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Implications of Local Potential-Based STEM Learning Model on Student Creativity

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ABSTRACT
This study was motivated by the low creativity of students in learning biology. The purpose of this study was to determine how the implications of local potential-based STEM learning models on student creativity on excretory system material. This study used a quantitative approach, quasi-experimental method with non-equivalent control group design, sample selection by purposive sampling. The instruments used were verbal and figural creativity tests, product creativity assessment and student response questionnaire. The research subjects were junior high school students in grade VIII, 27 experimental class students and 27 control class students. The results of hypothesis testing H_0 was rejected and H_1 was accepted with Sig (2-tailed) results of verbal creativity 0.000 and figural creativity 0.001 where the data were significantly different. N- Gain of verbal creativity of experimental class is 0.65 and control class is 0.48 while N-Gain of figural creativity of experimental class is 0.63 and control class is 0.45. The average student response questionnaire was 81.79% in the very good category. The conclusion of this study is that there is an implication of STEM learning model based on local potential on the creativity of students of one of the public junior high schools in Sukabumi.

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1. INTRODUCTION

Current education must build human resources who have the skills to face life in the 21st century. The National Education Association has identified 21st century skills as “The 4Cs” skills. One of “The 4Cs” skills is creativity. The importance of creativity possessed by students can reflect an urgent need to prepare students to face complex changes and global challenges (Hasanah et al, 2023). Creativity is not only an important aspect of innovation, but also a skill that supports problem solving in various aspects of life (Mursidik et al., 2015). Holistic education that integrates aspects of creativity and personality provides a foundation for the growth of learners as a whole (Hasanah et al., 2023). Therefore, students' creativity with the needs of 21st century life is essential. However, a survey conducted by the Martin Prosperty Institute by Florida, et al (2015) ranked Indonesia 115th out of 139 countries in relation to the Global Creativity Index (CGI). This shows that Indonesia is a country with low creativity.

According to the results of research conducted by Betti (2021), one of the reasons for students' low creativity is because the biology learning process that is often used is lecturing, so students do not have enough space to develop their creativity. One alternative that is considered to be able to overcome low student creativity is using the Science, Technology, Engineering, and Mathematic (STEM) learning model. Because the STEM learning model is able to increase student creativity in doing the project given (Simanullang et al, 2023).

The STEM learning model is a harmonious learning model between problems that occur in the real world and also problem-based learning (Renandika et al., 2020). The STEM learning process is carried out to solve a problem systematically (mathematics), by making observations or trials (science), using the field of science mastered (engineering) and utilizing available facilities (technology) (Karmila & Putra., 2022; Rahmi et al, 2022). According to Devi (2018) in science learning with the STEM model, there is one characteristic that must be seen in the STEM learning process, namely the Engineering Design Process (EDP). There are skills that students must have in the EDP process, namely creativity.

Creativity can be an integral part of the EDP process, the presence of creativity brings an important influence in product development. This EDP product is certainly a potential in developing student creativity (Setiono. et al., 2023). Based on research conducted by Syarah et al., (2021) shows that STEM learning is suitable for the implementation of learning with the 2013 curriculum and to face life in the 21st century. Therefore, STEM learning is assumed to have implications for student creativity.

In an effort to maximize the learning model used in this study, researchers want to use an local potential- based learning model. local potential-based in education is learning that links culture and science (Sudarmin, 2017). This is in line with the opinion of Shiddiq (2016) in (Nuralita, 2020) saying that local potential-based encourages teachers and also educational practitioners to teach science based on culture, local wisdom and problems that exist in society, so that students can understand and apply the science they learn in the classroom us-ed to solve problems they encounter in everyday life. The existence of an local potential-based STEM learning model students can solve problems with natural resources or local wisdom in the surrounding environment. In solving these problems, of course, students need creativity. This is supported by the research of Rahman A et al., (2023) local potential-based STEM learning can make students creative. In another study, it was found that STEM learning integrated with local potential and supported by learning modules can increase student creativity. In addition, local potential-based STEM learning provides interactive, creative, and innovative learning for students. So, the local potential-based STEM learning model is one of the solutions to develop students' potential (Rahman et al, 2023).

