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BUILDING CREATIVITY IN STUDENTS' SPATIAL THINKING SKILLS USING ARCGIS STORY MAPS

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ABSTRACT

Knowledge of spatial concepts, the process of reasoning, and the use of representational tools are characteristics of cognitive skills from spatial thinking abilities that students should master. This study aims to determine the effect of using ArcGIS Story maps in collaboration with a challenge-based learning model on the creativity of students' spatial thinking skills. Quasi Experiment with a quantitative approach is a research method used in research. The subjects of the research analysis were high school students, with 68 students consisting of two homogeneous classes. The creative essay test of spatial thinking ability and questionnaire were chosen as data collection techniques. And data analysis using a t-test. Statistical tests prove that using ArcGIS Story maps affects the creativity of spatial thinking skills manifested in the mastery of spatial perception, spatial visualization, spatial relations, spatial orientation, and mental rotation, which increases students' posttest scores. Meanwhile, there are inconsistencies in the skills of using ArcGIS Story maps with posttest scores.

Keywords: *Story Maps, Spatial Thinking Creativity, Challenge Based Learning*

INTRODUCTION

The learning process in the education system must have a flexible nature. This can be interpreted that the flexible nature of the learning process can benefit students and educators in the learning process (Ismail JR, 2023). The use of technology is an example of a flexible learning process (Ridwana et al, 2022). Learning that utilizes technology must be balanced with the benefits and results obtained from using the technology (Belawati, 2019). So that learning can be applied as needed to solve the problems encountered. A flexible learning process can stimulate active participation and open space for students' creativity (Sadikin & Hamidah, 2020). The learning process does not necessarily convey material from the teacher to students but includes guiding activities, training intellectual abilities, psychomotor skills, innovation, creativity, initiative, courage, and student skills (Kemdikbud, 2014).

Learning geography emphasizes contextual learning related to students' daily activities. In the opinion (of Utami et al., 2016), Contextual learning suggests that students need to find and manage information individually, compare the data with facts, and create an appropriate and applicable information output to their environment. Contextual learning that characterizes geography is expertise in recognizing the environment in the field by looking at the available maps. Students are taught directly about the environment and surrounding area, so they can build spatial thoughts and will be processed into skills in spatial thinking (Aliman et al., 2018). Learning geography has a distinctive thinking ability, namely the ability to think spatially, which has a role in

describing, transforming, and describing the visual-spatial world (Al Fauzi R et al, 2022).

Geography learning emphasizes contextual learning on problems in the daily lives of students. In the opinion (of Utami et al., 2016), Contextual learning suggests that students need to find and manage information individually, compare the data with facts, and create an appropriate and applicable information output to their environment. Contextual learning that characterizes geography is expertise in recognizing the environment in the field by looking at the available maps. Students are truly about the environment and surrounding area, so they can build spatial thoughts and will be processed into skills in spatial thinking (Aliman et al., 2018). Learning geography has a distinctive thinking ability, namely the ability to think spatially, which has a role to describe, transforming, and describing the visual-spatial world.

The ability to think spatially universally has many benefits in various disciplines. In addition, spatial intelligence is required to be taught at all levels of the education system (Lee & Bednarz, 2009). A collection of cognitive skills in which there is knowledge of the concept of space, representational tools and reasoning is the ability to think spatially (Jo & Bednarz, n.d.). Explicitly spatial thinking uses representations to help students remember, understand, reason, and communicate about the nature and relationships between objects represented in space (Lee & Bednarz, 2012). Therefore, spatial thinking skills need to be improved, considering that there are still many high school students who have not been able to understand the concept of space in geography well.

