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The Effect of Scientific Approach on Junior High School Students' Scientific Creativity and Cognitive Learning Outcomes

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Abstract

This study investigates the effects of using scientific approach-based learning tools on students' scientific creativity (SC) and cognitive learning outcomes (CLO). This study employed a one-group pretest-posttest design that involved 70 students of Maduran Junior High School Lamongan. Students' SC and CLO were collected by using fifteen essay tests and analyzed descriptively and statistically. The result shows that (1) the proportion of lesson plan (RPP) implementation was highly excellent, (2) students' responses were quite strong to the learning activities, and (3) students' SC and CLO improved moderately. Statistically, students' SC and CLO stated significantly different after treatment ($p < 0.05$) and positively correlate (Sig. > 0.7). Based on the study findings and discussion, it can be concluded that the scientific approach significantly affects students' SC and CLO.

Keywords: Scientific approach; Scientific Creativity; Cognitive Learning Outcomes

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INTRODUCTION

Technology development to facilitate human activities is accelerating in all fields (Utami et al., 2020). Notebooks and smartphones are two primary examples of communication technologies becoming more complex and valuable for human productivity. Rapid technical progress is based not only on a high level of knowledge but also on an element of creativity contained in technological innovations that are required to respond to the issues that exist in the current period of globalization (Faresta et al., 2020; Seprianto & Hasibuan, 2021). The abilities required to perform a task, particularly a student, to innovation strategy in an era of globalization and rapid technological advancements in the globe are compiled in twenty-first-century talents (21st Century Skills) (Bozkurt Altan & Tan, 2020). These 21st-century abilities allow pupils to overcome all difficulties and obstacles in a more complicated life and to enter the workforce. A person needs a variety of 21st-century talents, including life skills, creativity, learning and teaching skills, 21st Century evaluation, and others.

Creativity is one of the 21st Century Skills that aids in developing pupils' capabilities (Gupta & Sharma, 2019; Thuneberg et al., 2018; Torrance, 1995). Students' creativity must be polished and enhanced to be prepared to confront any challenge in the twenty-first century. Creativity may not happen naturally to everyone, but it does need knowledge of something to be learned (Kim, Min-Ju. Lim, 2018). The curriculum utilized to implement teaching and learning activities in Indonesia is also employed by the Government of the Republic of Indonesia to prepare its young people for the future. Creativity could be cultivated via instructional experiences, proven by numerous ways to develop creativity in education have been created (Dao et al., 2021; Sopacua et al., 2020).

The education curriculum in Indonesia (The 2013 Curriculum) focuses on the challenges of worldwide changes in technology innovations (Bay et al., 2021). The goal of adopting the 2013 Curriculum is to equip Indonesians to live as creative persons capable of contributing to social life. The 2013 curriculum is also intended to deliver learning that pushes pupils to solve issues in novel ways. Creativity is a type of higher-order thinking. According to Anderson's updated Bloom's taxonomy (Septaria & Dewanti, 2021), a human's highest cognitive level is "create." Pupils must first comprehend the idea being studied in the previous stage to achieve the cognitive level at the creation level.

Scientific creativity is one type of creativity. Scientific creativity is a subset of creativity (special domain creativity). Hence it is distinct from public creativity (Dău-Gaşpar, 2013; Septaria et al., 2020; Sopacua et al., 2020). Scientific creativity may be described as the consequence of thinking abilities shown in products that answer unique scientific challenges (Djidu et al., 2021). Scientific creativity is indeed the result of an education process and a product made in learning that has novel value and is gained from scientific investigations. Therefore, scientific creativity is vital for someone to be trained from an early age to build thoughts and produce different ideas or products supported by science – and a high level of knowledge to positively contribute to the environment.

The 2013 curriculum, which is presently being implemented, employs a scientific approach to learning. The term approach represents a point of view mostly on developing an activity that is nonetheless quite generic (Ozkan & Umdu Topsakal, 2021). The technique dictates the program's structure and pattern (Hamel et al., 2021). The scientific approach to teaching and learning follows scientists' stages in developing knowledge using the scientific method (Roth et al., 2021). The scientific method aims to allow students to use all their capacities for idea acquisition, including higher-order thinking skills, one of which is developing pupils' scientific inventiveness. Teachers may better satisfy students' requirements for the design of scientific creativity by using suitable learning techniques and providing learning opportunities that encourage the development of students' scientific creativity (Henry et al., 2021; Septaria, 2019).

All of us can be creative, but not everyone has the skill to develop their creativity, which is heavily impacted by their surroundings. As an upcoming generation, students must be instructed in developing their creativity by mentors (teachers) and other people in a supportive atmosphere to achieve their scientific creativity mentality through teaching, and learning activities carried out by instructors in the classroom (Said-Metwaly et al., 2021). Natural Sciences (IPA) is one of the disciplines specified by the teaching Materials to enable students to prepare for and deal with environmental changes (Woods & Hsu, 2020). The science learning process in the 2013 Curriculum is designed to be applied to foster critical thinking skills, learning capacities, curiosity, and caring and responsive behaviors toward the cultural and economic world (Septaria & Dewanti, 2021).