The local potential-based STEM learning model is very potential to be used in learning science, especially excretory system material, especially regarding the treatment of excretory system diseases. The use of family medicinal plants is part of the culture and tradition of society in Indonesia (Adiyasa & Meiyanti, 2021). Based on the utilization of digital technology, research results show that there are 56 types of medicinal plants from 12 families that are used by the people of Sukabumi (Yolanda et al., 2020). Based on research by Al Idrus et al (2022), local potential STEM learning provides positive results if used in all science materials.

Therefore, this study aims to provide implications for student creativity through learning by using local potential-based STEM models on excretory system material. The results of this study are expected that students are able to search and find the concept of treatment of excretory system diseases using family medicinal plants found in the surrounding environment.

2. RESEARCH METHOD

This research uses a quantitative approach, quasi-experimental method with a non-equivalient control group design, in the selection of samples by purposive sampling. In this design there are two groups of subjects where one group gets local potential-based STEM model learning treatment, while the control group gets discovery learning treatment. Both conducted pretest and posttest. The research design can be seen in Figure 1.

E :	0_1	X_1	0_2
C :	0_3	X_2	0_4

Figure 1. Pola Non-Equivalent Control Group

(Sugiyono, 2019)

Description:
E : Experimental class
C : Control class
0_1 : Experimental class before treatment (pretest)
0_2 : Experimental class after treatment (posttest)
0_3 : Control class before treatment (pretest)
0_4 : Control class after treatment (posttest)
X_1 : Application of local potential-based STEM learning model in experimental class
X_2 : Application of discovery learning model in control class

The research school was selected in one of the public junior high schools in Sukabumi Regency. The research subjects or research participation were not randomly selected to be involved in the experimental group and control group. The number of research samples was 54 VIII grade students divided into 27 students in the experimental class and 27 students in the control class. This research was conducted in the even semester of January to June 2024. The research flow is listed in table 1.

Table 1. Flow of Research

No	Research Flow	Place of Implementation	Description
1	Initial observation	Place of research	Finding out the conditions or problems that are happening at school.
		University of Muhammadiyah Sukabumi	1. Conduct a literature study. 2. Designing the implementation of local potential-based STEM learning and discovery learning. 3. Developing student worksheets.
2	Research Instrument Preparation	University of Muhammadiyah Sukabumi	1. Verbal and figural creativity test according to Torrance. 2. Product creativity assessment 3. Response questionnaire sheet.
3	Judgment and Revision	University of Muhammadiyah Sukabumi	1. Local potential-based STEM learning implementation design 2. 2. Student worksheet. 3. Verbal and figural creativity test. 4. Response questionnaire sheet.
4	Conducting instrument trials	Place of research	Test of figural and verbal creativity test instruments.
5	Implementation of research	Place of research	1. Conduct learning. 2. Instrument testing.
6	End of Research	University of Muhammadiyah Sukabumi	1. Data processing. 2. Presentation of research results. 3. Preparation of research journal.

An independent variable is a factor that can have an influence. The independent variable in this study is the local potential-based STEM learning model. The dependent variable is a variable that results from the influence. The dependent variable in this study is student creativity on excretory system materia l. The STEM learning model used by researchers in experimental classes uses learning steps according to James Morgan (cited by Setiono et al., 2023) which consists of, (1) Identify Problems and Constraints, (2) Research, (3) Ideate, (4) Analyze Ideas, (5) Build, (6) Test and Refund, (7) Communicate and Reflect. In the discovey learning model, researchers use learning steps according to Marisya & Sukma (2020) which consists of, (1) Stimulant, (2) Problem Statement, (3) Data Collection, (4) Data Processing, (5) Verification, (6) Generalization (Setiono et al, 2023). The instruments used in this study include verbal and figural creativity tests, as well as student response questionnaires to local potential-based STEM learning models.

The student verbal creativity test uses the Torrance Test of Creative Thinking Verbal (TTCT-V) indicators assessing three aspects of creativity including fluency, flexibility, and originality (Fauziah et al., 2021). The figural test was developed by Torrence because he realized the weaknesses in verbal measurement tools that are only able to measure verbal abilities of creativity, while the figural test is able to measure non-verbal aspects. According to Torrance, the instrument that supports the data in the study is the figural creativity test or Torrance Test of Creative Thinking-Figural (TTCT-F) which assesses three aspects of creativity including fluency, elaboration, and originality (Situmorang et al., 2020).

