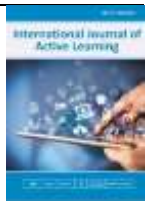
IJAL 4 (2) (2019)

International Journal of Active Learning

Terakreditasi SINTA 4

http://journal.unnes.ac.id/nju/index.php/ijal



The Effectiveness of Integrated Natural Science Learning by Using Scientific Approach-Based Module to Improve Students' Creative Thinking Skill

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Info Articles

History Articles:
Received 8 January 2019
Approved 11 July 2019
Published 1 October 2019

Keywords:
Creative Thinking Skill, Module, Integrated Natural Science Learning, Scientific Approach, Substance Pressure

Abstract

The research aimed to investigate the effectiveness of integrated Natural Science learning by using a scientific approach-based module to improve students' creative thinking Skill at substance pressure concept. The module was developed by employing a 4D model by Thiagarajan, Semmel & Semmel (1974) with one group pretest-posttest design. The research involved 30 students at SMP Negeri 2 Luwuk, particularly in class VIII A2 and its instrument was creative thinking skill test adopted and composed from a test developed by Hu, Weiping (2002) and Panjaitan (2014). The instrument comprised 3 indicators which were thinking fluency, thinking flexibility, and thinking originality. It used average normalized gain as analysis. The finding of research showed that the result of the normalized N-gain test differed in each of creative thinking indicator. The values of N-gain for an aspect of fluency was 0.58 with a medium category, for an aspect of flexibility was 0.57 with medium category and for an aspect of originality was 0.13 with a low category. In brief, the average value of N-gain for all creative thinking indicators was 0.42 with a medium category. To conclude, the finding confirmed that the integrated Natural Science learning by using scientific approach-based module was effective in improving students' creative thinking skill at substance pressure concept.

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p-ISSN 2528-505X
e-ISSN 2615-6377

INTRODUCTION

Education is the most influential aspect in forming the nation to be ready for encountering globalization era issues. Education quality in Indonesia remains including in low category as revealed through research by Hans Jellen that sorted the following 8 countries based on the creative skill from average highest to lowest score namely Philippine, United States of America, England, Germany, India, China, Cameroon, Zulu, and Indonesia. In addition, finding of research from Program for International Student Assessment (PISA) held by Organization for Economic Cooperation and Development (OECD, 2014) and Trends in Mathematics and Science Study (TIMSS) regarding rank of students' knowledge ability in fields of mathematics, science, and literacy in real life context placed Indonesia in the 64th position from 65th and it was under the average. Instead, questions provided by PISA were mostly to measure abilities of problem-solving, argumentation, communication, reasoning, and high thinking.

The previous issues have made the Ministry of Education and Culture of The Republic of Indonesia attempt to adjust the load, process enforcement, material deepening, mindset management, and management from KBK (*Kurikulum Berbasis Kompetensi* or Competency-Based Curriculum) and KTSP (*Kurikulum Tingkat Satuan Pendidikan* or Educational Unit Level Curriculum) to 2013 Curriculum as managed in Constitution number 20 about Education System. The learning of the 2013 Curriculum aimed to develop 4C (Communication, Collaboration, Critical Thinking and Problem Solving, and Creativity and Innovation) characters. Several experts have elucidated the importance of 4C mastery as media to achieve success, particularly in the 21st century, the century with rapid and dynamic world development. Also, 4C is a soft skill that has more worthwhile than the hard skill for daily implementation.

Finding of observation and interview conducted in one of the schools in Luwuk Sub-district, Banggai District, Central Sulawesi Province revealed that the learning performed by either physics and biology teachers was nearly the same which concerned on integrated material between the two subjects. Teacher of biology basic was demanded to teach physics material although it was not even the expertise, thus it impacted students in the teaching and learning process where most activity run in classroom discussion and students were not insisted on asking, finding out and solving a problem related to physics. Also, the learning was not related to creative thinking aspect, for instance, a teacher gave chance to students to answer questions as many as they could and teacher facilitated them in finding different answer alternative. Consequently, students' creative thinking ability towards Natural Science concepts was generally low. Thus, students were prone to be bored to learn the Natural Science and their low creative thinking skill was evidenced when they were given several phenomenon or problems in daily life.