The 2013 Curriculum's science instructional methods emphasize occurrences in everyday life that are degraded and related to existing ideas. Students are also expected to be active participants in their learning, implying that they must be willing to figure out what they want to grasp or master (Thuneberg et al., 2018). According to Hadzigeorgoiu et al. (2012), science education is one of the creative initiatives to develop creativity from a younger age. Learning science in the classroom is intended to help students broaden their knowledge, practice process skills, comprehend the nature of science, and develop a positive attitude toward science. What students learn in science lessons in class is critical for developing scientific creativity. Global climate change is one of the themes covered in science classes. Even starting in 7th grade, the issue of global warming is covered. Ocean warms as an increase in the average temperature of the earth's atmosphere, sea, and land (Moura et al., 2020; Septaria, 2019). Global warming affects life and the ecosystem on Earth (Handayani & Putra, 2019). Global warming is one of the most severe environmental issues today.

Global warming has been and continues to be a problem for the earth, and steps must be taken to avoid and mitigate it (Sayuti et al., 2021). Following the scientific method in junior high school science, the instruction may be used to show the reality of global warming. Early evidence of global warming will make pupils more conscious of the need to care for the environment. The study of global warming in junior high school pupils tries to describe the causes of global warming and its influence on ecosystems. Students are expected to be able to explain using higher-order thinking abilities in learning based on the objectives of studying science on global warming topics (Al-Ghussain, 2019). Describe may be remembered, understood, applied, analyzed, evaluated, and created according to Bloom's taxonomy (Anderson & Krathwohl, 2001). Students are required to remember definitions, understand concepts, look for examples, analyze and evaluate causes and impacts, and creatively come up with ideas to reduce or prevent global warming.

Based on the Trends in International Mathematics and Science Study (TIMSS) study in 2020, which was conducted to measure the realization of mathematics and science for 7th-grade students, Indonesia was ranked 40th out of 42 countries that registered and took part in the activity. The results showed that Indonesian students disable to answer problems related to knowledge and beliefs about the events that occur in their daily environment. Students may recognize a variety of fundamental facts but cannot discuss and link numerous science topics, much alone apply complicated and abstract concepts (Samsudin et al., 2018). Furthermore, the Program for International Student Assessment (PISA) study in 2020 found that Indonesia might be described as highly poor. Indonesia is ranked 64th out of 65 participating countries. Students in Indonesia are at the stage below 2, defined as being able to answer familiar questions with available supporting knowledge, identifying information but employing it procedurally requires explicit guidance, and taking action if provided an apparent stimulus. There appears to be a disconnect between the expectations of developing students' higher-order thinking skills, one of which is scientific creativity compared to the current reality. Learning continues to stifle the growth and development of student creativity (Pisl et al., 2021). Furthermore, based on observations of scientific subject instructors at Maduran Junior High School Lamongan (MJHSL), it was discovered that Maduran Junior High School had followed the 2013 Curriculum since its inception. However, interviews with science instructors at Maduran Junior High School revealed that, while the school has adopted the 2013 Curriculum as the foundation for learning, pupils are not educated in acquiring or interpreting a phenomenon using the scientific method or scientific approach.

According to MJHSL teachers, students are less trained in developing knowledge and creativity, and there is a lack of assessments that measure scientific creativity carried out or produced. Students are too focused on completing the learning materials. Furthermore, interviews with science instructors revealed that teachers lack the time and cannot further enhance students' creative skills through gadgets and during instruction. Conversely, science learning in MJHSL has progressed to the comprehension stage. The claims that students are only taught to have low-level thinking abilities instead of high-level thinking skills, one of which is that students' scientific creativity is unaffected. Students are not conscious that they are being taught to improve their scientific knowledge and creativity, yet these talents indirectly impact a person's future. Essentially, learning activities in formal and non-formal educational institutions are designed to prepare and assist students in becoming capable of living in the future.

Students' issues at MJHSL are basic portrayals of students in Indonesia at the regional and national levels. Middle school learners are more likely to study alongside their peers without considering the abilities they may need in the future (Faresta et al., 2020). Students aged 12 to 15 today gain extremely few skills from schooling; students at this age often increase their cognitive abilities through audio-visual media such as YouTube, TikTok, and others (Chotijah Fanaqi, 2021). Creativity is acknowledged when anyone creates something new. However, creativity is a talent performed via the habituation of action (Dău-Gaşpar, 2013). Behavior modification to maximize creativity is critical for preparing the next generation to solve complicated challenges.

