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The Effect of the EarthComm Learning Model on Students' Spatial Thinking Ability in Geography

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ABSTRACT

The purpose of this study was to determine the effect of the EarthComm learning model on the spatial thinking abilities of students at SMAN 16 Bandar Lampung. To achieve this objective, this study used a one-group pre-test post-test design with a quantitative approach. The population in this study consisted of 325 students, while the sample was determined using purposive sampling. The sample in this study, which became the experimental class, consisted of 32 students from class XI.F2. Data collection techniques used closed questionnaires, pre-tests and post-tests based on spatial thinking indicators, observation sheets, and documentation. To analyze the data obtained, normality tests, linearity tests, and paired sample t-tests were used. The results of this study show that there is an effect of using the EarthComm model on the spatial thinking abilities of students in class XI.F2 at SMAN 16 Bandar Lampung. This is proven by the paired sample t-test on the pre-test and post-test compiled using spatial thinking ability indicators. A significance value of 0.000 was obtained in the paired sample t-test, which means that H1 is accepted.

INTRODUCTION

Education plays a role in shaping students' thinking abilities, skills, and character to face various challenges. In this era of globalization and rapid development of information technology, students are required to have higher-order thinking skills, such as critical, creative, and analytical thinking. Education no longer focuses solely on mastering information, but also on developing ways of thinking to solve real problems that occur in the surrounding environment. One subject that plays an important role in developing these thinking skills is geography. Geography not only teaches about the conditions of the earth's surface, but also trains students to understand the interrelationships between spatial phenomena and to be able to analyze them comprehensively.

Geography learning related to geosphere phenomena requires an appropriate learning model so that students can understand the interrelationships between various components of the geosphere. The EarthComm model is highly relevant to geography learning because it encourages students to analyze geosphere phenomena comprehensively. With a project-based approach, students are required to explore environmental issues through research and teamwork. This allows them to see how changes in one geosphere system can affect other systems and how human activities can impact the environment. The EarthComm Learning Model is an acronym for Earth Science System in the Community, which was developed when science education in the United States

(US) was in the midst of a new curriculum reform movement. One of the most recent curriculum reforms published was the Earth System Science in the Community (EarthComm) project, supported by the National Science Foundation. This is an American Geological Institute project that began in 1995 and continued until 2000. (Park, 2006).

Spatial thinking skills play an important role in the geography learning process because they help students understand the patterns, relationships, and processes that occur on the earth's surface and are needed to face the competition of the industrial revolution 4.0 (Aliman, 2020). Spatial thinking can be defined as a cognitive process that includes knowledge, skills, and habits in thinking using spatial concepts. According to the National Research Council (NRC) Committee on Spatial Thinking, spatial thinking is the ability to understand natural elements and represent information (Febrianto et al., 2021).

Preliminary observations conducted at SMA Negeri 16 Bandar Lampung revealed that in geography lessons, teachers mostly deliver material directly to students through lectures in front of the class, using several learning models such as Problem Based Learning and Contextual Teaching Learning, which are often used, while the EarthComm model has never been used for geography lessons at SMA Negeri 16 Bandar Lampung. To support the delivery of material, teachers utilize several learning media such as maps, globes, and educational videos, but in reality there has been no change in students, such as students being less active in answering questions, and the classroom conditions being less conducive to the learning process. The students' scores on the material on natural resource potential did not meet the minimum passing grade, because based on the data above, there were 4 students who scored above the minimum passing grade of 76, and 31 students who scored below the minimum passing grade. Meanwhile, understanding the distribution and utilization of natural resources is very important because it requires students to be able to understand spatial patterns and the impact of resource utilization on the environment and society. This certainly requires good spatial thinking skills. In addition, issues related to natural resource management can be used as an approach in the EarthComm model, where students are invited to examine real problems in their environment.