The Natural Science learning was appropriate to be used to train the creative thinking (Integrated Natural Science Team, 2010). In addition, it might courage students to be responsive to the environment, thus it would trigger them thinking creatively to solve any problem by applying Natural Science concept. The integrated Natural Science learning was performed with varied models, and it was adjusted with the future type or theme of material. Fogarty (Odja, 2016) stated that the implementation of an integrated learning approach in the classroom was through several models. There were ten models of integrated learning namely fragmented, connected, nested, sequenced, shared, webbed, threaded, integrated, immersed, and networked.

It was a fun learning if it was able to create a learning condition which led students to get involved actively and creatively in the learning process. One of the learning sources and media that could help either students or teachers in a learning process to improve students' creative thinking skill was integrated Natural Science learning module. A module was one of the smallest learning units in regards to certain topic or problem. Independence learning package encompassed a set of learning practice based on systematic plan and design to help students

achieve the learning goal. The module was included in printed media or media that is presented in printed form and materials. (Syaodih, 2010: 114)

According to the cognitive theory of Piaget, the age of students at class VIII was around 13-14 years, and they transformed from a concrete operational to formal operational phase. The children at the concrete phase would be easier recognizing and understanding materials entirely first that was marked based on what the real thing was. The module was equipped with students' activities that were able to make students' thinking concretely and emphasized students entirely to find material in regards of concept, theory, or understanding through examples they meet in the daily activity, and students were trained to be able to think creatively through real seeking and experience.

The learning with module made students being active, thinking creatively and helping students in finding the concept. This was based on constructivism theory of Vygotsky which stated that the learning activity required children to obtain ample opportunity to develop the proximal development zone or potential through learning and developing. The module was a form of scaffolding that could be used in the learning particularly at Natural Science thus students were able to master the concept as a demand of curriculum.

The Natural Science learning applying scientific approach-based module comprised activities that could improve students' creative thinking skill. In addition, repetitive learning through module would engage students to directly involve in the learning where the developed module triggering students to be active thus the knowledge they obtained would stay longer. The fact was in accordance with information processing theory namely theory that was related to person's way in obtaining and processing information, saving information, and tracing knowledge from a brain or thought comprising components of a sensory register, short-term memory, long-term memory (Sudirman et al., 2016).

Therefore, the previous cases required an alternative solution to solve a necessary problem of both students and teachers which one of them was by using a scientific approach-based module in the Natural Science learning to improve students' creative thinking skill.

METHODS

The research employed one-group pretest-posttest design (Fraenkel & Wallen, 2003) with one experimental group that was tested before and after treatment to observe achievement of students' creative thinking skill as shown in Table 1.

Table 1. The One-Group Pretest-Posttest Design

Group	Pre-test	Treatment	Post-test
A	O_1	X	O_2

Notes: O_1 = Pre-test, O_2 = Post- Test
X = The learning of Natural Science by Using Scientific Approach-Based Module

The subjects in the research were 30 students from Class VIII A^2 of SMP Negeri 2 Luwuk, Central Sulawesi Province. The instruments used creative thinking skill tests and their scoring procedures that were adapted and adjusted from the scoring developed by Hu, Weiping (2002) and Panjaitan (2014) comprising 3 indicators namely thinking fluency, thinking flexibility, and thinking originality. The test used to assess creative thinking skill comprising 4 questions. The detail scoring procedures on each indicator of creative thinking could be seen in table 2 below:

Table 2. Scoring Procedure of Creative Thinking Skill Test

Indicator	Assessment	Score	Amount
Fluency (Flu)	All responses/ answers of students without noticing quality	1	Score x Amount of response
Flexibility (Fle)	Correct answer;	2	Score x amount of

	amount of approach; coverage in the answers		correct answers; approach; coverage in the answers
Originality (O)	Developed from tabulation of all obtained responses frequency	P < 5%; 3 5% ≤P≤10%; 2 P ≥10%; 1	Note: If probability is less than 5%, it obtains 3 points, probability from 5 to 10 obtains 2 points; If probability is higher than 10, it obtains 1 point

Data of preliminary test result (pretest) and final test (posttest) of students' creative thinking skill calculated the improvement stated in the form of n-gain (normalized gain). The N-gain analysis aimed to categorize the amount of improvement of students' creative thinking skill after using a scientific approach-based module. To obtain the normalized gain from the score of creative thinking, it used equations according to (Hake, 2002) namely:

The n-gain value is determined by the equation: N-gain = (score post-test - score pre-test) / (maximum score - pre-test score). According to the following criteria, as shown in Table 2.