The bulk of repetition in schools is accomplished through a learning process that employs a learning model or strategy that stimulates student involvement in class (Sukaisih et al., 2020). Habituation to improve creativity may be aided by engaging students in activities such as watching, trying/practicing, and drawing conclusions from the studied topics (Thuneberg et al., 2018). Previously, relevant research employed specialized learning models such as project-based learning and problem-based learning. It relied on markers of originality made by someone to be classified as having creativity in themselves (Ozkan & Umdu Topsakal, 2021). The technique applied in this research, namely employing 6M and assessing the four indications of creativity that a person has, and searching for the association between cognition and creativity, is innovative.

Students in middle school are 11 years old or older, and Piaget's theory of cognitive development proposes that at this point, kids are grouped at the formal operational stage, where they should be urged to think rationally (Sapuadi & Nasir, 2020). Students should be able to answer issues based on observations made in everyday life. This issue is especially problematic in science fields and results in goods with high novelty and utility qualities. Vygotsky's theory of the Zone of Proximal Growth (ZPD) and scaffolding asserts that a person's cognitive development is governed not just by the individual but also by an active social environment (Nurhidayati, 2017). An educator's learning environment influences his students, either directly or indirectly. Students can absorb knowledge and retain it in their memory well if the learning environment is suitable and encouraging for them, even if repetition is required to store it in their long-term memory (Dökme & Koyunlu Ünlü, 2021). Most of the information taught in science classes is about contextual issues and phenomena.

In a class, a teacher must create and implement a learning environment that is hospitable to students and capable of developing information and training high-level thinking abilities, particularly scientific creativity in science topics on the issue of global warming (Septaria, 2019). This activity to develop scientific creativity on global warming from an early age is centered on educating children and sharpening and maximizing students' creative thinking in dealing with global warming through relevant procedures. Practicing kids' scientific creativity may be overcome by using a science learning strategy that allows students to make creative efforts in science learning (Genek & Küçük, 2020).

According to the statement above, the background is to conduct a study on developing junior high school students' scientific creativity using a scientific approach. As a result, it is predicted that after receiving this therapy, kids will have sufficient information and will be able to enhance their creativity. The creativity in question, particularly scientific creativity in students and science subject teachers, includes procedural principles and instruments for making learning exciting and pleasurable to encourage student inventiveness. Learning that assists in the construction of knowledge and helps to connect students with maximizing their skills is critical (Sánchez et al., 2021). Creativity is one of the talents that kids will require to live their lives shortly (Faresta et al., 2020).

Students' scientific creativity is highly critical to be developed; creativity growth is vital in relation to the uniqueness of work, and creativity has various additional signs that classify a person as creative (Harris & de Bruin, 2018). This research aims to take better advantage of scientific creativity. It is supported by qualifying cognitive capacities for students to prepare themselves in times of uncertainty (disruption) and demand innovative thinking to tackle an issue (Lu, 2017). This investigation looks at four indices of scientific creativity, namely fluency, flexibility, originality, and elaboration, which each student develops throughout scientific method instruction. It contains four indications in the cognitive domain: anticipating global warming conditions in the next three years, recognizing human behaviors that may contribute to global warming substances, proving global warming through simple experiments, and producing a simple visual to teach about global warming.

METHOD

This research method is a pre-experimental study that only employs one therapy and does not include a control group. This study's design is a pre-experimental research design, specifically one group pretest-posttest design (Sutrio et al., 2020).

Table 1. Research Design

Pretest	Treatment	*Post-test*	Description
T1	X	T2	The first replication (VII-G)
T1	X	T2	The second replication (VII-F)

Description:
T 1 = Pretest was carried out before treatment
X = Treatment in the form of applying the scientific approach
T2 = Posttest was carried out after treatment

The study was conducted at Maduran Junior High School in the even semester of the 2020/2021 school year, with 34 students from Class VII-G and 36 from Class VII-F participating.

The following data collection techniques were used: (1) observation methods to obtain data on the implementation of learning and observe aspects of students' attitudes and psychomotor abilities; (2) the test technique to obtain data on students' cognitive and scientific creativity. The cognitive test consisted of ten questions, and the scientific creativity test consisted of five essay questions. Before their usage in this research, the validity of the four validators was assessed, and the reliability of all test instruments was certified reliable; and (3) the survey instrument to obtain data on student responses to the applied learning process. The data were descriptively and quantitatively examined by describing the scores in each feature noticed. Research data was further analyzed statistically using normality tests followed by paired sample t test with the help of SPSS software version 22. The following are the parameters for determining the percentage of learning implementation (Table 2).

Table 2. Percentage of Learning Implementation (Ratumanan, 2019)

Percentage (%)	Criteria
0 – 20	Not good
21 – 40	Not good
41 – 60	Pretty good
61 – 80	Good
81 – 100	Very good

The following are the parameters for determining the proportion of students' scientific creativity (Table 3).