The data analysis technique used SPSS ver 25 and Microsoft Exel. Data analysis of the research results was adjusted to the instruments used, namely: verbal and figural creativity tests, as well as student response questionnaire sheets to local potential-based STEM learning models.

Data analysis of verbal and figural creativity test results using N-Gain calculation. Gain is the difference between pretest and posttest scores to determine the value criteria or show an increase in student creativity, the N-Gain calculation uses the following formula.

$$\text{N} - \text{Gain} = \frac{\text{Posttest score} - \text{Pretest score}}{\text{Ideal score} - \text{Posttest score}}$$

Table 2. Creativity N-Gain Criteria

N-Gain Range	Criteria
-100 < g < 0,00	There was a decrease g = 0,00
0,00 < g < 0,30	Low
0,30 ≤ g < 0,70	Medium
0,70 ≤ g ≤ 1,	High

(Richard R. Hake, 1998)

Analyze the data from the response questionnaire using a likert scale with the following calculation.

$$\% = \frac{\text{Number of student scores}}{\text{Maximum score}} \times 100\%$$

Table 3. Likert Scale Criteria

Percentage	Criteria
0% - 24,99%	Not good
25% - 49,99%	Not good
50% - 74,99%	Good
75% - 100%	Very Good

3. RESULT

Based on the results of the research conducted, data from experimental class students using the STEM learning model and control class students using the discovery learning model were obtained.

Table 4. Data of Pretest-Posttest Score of Verbal and Figural Creativity

Context	Pretest				Posttest			
	Experiment		Control		Experiment		Control	
	Verbal	Figural	Verbal	Figural	Verbal	Figural	Verbal	Figural
N	27	27	27	27	27	27	27	27
Minimum	24,07	11,11	22,22	0,00	64,81	44,44	55,56	44,44
Maximum	44,44	66,67	44,44	66,67	87,04	100,00	77,78	77,78
Median	29,63	33,33	29,63	33,33	75,93	77,78	62,96	66,67
Mode	27,78	22,22	29,63	33,33	70,37	66,67	62,96	66,67
Standard Deviation	6,39	14,39	4,00	17,62	6,95	14,77	4,74	11,25
Average	32,10	30,04	29,77	31,69	75,26	74,07	63,85	64,20

Table 4 shows that there is a difference in the verbal and figural creativity scores of experimental class students using the local potential-based STEM learning model higher than the control class students using the discovery learning model. Furthermore, to find out whether the difference is significant or not, statistical tests of pretest-posttest data from experimental and control classes are carried out normality test, homogeneity test, and hypothesis testing. The normality test aims to determine the value of data distribution in a group or data variable is normally distributed or not. Homogeneity test is used to determine whether some population variants are the same or not. Then, the hypothesis test aims to establish an objective basis in determining whether the statements or assumptions that have been made are accepted or rejected. The calculation of the three tests was carried out by calculating using SPSS 25. Normality test, homogeneity test, and hypothesis test researchers use the N-Gain value obtained from the difference in pretest-posttest scores. The following are the results of the recapitulation of the normality test, homogeneity test, and hypothesis test.

Table 5. Recapitulation of Normality Test, Homogeneity Test, and Hypothesis Test of Verbal - Figural Creativity

Test	Description	Verbal (Sig.)		Figural (Sig.)		Description
		Experiment	Control	Experiment	Control	
Normality Test	Shapiro-wilk	0,765	0,701	0,437	0,147	Normally Distributed Data
Homogeneity Test	Based on Mean	0,139		0,992		Homogeneous Data
	Based on Median	0,149		0,796		
	Based on Median and With Adjusted df	0,149		0,796		
	Based on Trimmed Mean	0,137		0,948		
Hypothesis Test (Independent Sample T-Test)	Equal Variances assumed	0,000		0,001		Significantly Different Data
	Equal Variances not Assumed	0,000		0,001		

The results of the normality test and homogeneity test can be stated that the data is normally distributed and homogeneous, because the results show sig. > 0,05. Furthermore, hypothesis testing was carried out using the independent sample t-test parametric test. Based on the significance value of the hypothesis test Sig (2-tailed)
<0.05, it can fulfill the condition that the N-Gain value between the experimental class and the control class is significantly different. So, it can be stated that H_0 is rejected and H_1 is accepted. That is, there is an implication of local potential-based STEM learning model on students' verbal and figural creativity.