The role of spatial information and data in the educational aspect is useful in supporting efforts to realize sustainable education and preventing efforts to improve the quality of education properly (Khudzaeva, 2015). Spatial data or the use of maps are considered very important in learning geography. Spatial data acts as a display that can provide spatial analysis and provide benefits in a geography lesson (Zwartjes, 2014). This spatial-based data is an important element, which has a function as a foundation in implementing and supporting learning activities. Bearing in mind that this is based on a review of geographical phenomena, it does not only explain the existence of a process and phenomenon occurring on the earth's surface, but also the pattern, size, shape, and direction of the phenomenon and its relationship to other phenomena. Therefore, to support spatial abilities, students can take advantage of spatial technology in studying geography by using spatial technology as a learning resource (Ahyani et al., 2013).

The results of previous research regarding spatial ability are (1) research with the title "The Role of Geographic Information Systems in Improving Spatial Thinking Ability" with the results of research on the effect of using GIS in improving students' spatial thinking (Setiawan, 2016). (2) research by Rudy Saputro (2019) The Student Spatial Critical Thinking Skill by Using Map and Remote Sensing Imagery on Geography Lesson, aims to analyze spatial thinking skills using maps and remote sensing. The average score of the research results shows that students' spatial thinking skills using maps are higher than using remote sensing images (Saputro et al., 2020). (3) Research entitled "Understanding 'change' through spatial thinking using Google Earth in secondary geography" was conducted by X. Xiang and Y. Liu regarding the comparison of the effectiveness of two pedagogical approaches between learning to use Google Earth and traditional methods. The results study show that using earth significantly improves students' spatial thinking skills (Xiang & Liu, 2017).

Along with the times, technology and science have also developed and have an important role in human life. Geography, a science combining sciences with social sciences, plays a very important role in the development of technology and science today. To optimize the learning system that can have a positive influence on students' cognitive, affective, and psychomotor abilities (Condliffe et al., 2016), a technology that supports learning geography is needed.

The use of spatial technology in geography learning can be expected to generate student learning motivation and assist an effective learning process (Fargher, 2018). Support from information technology such as geographic information systems will facilitate work such as environmental issues, urban areas, and various other human activities, such as determining modeling, patterns, and locations, spatial technology will certainly be useful (Jo et al., 2018). So in learning geography, it is important to emphasize how to think spatially and not just information about symptoms or activities in the geosphere.

ArcGIS Story maps is a software development from ArcGIS Online. ArcGIS Online is a cloud-based geographic information system software platform that allows teachers and students to easily create, view, integrate, and display various spatial data (Battersby & Remington, 2013). ArcGIS Story maps are media used to combine interactive maps with content such as text, photos, or videos that are useful for showing a location, event, problem, or pattern in a geographical context (Marta & Osso, 2015). Simply put, this software is like a presentation application owned by Microsoft, but with facilities that can combine it with maps interactively.

Some of the results of previous research on ArcGIS Story Maps are (1) research conducted by Esohe E. Egiebor and Ellen J. Foster with the title Students' Perceptions of Their Engagement Using GIS-Story Maps. This research is qualitative research with the topic of student interest using ArcGIS Story Maps in implementing geography learning. The results of the analysis show that students are interested in ArcGIS Story Maps because there are 4 advantages, namely being able to generate investigations, being able to visualize information, mapping interactively, and data that can be reused (Egiebor et al., 2018). (2) Research by Shuhaida, Mokhtar, and Kadaruddin with the title "Teachers and Students' Views on the Application of GIS Story Map in STPM History subjects". The purpose of this study was to explore the understanding of teachers and students on the use of ArcGIS Story maps in historical subjects. The results of this study are teachers and students have a good perspective on the use of ArcGIS Story Maps in history subjects, and in using them students can be introduced to spatial concepts (Abdul Malek et al., 2019). (3) The research entitled Developing and Evaluating an ESRI Story Map as an Educational Tool written by M. P. Cope aims to develop ArcGIS Story Maps "Soil Forming Factors: Topography" to teach introduction to soil science and to assess the performance of Story Maps. The result is that respondents responded positively to ArcGIS Story Maps which is, an effective medium that can be combined with other media (Cope et al., 2018).