Table 3 . Student Scientific Creativity Ability (Thuneberg et al., 2018)

Percentage (%)	Criteria
81. 6 - 100	Very creative
61. 2 - 81.5	Creative
40. 8 - 61.1	Pretty creative
20.4 - 40.7	less creative
0. 0 - 20.3	Not creative

In the 2013 curriculum, the minimum for pupils' cognitive ability is 2.66 with category (B-). Furthermore, the proportion of student replies shown in Table 4 used to measure the percentage of student responses.

Table 4. Student response criteria (Riduwan, 2008)

Mark (%)	Criteria
Number 0 - 20	Very weak
Number 21 - 40	Weak
Number 41 - 60	Enough
Figures 61 - 80	Strong
Number 81 - 100	Very strong

Descriptive analysis in the form of a standardized N-Gain (Formula 1) test was used to measure the growth in students' creative and cognitive abilities in the pretest and posttest.

$$\text{n-gain} = \frac{\% < S_f > - \% < S_i >}{\% < S_{maks} > - \% < S_i >} \quad \text{.......} (1)$$

with:
S_f = final score (posttest)
Si = initial score (pretest)
Smax = maximum possible score

Then the normalized *Gain* is interpreted according to Hake's criteria, namely (1) n-gain > 0.7 = height; (2) 0.7 < n-gain < 0.3 = moderate; and (3) n-gain < 0.3 = low (Hake, 1999). Additionally, a correlation test was performed to examine the relationship between students' cognitive abilities and scientific creative skills, with the characteristic that both data were normally divided.

RESULTS AND DISCUSSION

The teaching application is carried out to determine if the lesson plan (RPP) created by researchers in the learning process on the problem of global warming has been implemented. A learning implementation observation sheet was used to collect data on the learning process's implementation. Figure 1 depicts the findings of the average evaluation score of learning implementation.

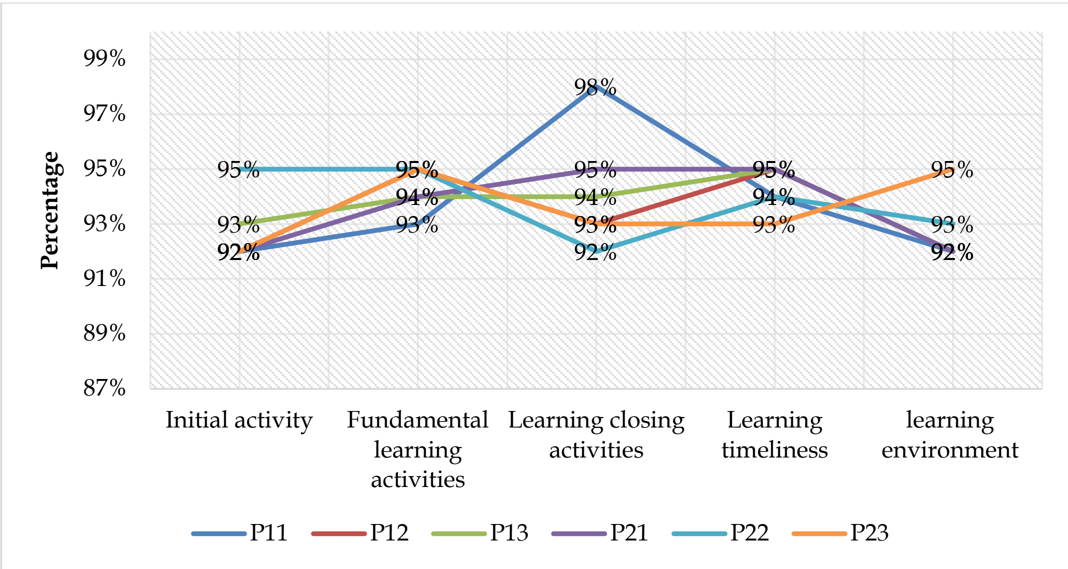

Figure 1. Percentage of Learning Implementation

Description:
P11 : Meeting I Replication I (Class VII-G) P13 : Meeting III Replication I
P12 : Meeting II Replication I (Class VII-G) R22 : Meeting II Replication II
P21 : Meeting I Replication II (Class VII-F) P23 : Meeting III Replication II

The proportion of learning implementation in Class VII-G and Class VII-F at meetings I, II, and III with very good criteria can be shown in Figure 1 above (Ratumanan & Laurens, 2011). One of the key components of a learning process is good learning planning (Ambarawati, 2016; Sukaisih et al., 2020). After analyzing the implementation of learning, data such as pretest and posttest cognitive data, pretest and posttest scientific creativity that can be used to evaluate and test descriptive statistics, and testing the normality of the sample utilized, were acquired. The following Table 5 shows the descriptive test results based on the data obtained.