Table 6. Product Creativity Score of Experimental Class

No	Indicator	Group 1	Group 2	Group 3	Group 4
		Skin	Lung	Kidney	Liver
		Tomato Juice	Ginger Drink	Binahong Crispy	Turmeric Chicken
1	Fluency	75	75	81	88
2	Flexibility	94	75	88	69
3	Elaboration	81	81	88	75
4	Originaity	88	88	94	75
	Rata-Rata	84,38	79,69	87,50	76,56

Based on the results of the product assessment, the highest score was obtained by group three where the product produced was binahong crisping for the treatment of kidney failure, while the lowest score was obtained by group four where the product produced was turmeric chicken for the treatment of hepatitis. The assessment was carried out based on creativity indicators.

The data of verbal and figural creativity test results of experimental and control class students were classified based on creativity indicators according to Torrance (1977). The following is the N-Gain value per indicator of verbal and figural creativity obtained by experimental and control class students.

Table 7. N-Gain Value Based on Students' Verbal Creativity Indicator

No	Indicator	Experiment		Control	
		N-Gain	Category	N-Gain	Category
1	Fluency	0,78	High	0,54	Medium
2	Flexibility	0,73	High	0,54	Medium
3	Originality	0,49	Medium	0,41	Medium

Table 8. N-Gain Data Based on Figural Creativity Indicator

No	Indicator	Experiment		Control	
		N-Gain	Category	N-Gain	Category
1	Fluency	0,54	Medium	0,48	Medium
2	Elaboration	0,64	Medium	0,42	Medium
3	Originality	0,68	Medium	0,51	Medium

The results of the verbal and figural creativity test research in table 6. and table 7. show that each experimental class indicator has a higher value compared to the control class value. The increase in verbal and figural creativity scores of the experimental class occurred due to using the local potential-based STEM learning model.

Student response questionnaires to the local potential-based STEM learning model were given to experimental class students. The student response questionnaire consists of three indicators, including: I) student interest in the use of local potential-based STEM learning models, II) student responses related to creativity using local potential-based STEM learning models, III) the relationship between local potential-based STEM learning models and the concept of excretory system material.

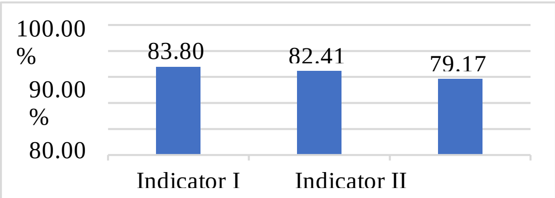

Figure 2. Percentage of Student Response to Local Potential-Based STEM Learning Model

Based on these three indicators, it was found that students gave positive responses with a percentage of 79- 83% or in the very good category.

4. DISCUSSION

The research results listed in Table 4 show that the average verbal creativity and figural creativity of the experimental class using the local potential-based STEM learning model has a higher value than the control class using the discovery leaning learning model. These results are supported by the research of Rahman et al (2023) which states that the application of local potential-based STEM learning models has a positive impact on student creativity.

Based on the results of hypothesis testing H_0 is rejected and H_1 is accepted. Proven by the results of the independent sample t-test parametric hypothesis test on verbal creativity Sig. (2-tailed) 0.000 and figural creativity Sig. (2-tailed) 0.001 experimental class and control class are significantly different. Thus, it shows the implication of local potential-based STEM learning model on students' creativity. Student responses related to creativity using local potential-based STEM learning models in Figure 2 state that local potential-based STEM learning models can increase their creativity. In line with Sumarni and Kadarwati's research (2020) which states that the use of local potential-based STEM learning models shows a significant effect on increasing student creativity. Supported by research by Ahmad et al (2023) which states that the positive response given by students and the increase in student creativity scores are based on the encouragement of students to use their creativity in local potential-based STEM learning, through the use of learning media in the environment with a science, technology, engineering and mathematics approach. In the local potential-based STEM learning process, students are given the opportunity to utilize their potential, and explore local wisdom found in the surrounding environment, so that students can find ideas in working on learning projects to solve a problem.