Based on the background described above, there is a problem formulation that needs to be answered, namely whether there is an effect of the EarthComm learning model on the spatial thinking abilities of students at SMAN 16 Bandar Lampung. This study has an objective or answer to the problem formulation, namely to determine the effect of the EarthComm learning model on the spatial thinking abilities of students at SMAN 16 Bandar Lampung. Thus, the researcher conducted a study entitled, "The Effect of the Earthcomm Learning Model in Geography on the Spatial Thinking Abilities of Students at SMAN 16 Bandar Lampung".

METHOD

The method used in this study was quantitative, with a quasi-experimental design focusing on a one-group pretest-posttest design because the testing was conducted using pre-tests and post-tests given to the experimental class. This design was chosen because this study used one class selected as a sample and not chosen randomly. The pre-test and post-test were used to compare the differences that occurred before and after the students received the treatment. The experiment was implemented by providing treatment to the experimental class using the EarthComm model and Google Earth as the learning media. The material presented was about the potential of Indonesia's natural resources and their impact on life. The spatial thinking ability indicator was tested using a pre-test administered before the treatment, while a post-test was administered after the students received the treatment. The results of the two tests were used to compare the differences that occurred before and after the students received the treatment (Utami, 2018) and would be compared to determine whether there was an effect on the learning model that had been applied.

The population of this study was all grade XI students at SMA Negeri 16 Bandar Lampung. Sampling in this study was done by selecting one class from the population, considering that this class chose the geography lesson package in grade XI at SMAN 16 Bandar Lampung. Therefore, the sample selected was class XI.F2 as the experimental class with a sample size of 32 students. This class was selected based on the geography teacher's consideration that this class was more active in the learning process, so the EarthComm model would be more effective if applied in this class.

The data collection techniques in this study were, first, using test instruments divided into pre-tests and post-tests in the form of essay questions that had been designed in accordance with spatial thinking ability indicators. The second data collection technique was using a closed questionnaire to find out students' opinions regarding the EarthComm learning model and its effect on spatial thinking ability. The last data collection technique was observation by the geography teacher of the learning process. In addition, documentation was used to collect data in the form of textbooks, student attendance, and student assignments. The instruments used were tested for validity and reliability to determine their suitability, and the data used for testing were the results of distributing the instruments to classes that were not part of the experiment. Data analysis techniques used normality tests, linearity tests, and paired sample t-tests. The tests were conducted using SPSS 23.