Table 5. The results of descriptive statistics test

	N	Minimum	Maximum	Mean	Std. Deviation
Pretest cognitive R1	34	7	76	44.534	7.53673
Posttest cognitive R1	34	78	100	80.646	10.62417
Pretest cretivity R1	34	12	75	37.242	8.14168
Posttest creativity R1	34	82	97	84.663	10.52673
Valid N (Listwiss)	34				
Pretest cognitive R2	36	5	77	36.736	7.93292
Posttest cognitive R2	36	79	100	82.735	10.91513
Pretest cretivity R2	36	10	76	43.525	7.12415
Posttest creativity R2	36	81	98	83.624	10.91513
Valid N (Listwiss)	36				

Description:
R1 : Replication I (Class VII-G) R2 : Replication II (Class VII-F)

The collected data was further analyzed by using the Kolmogorov-Smirnov test or the Shapiro-Wilk test to identify data normality. Table 2 shows the results of the normality test on the collected data.

Table 6. Test of Normality

	Class	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Cognitive	VII F	.195	36	.151	.923	36	.213
	VII G	.173	34	.211	.812	34	.205
Scientific Creativity	VII F	.204	36	.126	.945	36	.224
	VII G	.164	34	.152	.861	34	.212

Based on the findings of the normality test (Table 6) using the Kolmogorov-Smirnov test or the Shapiro-Wilk test, it seems to have a significance > 0.05 during each class examined, implying that cognitive data and scientific creativity are normally distributed and acceptable for future parametric testing. Furthermore, the Levene test was carried out to identify the homogeneity of the research data as presented in Table 7.

Table 7. Test of Homogeneity of Variance

		Levene statistic	df1	df2	sig.
Cognitive	Based on Mean	.349	1	68	.213
	Based on median	.350	1	68	.271
	Based on median and with adjusted df	.350	1	67.414	.215
	Based on trimped mean	.373	1	68	.224
Scientific Creativity	Based on Mean	.507	1	68	.226
	Based on median	.260	1	68	.215
	Based on median and with adjusted df	.260	1	66.246	.245
	Based on trimped mean	.545	1	68	.252

The homogeneity test show that the data acquired is homogenous since the significance value (sig) based on mean 0.213 (Cognitive) and 0.226 (Scientific Creativity)> 0.05, the tested data is considered homogeneous. After determining that the data were normally distributed and homogenous, the researchers used a paired sample t-test to assess the impact of the scientific method on scientific creativity and cognitive capacities based on pretest and posttest results for each student in different classes. The paired sample t-test results are shown in Table 8.

Table 8. Paired Samples Test

	Group	Mean	Std. Deviation	t	df	Sig.
Cognitive	RI	-36,112	7.84423	9.84548	33	.000
	R2	-45,999	7.88246	10.62466	35	.000
Scientific	R1	-47,421	8.84574	10.66734	33	.000
Creativity	R2	-40,099	8.64367	9.62468	35	.000

Description:
R1 : Replication I (Class VII-G) R2 : Replication II (Class VII-F)

According to the paired sample test results, the significance value (2-tailed) on cognitive and scientific creativity in replication classes 1 and 2 is 0.000 < 0.005, indicating a significant difference between the initial variable (pretest) and the final variable (posttest) on students' cognitive and scientific creativity. This reveals that the variation in treatment offered to each variable, namely the scientific approach to students' cognitive learning outcomes and scientific creativity, has a substantial influence.

Figure 2 depicts the increase in students' cognitive learning outcomes before (pretest) and after (posttest) receiving lessons utilizing the scientific approach. Figure 2 shows that studying through a scientific approach encourages students since students will be actively involved in learning and develop student comprehension (Tambunan, 2019). Students driven to learn something will engage in higher cognitive processes while studying the subject, allowing them to absorb and internalize the data more effectively. Students' knowledge can be acquired in the student's mind; in this example, students will seek the relationship sequence of events from the information they get based on their experience. Furthermore, Ausubel (Suarman et al., 2018) state that rote learning does not assist students in developing knowledge, that learning by instructors must establish comprehension in students' cognitive structures, and that learning must be relevant for students to overcome issues in their lives (Sari et al., 2018).