This is supported by Wibowo's research (2022) which states that the local potential-based STEM learning model is very helpful for teachers and students in expressing their ideas when learning. Based on the findings in the field, the activity of expressing ideas when students make product designs for the treatment of excretory system diseases. Product design starts with the selection of tools and materials of family medicinal plants, manufacturing procedures, product design and packaging, product testing, and product improvement. When students determine the products and medicinal plants that will be made, of course, it is based on the results of the literature conducted. Supported by student responses in Figure 2 which are very good regarding the relationship between the local potential-based STEM learning model and the concept of excretory system material. The series of local potential-based STEM learning activities in the experimental class can be implemented very well. This attracts students' interest in the local potential-based STEM learning model as evidenced by the excellent student response shown in Figure 2.

During the implementation of the local potential-based STEM learning model, researchers divided students into four groups. Each group was given a student worksheet to guide students in carrying out a project. The first group was given the problem of acne, the second group was given the problem of chronic obstructive pulmonary disease, the third group was given the problem of kidney failure, and the fourth group was given the problem of hepatitis. From these problems, students were directed to make products to treat excretory system diseases.

Figure 3. Tomato juice

Figure 4. Wedang Jahe

Figure 5. Binahong Crispy

Figure 6. Turmeric chicken

Based on the research results in table 6. group three got the highest score, where group three made crispy binahong products for the treatment of kidney failure. The highest score in group three can be seen in the process of implementing the local potential-based STEM model very well, and the products made are unique, interesting, innovative, and different from other groups, besides that the aspects of the family medicinal plants used can play a role as the main ingredients of the product. in contrast to group four getting the lowest score, where group four made turmeric chicken products. The low assessment of group four's product can be seen when the product made does not bring out the role of the family medicinal plants used, because the turmeric chicken product brings out the role of chicken more than turmeric as a family medicinal plant used.

In the fluency indicator, group four got the highest score because group four had to recreate the product design for the treatment of excretory system diseases, the turmeric chicken product that had previously been made did not highlight the role of turmeric itself as a family medicinal plant. On the flexibility indicator, group one got the highest score, because group one chose a tomato family medicinal plant that was different from the family medicinal plant references given on the student worksheet, the selection of tomatoes as an acne treatment product was in accordance with the results of the literature that had been done by students, and the tomato juice product that had been made could bring out the role of tomatoes as a family medicinal plant. In the elaboration indicator, group three got the highest score, because group three made binahong krispi products, where binahong krispi is a new innovation made, besides that in testing the product group three brought the product to school to be tested so that the participants became diverse and the evaluation given could be conveyed directly. In the originality indicator, group three got the highest score because group three made an interesting binahong crispy product design, unique and rarely found in everyday life, as well as a product packaging design that can make it easier to consume the product. Based on the results of excretory system disease treatment products produced by students through local potential-based STEM learning, students can apply their creativity to learning and have interesting experiences during the science learning process. This learning experience can pr ovide provisions for students to conduct STEM learning with very limited resources, utilizing materials and tools that are affordable and easily accessible to students (Setiono & Windyariani, 2023).

The research results listed in tables 7 and 8 of the fluency indicator, show that students have been able to find ideas and provide questions or statements or draw objects with more than one answer. Supported by the statement of Muslimah & Listiyani (2022) fluency is the ability of fluency in solving problem plans shown by thinking of more than one answer, and providing many answers. Fluency measurement in this study can be seen when students submit statements or questions or draw as many objects as possible based on the problems or stimuli given. In line with Torrance's statement (cited in Apulembang, 2017), fluency is the ability to generate or produce a number of ideas, answers and questions quickly (emphasis on quantity). The increase in fluency indicator scores in the experimental class was influenced by the implications of the local potential-based STEM learning model. In the implementation of learning, students are encouraged to submit various references to products for the treatment of excretory system diseases through local wisdom using family medicinal plants along with the product design. In line with the opinion of Febrianti et al (2016) that students who meet the fluency indicator are students who can ask several questions, are adept at conveying ideas or ideas, and have the ability to think faster than students in general. The submission of product ideas and family medicinal plants submitted by students must be based on clear literature sources either through articles, journals, or information circulating in the surrounding environment. This is done so that the products made by students are based on accurate information so that they can be accounted for and can strengthen the concept of student excretory system material. The more accurate information is, the more useful and reliable it is for making decisions (Pratomo & Yuliandhari, 2014).