Students' spatial thinking skills need to be improved by involving students in actively seeking information, and solving a problem in groups from various points of view in learning (Anwar et al., 2017; Somantri L & Ridwana R, 2021). The learning model that is considered appropriate is Challenge Based Learning. Challenge Based Learning is a learning model that is felt to motivate students to use technology to solve existing problems (Johnson & Adams, 2011). This learning model is collaborative, where students are involved with other colleagues, teachers, experts, and the surrounding community to solve problems (O'Mahony et al., 2012). It is necessary to convey big ideas to students and to find some questions from those ideas. Then students analyze the questions and can define the challenges obtained from the results of the analysis (New & Consortium, 2019). The challenge is done collaboratively by involving several people from their educational environment (Conde et al., 2019).

Based on research that has been done, and refers to the initial problem regarding the lack of creativity in students' spatial thinking abilities. The use of ArcGIS Story Maps in an educational environment still needs to be improved and developed. Considering that in Indonesia the use of interactive teaching media such as ArcGIS Story Maps has not been widely developed. Students must know that there are media that can stimulate spatial thinking skills to make easier to understand

the material (Baidowi et al., 2015). Teachers as instructors can also develop their abilities in developing teaching media using ArcGIS Story Maps coupled with qualified learning models. The purpose and objective of this research are that the use of ArcGIS Story Maps can increase the creativity of spatial thinking skills in increasing students' understanding of atmospheric dynamics material.

RESEARCH METHOD

Research Design

The research design used was quasi-experimental using a pre-test – post-test control group design. The quasi-experiments used in this research have considered that the object of research is students with dynamic characteristics so that the implementation of research can occur naturally like learning in a class in general. It is hoped that students are not aware that being experimented with in a study and in that situation can contribute to the level of validity of the research.

The class selection used as the experimental class and the control class was selected based on the students' average PTS scores. The selection of the two classes was based on mid-semester assessment scores because out of 5 class X social studies, there were two classes with the lowest average mid-semester assessment scores for geography subjects. In this study, the experimental class was treated by applying the ArcGIS Story Maps media with the Challenge Based Learning model, while the control class used a conventional learning model, namely discussion and question and answer using PowerPoint media. During the process of giving treatment to each class, observations were made on the course of the learning process, and at the end of the treatment, a test was conducted to see the creativity of students' spatial thinking skills and the provision of a learning survey questionnaires using Story maps.

The first thing to do is give the experimental and control classes a pre-test. The next step is to treat the experimental group using ArcGIS Story maps with a challenge-based learning model, while the control class uses a conventional model, namely discussions and questions and answers using PowerPoint media. Then the two groups will be given a post-test, and the results will be compared with the pre-test score so that a gain score is obtained or the difference between the pre-test and post-test scores. The subject of this research was carried out at SMA Negeri 1 Tumpang in class X students. This research was conducted in class X IPS 4 as the experimental class and class X IPS 5 as the control class.

Research Instrument

This research instrument uses an essay test which consists of 7 items of spatial thinking ability. It is necessary to have the validity of the instrument that will be used to measure this ability. So it takes the assessment of several experts, such as education experts and materials experts to assess an instrument and required data analysis consisting of validity, and reliability, analysis of test item discriminating power, and analysis of difficulty based on test results. The trial was conducted to know whether an instrument was valid and reliable. Class XI acted as testers because they had studied the material dynamics of the atmosphere.

The data in this study are quantitative data obtained through test results. The test is full to determine the creativity of students' spatial thinking skills in the experimental class and control class. The data collection technique used in this research is to use observation and tests. Observations were made to observe the learning media used by educators during the learning process. The level of creativity in spatial thinking skills is known through tests. The essay test was used as an instrument in this study as a pre-test and post-test.