RESULTS AND DISCUSSION

Results

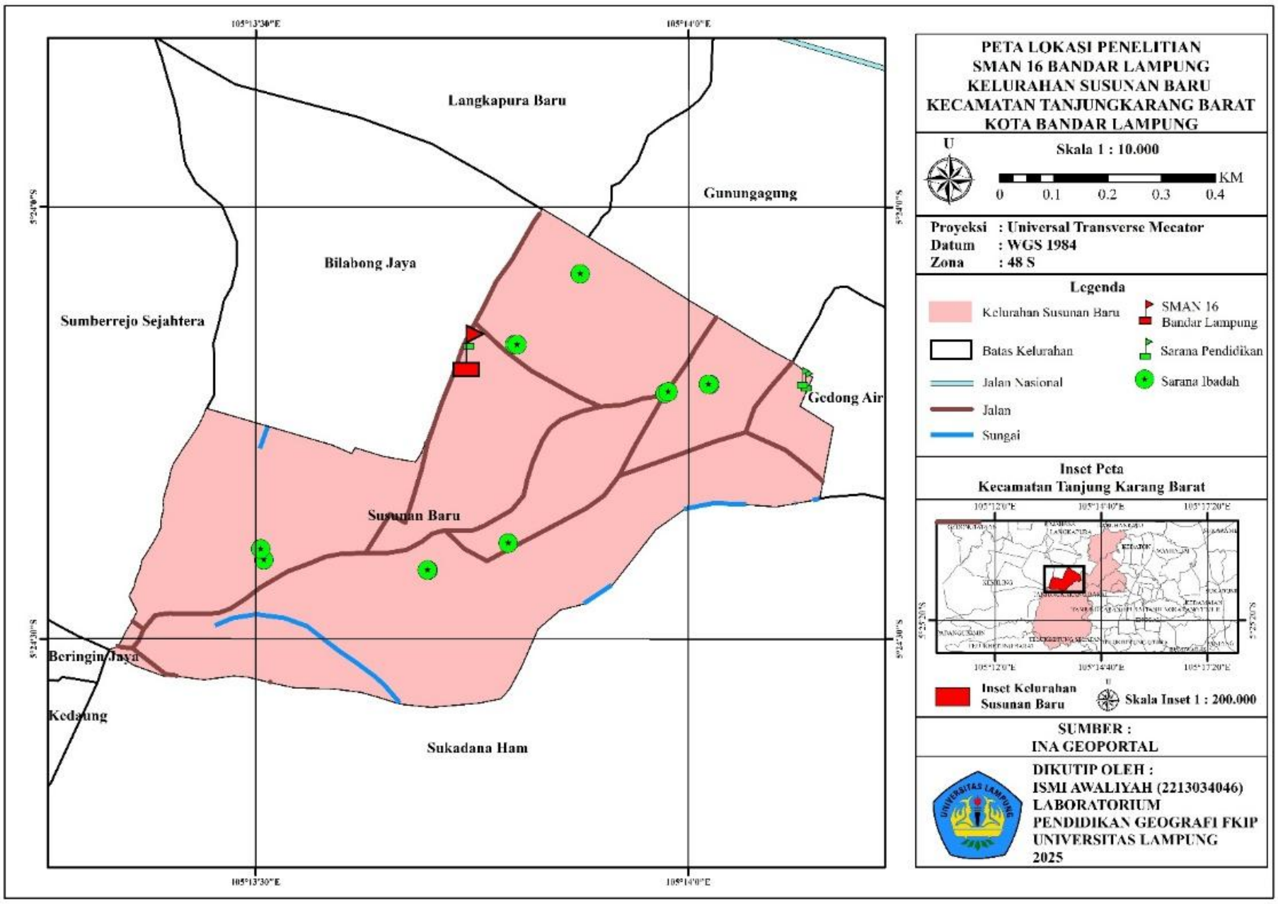

Figure 1. Map of the Research Location of SMA Negeri 16 Bandar Lampung 2025
Source: ArcGIS Mapping Results, 2025

The research was conducted at SMA Negeri 16 Bandar Lampung, located on Jl. Darussalam, Kel. Susunan Baru, Kec. Tanjung Karang Barat, Bandar Lampung City. The total number of students enrolled in the 2025-2026 academic year was 836, with 57 subject teachers. The data from this study is divided into three categories: the results of the EarthComm model observation, the results of the closed questionnaire, and the results of the pre-test and post-test from the experimental class. The following is an analysis of the research results:

Table 1. Results of the EarthComm Model Observation Sheet

Observed aspects	Score			
	1	2	3	4
INTRODUCTORY ACTIVITIES				
Greetings				✓
Checking student attendance				✓
Conveying learning objectives				✓
CORE ACTIVITIES				
Teachers explain material on Indonesia's natural resource potential				✓
Chapter Challenge				✓
Think About It				✓
Investigating			✓	
Reflecting on the Activity and Challenge				✓
Digging Deeper			✓	
Check Your Understanding				✓
Applying What You Have Learned:				✓
Preparing for the Challenge				✓
Inquiring Further			✓	
Chapter Assessment				✓
CLOSING ACTIVITIES				
Alternative Assessment				✓
Ending the lesson by inviting students to pray				✓
The activity ends with a greeting				✓

Source: Primary Research Data, 2025.