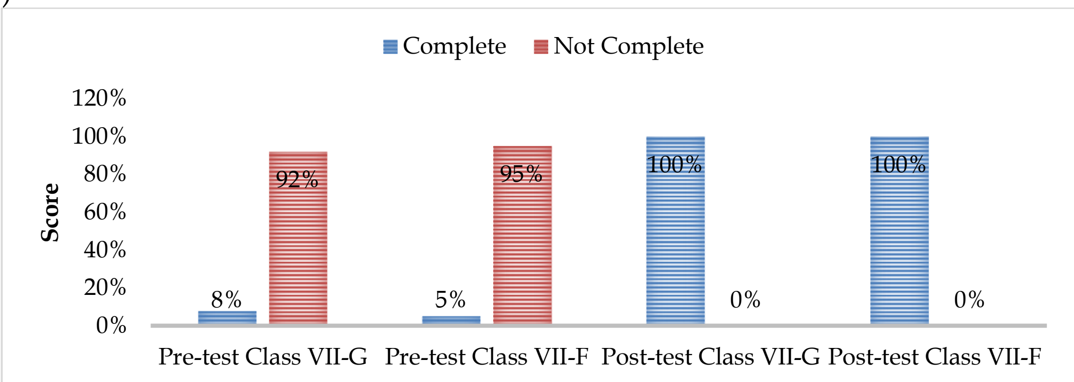

Figure 2. Increasing students' cognitive abilities

In terms of cognitive learning outcomes, students' emotional learning outcomes are evaluated. The learning outcomes of social and spiritual attitudes, each of which has various markers, are used to measure affective learning outcomes. Figure 3 depicts the emotional learning results of students.

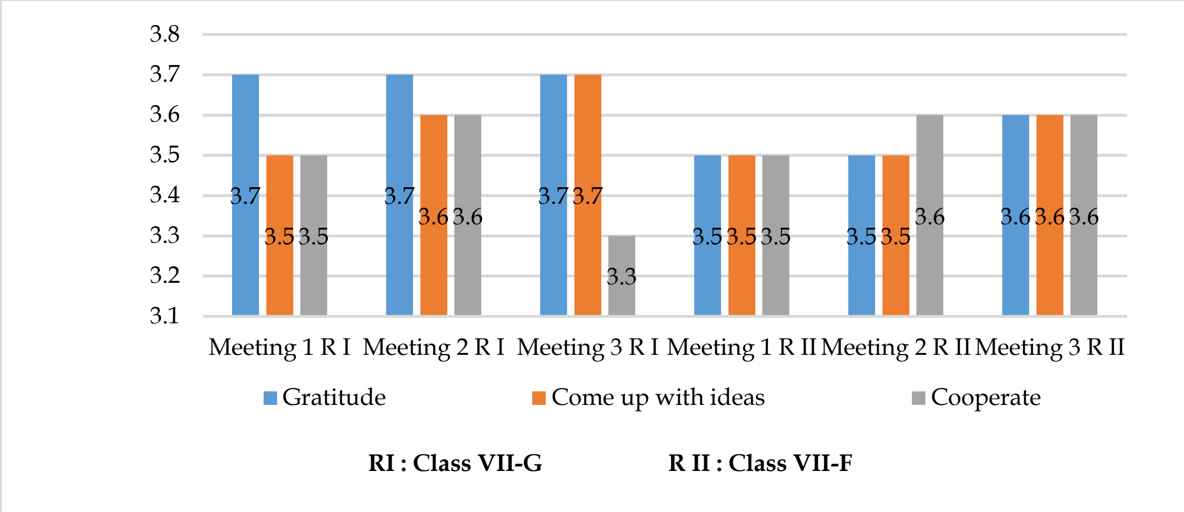

Figure 3. Recapitulation of Student Affective Learning Outcomes

Description:
R1 : Replication I (Class VII-G) R2 : Replication II (Class VII-F)

Although attitudes cannot be developed quickly, behavioral markers can be noticed and educated by the instructor (Handayani & Putra, 2019). Students have a good, discipline attitude toward instructors and friends, and in accomplishing tasks, they are curious and actively participate in group discussions and class debates (Nurhidayati, 2017). There at the second session, the evaluation of students' psychomotor learning outcomes was performed. Students' psychomotor learning outcomes were assessed while executing a basic experiment on the influence of global warming on the temperature of the earth's atmosphere (Sulisworo et al., 2021). Students' psychomotor evaluation is centered on the development of mental processes via muscular components and shapes students' abilities (Elmer et al., 2020). Figure 4 depicts the psychomotor learning results of students.