Table 2. N-gain Criteria

N-Gain Score	Criteria
Score ≤ 0,3	"Low-g"
0,3 < score ≤ 0,7	"Medium-g"
Score ≥ 0,7	"High-g"

RESULTS AND DISCUSSION

The effectiveness of integrated Natural Science learning with scientific approach-based module observed from the improvement of ability at students' creative thinking indicator during pretest and posttest. The results of students' creative thinking skill showed improvement as seen from the average of pretest and posttest measured based on guidelines for scoring students' creative thinking skill and it could be seen in the following table 4.

Table 4. Result of Pretest and Posttest Score for Students' Creative Thinking Skill

Component	Pre test			Post test		
	Flu	Fle	O	Flu	Fle	O
Number of Students	30					
Average Score	8.43	9.2	0	15.83	28.13	0.8
The Highest Score	15	16	0	19	36	4
The Lowest Score	2	4	0	12	10	0

The table 4 above showed that there was an improvement of students' creative thinking skill as seen from the average score of pretest and posttest. The improvement was measured by using a test of average improvement to observe students' creative thinking skill after implementing the module in the learning. The improvement was then analyzed by applying the normalized N-gain formula in which its result was presented in table 5 below.

Table 5. Result of N-gain test for Data of Pretest and Posttest Data

No.	Indicators of Creative Thinking Skill	Rata-rata Skor		N-gain value	Criteria
		Pre test	*Post test*		
1	Thinking Fluency	8.43	15.83	0.58	Medium
2	Thinking Flexibility	9.2	28.13	0.57	Medium
3	Thinking Originality	0	0.8	0.13	Low
Average N-gain Value				0.42	Medium

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Based on tables 4 and 5, overall, there was an improvement in students' creative thinking skill towards 30 students in class VIII A2 of SMP Negeri 2 Luwuk with N-gain calculation showing an average of 0.42 with a medium category. This indicated that the integrated Natural Science learning through using scientific approach-based module was effective in improving students' creative thinking skill as there were activities that could support students in the integrated Natural Science learning process that used scientific approach-based module, students were actively involved in conducting experiments independently either at home or school, and they could analyze to collect data, to discuss and to draw conclusions about the activities. The Natural Sciences learning through module could make students being active, thinking creatively and helping them find their own concepts. Besides, the concept of the scientific approach (Observing, asking, collecting data, associating, and communicating) in the 2013 curriculum could train students to be more independent, creative, and innovative thus students could develop their own knowledge. This was in accordance with the finding of research conducted by Aji Setiawan (2014) which stated that the learning module could improve the creative thinking skills of junior high school students and it could be used as learning alternative source or medium of creative thinking.

Instead of being scaffolding, the scientific-based module in learning was also a medium to facilitate person in self-regulation while learning (self-regulated learning). The compiled module facilitated students to solve problems and tasks that could be finished during lesson hours either at school or outside of learning activities which were at home for example. Thus, learning activities could be carried out by students anytime and anywhere based on the module guideline. In the classroom learning, the teachers facilitated students learning based on their needs. This was in accordance with Woolfolk (Odja, Supardi, Jatmiko, 2016) who expressed that teachers could help or share control on self-regulated learning of students by providing choices in reachable steps in solving problems or tasks. The students' activities steps in the research were clearly presented in the module.