Based on observations made by the geography teacher while the researcher was conducting research in class XI.F2, the researcher obtained a score of 65/68, or 98% when presented as a percentage, indicating that the implementation of the EarthComm model syntax was running very well. The second instrument used in this study was a closed questionnaire distributed to the experimental class after receiving treatment using the EarthComm model. The results are as follows:

Table 2. Closed Questionnaire Results

Statement	Category					Statement	Category				
	SS	S	KS	TS	STS		SS	S	KS	TS	STS
K1	36%	61%	7%	-	-	K9	21%	61%	12%	6%	-
K2	49%	36%	15%	-	-	K10	4%	33%	36%	12%	15%
K3	39%	42%	15%	4%	-	K11	4%	18%	39%	21%	18%
K4	27%	67%	6%	-	-	K12	4%	36%	36%	15%	9%
K5	27%	67%	6%	-	-	K13	21%	51%	28%	-	-
K6	30%	55%	15%	-	-	K14	24%	61%	12%	3%	-
K7	21%	51%	21%	7%	-	K15	27%	64%	6%	3%	-
K8	33%	52%	15%	-	-						

Source: Primary research data, 2025.

Based on the results of a closed questionnaire given to students, it can be seen that most respondents responded positively to the EarthComm learning model in geography lessons. In the first and second statements, the majority of students agreed that discussion activities in each syntax helped them understand the relationship between natural resources and everyday life. In the third to eighth statements, the students' responses showed that the observation activities, which are a characteristic of the EarthComm model, made learning about natural resources easier to understand. Then, in the ninth statement, most students stated that the presentation stage made them more confident in expressing their answers. This is because the stages are applicable and communicative for students. Statements 10 to 12, which are negative statements, show that the majority of students disagreed with the EarthComm model, which made students feel pressured, ineffective use of time, or difficulty in following the learning process. Based on statements 13-15, learning with the EarthComm model provides a fun learning experience and improves their spatial thinking skills. Students found it easier to relate theory to real conditions in their surroundings. These findings indicate that the EarthComm learning model not only improves conceptual understanding but also helps students build awareness of the relationship between humans and their wider physical environment. Spatial thinking skills were measured using pre-test and post-test essay questions. The following are the pre-test and post-test scores:

Table 3. Pre-Test and Post-Test Scores for the Experimental Class

Score	*Pre-test*	*Post-test*
Maz	89	92
Min	19	41
Mean	55	72
Median	56	73
Modus	36	74

Source: Primary Research Data, 2025.

The pre-test results of class XI.F2 students showed that the highest score was 89 and the lowest was 19, indicating a considerable gap between the highest and lowest scores, which means that the students' spatial thinking abilities before receiving the treatment varied greatly. The post-test results for students in class XI.F2 showed that the highest score was 92 and the lowest score was 41, indicating an increase between before and after the treatment using the EarthComm model. After obtaining the pre-test and post-test results, they were classified based on assessment groups. The following is the classification of the scores:

Table 4. Classification of Pre-Test and Post-Test Scores for the Experimental Class

Score	*Pre-test*	*Post-test*	Assessment Group
89 to 100	1 student	3 students	Very high
60 to 88	14 students	22 students	High
41 to 59	7 students	7 students	Medium
12 to 40	10 students	-	Low
<11	-	-	Very low

Sumber Data Primer Penelitian, 2025.

Based on the pre-test scores measuring students' spatial thinking abilities, 10 students were classified as low, 7 students as moderate, 14 students as high, and 1 student as very high. Meanwhile, in the post-test results, 7 students were classified as moderate, 22 students as high, and 3 students as very high. This indicates that EarthComm learning had an effect on the spatial thinking abilities of students in class XI.F2, as there was an increase in spatial thinking abilities after students were given treatment using the EarthComm model. This can be seen in Table 24, which shows that in the pre-test, there were students in the low spatial thinking category and only 1 student in the very high category, but in the post-test, there were only 3 categories of student spatial thinking, namely medium, high, and very high.