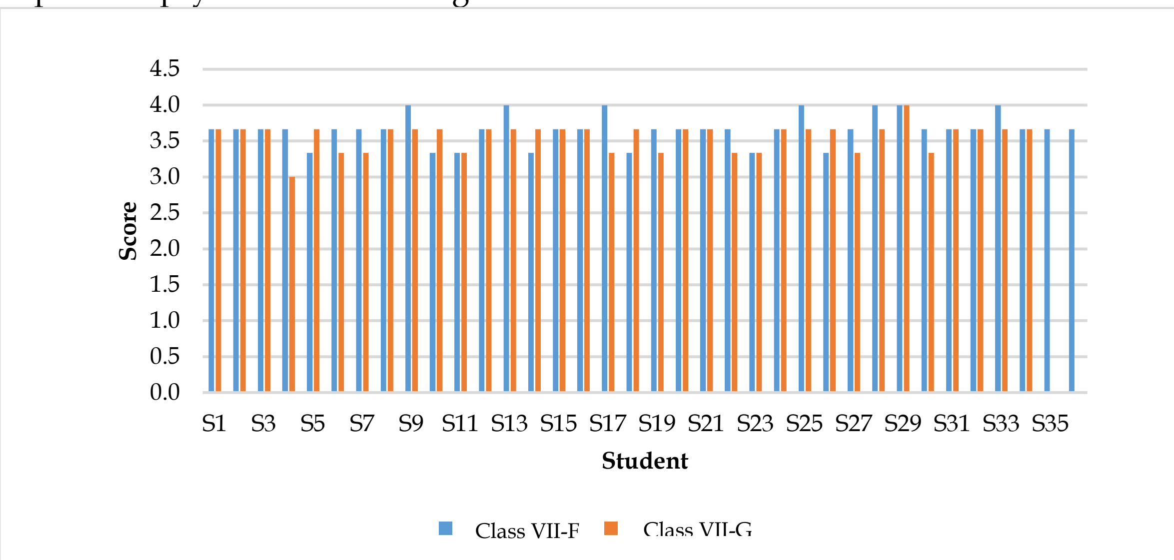

Figure 4. Psychomotor Value of Each Student

In the field of students' scientific creativity, the scientific creativity researched contains six markers of scientific creativity and four aspects of creativity, according to evaluation tools and rubrics devised and confirmed by researchers (Gupta & Sharma, 2019). The scientific creativity indicators that were assessed are (1) the ability to formulate problem methods problems; (2) the ability to phase of information; (3) the basis for deciding investigation steps; (4) the ability to produce new products; (5) the ability to generate problem solutions; and (6) the capacity to generate tables to record the investigation's findings (Gupta & Sharma, 2019; Roth et al., 2021). Figure 5 depicts the development of scientific creativity skills.

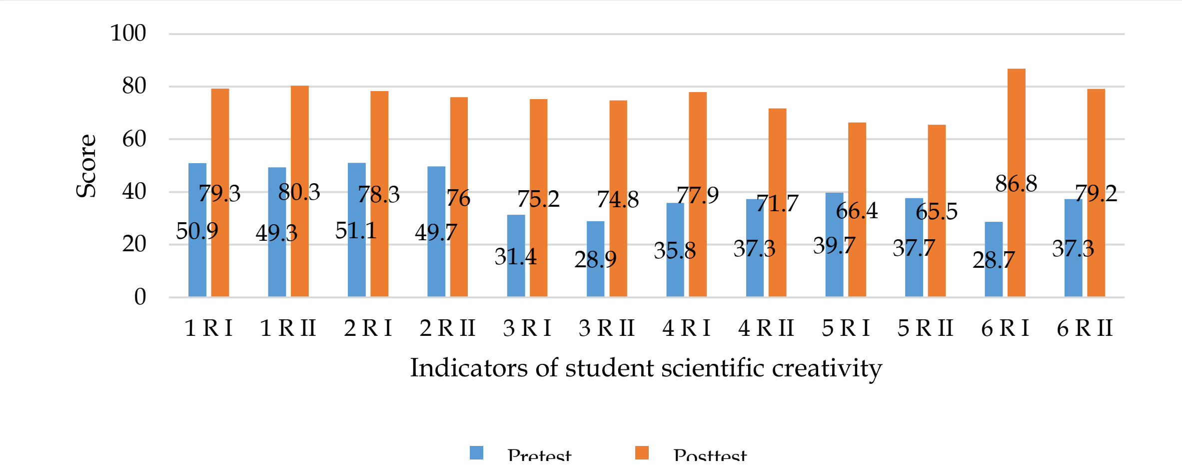

Figure 5. Increasing students' scientific creativity

Description:
RI : Replication I (Class VII-G) R II : Replication II (Class VII-F)

Although teachers/institutions/schools may assist students in growing each student's creativity, scientific approach learning is provided; in this situation, the teacher/school controls a student learning environment that fosters the growth of students' scientific creativity (Said-Metwaly et al., 2021). Furthermore, one of the measures of student emotional learning outcomes, namely expressing views that each class has increased and has good criteria, supports the capacity to ask questions / uncover difficulties that are measured. The results of this emotional learning help students' scientific creativity since they have been taught to ask questions and articulate global warming challenges (Septaria, 2019).

The improvement of scientific creativity skills could be attributed to scientific approach-based learning therapy (Biazus & Mahtari, 2022; Roth et al., 2021). The phase of the scientific approach has been implemented almost 100% with very good criteria. These learning activities could increase students' scientific creativity because the stage in the scientific approach to science learning provides opportunities for students to make creative efforts in building their knowledge (Harris & de Bruin, 2018). This is consistent with study findings that training students' scientific creativity may be addressed through a science learning strategy that allows students to make creative efforts in science learning (Hamel et al., 2021).