The research results listed in table 7 of the flexibility indicator, show that students have been able to provide varied solutions. In line with the results of Riyadi's research (2022) the achievement of student flexibility is included in the good category, it can be seen from most of the students' answers are not fixated on one way of solving that is usually taught, the answers vary not centered on one point of view. Measurement of flexibility in this study can be seen when students convey a question or statement from several different points of view. In line with the opinion of Andini (2015) which states that this flexibility indicator, when students can produce varied ideas, answers, or questions, can see a problem from different points of view. The increase in the value of the flexibility indicator in the experimental class was influenced by the implications of the local potential-based STEM learning model. In the implementation of learning, students are faced with two conditions. First, the problem of excretory system disease is raised. Second, students are expected to be able to make products for the treatment of excretory system diseases by utilizing local wisdom available in the surrounding environment, using the basic ingredients of family medicinal plants. Given these conditions, students are required to be able to find solutions by first considering various points of view, so that the solutions provided are varied (Qomariyah et al, 2021). In line with the opinion of Fajriah & Asiskawati (2015), it is stated that the flexibility indicator in creativity is related to the number of ideas that can be raised by students and these answers must vary. The characteristics of flexibility include 1) producing varied ideas, answers, or questions, 2) seeing a problem from different points of view, 3) looking for many alternatives or different directions, 4) being able to change the approach or way of thinking (Munandar, 2009; Islami et al, 2018).

The research results listed in table 8 of the elaboration indicator, show that students have been able to develop an idea. Supported by Andini's statement (2015) elaboration is the ability to develop an idea. The measurement of this elaboration indicator is seen when students can develop an object in detail into an interesting object. In line with the opinion of Fatmah (2022), elaboration is the ability to describe an object, idea in detail to produce something more interesting. The increase in the value of the elaboration indicator in the experimental class was influenced by the implications of the local potential-based STEM learning model. In the implementation of learning, students are directed to make designs to finished products for the treatment of excretory system diseases through local wisdom using the basic ingredients of family medicinal plants. The design made by students includes product manufacturing procedures, product design, product packaging design, product manufacturing to design or product improvement. In line with the opinion of Ulfa et al (2018) stated that problem solving activities such as conducting experiments, making students design the experimental process which includes the title, design, objectives, tools and materials, as well as how to work, a series of processes in conducting experiments that are systematic and detailed can train students' elaboration skills. The product that has been made by students is tested to find out the shortcomings of the product, which will later be made an improvement with the aim of developing the product. Supported by the statement (Agustiana et al, 2019; Primayonita et al, 2020), elaboration is the ability to develop ideas and add or detail the details of an object. A series of elaboration activities can challenge students to apply students' new knowledge to different contexts (Surur, 2017).

The research results listed in tables 7 and 8 of the originality indicator, show that students have been able to convey questions or questions presented in their own language or drawings made unique. The originality indicator can be seen when children can provide unusual ideas (Fauziah et al, 2021). Measurement of originality can be seen when students can convey a question or statement or image that is unique, interesting and different from other students. Supported by the statement of Kadir et al (2022) originality is the ability to think original, think of unusual ways of expressing oneself, and be able to combine unusual parts or elements. The increase in the value of the originality indicator in the experimental class was influenced by the implications of the local potential-based STEM learning model. In the implementation of learning, students are expected to make products for the treatment of excretory system diseases using local wisdom using the basic ingredients of family medicinal plants that are interesting and unique. Products that are interesting, unique, and different from other products can be seen from the basic ingredients that use family medicinal plants, besides the product design and product packaging design made by the students themselves. Supported by Samura (2019) states that originality is a student's skill in solving problems in his own way or in other words a way that people usually don't think of.

5. CONCLUSION

Based on the results of the research and discussion above, it can be concluded as follows: 1) The results of hypothesis testing show H_0 is rejected and H_1 is accepted with Sig (2-tailed) results of verbal creativity 0.000 and figural creativity 0.001 where the data is significantly different. 2) N-Gain of verbal creativity of experimental class is 0.65 and control class is 0.48 while N-Gain of figural creativity of experimental class is 0.63 and control class is 0.45. 3) The average student response questionnaire is 81.79% in the very good category. 4) There is an implication of STEM learning model based on local potential on student creativity in one of the public junior high schools in Sukabumi. 5) It is expected that all junior high schools in Sukabumi Regency are able to apply local potential-based STEM learning models in learning. Because local potential-based STEM learning models can have implications for student creativity, and students can experience interesting learning experiences because they are based on problems from everyday life through local wisdom in the surrounding environment.

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