Data Analysis

Data analysis of post-test and pre-test values was carried out by prerequisite test which included normality analysis to know whether the data were normally distributed or not. Normality test was carried out using SPSS 26, namely the Kolmogorov-Smirnov Test. Data can be said to be normally distributed if it has a value > 0.05. The next prerequisite test is the homogeneity test using

Levene's test of equality of error variance to determine the homogeneity of the data and the variance obtained. The hypothesis test uses a t-test to reveal whether the learning carried out influences students' spatial thinking skills. The use of media and learning models will have an impact on spatial thinking skills if they have a different level (sig) < 0.005 and have no significant impact if > 0.005.

RESULTS AND DISCUSSION

The first data that was processed was the post-test and pre-test scores for the creativity of the students' spatial thinking ability in the experimental class and the control class. Where in the test has several indicators that determine the spatial intelligence of students. There are 7 questions in the form of an essay, each of which has a different indicator. Comparison elaboration, aura fluency, transition flexibility, pattern fluency, analogy flexibility, region elaboration, and association originality are the development of indicators of spatial thinking ability and creative thinking ability. From these indicators, it is expected to measure the extent to which students can master the mastery of spatial perception, spatial visualization, spatial relations, spatial orientation, and mental rotation in a geography lesson. To see the normality and homogeneity of the data on the creativity value of students' spatial thinking skills, several tests must be carried out to meet the requirements in data management.

Prerequisite Test

Prerequisite tests were conducted to determine the validity of the research data consisting of normality and homogeneity tests. Decision-making on the Kolmogorov Smirnov normality test and homogeneity test, namely the research data is normally distributed and homogeneous if the value (sig.) is more than 0.05.

Hypothesis:

a) H0 = Data is homogeneous and normally distributed if (sig. > 0.05)
b) H1 = Data is not homogeneous and not normally distributed if (sig. < 0.05)
c) Research hypothesis: H0 is accepted, which means the value of Sig. more than 0.05

Table 1. Normality Result Data

	Class	Kolmogorov Smirnov[a]			Saphiro- Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Result	Pre-test Experiment	.144	35	.065	.960	35	.236
	Post-test Experiment	.146	35	.057	.939	35	.051
	Pre-test Control	.132	33	.152	.949	33	.128
	Post-test Control	.133	33	.145	.948	33	.119

Source: Data analysis (2022)

The results of the normality test show that the value of Sig. experimental pre-test data of 0.065, the value of Sig. the experimental post-test data was 0.057, the significance of the control class's pre-test value was 0.152, and the significance of the control class's post-test value was 0.145. It can be concluded that the research hypothesis is accepted, and the data is normally distributed. After the normality test was carried out, the homogeneity test was carried out using Levene's test for equality of variances method (Table 2).

Table 2. Homogeneity Result Data

		Levene Statistic	df1	df2	Sig.
Result	Based on Mean	.690	3	132	.560
	Based on Median	.633	3	132	.595
	Based on Median and with adjusted df	.633	3	121.386	.595
	Based on trimmed mean	.714	3	132	.545

Source: Data analysis (2022)

Based on the calculation results, the significance value of the results is 0.545, meaning that the research data is homogeneous where the average sig. > 0.05. So that the thinking ability of the experimental class and the control class has the same or homogeneous variety. The analysis results showed that the data had met the requirements for further analysis with the Independent Sample t-test.

Independent Sample T-Test

After thoroughly testing the prerequisites, it is known that the research data is normally and homogeneously distributed. The next step is hypothesis testing, which is the stage to determine whether the hypothesis is accepted or rejected.

a. H0 = learning models and media do not influence students' abilities

b. H1 = learning models and media influence students' abilities

The research hypothesis H1 is accepted if the significance value (2-tailed) is 0.05, or if there is an influence of ArcGIS Story maps media in collaboration with a challenge-based learning model on the creativity of students' spatial thinking skills. While H1 is rejected if the significance value (2-tailed) is 0.05 or there is no influence from the ArcGIS Story maps media in collaboration with a challenge-based learning model on the creativity of students' spatial thinking skill.