Prerequisite tests were conducted before testing the research hypothesis. In this study, normality and linearity tests were used as prerequisite tests. The normality test was used to determine whether the data obtained from the research results were normally distributed or not. The method used in the normality test was the Shapiro-Wilk test, assisted by the SPSS Statistics 23 program, because the Shapiro-Wilk test is generally used for small samples (Ismail, 2022). The results of the normality test are as follows:

Table 5. Normality Test Results

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Kelas	Statistic	df	Sig.	Statistic	df	Sig.
Results	Pre-Test Experimental Class	.129	32	.189	.958	32	.236
	Post-Test Experimental Class	.114	32	.200*	.943	32	.090

Sumber: Hasil Pengolahan Data Menggunakan SPSS, 2025.

The normality test using the Shapiro-Wilk test has a basis for decision making, if the significance value or probability value is < 0.05, it means that the data is not normally distributed (Agustin & Permatasari, 2020). But if the significance value or probability value is > 0.05, it means that the data is normally distributed. Based on the results of the normality test, the pre-test value for the experimental class obtained a significance of 0.236, which means that the data is normally distributed because the significance value is >0.05. Meanwhile, for the post-test data, a significance value of 0.090 was obtained, indicating that the data is normally distributed because the significance value is >0.05.

Meanwhile, the linearity test aims to determine whether two or more variables being tested have a significant linear relationship or not (Salsabrina Putri Lestari & Rita Intan Permatasari, 2023). The basis for decision-making in the linearity test is that if the Deviation From Linearity significance value obtained is > 0.05, then the relationship between the variables is linear, or if the Deviation From Linearity significance value obtained is < 0.05, then the relationship between the variables is not linear. The following are the results of the linearity test:

Table 6. Linearity Test Results

ANOVA Table							
			Sum of Squares	df	Mean Square	F	Sig.
Y*X	Between Groups	(Combined)	908.775	9	100.975	.407	.918
		Linearity	266.748	1	266.748	1.076	.311
		Deviation from Linearity	642.027	8	80.253	.324	.948
	Within Groups		5456.100	22	248.005		
	Total		6364.875	31			

Source: Data Processing Results Using SPSS, 2025.

Based on the linearity test results, a significance value of 0.948 was obtained for the deviation from linearity, indicating a significance value >0.05. This indicates that variable X (EarthComm model) and variable Y (spatial thinking) in this study have a linear relationship. The next test was hypothesis testing using a paired sample t-test. The data used to test the research hypothesis was the pre-test and post-test data obtained from class XI.F2 as the experimental class. There are two hypotheses in this study, namely H0 "There is no effect of the EarthComm learning model in geography on the spatial thinking skills of students at SMAN 16 Bandar Lampung" and H1 "There is an effect of the EarthComm learning model in geography on the spatial thinking skills of students at SMAN 16 Bandar Lampung". To see the results of the hypotheses accepted in this study, refer to the following table:

Table 1. *Paired Sample T-test*

Paired Samples Test									
		Paired Differences							
					95% Confidence Interval of the Difference				
		M.ean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	PRE TEST - POST TEST	-17.156	17.746	3.137	-23.554	-10.758	-5.469	31	.000

Sumber: Hasil Pengolahan Data Menggunakan SPSS, 2025.

Decision making in paired sample t-test by comparing the significance level If sig > 0.05, then Ho is accepted If sig. < 0.05, then Ho is rejected. Based on the results of the paired sample t-test, the significance value is 0.000. This figure indicates that Ho is rejected and H1 is accepted, meaning that there is an effect of the EarthComm learning model on spatial thinking skills.

DISCUSSION

Earthcomm learning is formulated based on the constructivist paradigm, which focuses on student understanding through learning experiences. The research conducted in class XI.F2 at SMAN 16 Bandar Lampung was carried out over four meetings. In each session, students were given treatment in accordance with the EarthComm model syntax, namely Chapter Challenge, Think About It, Investigating, Reflecting on the Activity and Challenge, Digging Deeper, Check Your Understanding, Applying What You Have Learned, Preparing for the Challenge, Inquiring Further, and Chapter Assessment. All stages of learning were carried out in groups, which helped students develop their communication skills. This communication led to the formation of new knowledge for students. At each meeting, the researcher explained the material on Natural Resource Potential and Its Impact on Life and acted as a facilitator who guided students to actively work on challenge scenarios related to urban forestry issues provided in accordance with the EarthComm model syntax.

