	pretest	*posttest*		
34	27,6	83,4	25,668	0,77

The resulting graph shows that there is an increase in the results of the pretest and posttest scores with details of the results as shown in table 4 below:

The level of effectiveness of textbooks is calculated using the paired sample t-test. Before carrying out the paired sample t-test, prerequisite tests were carried out, namely the normality test and homogeneity test. The results of the normality test shows that the data has a normal distribution. Furthermore, based on the results of the paired sample t-test, a significance level of 25,668 was obtained. This shows that integrated STEM-based textbooks and local potential have a significant effect because the significance level is below 0.05, which means there is a difference between before and after treatment. So it can be concluded that the treatment using integrated STEM-based textbooks and local potential in this study had a significant influence on the effect of students' scientific literacy abilities before and after using integrated STEM-based textbooks and local potential.

A significant increase in students' scientific literacy skills can occur because natural science learning in the temperature and heat sub-chapter in this study is assisted by integrated STEM-based textbooks and local potential. Learning is carried out following a series of processes contained in textbooks. Thus, students can receive the material well through discussion, practicum, presentation, and evaluation activities which are carried out in stages. According to research by Yuliati et al., (2011), several activities such as discussing and making projects can improve student learning outcomes. These results are also supported by the results of Roberts' research (2012), which revealed that STEM-based learning can add to the learning experience through practical activities and applying general principles of the material being studied, so that creativity and curiosity grow and encourages collaboration between students. Learning related to STEM aspects provides opportunities for students to understand the concepts of natural science around them combined with technology, engineering, and mathematics through discussion, practicum, and project creation. The activities carried out during the learning process can

attract students' interest and have an impact on increasing students' scientific literacy skills. The results of Yusuf's research (2015) stated that learning carried out through observation and practice or practicum activities can create a pleasant atmosphere and can improve learning outcomes. Engineering activities such as making projects that integrate science, technology, and mathematics also support deepening students' knowledge. According to Rehmat's research (2015), activities involving design and engineering facilitate students being actively involved in learning science. The integration of engineering design into the learning process encourages students to conceptualize the project designs they have made into actual prototypes like professional technicians in the field. it can stimulate the curiosity and scientific literacy skills of students.

Student responses were obtained by giving a response questionnaire which was given at the 5th meeting before the posttest was given. Student response questionnaires were analyzed using response percentages to determine the practicality of integrated STEM-based textbooks and the local potential developed. The student response data for each aspect can be seen in Table 5. below:

Table 5 Student response questionnaire data

No	Aspect	*Percentage of agreement*	Category
1	Fill	88,92%	Very good
2	Presentation	88,88%	Very good
3	Design	87,43%	Very good
4	Language	91,74%	Very good
	Average	89,24%	Very good

The results in the percentage of agreement column are obtained from the average of all indicators that appear in each aspect. The average percentage of agreement for student responses obtained from all aspects was 89.98% in the very good category. So it can be concluded that integrated STEM-based textbooks and local potential are very practical and good for students.

4. CONCLUSION

Based on the data obtained from the results and discussion of the development that has been presented, it is concluded that integrated STEM-based textbooks and local potentials that are developed get a validity value with a very valid category, or can be used. Thus integrated STEM-based textbooks and developed local potential are declared valid for use in learning, for practical purposes, integrated STEM-based textbooks and developed local potential obtain very good student response results, thus integrated STEM-based textbooks and local potential developed declared practical use for students. As well as students' scientific literacy skills using integrated STEM-based textbooks and local potential that is developed to improve students' scientific literacy skills, is due to obtaining an average N-gain score from the research results of 0.77 and belonging to the high criteria. Thus integrated STEM-based textbooks and local potential developed are declared effective in increasing students' scientific literacy skills.

The limitations in activities carried out in this study are limited to only one class, but even so, it can also give the result that the development of STEM-based textbooks is very good at increasing students' skills. So it is suggested that in subsequent lessons both teachers and researchers implement and develop STEM-based textbooks with various topics and content following the regional potentials of students so that learning perceived by students is getting better and more effective.

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