Table 3. Data Analysis Results of Independent Sample Test

		t-test for Equality of Means						
							95% Confidence Interval of The Difference	
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Result	Equal variances assumed	9.290	66	0.000	18.89974	2.03443	14.83787	22.96161
	Equal Variances not assumed	9.283	65.516	0.000	18.89974	2.03602	14.83413	22.96535

Source: Data analysis (2022)

After analyzing the normality and homogeneity tests, the next step is the analysis of the Independent Sample T-Test. The Independent Sample T-Test analysis table, its significant data with a value of 0.000 which proves that the value is 0.05. So it can be concluded that H0 is rejected and H1 is accepted. It can be supposed that the ArcGIS Story maps media with a challenge-based learning model has affected the creativity of students' spatial thinking abilities.

N-Gain Score Effectiveness Score

The n-Gain score is an analysis used to see the difference between the pre-test and post-test mean scores. The gain value is also used to see any changes in the score so that the effectiveness of the media and learning models

used can be seen. The results of the N-Gain score analysis (Table 4).

Table 4. N-Gain Score Effectiveness Test Results Data

	N	***Min***	***Max***	***Means***	***Stdev.***
Experiment Class	35	37.53	100.00	68.6352	18.63152
Control Class	33	0.00	58.33	22.2520	17.66852

Source: Data analysis (2022)

Based on the calculation results, the experimental class gain score is higher than the control class. The average gain score for the experimental class is 68.6352 which is included in the quite effective group and the average gain score for the control class is 22.2520 which is included in the ineffective category. The difference in gain score between the experimental class and the control class is 46.3832. So that it can be seen that the creativity of students' spatial thinking abilities in the experimental class and the control class is different. The data shows that the control class's spatial thinking ability is lower than that of the experimental class.

3.4 Comparison of the results of pre-test and post-test control and experimental classes

The results of the pre-test are the test results obtained by the students of the control class and the experimental class before being given treatment. The pre-test was conducted to determine the initial ability of the students in the control class and the experimental class. The following table compares the pre-test scores of the control class and the experimental class.

Table 5. Frequency Distribution Comparison of Final Results Pre-test Control Class Experiment Class

Value Range	**Qualification**	**F**		**%**	
		Experiment	**Control**	**Experiment**	**Control**
91-100	Very Good	0	0	0	0
75-90	Good	0	0	0	0
60-74	Fair	9	11	26	33
40-59	Less	25	22	71	67
< 40	Very less	1	0	3	0
Amount		35	33	100	100

The final result of the post-test is a reaction after students are given treatment to determine the creativity of spatial thinking skills in the control class and the experimental class. After being given different treatments to the experimental class with story maps media with CBL model and control class with conventional learning in the form of discussion and question and answer using power point media, the following are the results of the comparison of post-test scores.

Table 6. Frequency Distribution Comparison of Final Results Pos-test Control Class Experiment Class

Value Range	Qualification	F		%	
		Experiment	Control	Experiment	Control
91-100	Very Good	14	0	40	0
75-90	Good	18	9	51	27
60-74	Fair	3	19	9	58
40-59	Less	0	5	0	15
< 40	Very Less	0	0	0	0
Amount		35	33	100	100

According to the data obtained from the pre-test results of the control class and the experimental class, the dominant value qualification is not good. This is shown in the control class data as many as 25 students with a value range of 40-59, with a percentage of 71%. While the control class as many as 22 students with the same range of values has a percentage of 67%. However, in the control class, 11 students got quite good grade qualifications, with a score range of 60-74. This frequency is greater than in the experimental class which only 9 students and 1 other student with very low-grade qualifications.