The implementation of the EarthComm model syntax guides students to solve problems in a structured and systematic manner, supported by the EarthComm report. The syntax of think about it, investigation, and reflecting on the activity and challenge reinforces the cognitivism paradigm by requiring students to use their cognitive abilities to solve problems and conduct investigations (Polat, 2020). During the investigative learning stage, where students observe, dig deeper, and ask questions actively, they can gain knowledge related to identifying and formulating solutions to related problems. This can increase students' awareness and concern for issues in their surrounding environment.

The observation sheet used to measure the implementation of the EarthComm model syntax shows that based on a score of 65 out of a total score of 68 given by the geography teacher to the researcher, the success rate of implementing the EarthComm model syntax was 98%. The teacher assessed that during the implementation, the researcher was able to be a good facilitator for the students during the group discussion. This was also supported by the results of statement 13 in the closed questionnaire, where the accumulation of agree and strongly agree responses was 72%, indicating that learning using the EarthComm model was more conducive, which could be attributed to the group discussions. However, there were three learning syntaxes, namely investigating, digging deeper, and inquiring further, which did not run optimally due to technical obstacles, thus obtaining a score of 3 from geography teachers. However, this did not interfere with the learning process because it could still be overcome well. For example, in the investigating stage, only group representatives participated in this stage, while other group members who did not participate in the investigating stage still received explanations related to the observations made. The digging deeper stage can still run with students who quickly grasp the understanding of finding information sources or references related to the challenge scenario. Meanwhile, the inquiring further stage can still run because not all students have doubts in presenting the EarthComm report results, and this helps other students to be better at presenting reports.

Learning using the EarthComm model, which combines observation with contextual concepts, makes students more enthusiastic, active in discussion, and able to systematically relate geosphere phenomena. This is evidenced by the results of student questionnaire number 14 regarding learning about Natural Resources using the EarthComm model, which is more interesting to study, with 66% of students answering strongly agree and 24% of students answering agree. One of the challenges in this learning process is time, because the model syntax is quite long and there is learning outside the classroom at the observation stage that requires more time. This is in line with 40% of students responding strongly agree and agree to statement number 12. However, this did not pose a major obstacle for students in conducting observations, as the observations provided new experiences for students to participate in learning outside the classroom and directly observe issues in their surroundings.

The preparation of pre-test and post-test questions in accordance with the eight spatial thinking indicators used in this study is a combination of spatial thinking indicators based on the AAG (Association of American Geographers) (Nandi Kurniawan, 2022) and Lee and Bernadz (Santoso, 2022), namely Comparison (comparing locations that have similarities and differences) Aura (explaining the cause-and-effect relationship of phenomena) Region (identifying places that have similarities and classifying them as a single entity) Hierarchy (recognizing locations based on certain levels) Transition (analyzing changes in places that occur suddenly, gradually, or irregularly) Analogy (finding places in other regions that have the same position and similar conditions) Pattern (analyzing why an appearance has certain patterns) Association (explaining the influence of a phenomenon in one location on another nearby location).

Based on the pre-test scores to measure students' spatial thinking abilities, 10 students were classified as low, 7 students as medium, 14 students as high, and 1 student as very high. Meanwhile, in the post-test results, 7 students were classified as medium, 22 students as high, and 3 students as very high. This indicates the influence of EarthComm learning on the spatial thinking abilities of students in class XI.F2, as there was an increase in spatial thinking abilities after students were given treatment using the EarthComm model. This can be seen in Table 24, which shows that during the pre-test, there were students in the low spatial thinking category and only 1 student in the very high category, but during the post-test, there were only 3 categories of student spatial thinking, namely medium, high, and very high.