Students' scientific creativity is also promoted during the scientific approach activities. This stimulation will increase awareness of the difficulties, causing students to seek viable solutions to these problems (Ozkan & Umdu Topsakal, 2021). Students could still grow theories from understanding and apply that knowledge to their everyday environment while learning. In addition to gaining theories about global warming in class and during group discussions, students can apply the theory of global warming by making simple observations as an application of theory outside the classroom (Al-Ghussain, 2019). Students will improve their scientific creativity while receiving information in this learning method because creativity is in line with knowledge and participates in finding knowledge itself (Dökme & Koyunlu Ünlü, 2021). The activities resulted in the majority of student replies (91%, Class VII-G) and (94%, Class VII-F) after acquiring scientific learning to complete the offered scientific creativity exam, which was rated easy for students on the global warming material investigated.

The current research found that students were able to formulate problems (91%), formulate hypotheses (91%), test the hypotheses through observation or experimentation (88%), process data and turn it into tabular form (94%), and concluded trouble observed phenomena or experiments after receiving scientific learning (91%). In Class VII-F (Replication II), 92% of students are able to formulate problems, 94% of students are able to formulate hypotheses, 92% of students are able to test hypotheses through observation or experiment, 94 % of students are able to process data and turn it into tabular form and 97% of students able to conclude problems based on the results of observations or experiments.

Students are also expected to have a solid comprehension or mastery of ideas and creativity while participating in learning using the scientific approach, because creativity in a person does not come spontaneously but requires knowledge of things being studied (Tambunan, 2019). Students' creativity and cognitive learning outcomes impact each other, and correlation testing is required to determine the extent of the link between creativity and knowledge (Chankseliani et al., 2021). Table 9 shows the findings of evaluating the association between the results of cognitive learning outcomes and creativity.

Table 9. Correlation of scientific creativity and knowledge

Class	Average Scientific Creativity	Cognition	Correlation
Class VII-G (Replication I)	79.26 (± 6,64)	3.48 (± 0.33)	0.72
Class VII-F (Replication II)	73.8 (± 4,46)	3.16 (± 0 , 32)	0.79

According to Table 9, the resultant association between scientific creativity and student knowledge falls into the strong category, indicating that students' scientific creativity is supported by their knowledge (Riduwan, 2019). Understanding a problem-solving concept will allow pupils to develop innovative thinking processes (Suarman et al., 2018). According to Bloom's taxonomy (Anderson & Krathwohl, 2001), a person's creativity ranges from C1 (remembering) to C6 (creating). A person's creativity is at the C6 (creating) level, with a knowledge foundation extending from C1 (remembering) to C5 (creating) (evaluating). This might be construed to mean that a person's creativity must be founded on the information that person possesses.

Table 9 summarizes student learning outcomes in the cognitive domain for Class VII-G (Replication I) and Class VII-F (Replication II). Cognitive learning outcomes are an assessment of students' abilities in the cognitive domain or areas connected to thinking abilities (Sukaisih et al., 2020). According to the cognitive learning results of students in Table 4.2, scientific approach-based learning can increase students' cognitive capacities on global warming content. The rise in the average effect of each student's Gain computation supports the increase in student learning outcomes in the knowledge element of 0.79 and 0.76 in Class VII-G (Replication I) and Class VII-F, respectively (Replication II).

Teachers should assist pupils in discovering and appreciating their skills. Activities that result in anything in this learning might encourage a desire to remain occupied with innovative activities that stimulate cognitive growth or thinking abilities (Bozkurt Altan & Tan, 2020; Henry et al., 2021). Students learn to find the concept through practical activities by connecting the concepts found with the previous concepts learned. The conditions cause concepts to enter long-term memory and are not easily lost. According to the Zone of Proximal Development (ZPD) and scaffolding, a person's cognitive development is determined by the individual and an active social environment (Faresta et al., 2020). The atmosphere generated by an instructor in a class will affect his students, either directly or indirectly.

According to Piaget's theory of cognitive development, the average junior high school student is 11 years old or older. At this time, pupils are grouped at the formal operational stage, where they should be asked to think rationally (Utami et al., 2020). Students should be able to answer issues based on observations made in everyday life (Trust & Whalen, 2020). This issue is especially problematic in science fields and results in goods with high novelty and utility qualities. Furthermore, it is backed by information processing theory, which claims that the growth of students' knowledge depends on how much they engage with their surroundings directly and actively so that the information gained is more meaningful (Moura et al., 2020).

CONCLUSION

Based on research findings, it can be concluded that the implementation of scientific method on the issue of global warming affects ($p < 0.05$) students' scientific creativity skills and cognitive learning outcomes of Maduran Junior High School students. The research also found that students' scientific creativity skills positively correlated with cognitive learning outcomes (sig. > 0.7).

RECOMMENDATION

The current research is limited to global warming material, so further research using various materials in science learning needs to be done. The use of a scientific approach also requires a good initial conceptual understanding, so it is necessary to pay attention to students' prior knowledge before using a comprehensive scientific approach.

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