The post-test score table shows that the experimental class has good to very good qualifications. This can be seen in the experimental class with many as 18 students with a value range of 75-90 with a percentage of 51%, and as many as 14 students with a value range of 91-100 with a percentage of 40% and the remaining 9% are in fairly good qualifications. While the control class post-test scores as many as 19 students get quite good qualifications, with a percentage of 58%. There are 9 students with a score range of 75-90, having good qualifications with a percentage of 27%, and the remaining 15% are in poor qualifications. This shows that the experimental class experienced a significant change in value after being given treatment in the form of using story maps in collaboration with the challenge-based learning model.

3.5 Utilization of Story maps can Increase Students' Spatial Creativity Skill

The results of the analysis stated that there was an increase in spatial creativity thinking skills through ArcGIS Story maps media with a challenge-based learning model. This can be seen from the increase in post-test scores, after learning using ArcGIS Story maps media with a challenge-based learning model. Based on the research conducted (Baidowi et al., 2015) ArcGIS Story maps can be used as a medium for students' exploration in increasing the creativity of their spatial thinking skills. As well as the use of interactive map media that can support students' spatial thinking skills according to research conducted by (Saputro et al., 2020).

The significant difference can be seen from the gain score of the experimental class and the control class. The gain score of the experimental class is higher than the control class with a percentage of 69% which is categorized as quite effective. While the control class gets a percentage gain score with a percentage of 22% and is categorized as ineffective. Learning carried out in the experimental class using ArcGIS Story maps media with a challenge-based learning model has more influence on the creativity of students' spatial thinking skills compared to the control class using the conventional learning model of discussion and question and answer using Powerpoint media. This agrees with the statement (Groshans et al., 2019), that ArcGIS Story maps are able to effectively improve students' spatial thinking skills.

Story maps provide a presentation of text, images, videos, and maps in one container where which can help hone map visualization and interpretation skills in class X IPS SMA Negeri 1 Tumpang. The material on story maps is easy to present and can be visualized in the

storytelling style of the teachers and students involved in making them (Strachan & Mitchell, 2014).

Various features available in story maps can increase students' creativity in designing a website and are able to support their spatial thinking skills (Vojteková et al., 2021). Students can more easily carry out causal analysis resulting from a geographical phenomenon through the analysis of the available maps.

3.6 Student Response to ArcGIS Story maps in Learning

The purpose of using story maps is to identify how students can recognize various problems by understanding text or maps and or identify difficulties in interacting with maps (Berendsen et al., 2018). The use of ArcGIS Story maps as a learning medium gives the impression that learning activities become more interesting and make students enthusiastic. This can be seen in the analysis of student responses to the use of ArcGIS Story maps media.

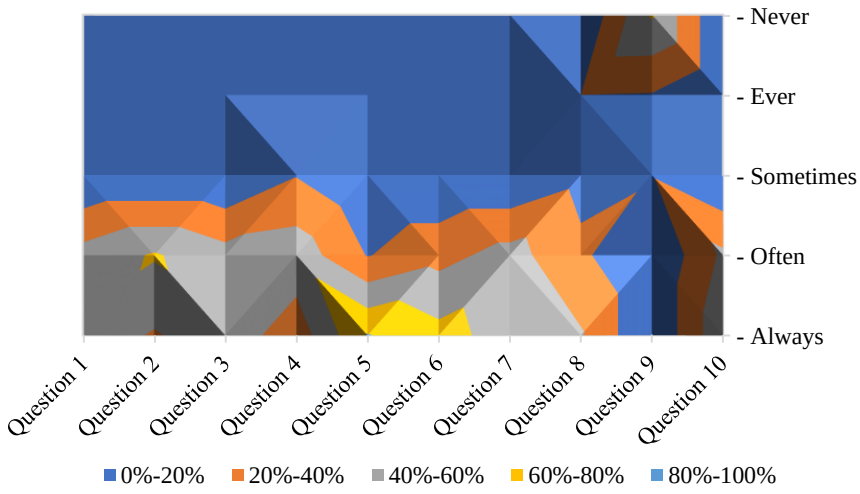

Figure 1. Image Response to the Use of Student Story maps

Based on Figure 1, the interpretation of the results of students' responses to the use of ArcGIS Story maps media shows that students gave good to very good responses in using Story maps media. This is indicated by several question indicators, one of which reads “I feel interested in continuing to use Story maps in learning geography” which results in the percentage of responses often – always at 40-60%. However, students still find it difficult to operate Story maps media and test work as indicated by the data in the image as much as 20-40% of students still find it difficult to use Story maps.