The increase in post-test scores, as seen in two students who were in the high category during the pre-test but in the very high category during the post-test, as well as the increase in scores for several students who achieved a higher spatial thinking category during the post-test. Based on statement number 15 on the closed questionnaire, the two students agreed that the EarthComm model helped them develop their spatial thinking skills. This was also influenced by several factors. First, the EarthComm model provided opportunities for students to actively build their knowledge through observation activities. Second, learning was carried out using a project-based and problem-based approach, which required students to analyze real problems in their environment, such as the utilization and management of natural resources. Third, the use of maps showing the distribution of natural resources in learning activities also made it easier for students to understand spatial concepts visually.

In addition, the questions presented in the form of articles and challenge scenarios also contribute to improving students' spatial thinking skills. These questions not only require students to remember the material, but also encourage them to analyze contextual problems related to natural resources. Through article-based questions, students are trained to interpret spatial information, compare phenomena between regions (comparison), explain cause and effect (aura), and identify spatial patterns and associations (pattern and association). The following is a discussion of students' spatial thinking skills based on the indicators used in this study.

The EarthComm model is related to spatial thinking skills because this model not only helps students understand geographical phenomena conceptually, but also encourages them to think spatially, analyze problems which are then compiled into systematic reports, and encourages students to be reflective about phenomena in their surroundings.

Spatial thinking skills can develop when geography lessons do not only focus on theoretical instruction but also actively involve students in various fieldwork and assignments to introduce them to their local environment (Mkhize, 2023). This shows a relationship between the EarthComm model and spatial thinking, because in this model there are stages that require students to directly identify existing problems. In addition, the investigating stage also makes students better understand the natural resource issues around them, which is related to spatial thinking skills because classroom learning does not only focus on conceptual material but is also contextualized and carried out in the field so that students can hone their spatial thinking skills, such as comparing the similarities and differences between places, analyzing settlement patterns that can cause problems for natural resources, and determining the causes and effects of a phenomenon within a certain area.

EartComm encourages students' understanding of spatial concepts through the concepts of relevance, community, inquiry, and systems through geography learning. In other words, geography learning using the EarthComm model is a form of learning to think and practice spatial skills (Hidayaht et al., 2017). The concept of relevance helps students to relate geographical concepts to phenomena around them, community encourages students to collaborate in understanding and solving problems, inquiry requires students to make direct observations of specific locations, and the concept of systems helps students to understand the relationship between cause and effect and the impact of a geographical phenomenon on the physical and social environment.

The relationship between the two variables is shown by the linearity test and t-test, and the results of both tests indicate that the EarthComm model as variable X and spatial thinking as variable Y have a linear relationship. Meanwhile, the t-test shows that the hypothesis accepted in this study is H1, namely that there is an influence of the EarthComm model on the spatial thinking abilities of grade XI.F2 students at SMAN 16 Bandar Lampung.

CONCLUSION

Based on the research questions, results, and discussion, it can be concluded that the use of the EarthComm learning model has a significant effect on the spatial thinking abilities of grade XI.F2 students at SMAN 16 Bandar Lampung. This conclusion is supported by the results of the paired sample t-test conducted on the pre-test and post-test, which were developed based on spatial thinking ability indicators. The significance value obtained from the paired sample t-test was 0.000, indicating that H_1 is accepted. This means that the EarthComm model effectively enhances students' spatial thinking skills.

Furthermore, the analysis of the eight spatial thinking indicators reveals that each indicator showed an increase in students' post-test scores compared to the pre-test. Most students achieved high scores within the range of 5–10 on nearly all indicators, demonstrating a strong improvement in their spatial reasoning performance. Among these, the Analogy (94%), Transition (91%), and Region (88%) indicators recorded the highest scores. These results indicate that students exhibited excellent abilities in identifying spatial similarities, analyzing spatial and temporal changes, and determining the characteristics of specific regions. Overall, these findings suggest that the EarthComm model effectively fosters active learning and spatial reasoning, both of which are essential competencies in geography education.

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