The finding of research was also in accordance with other researches in the Natural Science learning including: (1) Lestari, Sarwanto, Mohammad Masykuri (2015) which showed that the integrated Natural Science module with a scientific approach on waste theme that has been used in learning was considerably effective with percentage of 38%; (2) Ika Sufianti, Syifa'ul Gummah, Bq. Azmi Sukroyanti (2017) which showed that the average creative thinking skill in the experimental group was 72.32% which was categorized as a creative control group at 62.67% which was categorized as sufficiently creative. The findings concluded that there was an influence of the scientific approach on students' creative thinking skill on vibration and wave topics; (3) Taufik Isleyen & Betul Kucuk Demir (2015) which showed that argumentation-based science learning approach had positive influence on students' creative thinking skill; (4) research in the mathematics learning by Tresia Widiani, M. Rif'at, Romal Ijuddin (2016) which showed that mathematics learning with scientific approach and its influence on creative thinking skill improved for 84.48% on average.

The improvement of creative thinking skill based on each indicator was different either from values and categories. The following is a comparison graph of each indicator for creative thinking according to calculation results of N-gain.

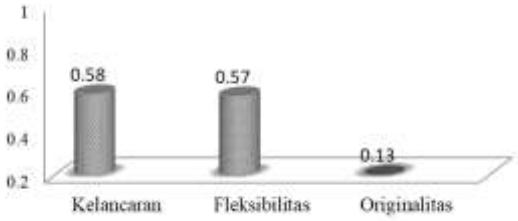

Figure 1. Calculation Results of N-Gain for Students' Creative Thinking Skill

The figure 1 above shows that the indicator of creative thinking skill that experienced the most significant improvement is the fluency. The fluency indicator is an ability to create as many ideas as possible. It is one of the strong indicators of

creative thinking, and the more ideas will lead to the higher possibility to achieve significant idea. The Natural Science learning through using module provided opportunities for students to deliver as many ideas/answers as possible, where students were facilitated to provide statements based on their initial experience or knowledge. This was based on the calculation result of the fluency indicator that was in the medium category (N-gain of 0.58) which meant that the average students had been able to show many ideas from the test of creative thinking skill provided.

The indicator of flexibility (flexibility) was an indicator of creative thinking that also experienced a significant improvement after the fluency indicator. The indicator was related to the number of ideas or answers that students created, where students were provided facilities/ opportunities to relate answers/ questions with existing concepts, thus the answer was in accordance with the concept of pressure. It did not only contain many answers but also the answers must be in accordance with the concepts they have learned. This could be seen from students' way to solve problems given when working on test questions and this indicator was in the medium category (N-gain of 0.57).

Originality was the most difficult indicator to be trained to students, due to students remained fixated and influenced by several things explained in the module on how to overcome problems. In general, the students were not able to freely express their ideas as only fixating to one idea when overcoming problems, even though there should be other ideas. Based on the obtained data, some students had been able to find a way of solving that was different from the concepts they obtained during learning. The case meant that several answers derived from other concepts or experiences that students have gone through, where there was 1 student who achieved score that was almost full namely 4 out of 6 as the maximum score, and 1 student achieved score of 3, while 17 other students achieved a score of 1 with the calculation results of N-gain of 0.13 with low category.

The originality was a complex aspect of creative thinking indicators. This was as shown by Michael D. Mumford, Kelsey E. Medeiros, Paul J. Partlow (2012) that showed that despite creative achievement is influenced by many variables, the basis of creativity is maintained to produce high-quality, original, and elegant solutions. Besides, the research finding indicated that creative problem solving depended on effective implementation of a complex set of cognitive processes. Another research by Hevy Risqi Maharani, Sukestiyarno, Budi Waluya (2017) showed that students required more intensive guidance than teachers to help students performing each of stage in the creative thinking process. For students in the middle category, the teacher required to provide few guidances and motivations to students from students solving problems until students finding the proper solution. Students in the high category have gone through the creative thinking process fluently, thus teachers required to provide further enrichment material.

The research object that was students at Class VIII aged about 13-14 years. The age had an important influence on students' creative thinking skill. This was in accordance with research of Ugur sak and C. June Maker (2006) that showed the relationship of age, years of education, and special knowledge in the development of children's creativity was good for indicators of originality, flexibility, and elaboration and fluency.

CONCLUSION

Based on the research finding and discussion that have been elaborated, thus it concluded that the implementation of integrated Natural Science learning with scientific-based module was effective in improving creative thinking with a medium category. The improvement of students' creative thinking skill for each of indicator was different. The indicators of fluency and flexibility improved with medium category while the indicators of originality improved with a low category.

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