Students can observe phenomena and conditions listed on maps and from other spatial data to improve higher-order thinking skills through the use of these learning media. The use of this learning media aims to provide students with the ability to think spatially in analyzing the geosphere phenomena that are around them. Spatial thinking skills are needed by students to analyze various kinds of geosphere phenomena directly, both in the form of challenges and problems that exist in the 21st century (Aliman et al., 2018).

3.7 Creativity in Using Story maps on Students' Spatial Creativity Skills

The role of story map media is able to encourage and improve students' abilities, which can be seen from student learning outcomes in the form of increasing post-test scores. ArcGIS Story maps are the right media to support geography learning using maps and can be integrated with other media (Battersby & Remington, 2013). When viewed from the relationship between post-test scores and creativity values in operating ArcGIS Story maps, there is an inconsistency. This can be seen in the graphic image of the relationship between Post-test scores and the creativity value of using Story maps.

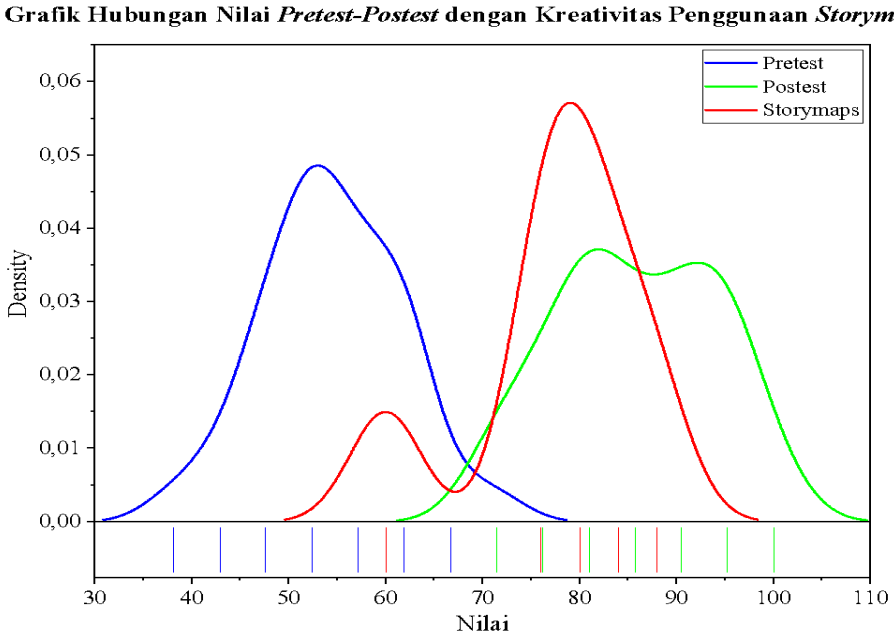

Figure 2. Graph of the Relationship of Pre-test – Post-test Scores with Story maps Creativity Scores

Based on the graphic image above, it provides information that subjects with high story map operating skills do not necessarily have high final results or post-test scores. On the other hand, the low value of students' story map use skills also does not necessarily result in low final or post-test scores. Referring to the results of the analysis of the difference between the pre-test and post-test scores with the results of the creativity test using story maps from 35 experimental class students, it can be seen that as many as 23 students with high skill in using story maps media are better in terms of creativity in spatial thinking than 7 students with low story map usage skills. However, there are 5 students with low creativity scores in the use of story maps who have high post-test scores.

Table 7. Correlation of Student Post-test Scores with Creativity Scores Using Story maps

		Score	Creativity
Score	Pearson Correlation	1	- .037
	Sig. (2-tailed)		.831
	N	35	35
Creativity	Pearson Correlation	-.037	1
	Sig. (2-tailed)	.831	
	N	35	35

The correlation test results from students' post-test scores with the creativity value of using story maps, have a negative relationship, which is indicated by the Pearson Correlation value of -.037. The results of the significance test that has been carried out, it has a value of 0.831 which states that there is no relationship between the results of the student's skill scores in the use of story maps and the students' post-test results. Although based on these findings, it can be concluded that the level of creativity in students' spatial thinking is not supported by the use of ArcGIS Story maps in general, but based on other

findings, students with high skills or creativity in using story maps have an effect on the creativity of their spatial thinking abilities.

Another thing that can support the creation of spatial thinking skills is the use of challenge-based learning models. The challenge-based learning model is one of the success factors of learning that is collaborated with ArcGIS Story maps media to achieve creativity in students' spatial thinking skills. Challenge Based Learning is a learning model that supports students in the use of technology used in their daily activities to solve real-world problems (Johnson & Adams, 2011). Students are involved with other colleagues, teachers, experts, and the local community to solve problems. The first step is conveying the big idea to students, to find some questions from the idea. Then students in groups analyze the questions and can define the challenges obtained from the results of the analysis. The results of the analysis that have been found, along with the spatial data that has been obtained in the form of maps are then transformed into story maps and given text, images, and videos that can support spatial data (maps) into an interesting story (Berendsen et al., 2018).

There are other research findings that the use of ArcGIS Story maps in class X IPS SMAN 1 Tumpang can hone students' creativity in designing a website and provide comfort in learning geography, especially on the basic competencies of atmospheric dynamics. The data from the analysis shows that students who feel comfortable using story maps media tend to have high post-test scores compared to students who still feel hesitant in using story maps media. However, in its use, students still need guidance from the teacher to operate story maps. So it is expected that students can use the media for geography learning activities optimally and increase the creativity of their spatial thinking skills.

Spatial thinking creativity skill is learning spatial thinking which is characterized as a collection of cognitive skills consisting of knowledge of spatial concepts, use of representational tools, and reasoning processes (Jo & Bednarz, n.d.). The ability to think spatially universally has many benefits in various disciplines. In addition, spatial thinking can and should be taught at all levels in the education system, especially in the younger generation (Lee & Bednarz, 2009). The younger generation has an interest in the field of technology. So it is hoped that spatial data such as maps, images, and other spatial devices such as GPS can be transformed and visualized properly. The use of media story maps that are integrated with various other spatial data is expected to help teachers to increase the creativity of students' thinking abilities and provide skills where students can operate the digital spatial world that they can use to explore various geosphere phenomena.

CONCLUSIONS

The creativity of spatial thinking skills has a positive contribution, which is evidenced by the increase in post-test scores after learning using ArcGIS Story maps media with a challenge-based learning model. Students who learn to use the challenge-based learning model by creating a digital project based on story maps about global climate change on atmospheric dynamics material gain higher spatial thinking creativity than students who learn to use conventional models of discussion and question and answer using PPT media. This is obtained from the average value of the experimental class which is higher than the control class, so it can be concluded that there is an influence from the ArcGIS Story maps media in collaboration with the challenge-based learning model on creativity of students' spatial thinking abilities.

RECOMMENDATIONS

Learning geography in the future requires more collaboration with the use of spatial data. The combination of spatial data and various internet-based learning media is needed to improve students' advanced spatial thinking skills. The learning model is also important in influencing the quality of students' thinking skills. Therefore, in the future, it is hoped that there will be collaboration models and media that can represent spatial data to students better.

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